

# First Report of Two Diogenid Species of Hermit Crabs (Crustacea: Decapoda: Anomura) from Korea

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## ABSTRACT

Two diogenid hermit crab species, *Dardanus lagopodes* and *Diogenes deflectomanus*, are newly reported from Korea. *Dardanus lagopodes* is distinguished from the other species of genus *Dardanus* in Korea by having setae with cream-colored tips on the cephalothorax and the following characteristics: ocular peduncles somewhat longer than antennular peduncles, and the pereopod without a longitudinal sulcus and scute-like projections. *Diogenes deflectomanus* is similar to *D. nitidimanus* but can be distinguished by having the fixed finger of the left cheliped bent slightly downwardly and the following characteristics: slightly shorter ocular peduncle, elongated left cheliped with small granules on the surface, right cheliped without calcareous teeth on the cutting edge of the dactylus, and the minute spine of post-median margin of the telson is not well developed. The geographical distributions of these two species are extended by the present study. In particular, *D. deflectomanus* in the current study is the first report outside Chinese waters. Now, 20 species of the family Diogenidae are known in Korean waters.

**Keywords:** new record, *Dardanus lagopodes*, *Diogenes deflectomanus*, Decapoda, hermit crab, Korea

## INTRODUCTION

The family Diogenidae Ortmann, 1892 is one of the major taxa in the superfamily Paguroidea Latreille, 1802. Most genera of this family appear extensively near the equator in the Indo-Pacific region (McLaughlin et al., 2007). They are found in various habitats, from intertidal to slightly deep subtidal, and most species live in gastropod shells. Some species have formed a symbiotic relationship with anemones. Members of family Diogenidae are readily distinguished from other hermit crabs by their third maxillipeds, located close to each other in their bases. This family is also characterized by other characteristics: the left cheliped is generally larger than the right one, the antennular flagella terminating in a filament, no paired pleopods on the fourth and fifth abdominal somites, and the abdominal tergites mostly not well calcified (McLaughlin, 2003).

The family Diogenidae includes 20 genera and 429 species (McLaughlin et al., 2010). In Korea, only 6 genera and 18 species have been reported in this family: *Areopaguristes japonicus* (Miyake, 1961), *A. nigroapiculus* (Komai, 2009), *Ciliopagurus strigatus* (Herbst, 1804), *C. krempfi* (Forest,

1952), *Clibanarius virescens* (Krauss, 1843), *Dardanus arrosor* (Herbst, 1796), *D. aspersus* (Berthold, 1846), *D. crassimanus* (H. Milne Edwards, 1836), *D. impressus* (De Haan, 1849), *D. pedunculatus* (Herbst, 1804), *Diogenes edwardsii* (De Haan, 1849), *D. nitidimanus* Terao, 1913, *D. penicillatus* Stimpson, 1858, *Paguristes acanthomerus* Ortmann, 1892, *P. digitalis* Stimpson, 1858, *P. ortmanni* Miyake, 1978, *P. seminudus* Stimpson, 1858, and *P. versus* Komai, 2001 (Kim, 1973; Kim and Kim, 1997; Oh, 2001; Kim and Son, 2006; Lee and Ko, 2012). Two species, *Dardanus lagopodes* (Forskål, 1775) and *Diogenes deflectomanus* Wang and Tung, 1980 are newly reported as a result of ongoing systematic studies on Decapoda collected from Korean waters. Descriptions and figures of the two species are briefly provided.

## MATERIALS AND METHODS

All specimens were preserved in 99% ethanol and observed with a stereomicroscope (Leica MZ8; Leica, Wetzlar, Germany). Figures were drawn with a camera lucida on a Nikon

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SMZ800 (Nikon, Tokyo, Japan). Photos were taken with a digital camera (D200; Nikon) and assessed with the Helicon Focus software. The terminology follows McLaughlin et al. (2007). The abbreviation 'sl' refers to the shield length, measured from the end of the rostrum to the middle of the posterior margin of the shield, with digital slide calipers (Mitutoyo CD6CSX; Mitutoyo, Kawasaki, Japan) to 0.01 mm. The specimens examined in this study were deposited in the Marine Arthropod Depository Bank of Korea, Seoul National University (MADBK).

## SYSTEMATIC ACCOUNTS

Order Decapoda Latreille, 1803  
Superfamily Paguroidea Latreille, 1802  
Family Diogenidae Ortmann, 1892  
Genus *Dardanus* Paul'son, 1875

### <sup>1</sup>\* *Dardanus lagopodes* (Forskål, 1775) (Figs. 1, 2)

*Cancer lagopodes* Forskål, 1775: 93.

*Pagurus sanguinolentus* Quoy and Gaimard, 1824: 532, Pl. 79, fig. 2.

*Pagurus affinis* H. Milne Edwards, 1836: 274.

*Pagurus euopsis* Dana, 1852: 452; Alcock, 1905: 86, Pl. 9, fig. 2.

*Pagurus depressus* Heller, 1861: 248.

*Dardanus Hellerii* Paul'son, 1875: 90, Pl. 12, fig. 4, 4a–c.

*Dardanus sanguinolentus*: Miyake, 1965: 644, fig. 1081.

*Dardanus lagopodes*: Lewinsohn, 1969: 32, pl. 2, figs. 1, 2; McLaughlin et al., 2007: 91–93; 2010: 20 (list), fig. 8.

**Material examined.** 1 ♂ (sl 2.15 mm), Korea, Gyeongsangbuk-do, Ulleung-gun, Seo-myeon, Tonggumi, 15 Jul 2013, by SCUBA max 15 m, coll., Jung J, Park JH.

**Description.** Shield (Fig. 2A) almost as long as broad and with tufts of setae; rostrum almost absent. Lateral projection round, longer than rostrum. Ocular peduncle as long as shield; cornea somewhat dilated. Ocular acicle with 2 or 3 spines. Antennular peduncle not exceed distal corneal margin. Antennal peduncle shorter than ocular peduncle. Antennal acicle with several spines.

Left cheliped (Fig. 2B) not massive, slightly larger than right one, 2.3 times as long as shield; surface covered with long setae. Dorsal surface of chela with spines. Dactylus almost same length of palm measured along mesial margin; cutting edge with row of calcareous teeth, terminating in small corneous claw. Dorsal surface of palm with numerous scattered spines. Carpus 0.5 times as long as chela; dorsal



**Fig. 1.** *Dardanus lagopodes* (Forskål, 1775) (male, sl 2.15 mm), sl, shield length.

surface with scattered spines. Merus slender. Right cheliped (Fig. 2C) 2.2 times as long as shield, similar to left cheliped.

Second and third pereopods slender and long, with tufts of long setae. Second pereopod (Fig. 2D) 1.4 times as long as left cheliped. Dactylus 1.1 times as long as propodus; lateral surface with median longitudinal groove. Propodus 1.9 times as long as carpus. Carpus 0.5 times as long as merus; dorsoproximal margin bearing 1 strong spine. Third pereopod (Fig. 2E) similar to second pereopod.

Abdomen twisted, male with 4 unpaired pleopods and 4 calcified abdomen plates.

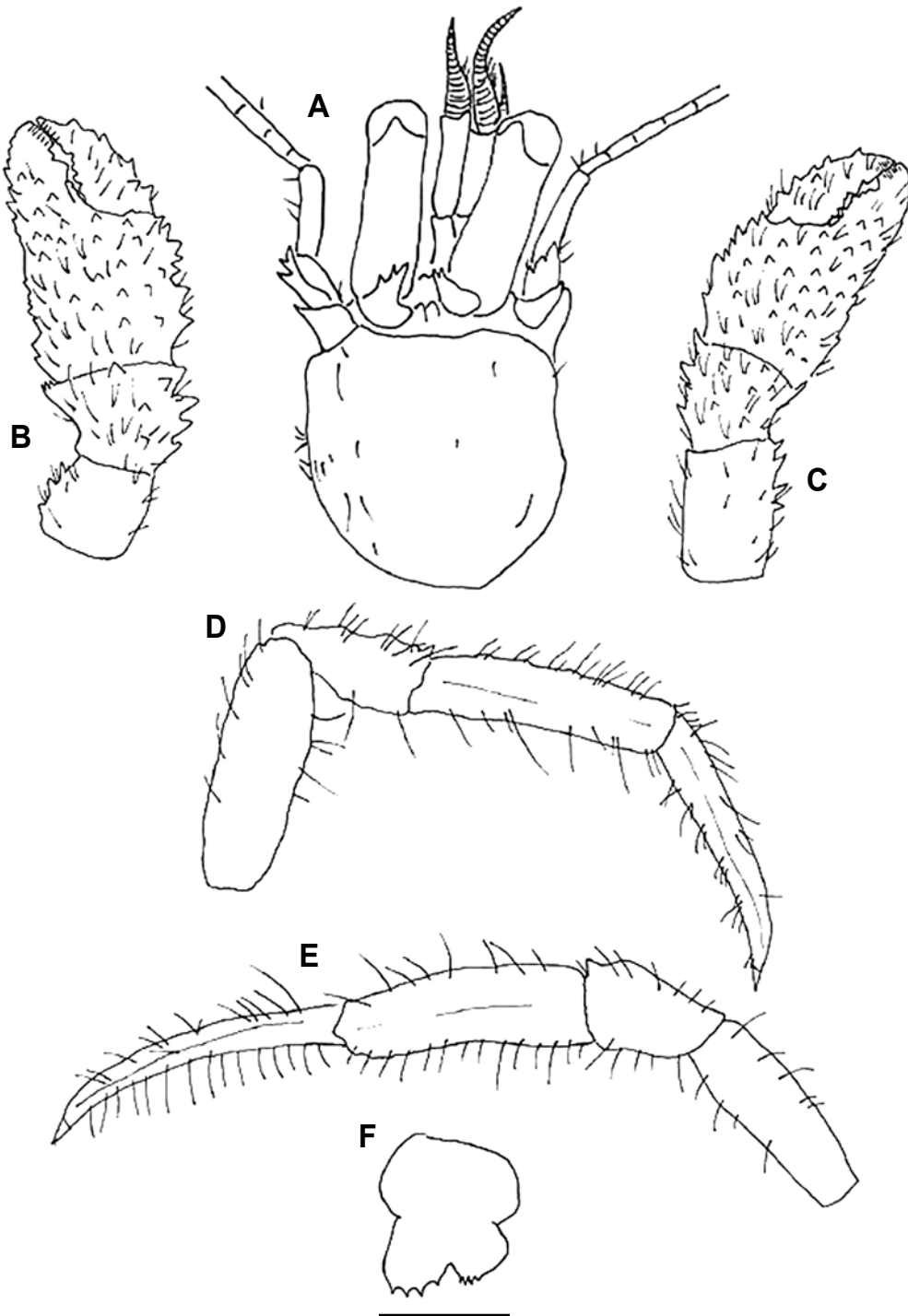
Telson (Fig. 2F) separated by narrow median cleft, asymmetrical, left lobe larger than right one. Posterior margins of 2 lobes, each with 4 spines.

**Coloration.** Shield white and mottled brown with old copper patch anteriorly. Ocular peduncle yellowish-brown. Pereopods white and mottled brown. Carpi of second and third pereopods old copper. Setae with cream tips.

**Distribution.** East Africa; Red Sea; Indian Ocean; Southeast Asia; Australia; Polynesia; Taiwan; Japan; Korea (Ulleung Is.).

**Habitat.** Living in a gastropod shell.

**Remarks.** This species is reported from Korean waters for the first time. It has been recorded from near the equator in the Indo-Pacific region. The present study extends the known range of this species northwardly. The specimen in this study was found living in the shell of a cone snail, oc-



**Fig. 2.** *Dardanus lagopodes* (Forskål, 1775), male. A, Shield and cephalic appendages; B, Left cheliped, dorsal view; C, Right cheliped, dorsal view; D, Right second pereopod, lateral view; E, Left third pereopod, lateral view; F, Telson, dorsal view. Scale bar: A-F=0.1 mm.

curing in the tropical area.

*Dardanus lagopodes* is distinguished from other hermit crabs of genus *Dardanus* in Korea by its setae with

cream-colored tip and the following characteristics: ocular peduncles somewhat longer than antennular peduncles; pereopods without sulcus and scute-like projections (Mc-

Laughlin et al., 2007).

McLaughlin et al. (2007) noted that this species has two color forms, “red-knee” form and “blue-knee” form, which originated in the color of the carpi of the second and third pereopods. They also mentioned that chelipeds of *D. lagopodes* are unequal, left not appreciably larger than right. And they make a remark that dactylus and propodus and carpus of left third pereopod of *D. lagopodes* covered with numerous strong spines. They also refer to the size range of *D. lagopodes* (sl 4.2–8.6 mm). Specimens of *D. lagopodes* collected from Malaysia in 2014 by the present authors also showed two color forms and those characteristics. And sl size range of those specimens is 7.9–11.8 mm. In the case of the current specimen of *D. lagopodes*, the color is “red-knee” form. But left and right cheliped are almost same, and its left third pereopod is almost unarmed except 1 strong spine on dorsoproximal margin of carpus. According to those difference and size of current specimen, it regard as juvenile.

Genus *Diogenes* Dana, 1851

<sup>1\*</sup>*Diogenes deflectomanus* Wang and Tung, 1980  
(Figs. 3, 4)

*Diogenes deflectomanus* Wang and Tung, 1980: 35, fig. 1 (type locality: Yangan, Zhejiang, China, 22 m); McLaughlin et al. 2010: 21 (list); Komai et al. 2012: 1228, fig. 6–9.

**Material examined.** 1 ♂ (sl 4.81 mm), Korea, Gangwon-do, Gosung-gun, Oho-ri, 27 Jul 2011, by SCUBA max 19 m, coll., Lee S.

**Description.** Shield (Fig. 4A) subquadrate, almost as long as broad; dorsal surface with transverse ridges with spine and tuft of setae laterally. Rostral lobe rounded, lateral projection bearing terminal spine. Intercalary rostral process long and slender, with acute tip. Ocular peduncle stout, 0.6 times as long as shield. Ocular acicle unarmed. Ultimate segment of antennular peduncle almost exceeding ocular peduncle. Antennal peduncle overreaching distal corneal margin. Flagella with long setae.

Left cheliped (Fig. 4B) larger than right one, 4.5 times as long as shield; most of the surface covered with small granules. Chela 2.1 times as long as broad; dorsomesial margin with strong tubercles. Dactylus curved, sharp, slightly longer than palm measured along mesial margin; dorsal surface depressed; ventral margin with groove; cutting edge with row of calcareous granules. Palm elongate; dorsal surface with 2 rows of tubercles; lateral margin convex, edge slightly depressed. Carpus with spinulose tubercles on dorsal sur-



**Fig. 3.** *Diogenes deflectomanus* Wang and Tung, 1980 (male, sl 4.81 mm). sl, shield length.

face. Merus depressed laterally; ventromesial margin with 3 moderately strong granules.

Right cheliped (Fig. 4C) reaching to middle of carpus of left cheliped; most surface with tuft of setae and rows of small tubercles. Chela 2.1 times as long as broad. Dactylus 1.5 times as long as palm; cutting edge without row of calcareous teeth. Palm not stout; dorsomesial margin with groove. Carpus 0.7 times as long as chela, strongly inflated ventrally; dorsomesial margin with rows of spinulose tubercles. Merus depressed laterally.

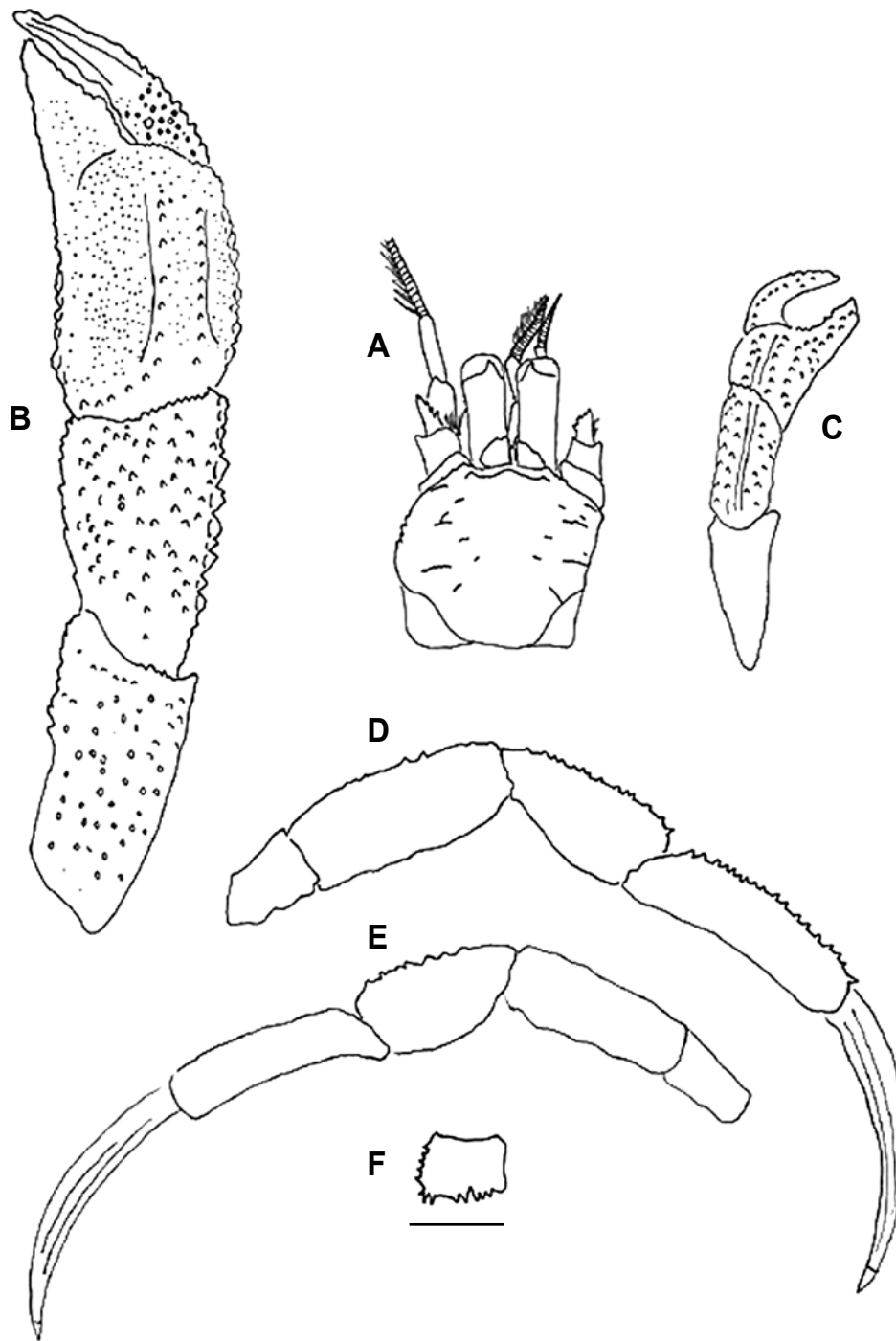
Second and third pereopods slender, covered with tuft of setae. Right second pereopod (Fig. 4D) reaching to base of dactylus of left cheliped. Dactylus 1.2 times as long as propodus, somewhat twisted; lateral margin with groove. Dorsal margin of propodus and carpus with rows of small spines. Merus depressed laterally.

Left third pereopod (Fig. 4E) similar to second pereopod but dorsal margin of propodus unarmed; in right pereopod row of spines present.

Abdomen twisted, with 4 unpaired pleopods in male.

Telson (Fig. 4F) separated by narrow median cleft, asymmetrical, left lobe larger than right one; left lobe with 9

Korean name: <sup>1\*</sup>긴넓적원손집게 (신칭)



**Fig. 4.** *Diogenes deflectomanus* Wang and Tung, 1980, male, setae omitted. A, Shield and cephalic appendages; B, Left cheliped, dorsal view; C, Right cheliped, dorsal view; D, Right second pereopod, lateral view; E, Left third pereopod, lateral view; F, Telson, dorsal view. Scale bar: A-F=0.2 mm.

strong spines laterally, 2 small spines mesially; right lobe with 3 small spines mesially.

**Habitat.** Living in a gastropod shell.

**Distribution.** Chinese coast from Bohai Sea to Hainan Island; intertidal to 30 m; Korea (East Sea).

**Remarks.** This species is reported from Korean waters for

the first time. It has been only recorded in the Chinese coast, from Bohai Sea to Hainan Island (Wang and Tung, 1980; Komai et al., 2012). The present study extends the range of this species eastwardly.

*Diogenes deflectomanus* is similar to *D. nitidimanus* Terao, 1913, reported in Korea. However, the slightly curved fixed finger of left cheliped and other characteristics distinguish *D. deflectomanus* from *D. nitidimanus*. These characteristics are the following: ocular peduncles slightly shorter; left cheliped elongated with surface bearing small granules; cutting edge of dactylus of right cheliped without calcareous teeth; minute spines of post-median margin of telson (Korn et al., 2008).

The examined specimen shows two slightly different characteristics compared with the description by Komai et al. (2012). The outer surface of fixed finger of left cheliped bears a row of tubercles on an elevated midline in their specimen, but the present specimen does not; ocular acicle is armed with four or five spines in their specimen but the present specimen does not. Because other characteristics agree with those of their description, such differences are regarded as individual variation.

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## REFERENCES

Alcock A, 1905. Anomura. Fasc. I. Pagurides. Catalogue of the Indian decapod Crustacea in the collections of the Indian Museum. Indian Museum, Calcutta, 2:1-197.  
 Dana JD, 1852. Crustacea, part I. United States Exploring Expedition, during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. Sherman C, Philadelphia, 13:1-685.

Forskål P, 1775. Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium; quae in itinere orientali observavit. ex Officina Molleri, Aulae Typographi, Havniae, pp. 87-96.  
 Heller C, 1861. Beitrage zur Crustaceen-Fauna des Rothern Meers, II. Teil. Sitzungs-Berichte der Mathematisch-Physikisch Klasse der Kaiserlichen Akademie der Wissenschaften, Wien, 44:241-295.  
 Kim HS, 1973. Anomura, Brachyura. Illustrated encyclopedia of fauna and flora of Korea. Vol. 14. The Ministry of Education, Seoul, pp. 1-506.  
 Kim MH, Son MH, 2006. Hermit crabs in Korean waters. Korea Inter-University Institute of Ocean Science, PKNU, Busan, pp. 1-89.  
 Kim W, Kim HS, 1997. Lists of animals in Korea (excluding insects). Korean Society of Systematic Zoology, Seoul, pp. 212-233.  
 Komai T, Liang J, Yang T, 2012. Records of four species of the shallow water hermit crab genus *Diogenes* (Crustacea: Decapoda: Anomura: Diogenidae) from southern China, with description of a new species. Journal of Natural History, 46:1219-1248.  
 Korn OM, Kornienko ES, Komai T, 2008. A reexamination of adults and larval stages of *Diogenes nitidimanus* (Crustacea: Decapoda: Anomura: Diogenidae). Zootaxa, 1693:1-26.  
 Lee SH, Ko HS, 2012. Larval stages of *Areopaguristes japonicus* (Miyake, 1961) (Decapoda: Anomura: Diogenidae) described from laboratory reared material. Zootaxa, 3368:146-160.  
 Lewinsohn C, 1969. Die Anomuren des Roten Meeres (Crustacea Decapoda: Paguridea, Galatheaidea, Hippidea). Zoologische Verhandlungen, 104:1-213.  
 McLaughlin PA, 2003. Illustrated keys to families and genera of the superfamily Paguroidea (Crustacea: Decapoda: Anomura), with diagnoses of genera of Paguridae. Memoirs of Museum Victoria, 60:111-144.  
 McLaughlin PA, Komai T, Lemaitre R, Rahayu DL, 2010. Annotated checklist of Anomuran Decapod crustaceans of the world (exclusive of the Kiwaoidea and families Chirostylidae and Galatheaidea of the Galatheaidea). Part I. Lithoidea, Lomisoidea and Paguroidea. The Raffles Bulletin of Zoology, 23:5-107.  
 McLaughlin PA, Lemaitre R, Komai T, Chan TY, 2007. A catalog of the hermit crabs (Paguroidea) of Taiwan. National Taiwan Ocean University, Keelung, pp. 1-365.  
 Milne Edwards H, 1836. Observations zoologiques sur les Pagures et description d'un nouveau genre de la tribu des Paguriens. Annales des Sciences Naturelle Zoologie, Paris, 6:257-288.  
 Miyake S, 1965. Anomura. In: New illustrated encyclopedia of the fauna of Japan (Eds., Okada YK, Uchida T). Hokuryukan, Tokyo, pp. 630-653.  
 Oh SC, 2001. Anomuran fauna from Geudo Island in Jinhae Bay. Underwater Science and Technology, 2:77-80.

- Paul'son O, 1875. Izsledovaniya rakoobraznykh krasnago moryas zametkami odnositel'no rakoobraznykh drugikh morei. Chast' 1. Podophthalmata i Edriophthalmata (Cumacea). S.V. Kul'zhenko, Kiev, pp. 1-144.
- Quoy JRC, Gaimard JP, 1824. Zoologie. In: Freycinet LCD, Voyage autour du monde entrepris par ordre du Roi, sous le Ministère et conformément aux instructions de S. Exc. M. Le Vicomte du Bocage, Secrétaire d'état au Département de la Marine, Exécuté sur les corvettes de S.M.l'Uranie et la Physicienne, pendant les Années 1817, 1818, 1819 et 1820. Vol. 1. Chez Pillet Aine, Paris, pp. 517-536.
- Terao A, 1913. A catalog of hermit-crabs found in Japan (Paguridae excluding Lithodidae), with description of four new species. *Annotationes Zoologicae Japonenses*, 8:355-391.
- Wang F, Tung Y, 1980. Two new species of hermit crab (Crustacea, Anomura) from China. *Acta Zoologica Sinica*, 5:35-38.

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