

Re-description of Sea Spider *Cilunculus armatus* (Pycnogonida: Ammotheidae) from Korea

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ABSTRACT

The sea spider genus *Cilunculus* Loman, 1908 comprises 33 species having short chelifores, separate lateral processes, and a hood structure on the cephalic segment. A pycnogonid species, *Cilunculus armatus* (Böhm, 1879), was collected from Baekdo Island and Chujado Island, Korea. This species is characterized by having a hood structure on the cephalic segment, separate lateral processes, a low ocular tubercle without eyes, and 3-segmented chelifores. In the examined material, chela shape, arrangement of compound spines on strigilis, and number of heel spines at propodus were different from the previous literatures. Here, we examined *C. armatus* collected in Korean waters and provided illustrations and pictures in detail.

Keywords: *Cilunculus armatus*, Chelifore, Korean Strait, sea spider, Korean waters

INTRODUCTON

The sea spider genus *Cilunculus* Loman, 1908 comprises 33 species (Bamber et al., 2020), including a species, *Cilunculus tricuspis* Wang et al., 2020, recently discovered. This genus is distinguished from the other genera by having short chelifores, separate lateral processes, and a hood structure on a cephalic segment.

During field surveys at the South Sea in 2017 and 2019, four specimens of *Cilunculus armatus* (Böhm, 1879) were obtained from Baekdo Island and Chujado Island, Korea (Fig. 1). The present species is characterized by having a hood structure on the cephalic segment, separate lateral processes, a low ocular tubercle without eyes, and 3-segmented chelifores.

Although Nakamura and Child (1991) found two specimens of *C. armatus* in the Korean Strait (33°53.6'N, 128°33.4'E) and included them in Japanese records, Kim (2013) included this species in the Korean pycnogonids without any description. Applying the collection coordinate to a map (Flanders Marine Institute, 2020), the coordinate of *C. armatus* is close to the boundary of Continental Shelf between Korean and Japan (Fig. 2), which is now the basis for estimating the sea territories in the Korean Strait. It is presumed that Kim (2013) included them as a Korean record since the sea territories may change if EEZ is established in the future.

Previous, there were no specimens of *C. armatus* lodged in domestic institutions, so it is difficult to observe the morphology of *C. armatus* and compare its morphology with other specimens collected abroad. Since four specimens of *C. armatus* living in Korean waters were obtained through field surveys and different features from the original description



Fig. 1. Distribution of *Cilunculus armatus* (Böhm, 1879) in Korea. Red circles indicating present records and black square indicating previous record.

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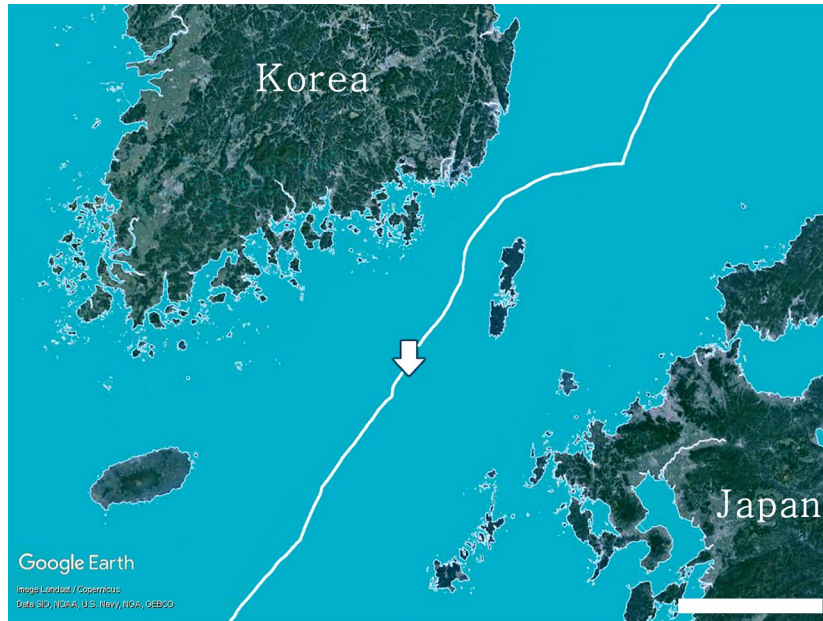


Fig. 2. Coordinates of *Cilunculus armatus* quoted from Kim (2013). Scale bar = 100 km. Quoted from Flanders Marine Institute (2020). This map from Google, Landset/Copernicus.

were found, the specimens were examined and the morphology of *C. armatus* was re-described.

MATERIALS AND METHODS

The examined specimens were collected by a grab sampling at Baekdo Island on 28 Jun 2017 and at Chujado Island on 16 Jan 2019. These specimens were fixed in 70% ethanol and stained by Lignin-Pink if necessary. Appendages were detached from the trunk and observed under a stereomicroscope (Leica M165C, Germany) and a light microscope (Olympus BX51, Japan). Images were recorded by a digital camera (Nikon D850, Japan) and a microscope digital camera (Leica MC170) and then blended using Helicon Focus software (Helicon Focus, Ukraine). Digital drawings were produced following the method of Coleman (2009).

Specimens were measured following the methods of Fry and Hedgpeth (1969), and Lee and Kim (2020). Trunk length was measured between the anterior margin of the cephalic segment and the posterior margin of the fourth lateral processes from the dorsal viewpoint. Trunk width was measured between the middle points of the distal ends of the second lateral processes from the dorsal viewpoint. The proboscis and abdomen were measured between the middle point of the basal width and the distal margin from the lateral viewpoint. Legs were measured between the middle points of the distal ends from the lateral viewpoint. Curved segments were mea-

sured according to the chord length of the central arc.

SYSTEMATIC ACCOUNTS

Order Pantopoda Gerstaecker, 1863

Family Ammotheidae Dohrn, 1881

Genus *Cilunculus* Loman, 1908

Cilunculus armatus (Böhm, 1879) (Figs. 3, 4)

Lecythorhynchus armatus Böhm, 1879: 141 (type locality: Tokyo, Japan).

Parazetes pubescens Ortmann, 1891: 163, Pl. 24, fig. 5a-d.

Cilunculus armatus: Loman, 1911: 9, Taf. 1, figs. 1-8; Hedgpeth, 1949: 294, fig. 43; Utinomi, 1955: 27, fig. 16; Nakamura and Child, 1983: 33; Hirohito and Nakamura, 1987: 33, Pl. 30, figs. 1-12; Nakamura and Child, 1991: 16; Miyazaki and Makioka, 1993: 127, figs. 1-5; Turpaeva, 2007: 117, Pl. 15, figs. 8-13; Kim, 2013: 40.

Material examined. Korea: 1♀, Jeju-do Island: Chujado Island, CJ4 point, 33°56'34.0"N, 126°17'06.6"E, grab, 30 m depth, 16 Jan 2019 (DMJS01), Kim S; 1♂, Chujado Island, CJ2 point, 33°59'06.9"N, 126°17'18.0"E, grab, 30 m depth, 16 Jan 2019 (DMJS02), Kim S; 1 juv., Chujado Island, CJ4 point, 33°56'34.0"N, 126°17'06.6"E, grab, 30 m depth, 16 Jan 2019 (NIBRIV0000866872), Kim S; 1 juv., Jeollanam-do: Yeosu-si, Geomun-ri, North of Baekdo, 34°03'04.0"N,

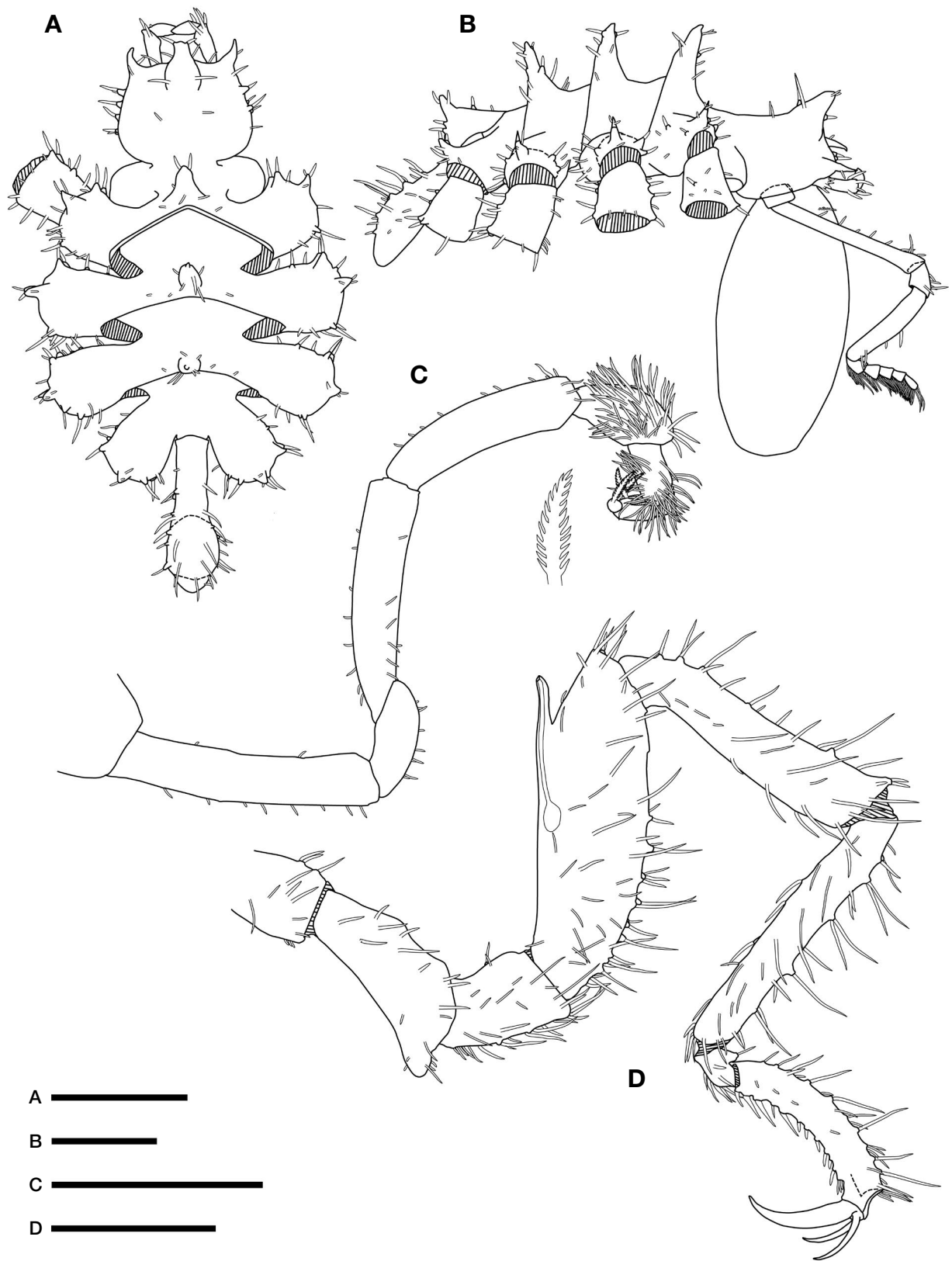


Fig. 3. *Cilunculus armatus* (Böhm, 1879), male. A, Trunk, dorsal view; B, Trunk, lateral view; C, Left oviger with compound spine; D, Right leg 3. Scale bars: A-D=1 mm.

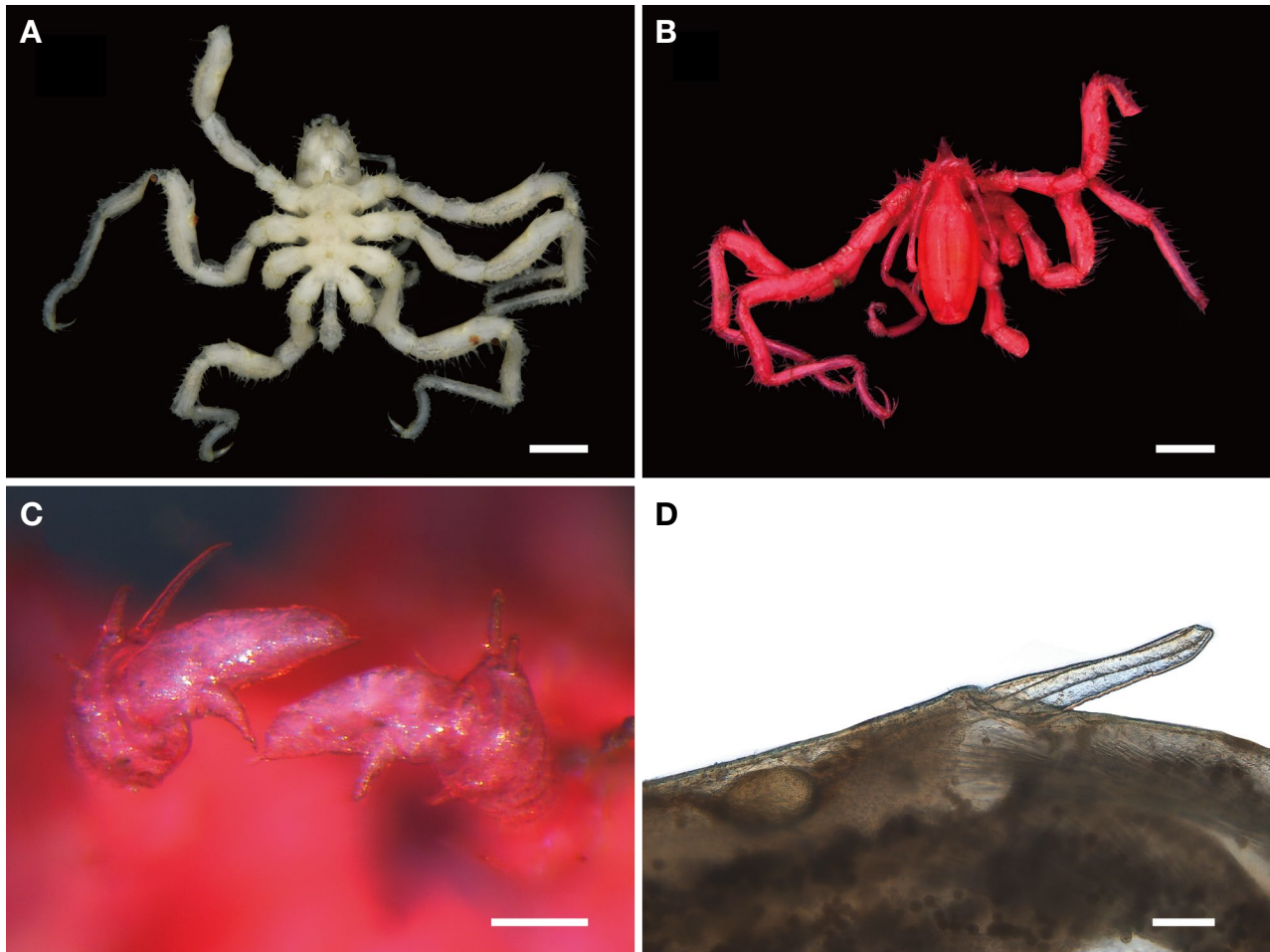


Fig. 4. *Cilunculus armatus* (Böhm, 1879), male. A, Trunk, dorsal view; B, Trunk, anterior view; C, Chela, anterior view; D, Cement gland on leg 4. Scale bars: A, B=1 mm, C, D=0.1 mm.

127°36'13.0"E, grab, 28 Jun 2017 (MADBK800107_001), Kim S.

Description. Trunk fully segmented (Figs. 3A, 4A). Each segment connected such as ball and socket joint, with transverse ridge on posterior margin having 3–4 spines and dorsomedian tubercle ornamented with spines on transverse ridge (Fig. 3A, B). Cephalic segment connected to main body through neck, forming hood structure, broad at base, slightly tapering distally, with hook-like process on anterolateral margin, and many spines on anterior and lateral margin (Fig. 3A, B).

Lateral processes about 2 times as long as basal width, separate by less than diameter, having several tubercles with spines on dorsodistal margin; median tubercle on dorsodistal margin tallest and largest (Figs. 3A, B, 4A).

Ocular tubercle present at anterior part of cephalic segment, about half height of dorsomedian tubercle on trunk, having two spines on dorsolateral margin; eye absent (Fig. 3A, B).

Proboscis pyriform, directing ventrally, about 0.8 times as long as trunk length, having 6–7 spinules on anterolateral proximal surface; spinules arranged in row along anteroposterior axis (Figs. 3B, 4B).

Abdomen club-shaped, articulated at base, not reaching distal margin of coxa 2, having many tubercles with spines on dorsal surface, bearing dorsal swelling on two third from base (Figs. 3A, B, 4A).

Palp 9-segmented, attached under hood; segment 2 longest, about 9 times as long as basal width, having dorsal setae; segment 4 second longest, about 6.7 times as long as basal width, having dorsal setae; segment 5–8 short, slightly expanded ventrally, having many setae on ventral surface; terminal segment about 3.7 times as long as basal width, having many setae on ventral and anterior surface (Fig. 3B).

Chelifere attached under hood, consisting of 2-segmented scape and chela (Fig. 3A, B). Scape segment 1 short, wider than scape 2, having long setae on distal margin; segment 2

about 3 times as long as basal width, having long setae on distal margin. Chela spindle-shaped, without teeth; immovable finger thick, longer than palm, having small tubercle on distal margin; movable finger small and sharp like spine, attached on ventral groove (Fig. 4C).

Oviger 10-segmented, ornamented with setae; segment 2 longest, about 5 times as long as basal width; segment 4 about 1.2 times as long as segment 5; segment 6 swollen in male, having many long setae; segment 7 having many long setae; segment 8 having long setae and 2 compound spines at inner surface; segment 9 having compound spine at inner distal margin; terminal segment small, having 2 compound spines (Figs. 3C, 4B).

Leg 3 ornamented with many setae (Fig. 3D). Coxa 1 about 0.8 times as long as basal width, sometimes having distinct dorsomedian tubercle with spine at distal margin. Coxa 2 about 4 times as long as basal width, having coxal spur on ventrodistal margin of leg 3–4 and gonopore on tip in male. Coxa 3 about 1.6 times as long as basal width, longer than coxa 1. Femur longer than other segments in leg, about 6 times as long as basal width, having cement gland tube on dorsal surface; cement gland stalk and ball-shaped, longer than basal width of femur (Figs. 3D, 4D). Tibia 1 about 5 times as long as basal width. Tibia 2 longer than tibia 1, about 6 times as long as basal width. Tarsus small, ventrally convex, having dorsal seta and five ventral setae. Propodus moderately curved, having many dorsal setae, five heel spines, six sole spines, and three sole setae. Main claw curved, about 0.5 times as long as propodus. Auxiliary claws curved, about 0.5 times as long as main claw.

In female, oviger less hairy than male; segment 6 not swollen; strigils having compound spines arranged 3:2:0:2. Gonopore present at ventral surface of coxa 2 of all legs. Coxal spur and cement gland absent.

Measurements (mm). DMJS02, trunk length, 3.09; trunk width, 2.25; proboscis, 2.59; abdomen, 1.60. Leg 3; coxa 1, 0.49; coxa 2, 1.03; coxa 3, 0.67; femur, 1.89; tibia 1, 1.61; tibia 2, 1.73; tarsus, 0.26; propodus, 1.18; main claw, 0.63; auxiliary claw, 0.37.

Type locality. Tokyo, Japan.

Distribution. Korea (Jeolla-do, Gyeongsang-do, and Jeju Island), Russia (the Sea of Okhotsk), and Japan.

Remarks. In comparison with the description given by previous literatures (Böhm, 1879; Loman, 1911; Hirohito and Nakamura, 1987), some variations are observed in the examined material. The chela is atrophied, spindle-shaped, and has fingers in Korean specimens (Figs. 3A, 4C). In the original description, only short description about the chela was found (atrophied, pointed shape). There was no figure of the species and description of fingers. Loman (1911) added figures of the present species. The chela shape in the figure (Taf 1: fig. 7) is

similar to that of the examined material, but it was described as a fingerless shape. Hirohito and Nakamura (1987) reported that chela was globular without fingers. The chela was 0.2–0.3 times as long as scape 2, while in the examined material, it is about 0.7 times as long as scape 2. Since the size of the examined material are smaller than the type specimen (total leg length: 9.49 mm in examined material; 11.5 mm in the type specimen), these variations are considered due to the developmental stage (maybe subadult stage).

The compound spines on the strigilis are arranged in 0:2:1:2 in male and 3:2:0:2 in female. However, those of the original description were arranged in 3:3:1:2 in female and those of Hirohito and Nakamura (1987) were arranged in 0:1:1:2 in male and 3:1:1:2 in female. The number of compound spines of strigilis appears to be variable.

In the examined material, there are five heel spines at the sole of the propodus, whereas three heel spines were described in the Japanese specimens (Hirohito and Nakamura, 1987). There is no explanation about the number of heel spines at the propodus in the original description and Loman's (1911) description.

The present species is distributed between the Sea of Okhotsk, Russia and Amakusa Island, Japan in latitude and 0–700 m at depth range.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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