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Two new species of hermit crabs (Decapoda: Anomura) from the Paleogene Kishima Group, Saga Prefecture, Japan

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Abstract

Two new species of the hermit crabs (Paguroidea, Diogenidae), *Paguristes michikoae* and *P. teruakii*, are described from the lower Oligocene Sari Sandstone Member of the Kishima Group of Saga Prefecture, Japan. Both species represents the oldest record for the genus and family from the Oligocene of Japan.

Key wards: Decapoda, Diogenidae, *Paguristes*, Oligocene, Kishima Group, Kyushu, Japan

Introduction

The hermit crab (Anomura, Paguroidea) from the Paleogene deposits of Japan has been extremely rare in the fossil record. *Pagurus* s.l. sp., an *in situ* pagurid has been only known from the lower Oligocene Yamaga Formation, Ashiya Group of Fukuoka Prefecture, Kyushu (Karasawa, 2002).

The purpose of the present paper is to describe two new species of *Paguristes Dana*, 1851, a hermit crab genus of Diogenidae Ortmann, 1892, from the Kishima Group. The specimens described herein were collected from sandstone within the Sari Sandstone Member of the Kishima Group at Komanaki, Okawa-cho, Imari City, Saga Prefecture [=Loc. KSM-12 of Karasawa and Fudouji (2000)]. Within Karasawa and Fudouji (2000) their assignment of the stratigraphic horizon has been error and the Sari Sandstone Member underlying the Yukiaino Sandstone Member was exposed at Loc. KSM-12 (Fudouji per. com.). Karasawa and Fudouji (2000) described *Neocallichirus sakiae* Karasawa and Fudouji, 2000, a callianassid from the present locality. Okada (1992) showed that the Sari Sandstone Member was assigned to the early Oligocene Zone CP16b–CP16c of Okada and Bukry's nannozones.

The specimens described here are deposited in the Mizunami Fossil Museum (MFM).

Systematics

Family Diogenidae Ortmann, 1892

Genus *Paguristes* Dana, 1851

Type species: *Paguristes hirtus* Dana, 1851, by subsequent designation of Stimpson (1858).

Extinct species included: *Paguristes baldoensis* Garassino, De Angeli, and Pasini, 2009; *P. cecconi* De Angeli and Caporiondo, 2017; *P. chipolensis* Rathbun, 1935; *P. clampensis* De Angeli and Caporiondo, 2017; *P. cserhatensis* Müller, 1984; *P. florae* Collins, Fraaye, and Jagt, 1995; *P. hokoensis* Schweitzer and Feldmann, 2001; *P. johnsoni* Rathbun, 1935; *P. lineatuberculatus* Beschin, De Angeli, Checchi, and Mietto, 2006; *P. liwinskii* Fraaije, van Bakel, Jagt, and Machalski, 2015; *P. mexicanus* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001; *P. michikoae*, new species; *P. oligotuberculatus* Müller and Collins, 1991; *P. ouachitensis* Rathbun, 1935; *P. paucituberculatus* Beschin, Busulini, and Tessier, 2016; *P. prealpinus* Beschin, De Angeli, Checchi, and Zarantello, 2005; *P. santamartaensis* Feldmann, Tshudy, and Thomson, 1993; *P. sossanensis* De Angeli and Caporiondo, 2009; *P. subaequalis* (Rathbun, 1926); *P. whitteni* Bishop, 1983; *P. wheeleri* Blow and Manning, 1996; *P. teruakii*, new species.

Remarks: *Paguristes* consists of over 120 extant species from the present oceans (McLaughlin *et al*., 2010; Komai *et al*., 2015). The above-mentioned list of the extinct species known from the Cretaceous to Miocene was modified from Fraaije *et al*. (2015). Most recently, De Angeli and Caporiondo (2017) added two new species from the middle Eocene of Italy to the genus and was moved *Paguristes extentus* Beschin, Busulini, De Angeli, and Tessier, 2007, known from the middle Eocene of Italy, to their new

diogenid genus, *Longipaguristes*. Two new species from the early Oligocene are herein described.

Two new specimens occurred from the same locality are quite different in the shape and ornaments of the cheliped. Both specimens are not conjoint chelipeds and one is the left chela bearing rows of tubercles on the dorsal surface of the propodus and the another one is the right chela ornamented with short, oblique ridges on the dorsal surface of the propodus. Therefore, the species represented by both specimens are not conspecific although chelipeds in *Paguristes* are equal, subequal or unequal in size and are similar or dissimilar in ornaments (Rahayu, 2006).

***Paguristes michikoae*, new species**

(Figs. 1.1a–1.3)

Diagnosis: Left cheliped. Dactylus slightly curved laterally; mesio-dorsal and mesio-ventral margins delimited by low, rounded tubercles; mesial surface with blunt tubercles; dorsal and ventral surfaces with sparsely arranged obtuse tubercles; occlusal margin nearly straight, bluntly dentate. Dactylus and finger without hiatus. Propodus much longer than wide, much longer than high, with variable-sized tubercles; dorsal surface strongly vaulted, ornamented with four longitudinal rows of low, spherical tubercles; mesio-dorsal, mesio-ventral, and latero-dorsal margins delimited by tubercles; lateral surface weakly vaulted; ventral surface gently convex; proximal margin at about 100 degree angle to lateral margin in ventral side, with flange at articulation with carpus. Palm longer than wide, distal margin at about 100 degree angle to mesio-dorsal margin. Fixed finger shorter than palm, occlusal margin nearly straight, obtusely dentate. Carpus short, about as long as wide, about as long as high, widest at distal margin, narrowed proximally, with variable-sized spherical tubercles on surfaces; mesial surface with densely arranged tubercles.

Etymology: The species is named after Michiko Fudouji, the junior author's wife who cheerily supported his research for a long time.

Description: Dactylus of left cheliped poorly preserved, slightly curved laterally; mesio-dorsal and mesio-ventral margins delimited by low, rounded tubercles; mesial surface slightly hollowed with blunt tubercles; dorsal and ventral surfaces with sparsely arranged obtuse tubercles; occlusal margin nearly straight, bluntly dentate. Dactylus and finger without hiatus.

Propodus about 1.8 times as long as wide, about 2.5 times as long as high; dorsal surface strongly vaulted, ornamented with four longitudinal rows of low, spherical tubercles; mesial first row just close to mesio-dorsal margin with four tubercles; second row on medial dorsal surface, weakly arcuate laterally, with six tubercles; third row extending from distal margin onto fixed finger, nearly parallel to lateral-most row; tubercles of fourth row just close to latero-dorsal margin much smaller than others; latero-dorsal margin delimited by small, low tubercles varying in size; mesio-dorsal margin with six variable-sized tubercles and mesio-ventral margin with four variable-sized tubercles, both margins connected with raised distro-mesial margin concaved medially. Mesial surface with variable-sized tubercles. Lateral surface weakly vaulted, ornamented with small, low, scale-like tubercles directed distally; Ventral surface gently convex with variable-sized tubercles. Proximal margin at about 100 degree angle to lateral margin in ventral side, with flange at articulation with carpus; flange broadened ventrally, bounded by deep groove. Palm about 1.2 times longer than wide, distal margin at about 100 degree angle to mesio-dorsal margin. Fixed finger about 0.8 length of palm, tapering distally, occlusal margin nearly straight, obtusely dentate; lateral surface nearly straight.

Carpus short, about 0.4 length of propodus, about as long as wide, about as long as high, widest at distal margin, narrowed proximally, with variable-sized spherical tubercles on surfaces; distal margin with strongly vaulted flange, bounded by groove, at articulation with propodus; mesial surface with densely arranged tubercles.

Two pereiopods poorly preserved; surface of meri with obtuse, transverse ridges, sparsely arranged.

Remarks: The new species resembles *Paguristes cecconi* from the middle Eocene of Italy (De Angeli and Caporiondo, 2017), *P. hokoensis* from the upper Eocene Hoko River Formation of Washington (Schweitzer and Feldmann, 2001) and *P. subaequalis* from the Eocene of California (Rathbun, 1926), by having well-defined tubercular rows on the dorsal surface of the propodus. Among these three species, the new species is most similar to *Paguristes subaequalis*, but it differs in that four tuberculated rows on the dorsal surface of the propodus are well-developed, the latero-dorsal margin of the propodus is delimited by tubercles, and the lateral surface is ornamented with scale-like tubercles. The mesial surface of the propodus and carpus in *Paguristes hokoensis* is ornamented with spines, but that in the new species is with tubercles. Four rows on the dorsal surface of the propodus in the new species, but *P. hokoensis* has only two. Tubercles on the dorsal and lateral surfaces of the propodus in the new species are more well defined than those in *P. hokoensis*. *Paguristes cecconi* has well-developed, distally directed spines on the mesial surface of the propodus, not seen in the new species.

Material examined: Holotype (MFM218525).

***Paguristes teruakii*, new species**

(Figs. 2.1a–2.1c)

Diagnosis: Right cheliped. Dactylus slightly curved

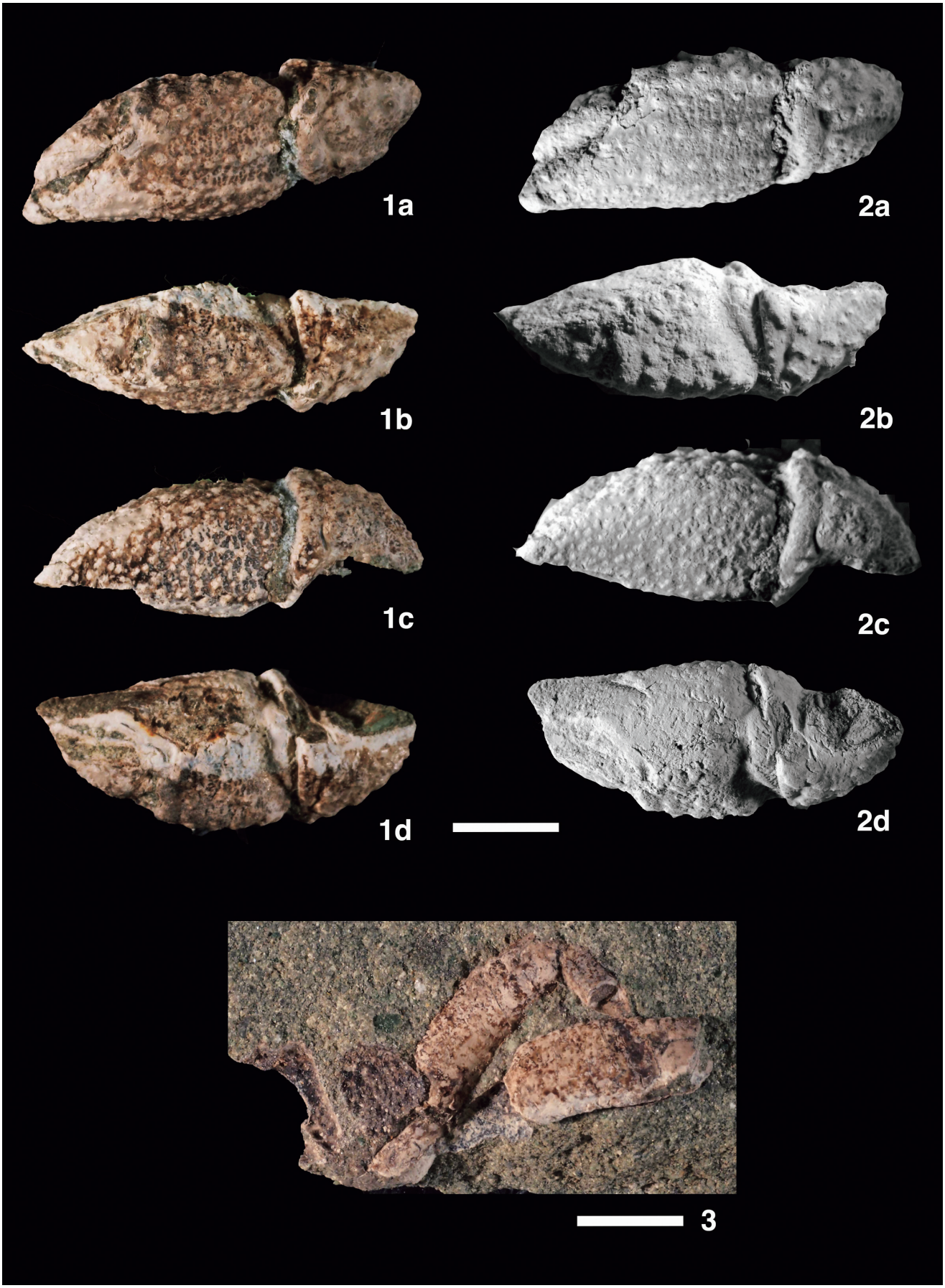


Fig. 1. ***Paguristes michikoae*, new species. 1, 2,** holotype (MFM218525), left cheliped, 2a–d coated with ammonium chloride sublimate, a, dorsal; b, mesial; c, lateral; d, ventral view. **3,** unidentified pereiopods. Scale bar = 5 mm.

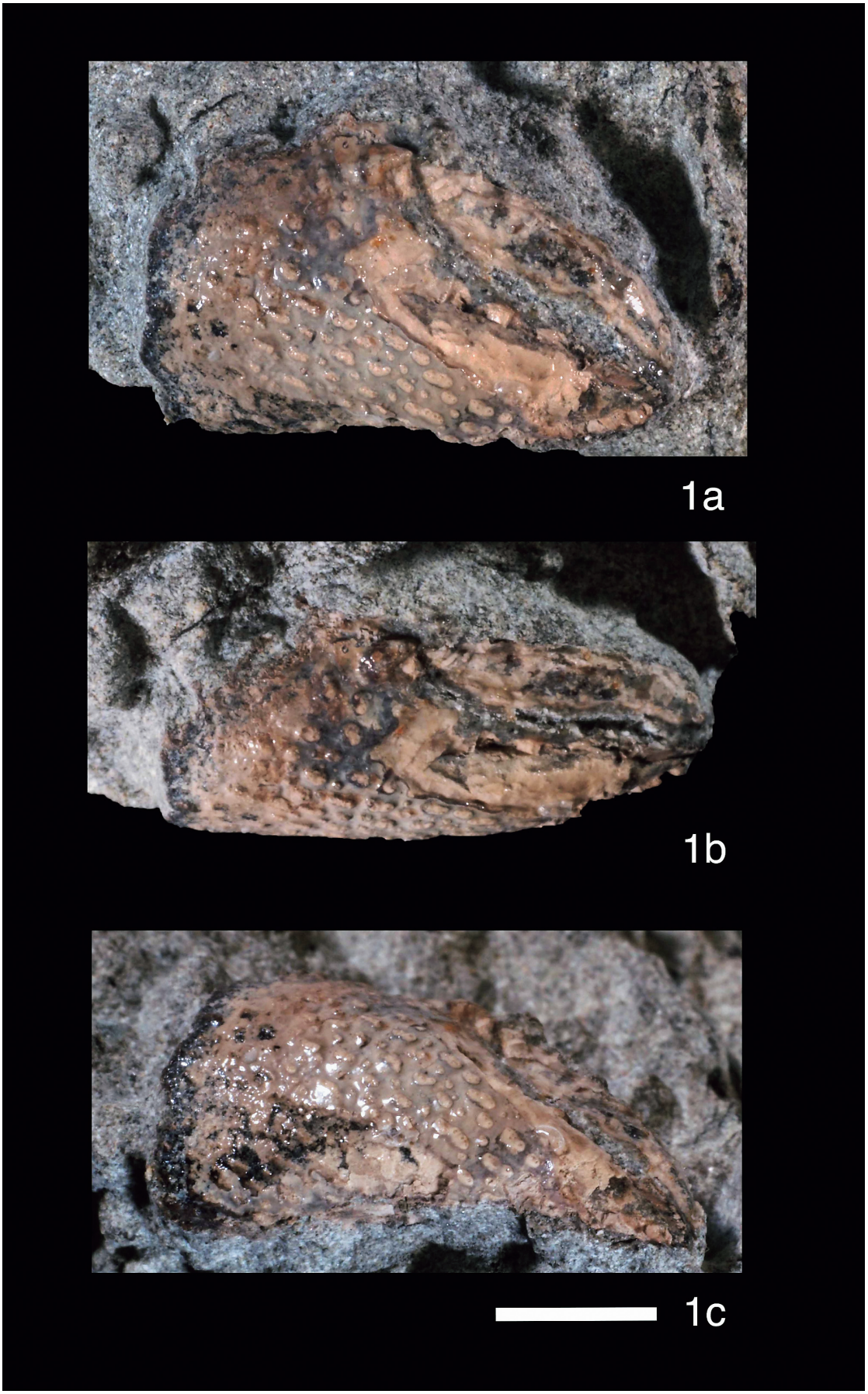


Fig. 2. ***Paguristes teruakii*, new species. 1,** holotype (MFM218526), right cheliped. a, dorsal; b, mesial; c, lateral view. Scale bar = 5 mm.

laterally; dorsal and mesial surfaces tuberculate; occlusal margin nearly straight, bluntly dentate, with corneous tip. Dactylus and finger without hiatus. Propodus short, much longer than wide, much longer than high; dorsal and lateral surfaces with short, irregular, oblique ridges, composed of rounded granules directed distally; mesial surface with large, distally directed tubercles; proximal margin at about 80 degree angle to lateral margin. Palm slightly wider than long, distal margin at about 100 degree angle to mesio-dorsal margin. Fixed finger about half length of palm, about as long as wide at the base, gently curved ventrally, occlusal margin nearly straight, bluntly dentate, with corneous tip.

Etymology: The species name is derived from Teruaki Fudouji who is the junior author's sum.

Description: Dactylus of right cheliped poorly preserved, slightly curved laterally; dorsal and mesial surfaces tuberculate, if cuticle present; occlusal margin nearly straight, bluntly dentate, with corneous tip. Dactylus and finger without hiatus.

Propodus about 1.4 times as long as wide, about twice as long as high; dorsal surface strongly vaulted, ornamented with short, irregular, oblique ridges, composed of rounded granules directed distally; mesio-dorsal margin short, about half length of propodus; mesial surface with large, distally directed tubercles, distal one largest; latero-dorsal margin not defined; lateral surface with short, irregular, oblique ridges, composed of rounded granules directed distally; proximal margin at about 80 degree angle to lateral margin. Palm about 1.2 times wider than long, distal margin at about 100 degree angle to mesio-dorsal margin. Fixed finger about half length of palm, about as long as wide at the base, gently curved ventrally, tapering distally; occlusal margin nearly straight, bluntly dentate, with corneous tip; lateral margin nearly straight.

Remarks: The new species has resemblance with three Italian Eocene species, *Paguristes clampensis* De Angeli and Caporiondo, 2017, *P. lineatuberculatus* Beschin, De Angeli, Checchi, and Mietto, 2006, and *P. sossanensis* De Angeli and Caporiondo, 2009, by having short, irregular, oblique ridges on the dorsal surface of the propodus of the cheliped. The new species differs from *Paguristes clampensis* by having a short palm with well-developed tubercles on the mesial surface. The ornaments on the dorsal surface of the propodus in the new species are more clearly defined than those of *Paguristes lineatuberculatus* and *P. sossanensis*. Additionally, *Paguristes lineatuberculatus* and *P. sossanensis* have rows of small tubercles on the dorsal surface, which lack in the new species.

Material examined: Holotype (MFM218526).

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