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First record of the *Cleantioides rotundata* (Malacostraca: Isopoda: Hologhathidae) from South Korea

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Cleantioides rotundata (Kussakin, 1982) is reported for the first time in South Korea. Specimens of *C. rotundata* were collected with a small hand net from the intertidal zone of Opo-ri, Yeongdeok-gun in South Korea. This species makes tubes using seagrass debris at our sampling location and distinguished by the following characteristics: pleotelson long, length almost 1.6 times as long as width; dorsum of distal one third with deeply bilobed depression on plane. In this paper, we provide descriptions of diagnostic characteristics and illustrations of morphology of *C. rotundata*. Additionally, a key to the Korean species of the genus *Cleantioides* is provided and the partial sequences of the mitochondrial cytochrome c oxidase subunit 1 (*CO1*) are provided as molecular characteristics.

Keywords: *Cleantioides rotundata*, *CO1*, Isopoda, key to the Korean species, South Korea, tube

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Introduction

The genus *Cleantioides* Kensley & Kaufman, 1978 (Malacostraca: Isopoda: Hologhathidae), is one of five genera belonging to the family Hologhathidae Thomson, 1904. It is currently comprises of 13 species (Poore and Schotte, 2015). This genus is diagnosed by: 1) cylindrical body; 2) pleonite 1 free and articulating; 3) antenna 2 flagellum with a clavate article; 4) dactylus of pereopod 4 reduced; and 5) uniramous uropods (Poore and Lew Ton, 1990; Kwon and Kim, 1992). Four species of *Cleantioides*: *C. japonica* (Richardson, 1912), *C. emarginata* Kwon and Kim, 1992, *C. poorei* Kwon and Kim, 1992, and *C. planicauda* (Benedict, 1899) have previously been recorded in South Korea (Richardson, 1912; Kwon and Kim, 1992; Song *et al*., 2014).

We provide descriptions of the diagnostic characteristics and illustrations of morphology of *C. rotundata*. Additionally, a key to the Korean species of the genus *Cleantioides* is provided and the partial sequences of *CO1* are provided as molecular characteristics.

Materials and Methods

Sample collection

Specimens of *C. rotundata* were collected using a small hand net from Opo-ri, Ganggu-myeon, Yeongdeok-gun (36°21′N, 129°23′E) in South Korea. They were immediately preserved in 95% ethyl alcohol after collection. All examined specimens were deposited in the National Institute of Biological Resources (NIBR) and Inha University, South Korea.

Morphological Analysis

The specimens were transferred to glycerin for dissection and then examined and dissected under a stereomicroscope (Model SZX-7; Olympus, Tokyo, Japan). Figures of dissected appendages were obtained by light microscopy with attached drawing tube (Model DM 2500; Leica, X50-630, Wetzlar, Germany). Figures of the whole body were obtained using the drawing tube attached to a stereomicroscope (Olympus SZX-12, Tokyo, Japan). The lengths of all appendages and the whole body were measured with a stage micrometer (Model No. 11513106; Leica, Germany) and an ocular micrometer. Photographs of the whole bodies were taken with a microscope digital camera (Model eXcope K6; DIXI Science, Korea).

Photographs of the pleotelson were obtained using a scanning electron microscope (SEM) (Model Hitach S-4200; Japan). In pre-treatment, we using a TWEEN 20 (Model 036K00963; Sigma, USA) to remove debris on



Fig. 1. Sampling site. Intertidal zone, sea grass debris; Opo-ri, Ganggu-myeon, Yeongdeok-gun, Gyeongsangbuk-do, Korea.

specimens and using a critical point dryer (CPD) (Model E3000; Quorum Technologies Ltd, UK) to avoid adhesion and/or damage on specimens.

DNA sequencing

DNA was extracted from one pleopod 1 from each specimen using DNeasy Blood and Tissue Kit (Qiagen, Valencia, CA, USA) according to the manufacturer's instructions. The DNA was amplified using PCR (polymerase chain reaction) with two primers: jgLCO1490 5′-TITCIACIAAYCAYAARGAYATTGG-3′ and jgHCO 2198 5′-TAIACYTCIGGRTGICCRAARAAYCA-3′ (Geller *et al*. 2013). PCR amplification was conducted under the following condition: 3 min at 94°C, 35 cycles at 95°C for 15 s, 42°C for 30 s, and 72°C for 60 s, and a final extension at 72°C for 7 min. PCR products were purified using the QIAquick PCR Purification Kit (Qiagen, Valencia, CA, USA) and were sequenced with an ABI3100 automated sequencer (Perkin Elmer, Foster City, CA, USA).

Results and Discussion

Order Isopoda Latreille, 1817 등각목
Suborder Valvifera Sars, 1882 유변아목
Family Hologнathidae Thomson, 1904
주걱벌레붙이과
Genus *Cleantioides* Kensley and Kaufman, 1978
주걱벌레붙이속

1. *Cleantioides rotundata* (Kussakin, 1982)
오목꼬리주걱벌레붙이 (신칭) (Fig. 3)

Synonyms. *Zenobiana rotundata* Kussakin, 1982: 99, fig. 71.
Cleantioides rotundata: Poore and Lew Ton, 1990: 59; Kwon and Kim, 1992: 89.

Material examined. Korea: 2♂♂, Opo-ri, Ganggu-myeon, Yeongdeok-gun, Gyeongsangbuk-do, 36°21′N, 129°23′E, August 27, 2014, depth 3-5 m, collected with light traps by Song J.-H.

Diagnosis. Body (Fig. 3A, D) cylindrical, approximately 13.2 mm, almost 5.1 times longer than greatest width. Head approximately 1.7 times wider than long; anterior margin some emarginated at midpoint. Coxal plates not visible dorsally on pereonites 2-4, but distinctly visible dorsally on pereonites 5-7. Maxillipedal palp (Fig. 3E) with 5 articles. Pleonites composed of 3 complete and 1 incomplete segments (3 + 1). Pleotelson (Fig. 3B, C) parallel-sided with anteriorly deeply bilobed depression.

Remarks. *Cleantioides rotundata* is distinguished from other species of *Cleantioides* by several characteristics: (1) maxillipedal palp with 5 articles; (2) very long pleotelson (more than 1.6 times longer than greatest width); and (3) pleotelson with anteriorly deeply bilobed depression. *Cleantioides rotundata* is very similar to *C. striata* Poore & Lew Ton, 1990 in external features. However, *C. rotundata* differs from *C. striata* in having a longer pleotelson (almost 1.6-1.8 times longer than width in *C. rotundata* vs 1.2 times longer than width in *C. striata*) and pleotelson with anteriorly deeply bilobed depression (pleotelson with dorsum of distal third with poorly defined oblique oval plane in *C. striata*). The characteristics of the pleotelson is very important in the genus *Cleantioides*. So, we photographed the pleotelson of *C. rotundata* using scanning electron microscopy (SEM) (Fig. 3B, C). In general, *C. rotundata* specimens from



Fig. 2. *Cleantioides rotundata*, makes tube by sea grass debris.

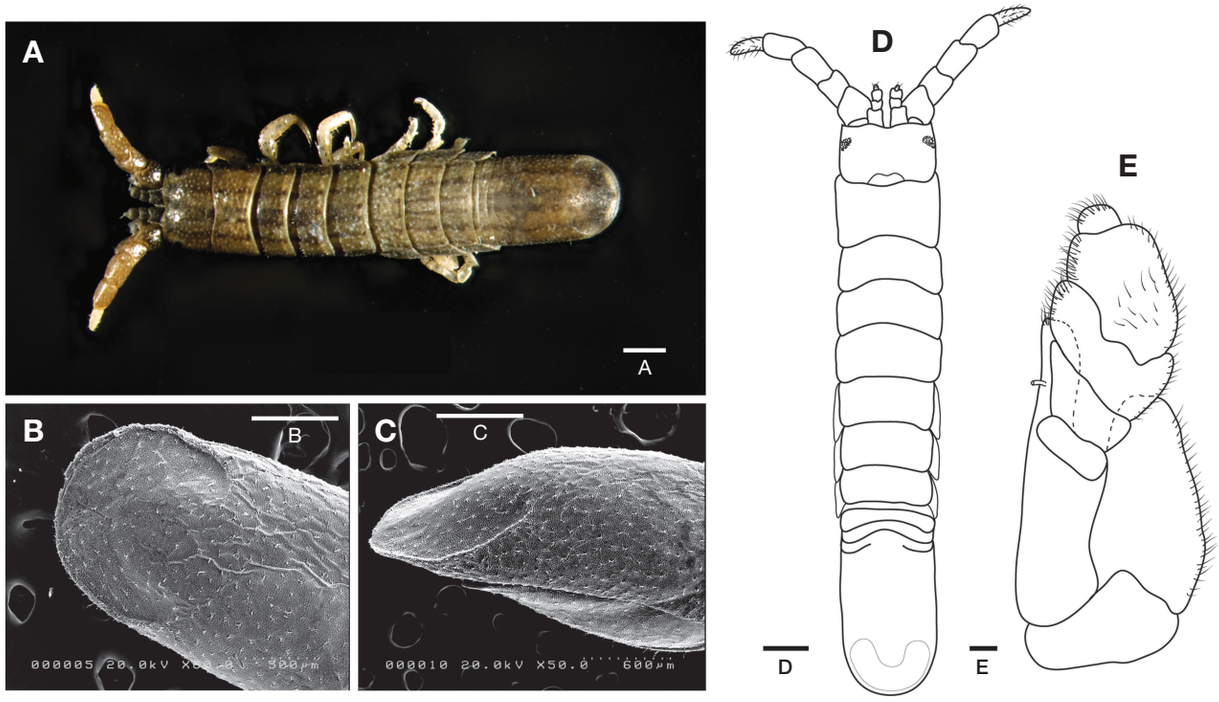

Fig. 3. *Cleantioides rotundata*: A, body of male, dorsal view; B, pleotelson and plane, SEM; C, pleotelson and plane, SEM; D, body of male, dorsal view; E, maxilliped. Scale bars: A = 1 mm, B = 500 µm, C = 600 µm, D, E = 0.1 mm.

South Korea agreed well with the illustrations and original description of Kussakin (1982).

Habitat. Habitat information is not available for the type locality. This species makes a tubes using seagrass debris at the sampling location of South Korea (Figs. 1, 2).

World distribution. Japan (Kussakin 1982), Korea.

Deposition. NIBR No. NIBRIV0000437273, NIBRIV 0000437274 (2 males).

Molecular characteristic. GenBank accession numbers: KX078773, KX078774 (2 males).

Identifiers. Ji-Hun Song, Gi-Sik Min.

2. *Cleantioides japonica* (Richardson, 1912)
왜주걱벌레붙이
Synonyms. *Cleantis japonica* Richardson, 1912: 27.
Cleantioides japonica: Kwon, 1986: 109; Kwon & Kim, 1992: 86.

3. *Cleantioides emarginata* Kwon & Kim, 1992
민꼬리주걱벌레붙이
Synonyms. *Cleantioides emarginata* Kwon & Kim, 1992: 86.

4. *Cleantioides poorei* Kwon & Kim, 1992
털보주걱벌레붙이
Synonyms. *Cleantioides poorei* Kwon & Kim, 1992: 89.

5. *Cleantioides planicauda* (Benedict, 1899)
납작꼬리주걱벌레붙이
Synonyms. *Cleantis planicauda* Benedict, 1899: 851.
Cleantioides planicauda: Song *et al*., 2014: 27.

Key to the Korean species of the genus *Cleantioides*

1. The posterior plane of pleotelson has a median tubercle ····· *C. japonica* (Richardson, 1912)
− The posterior plane of pleotelson unarmed (no tubercle) ····· 2
2. Posterior margin of pleotelson with emarginated apex ····· *C. emarginata* Kwon and Kim, 1992
− Posterior margin of pleotelson with rounded apex ···· 3
3. Body almost 4 times longer than greatest width; coxal plates visible dorsally on pereonites 2-7; suture of maxillipedal palp between 2 and 3 is partial ····· ····· *C. poorei* Kwon and Kim, 1992
− Body almost 5.1 times longer than greatest width; coxal plates visible dorsally on pereonites 5-7; suture of maxillipedal palp between 2 and 3 is complete ··· 4
4. Pleotelson length almost 1.3 times as long as width, dorsum of distal half with slightly bilobed depression ····· *C. planicauda* (Benedict, 1899)
− Pleotelson length almost 1.6 times as long as width, dorsum of distal one third with deeply bilobed depression ····· *C. rotundata* (Kussakin, 1982)

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