

A New Crab-shaped Anomura of the Genus *Paralomis* White, 1856 (Crustacea, Decapoda) from the depths off Okino-Torishima, Southernmost Island in Japan

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Abstract A new species of the genus *Paralomis* White, 1856 (Crustacea, Decapoda, Anomura, Lithodidae) is described from the depths off the southernmost island in Japan, Okino-Torishima, 1,740 km south of Tokyo. The sole specimen is named *Paralomis okitoriensis* as 69th species of the genus, being consistently covered with well-spaced, short tubercles on the pyriform carapace and armed with strong spines on the margins of the slender chelipeds and ambulatory legs.

Key words: Lithodidae, *Paralomis*, new species, Okino-Torishima Island, northwestern Pacific, Japan.

Introduction

Okino-Torishima is the southernmost island (20°25'31"N, 136°04'52"E) in Japan, located at ca. 1,740 km south of Tokyo on the Kyushu-Palau submarine ridge. It is a small oceanic coral atoll, with ca. 1.7 km long from north to south and ca. 4.5 km broad from east to west at low tide. Two islets named Kita-Kojima and Higashi-Kojima are exposed above sea level even at high tide, being important to keep the Japanese Exclusive Economic Zone.

In January, 2006, the benthic animals were collected with cage trap to get the information about the deep-water benthic fauna around the island. Among several decapod crustaceans then obtained is a female of crab-shaped Anomura referable to the genus *Paralomis* White, 1856 (Family Lithodidae). In this paper it is described as a 69th species in the genus.

In the following description, the terminology basically follows that of Ah Yong (2010), and the size of the specimen is indicated in mm by CL (postorbital carapace length) and CW (carapace

width excluding marginal branchial spines). The holotype is preserved in the Tsukuba Research Departments, the National Museum of Nature and Science, Tokyo (NSMT).

Description of a New Species

Family LITHODIDAE

Genus *Paralomis* White, 1856

Paralomis okitoriensis sp. nov.

(Figs. 1–4)

Material examined. Ovigerous female, holotype, NSMT-Cr 25932. 15-I-2006, off Okino-Torishima, far south of Ogasawara Is., 900–1,500 m deep, by cage trap.

Measurements. CL (postorbital carapace length), 44.2 mm, CW (carapace width excluding marginal branchial spines), 43.5 mm.

Diagnosis. Carapace pyriform in outline, slightly longer than wide, covered with symmetrically arranged, well-spaced sharp tubercles on dorsal surface, and several sharp spines along hepatic and branchial carapace margins. Rostrum



Fig. 1. *Paralomis okitoriensis* sp. nov., female (holotype), NSMT-Cr 25932, CL 44.2 mm, CW 43.5 mm. Color in life.

with a median lower spine and a pair of dorsal spines. Eyestalk with a spinule at dorsal median part and a spinule at peduncular distal extension onto cornea. Schaphocerite slender, distinctly spiniform, with a shorter spiniform branch at posterior one third of posterior margin and two spinules on dorsal surface. Chelipeds and ambulatory legs slender, fringed with sharp spines. Basal two somites of female abdomen covered with tubercles somewhat like carapace dorsal surface; other abdominal somites without distinct tubercles.

Description. Carapace (Figs. 1, 2, 3E) pyriform, distinctly constricted between hepatic and branchial carapace margins, slightly longer than broad, uniformly covered with well-spaced sharp tubercles rather than short spines; most of tubercles subequal in size and height; gastric, hepatic, cardiac and branchial regions demarcated, with distinct cervical groove. Gastric region (Fig. 2B) longitudinally oblong, twice longer than broad, convex laterally, shallowly subdivided into two

at about posterior one third by a transverse shallow groove extended from cervical groove; anterior part armed with ca. 26 tubercles, posterior part with ca. 13 tubercles; a tubercle at each anterolateral corner of gastric region suberect, spiniform, longer than others; median second tubercle hardly larger than others. Transverse gastro-cardiac groove (Fig. 2B) distinct, with a small dimple at median part of cervical groove; lateral grooves of cardiac region retreat posteriorly to make a longitudinal triangle, not completely closed at posterior end; cardiac region armed with ca. 15 tubercles. Hepatic region (Fig. 2B) shallowly separated from gastric region by longitudinal shallow groove, from branchial region by distal part of oblique cervical groove, with ca. 5 tubercles; hepatic carapace margin straight, nearly longitudinal or faintly divergent posteriorly, with 3 strong spines directed obliquely forward; first and third spines prominent, subequal to outer orbital and second branchial marginal spines. Branchial region (Fig. 2B)

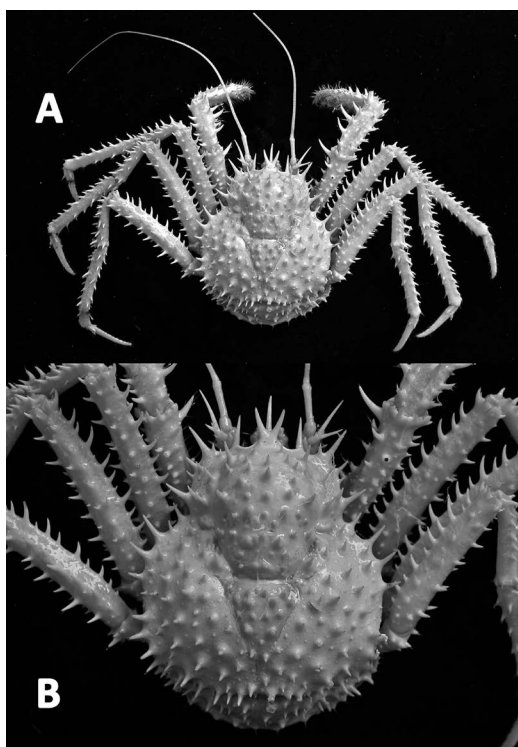


Fig. 2A–B. *Paralomis okitoriensis* sp. nov., female (holotype), NSMT-Cr 25932, CL 44.2 mm, CW 43.5 mm.

with ca. 30 regularly dispersed tubercles on dorsal surface, and with 4 equidistant strong spines along anterior one third of branchial carapace margin; median one third or less of branchial carapace margin longitudinal, unarmed; posterior one third of branchial carapace margin and posterior carapace margin armed with ca. 10 tubercles similar to those of carapace dorsal surface. Rostrum (Figs. 2, 3A, D, 4A) with a median spine and a pair of dorsal spines; median spine weakly curved downward along its basal half, weakly curved upward along its distal half; dorsal spines about half or slightly more than median spine, directed obliquely upward and outward. Outer orbital spine (Fig. 2) directed forward, as long as rostral median spine. Eyestalk (Figs. 3A, D, 4A) short, stout, weakly constricted medially, armed with two spinules on dorsal surface, viz., one at median part and another at peduncular extension onto cornea.

Antennal basal article stout, with a small plate produced at ventral part as a part of buccal frame; second article (Fig. 4B) cut obliquely, with a long, forward-directed and a short, obliquely upward-directed tubercles on outer margin. Right scaphocerite (Figs. 2, 4B) armed with a long main spine, a short spine branched at basal one third of outer margin, and two spinules on upper surface near articulation with antennal basal article, unarmed on outer margin of basal part; left scaphocerite (Fig. 2) with an abnormally short branched-spine, a spinule on upper surface, and a spinule on outer margin of basal part.

Both chelipeds (Fig. 2A) remarkably slender, the right being hardly longer than the left, with nearly same form and armature. Merus armed with sharp spines mainly on upper and lower margins, with short spines on outer margin; a subterminal tubercle on inner surface the longest of all. Carpus slender like merus, slightly shorter than merus, armed with some sharp spines on inner and outer margins; median spine of inner margin longer than others, subequal to subterminal spine of inner margin of merus. Chela (Fig. 3B) slender, compressed, with palm and fingers subequal in length; palm armed with short spiniform tubercles more or less arranged in two rows on upper margin, a longitudinal line of tubercles on median and outer lower parts of outer surface; each tubercle or spine tipped with some or several setae or bristles; inner surface with two or three rows of bundles of some setae or bristles. Fingers (Fig. 3B) bent downward at bases, excavated inside, not toothed, with many tufts of long bristles.

Ambulatory (Walking) legs (Figs. 2A, 3F) slender, strongly spinose along both margins of meri and propodi and anterior margin of each carpus; all spines subequal in length or some spines slightly shorter than others, 10 or more on each merus, 5 on each carpus; lower margin of each carpus unarmed; lower margin of each propodus with about 10 spines slightly shorter than those of anterior margin, with a subsidiary low of spines on upper surface close to lower margin.

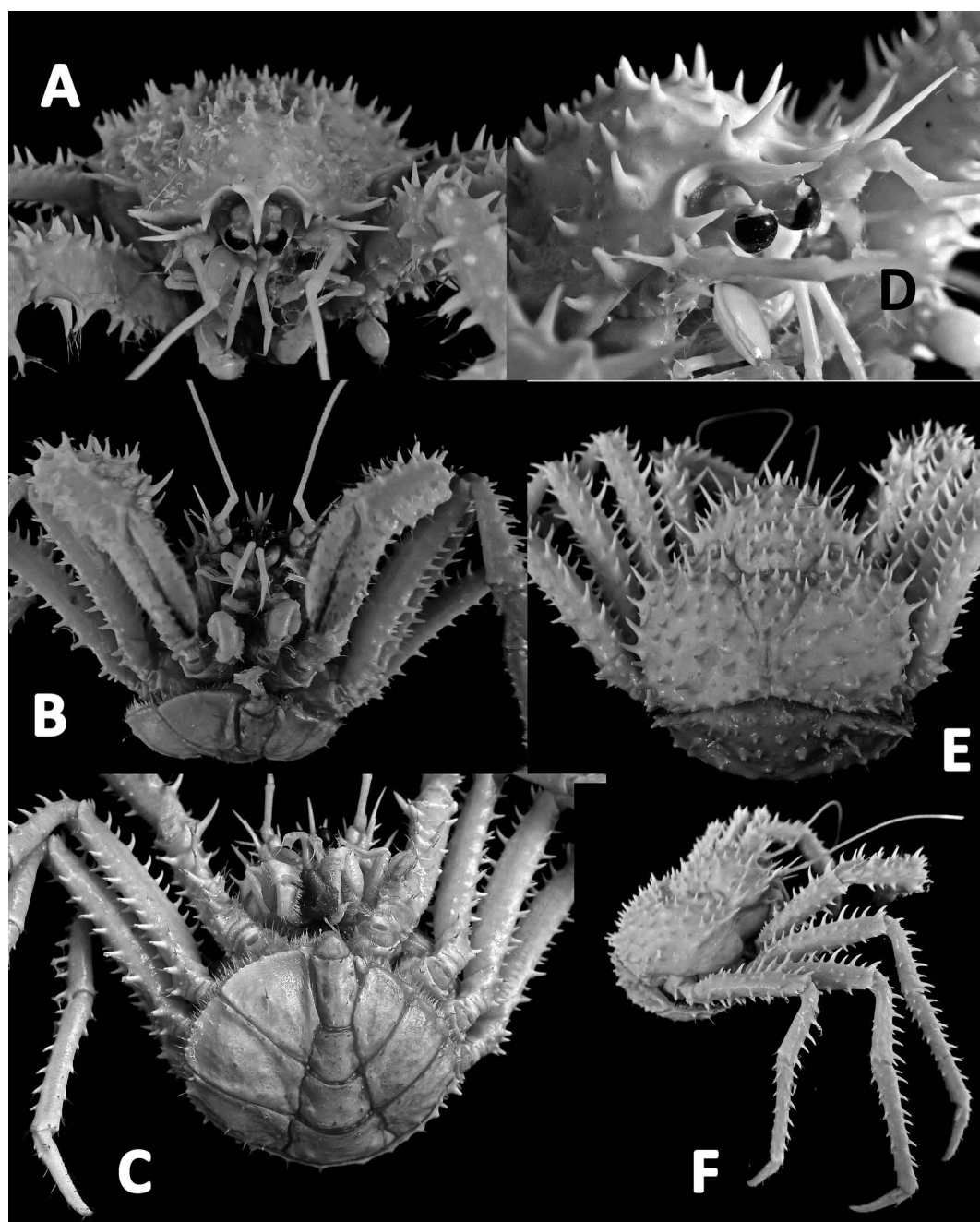


Fig. 3A–F. *Paralomis okitoriensis* sp. nov., female (holotype), NSMT–Cr 25932, CL 44.2 mm, CW 43.5 mm. Different angles to show the diagnostic characters.

Abdomen well developed as in Fig. 3C. Basal two somites with tubercles of variable size (Fig. 3E), other somites unarmed.

Etymology. The specific name of the new

species, *okitoriensis*, is referred to the abbreviated form, Oki-Tori, of the Japanese name of the island, Okino-Torishima.

Remarks. As Ahyong (2010) mentioned in

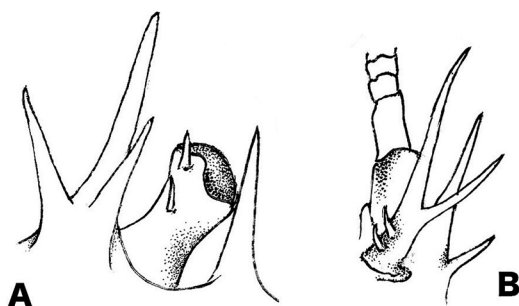


Fig. 4A–B. *Paralomis okitoriensis* sp. nov., female (holotype), NSMT-Cr 25932, CL 44.2 mm, CW 43.5 mm. A: Rostral spines, right outer orbital spine, and right eyestalk. B, Right scaphocerite and antennal basal part in dorsal view.

the monographic work on the Lithodidae from Australia, New Zealand and adjacent waters, the genus *Paralomis* White, 1856 with 67 known species, remarkably differentiated as for the shape and armature of the carapace and ambulatory legs and the biogeographic and bathymetric distributions, not only in the Lithodidae but also in the whole decapod crustacean groups. Subsequently, Muñoz and Garcia-Isarch (2013) described a new species, *P. macphersoni*, from Namibia, West Africa. The genus *Paralomis* is geographically worldwide, and the species are mostly deep-water inhabitants, with the deepest record, 4,152 m, of *P. bouvieri* Macpherson, 1988 from the North Atlantic.

According to Ah Yong (2010), there are some morphologically natural groups in *Paralomis*, such as 1) the short-legged, densely spiny forms similar to *P. hystrix* (De Haan, 1844) and *P. echidna* Ah Yong, 2010, 2) the relatively less spiny, long-legged forms similar to *P. aculeata* Henderson, 1888 and *P. spinosissima* Birstein and Vinogradov, 1972, 3) the rather sparsely adorned forms similar to *P. spectabilis* Hansen, 1908 and *P. birsteinii* Macpherson, 1988, 4) the long-legged forms with cristate carapace margins similar to *P. verrilli* (Benedict, 1895) and *P. cristulata* Macpherson, 1988, and 5) the forms with a subhexagonal carapace densely covered by nodular tubercles, such as *P. granulosa* (Hombron and Jacquinot, 1846), *P. dawsoni* Macpherson, 2001,

and *P. dofleini* Balss, 1911. Even if the second and third categories may be not always strictly distinguished as for the length of the ambulatory legs and the density and nature of the spines or tubercles, the above-mentioned categories are useful for the first step of the identification and relationship. In general, in *Paralomis*, the tuberculation and spininess may be variable developmentally rather than individually, and the exact description about the density and nature of the dorsal armature of the carapace is sometimes difficult and subjective.

Although the new species described in this paper, *P. okitoriensis*, belongs to the second category having the well-spaced, short tubercles on the carapace and the long chelipeds and ambulatory legs, two species in the third category having short chelipeds and ambulatory legs, *P. spectabilis* Hansen, and *P. birsteinii* Macpherson, are more or less similar to *P. okitoriensis* in their carapace appearance. In these two species, however, the carapace, chelipeds and ambulatory legs are armed with sparser, shorter and stouter tubercles than in *P. okitoriensis*. In *P. spectabilis* known from the northern Atlantic (off Iceland and eastern Greenland, 1,470–2,075 m) (Hansen, 1908, pl. 1 fig. 3, pl. 2 fig. 1; Macpherson, 1988, fig. 5f–g), the length of the dorsal tubercles of the carapace are variable, though short, with the larger tubercles arranged symmetrically on the gastric, cardiac and branchial regions. *Paralomis birsteinii* is at present well known as a circum-Antarctic species (Macpherson, 1988, 2004; Arana and Retamal, 1999; Thatje *et al.* 2008; Ah Yong, 2010), and Smith *et al.* (2017) showed that the rich populations are widespread on the slope off the western Antarctic Peninsula. As *P. birsteinii* was fully described and illustrated by Ah Yong (2010), the dorsal surface of the carapace is armed with scattered short spines or small tubercles, and the margins of the ambulatory legs are armed with fewer and shorter spines than in *P. okitoriensis*. According to Ah Yong (2010), the dactyli of the ambulatory legs are longer than the dorsal extensor margin of the respective propodus in *P. birsteinii* (shorter in *P. okitoriensis*).

The tuberculation and spination of the species in the above second category are evaluated in the following lines based on the published descriptions and photographs to confirm the taxonomic validity of *P. okitoriensis* as a new species.

Ahyong (2010) exemplified two species, *P. aculeata* and *P. spinosissima* for the second category. *Paralomis aculeata* is known only by the juvenile holotype from off Prince Edward Island in the sub-Antarctic Indian Ocean, 560 m deep, which was figured by the original author (Henderson, 1888, pl. 5 figs. 1, 1a–c) and photographed by Spiridonov *et al.* (2006, fig. 6). According to them, the carapace dorsal surface is covered with small tubercles and fringed with spines along the hepatic and branchial carapace margins, and the spines on the chelipeds and ambulatory legs are apparently smaller and shorter than those of *P. okitoriensis*. Otherwise, it is remarkable that there is a median spine at the dorsal basal part of the rostrum of *P. aculeata*, differing from the unarmed rostrum of *P. okitoriensis*. As remarked by Macpherson (1988) and Spiridonov *et al.* (2006), the presence or absence of the median dorsal spine of the rostrum has the diagnostic value for defining the *Paralomis* species. Another species, *P. spinosissima*, known from the southwestern Atlantic (sub-Antarctic waters from South Georgia Island to the Drake Passage, 132–650 m) was taxonomically described and figured by the original authors (Birstein and Vinogradov, 1972, fig. 1) and Macpherson (1988, figs. 33–34, pl. 18). The biology of this species was studied at the deep-sea off South George Island by López and Balguerías (1994) and Otto and MacIntosh (2006), and recently a juvenile male was recorded from off Mar del Plata, Argentina, by Olguín *et al.* (2015), extending the biogeographical distribution over 1,300 km northwards in the southwestern Atlantic Ocean. In *P. spinosissima* the dorsal surface of the carapace is armed with numerous spines much denser than in *P. okitoriensis*, and one prominent spine is present at the center of the gastric region. The rostrum is armed with a spine and a pair of smaller spines on the rostral dorsal

surface, and each of the inner and outer margins of the scaphocerite is armed with two or three spines.

Macpherson (1988) described *P. erinacea* from the eastern Atlantic off Guinea Bissau and the Ivory Coast, 125–900 m deep, as the close relative of *P. spinosissima*. As mentioned in the original description, the general appearance is close to that of *P. spinosissima*, but the dorsal surface of the carapace is covered only with small similar-sized spines, and the rostrum and scaphocerite are much more strongly developed.

Guzmán (2009) described *P. sonne* as the first occurrence of spiny species in Chilean waters, and compared it with some similar species, but most deeply with *P. spinosissima*. The new species, *P. okitoriensis*, differs not only from *P. aculeata* and *P. spinosissima*, but also from *P. erinacea* and *P. sonne* most remarkably in the tuberculation of the dorsal surface of the carapace and the different armature of the rostrum and scaphocerite.

In addition to the above-mentioned four species in the second category, *P. bouvieri* Hansen, 1908 and *P. hystrixoides* Sakai, 1980 are worthy of note for comparison with *P. okitoriensis* as the closest congeners. *Paralomis bouvieri* known from the northwestern Atlantic, 1,460–4,152 m deep (Hansen, 1908; Macpherson, 1988; Pohle, 1992) differs from *P. okitoriensis* in the features that 1) the dorsal surface of the carapace is covered with many spines of similar size except for one spine at the median part of the gastric region (no prominent spine in *P. okitoriensis*), 2) the rostrum is armed with the second pair of the lateral spines, without a median dorsal spine (no second pair of the lateral spines in *P. okitoriensis*), 3) the female abdomen is wholly covered with tubercles (smooth without tubercles and granules except for basal two somites in *P. okitoriensis*). *Paralomis hystrixoides* from Japan (Sagami Bay and off Kii Peninsula, 750–800 m) was compared in the original description (Sakai, 1980) with *P. hystrix*. In addition to having the short and stout chelipeds and ambulatory legs, *P. hystrix* is quite distinctive in the general shape of

the carapace (strongly vaulted in *P. hystrix*, and rather elongated in *P. hystrixoides*), and the armature of the carapace (stout tubercles in *P. hystrix*, and slender spines in *P. hystrixoides*). The general shape of the carapace, chelipeds and ambulatory legs of *P. okitoriensis*, is at first glance similar to that of *P. hystrixoides*, but the spines of the dorsal surface of the carapace are short and more or less tuberculated and fewer (needle-like and rather crowded in *P. hystrixoides*), the cheliped merus and carpus are armed with some strong spines on the inner margins (many sharp spines of equal size in *P. hystrixoides*), and the ambulatory meri, carpi and propodi are armed with sharp but rather short marginal spines (many spines of variable length even on the upper surfaces in *P. hystrixoides*).

Among the species from the South Pacific described by Ah Yong (2010) are two species to be comparable to *P. okitoriensis*. They are *P. poorei* from the Chatham Rise (900–1,156 m deep), Tasmania (987 m), and Western Australia (900–915 m deep), and *P. staplesi* from Tasmania (2,213 m) and the Kermadec Ridge (1,958–2,312 m). In *P. poorei* the dorsal surface of the carapace is covered with rather short, upright spines, and the chelipeds and ambulatory legs are comparatively shorter than those of the species in the second category. The rostrum is armed with two pairs of dorsal spines, the scaphocerite is multispinose, and the abdomen is covered with strong tubercles. *Paralomis staplesi* is similar to *P. okitoriensis* in the general contour of the carapace and having the long ambulatory legs, but differs from *P. okitoriensis* most remarkably in the dorsal surface of the carapace covered with small scattered granules, many conical, well-spaced granules, and some longer spines on the gastric, cardiac and branchial regions.

The following 11 *Paralomis* species listed chronologically have been recorded from Japanese waters.—*P. hystrix* (De Haan, 1844), *P. verrilli* (Benedict, 1895), *P. multispinosa* (Benedict, 1895), *P. japonica* Balss, 1911, *P. dofleini* Balss, 1911, *P. cristata* Takeda and Ohta, 1979, *P. truncatispinosa* Takeda and Miyake, 1980, *P.*

odawarai (Sakai, 1980), *P. hystrixoides* Sakai, 1980, *P. kyushupalauensis* Takeda, 1985, and *P. jamsteci* Takeda and Hashimoto, 1990. *Paralomis okitoriensis* is the 69th species of the genus *Paralomis* White, 1856, and 12th species in Japanese waters.

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