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# Two new records of free-living marine nematodes of the family Ironidae de Man, 1876 (Nematoda: Enoplida) from Korea

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Two new records of marine nematodes, belonging to the family Ironidae de Man, 1876, are reported based on the specimens collected from intertidal sediments from the west coast of Korea. *Conilia sinensis* is characterized by a relatively long body length, a well-developed buccal cavity with three claw-like teeth, the presence of a single spicule with transverse striations, the presence of rib-shaped telamons, and single precloacal supplement. *Pheronous donghaiensis* is distinguished from other species of the genus by a well-developed buccal cavity with four claw-like solid teeth and minute denticles, relatively short and thick spicules with the central septum, the presence of 8−9 curved tubular-shaped precloacal supplements, and a sharp pointed tail with three small tubular supplements arranged into two rows in males. In this report, we provide a taxonomic description and illustrations of two unrecorded species of the family Ironidae by differential interference contrast microscopy. This is the first taxonomic report on the species of the family Ironidae from Korea.

Keywords: *Conilia*, Ironidae, marine nematodes, *Pheronous*, taxonomy

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## Introduction

The family Ironidae de Man, 1876 was established based on the genus *Ironus* Bastian, 1865 as a type genus of the family. This group contains about 80 valid species belonging to nine genera combined into two subfamilies, Ironinae de Man, 1876 and Thalassironinae Andrássy, 1976, including the recently reported genus *Piipironus* Zograf and Mordukhovich, 2022 (Smol *et al*., 2014; Bezerra *et al*., 2021; Zograf and Mordukhovich, 2022). They are widespread and discovered in various habitats, such as marine, continental waters, and occasionally on land (Tahseen and Mehdi, 2009; Chen and Guo, 2015; Zograf and Mordukhovich, 2022). The members of this family can be distinguished from the other groups in having a narrow and strongly elongated buccal cavity armed with claw-like teeth in the anterior part (Platonova and Mokievsky, 1994; Tahseen and Mehdi, 2009).

The genus *Conilia* Gerlach, 1956 belongs to the family Ironidae, and three species have been previously described worldwide as follows: *C. divina* Gerlach, 1956 from Santos Beach of the Indian Ocean; *C. monospiculata* Aryuthaka, 1989 from Amakusa, Shinoshima Island of southern Japan; and *C. sinensis* Chen and Guo, 2015 from Dongshan Island of the East China Sea. Compared with other genera of this family, the genus *Conilia* is characterized by the following features: three teeth of different sizes and an oblique serrated plate, papilliform inner labial sensilla, setiform outer labial and cephalic sensilla, and single spicule with transverse striations (Smol *et al*., 2014).

The genus *Pheronous* was established by Inglis in 1966 with the type species, *P. ogdeni*. It differs from other genera of the family Ironidae by having the papilliform anterior sensilla, relatively short spicules, precloacal and postcloacal setae, and a conical tail with pointed tip. So far, only two species, *P. ogdeni* Inglis, 1966 and *P. donghaiensis* Chen and Guo, 2015, have been described in this genus (Inglis, 1966; Chen and Guo, 2015).

During the investigations on the free-living marine nematodes diversity, two unrecorded marine nematodes were collected from intertidal fine sandy beaches on the west coast of Korea. A taxonomic report on the family Ironidae has not yet been conducted from Korea. We provide taxonomic descriptions, illustrations, and photomicro-

graphs of two unrecorded marine nematodes using a differential interference contrast (DIC) microscopy in the present report.

## Materials and Methods

Sediment samples were collected from fine sandy beaches in the intertidal zone of the west coast of Korea using a hand shovel. Meiofauna extracted from the sediments through fresh-water osmotic shocking (Kristensen and Higgins, 1989) were filtered through a 63 μm mesh-sieve, and fixed in 5% neutralized formalin solution. Detritus and sediments were removed from the sample by flotation in Ludox HS 40 (Burgess, 2001). The nematodes were picked out from the mixed meiobenthos under high magnification of dissecting microscope (LEICA 205C). Target individual nematodes were picked out and transferred to 5% glycerin solution. The specimens were mounted in pure anhydrous glycerol on HS slides to examine both sides of the nematodes using a standard wax-ring method (Hooper, 1986; Shirayama *et al*., 1993).

Mounted specimens were observed with Olympus BX 53 microscope equipped with an Olympus DP 26 digital camera. All morphometric measurements were done manually using Olympus CellSens corresponding imaging software. All drawings were made with a drawing tube, and the technique of tracing with Adobe Illustrator 2022 software was used. Photographs were taken with an Olympus DP 26 digital camera, and the quality of the images was improved with Adobe Photoshop 2022 software.

All the measured sized are given in μm. Abbreviations used in the text are as follows: a, body length divided by maximum body diameter; b, body length divided by pharynx length; c, body length divided by tail length; V (%), vulva distance from anterior end as percentage of total body length.

## Systematic Accounts

Phylum Nematoda Potts, 1932
Class Enoplea Inglis, 1983
Order Enoplida Filipjev, 1929
Family Ironidae de Man, 1876
Subfamily Thalassironinae Andrássy, 1976

**Table 1.** Morphometrics of the Korean *Conilia sinensis* specimens.

| Characters | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | mean ± sd | 1 | 2 | 3 | 4 | mean ± sd |
| Total body length | 2586 | 2541 | 2567 | 2349 | 2511 ± 94.9 | 2145 | 2174 | 2196 | 2141 | 2164 ± 22.3 |
| a | 69 | 67 | 67 | 69 | 68 ± 1.2 | 43 | 42 | 47 | 41 | 43 ± 2.6 |
| b | 6 | 6 | 6 | 6 | 6 ± 0.3 | 5 | 5 | 5 | 5 | 5 ± 0.1 |
| c | 24 | 24 | 21 | 21 | 22 ± 1.5 | 16 | 17 | 16 | 15 | 16 ± 0.6 |
| Head diameter at cephalic setae level | 30 | 30 | 30 | 30 | 30 ± 0.1 | 33 | 33 | 33 | 32 | 33 ± 0.4 |
| Body diameter at pharynx level | 32 | 31 | 33 | 32 | 32 ± 0.7 | 39 | 41 | 38 | 36 | 38 ± 1.7 |
| Maximum body diameter | 37 | 38 | 38 | 34 | 37 ± 1.7 | 50 | 52 | 46 | 53 | 50 ± 2.5 |
| Length of cephalic setae | 8 | 8 | 10 | 10 | 9 ± 1.0 | 10 | 10 | 11 | 8 | 10 ± 1.0 |
| Length of longer cephalic setae | 24 | 26 | 24 | 22 | 24 ± 1.5 | 26 | 28 | 29 | 25 | 27 ± 1.4 |
| Buccal cavity length | 39 | 40 | 41 | 41 | 40 ± 0.8 | 46 | 43 | 45 | 46 | 45 ± 1.2 |
| Distance from anterior end to nerve ring | 146 | 167 | 159 | 158 | 157 ± 7.4 | 154 | 158 | 157 | 157 | 157 ± 1.4 |
| Body diameter at nerve ring level | 32 | 31 | 33 | 32 | 32 ± 0.7 | 34 | 37 | 34 | 34 | 35 ± 1.3 |
| Pharynx length | 409 | 429 | 427 | 426 | 423 ± 8.0 | 434 | 428 | 450 | 423 | 434 ± 10.0 |
| Spicule length along the arc | 99 | 89 | 98 | 99 | 96 ± 4.1 | – | – | – | – | – |
| Spicule length along the chord | 91 | 80 | 90 | 95 | 89 ± 5.5 | – | – | – | – | – |
| Gubernaculum length | 21 | 23 | 25 | 23 | 23 ± 1.6 | – | – | – | – | – |
| Distance from anal body diameter to precloacal supplement | 18 | 17 | 17 | 14 | 16 ± 1.5 | – | – | – | – | – |
| Telamon length | 27 | 24 | 22 | 21 | 24 ± 2.1 | – | – | – | – | – |
| Distance from anterior end to vulva | – | – | – | – | – | 1257 | 1274 | 1276 | 1229 | 1259 ± 18.8 |
| Body diameter at vulva level | – | – | – | – | – | 50 | 52 | 46 | 53 | 50 ± 2.5 |
| V (%) | – | – | – | – | – | 59 | 59 | 58 | 57 | 58 ± 0.5 |
| Anal body diameter | 27 | 27 | 30 | 29 | 28 ± 1.4 | 26 | 26 | 24 | 25 | 25 ± 0.8 |
| Tail length | 110 | 106 | 125 | 111 | 113 ± 7.1 | 133 | 132 | 140 | 144 | 137 ± 4.9 |

All measurements are in μm.

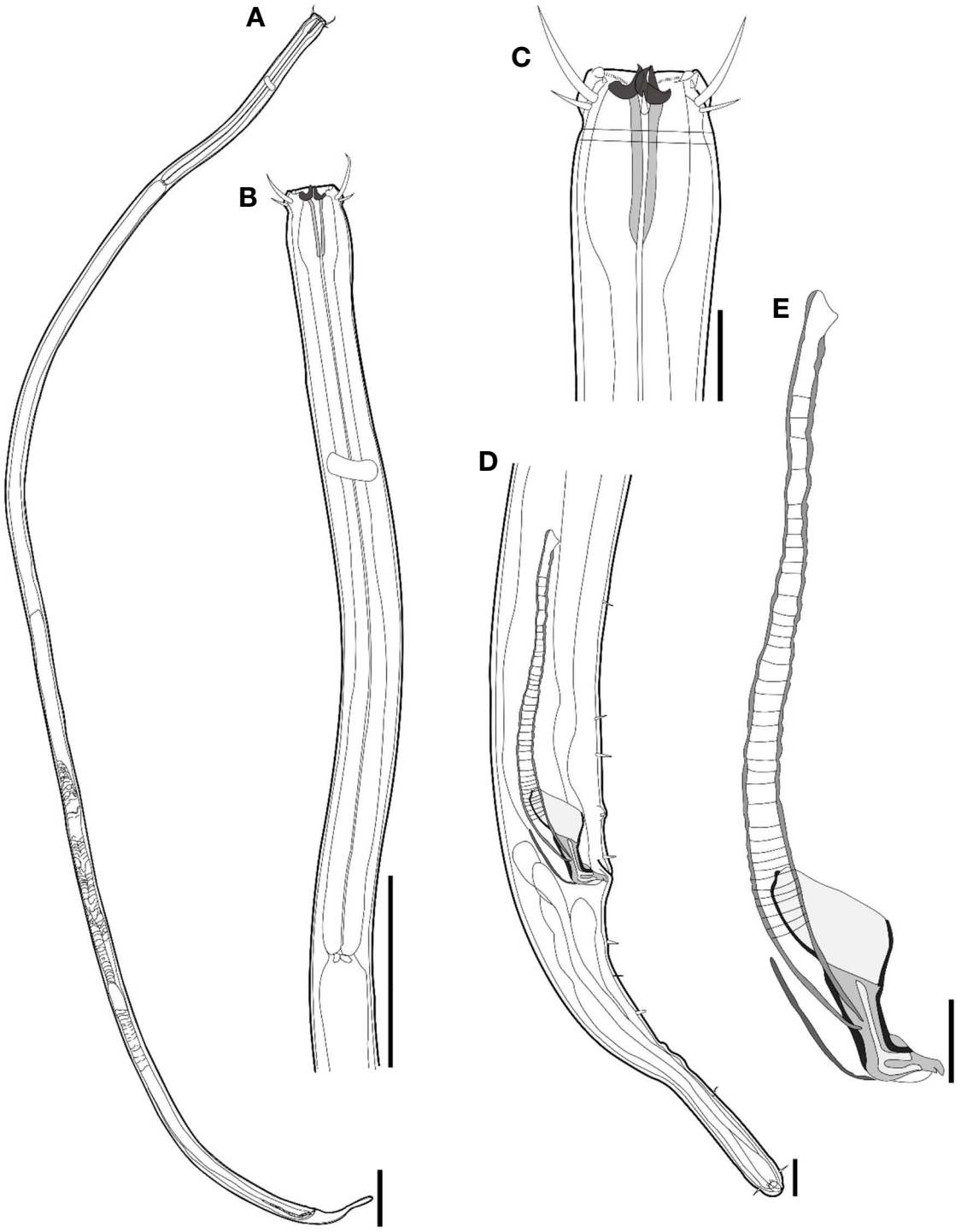



**Fig. 1.** *Conilia sinensis* Chen and Guo, 2015, male in lateral view. A, Habitus; B, Anterior region; C, Head region; D, Spicule and tail region; E, Spicule and gubernaculum. Scale bars: A, B, 100 μm; C, 20 μm; D, E, 10 μm.

**Genus *Conilia* Gerlach, 1956**

**Type species**
*Conilia divina* Gerlach, 1956

**Other species**
*Conilia monospiculata* Aryuthaka, 1989
*Conilia sinensis* Chen and Guo, 2015

***Conilia sinensis* Chen and Guo, 2015**
**(Figs. 1–3; Tables 1, 2)**

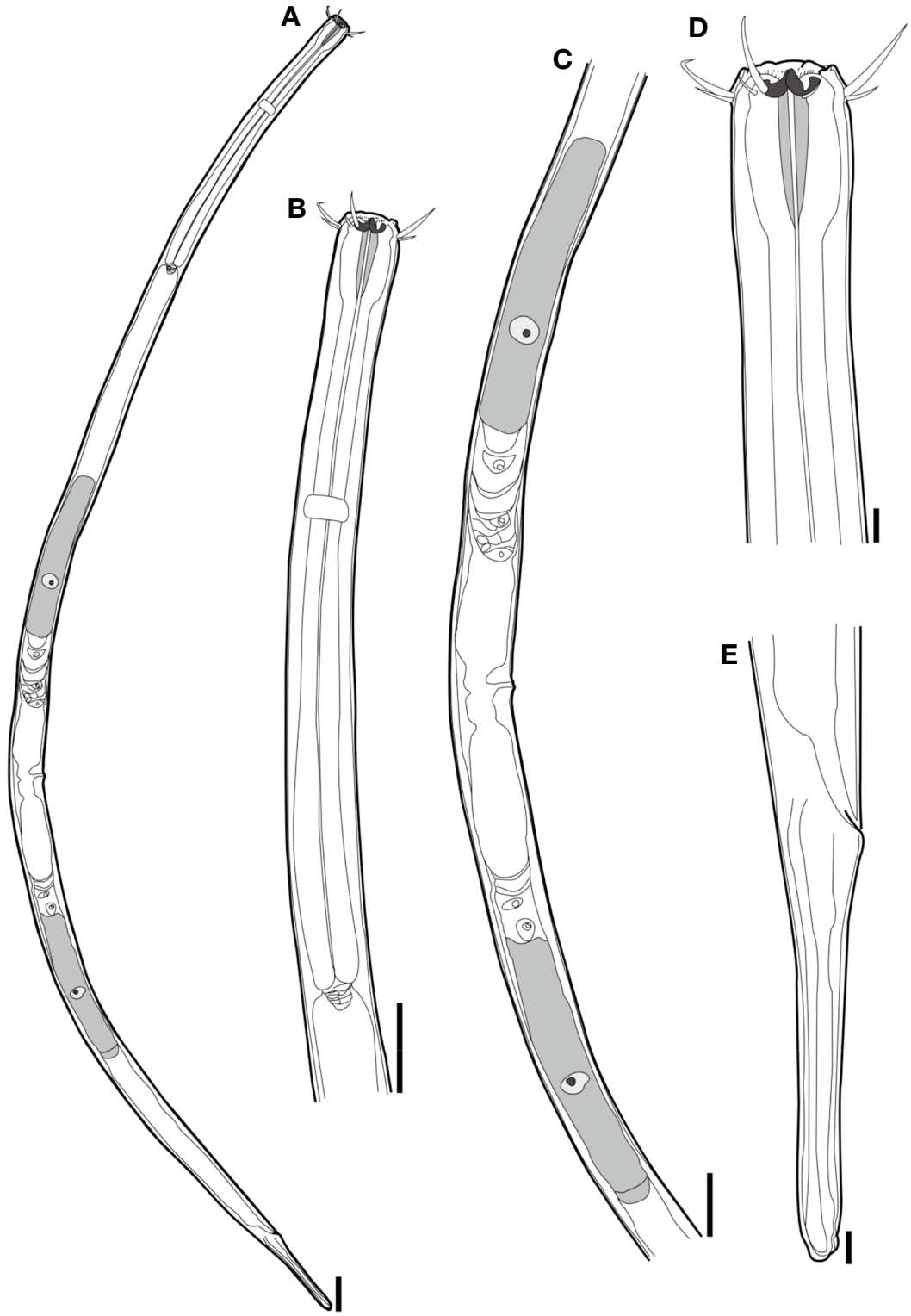



**Fig. 2.** *Conilia sinensis* Chen and Guo, 2015, female in lateral view. A, Habitus; B, Anterior region; C, Vulva region; D, Head region; E, Tail region. Scale bars: A–C, 50 μm; D, E, 10 μm.

*Conilia sinensis* Chen and Guo, 2015, p. 152, Figs. 1, 2.

**Material examined.** One male (MABIK NA00157737), in glycerin on HS slide, was deposited in the nematode col-

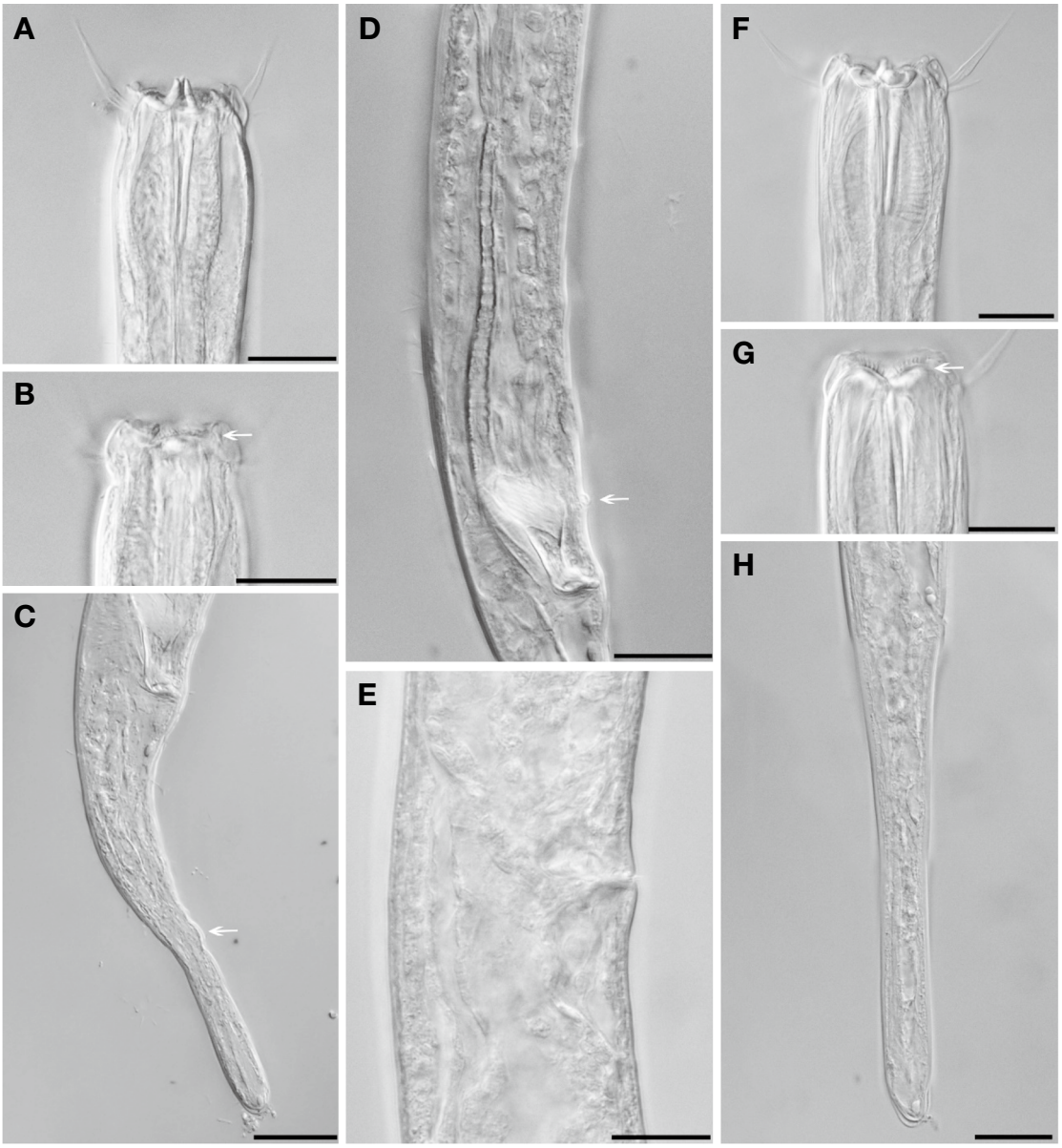



**Fig. 3.** *Conilia sinensis* Chen and Guo, 2015, DIC photomicrographs of male (A–D) and female (E–H), lateral view. A, Head region; B, Buccal cavity region showing small cuticular denticles in a row (white arrow); C, Tail region showing ventral swelling (white arrow); D, Copulatory systems showing precloacal supplement (white arrow); E, Vulva region; F, Head region; G, Buccal cavity region showing small cuticular denticles in a row (white arrow); H, Tail region. Scale bars: A–H, 20 μm.

lection at the specimen conservation room of the Marine Biodiversity Institute of Korea (MABIK), Seochun, Korea. Three males (KIOST NEM-1-2408, KIOST NEM-1-2650, KIOST NEM-1-2651) and Four females (KIOST NEM-1-2652, KIOST NEM-1-2653, KIOST NEM-1-2654, KIOST NEM-1-2655), in glycerin on HS slide, were deposited in the nematode collection at the specimen conservation room of the Bio-Resources Bank of Marine Nematodes (BRBMN), East Sea Research Institute, Korea Institute of Ocean Science & Technology (KIOST), Korea. All the specimens were collected from Mageompo Beach, Nam-myeon, Taean-gun, Chungcheongnam-do, Korea, 9 June 2018 (leg. H. Lee).

**Habitat.** Intertidal fine sand beach (36°37′07.32″N, 126°17′10.27″E).

**Measurements.** See Table 1 for detailed measurements and morphometric ratios.

**Description. Males.** Body cylindrical and slender (2,349–2,586 μm long), gradually tapering towards posterior end of body (Fig. 1A). Maximum body diameter at mid body

level 34–38 μm. Cuticles smooth. Head end compressed, lip region well-developed and slightly swelled on both sides, with six papilliform inner labial sensilla (Fig. 1C). Head diameter 30 μm wide, with remarkable constriction at posterior to cephalic setae. Six outer labial setae (8–10 μm long) and four relatively long cephalic setae (22–26 μm long) arranged in a single circle. Buccal cavity divided into two parts: anterior one cup-shaped and posterior one strongly cuticularized tube-shaped (Figs. 1C, 3A). Three solid curved claw-like teeth lie in anterior part of buccal cavity, with small cuticular denticles in a row at edges (Fig. 3B). Amphideal fovea not observed. Anterior pharynx region surrounding buccal cavity slightly inflated and posterior region general cylindrical without swelling. Pharynx cylindrical (409–429 μm long), corresponding body diameter 31–33 μm. Nerve ring located on 146–167 μm from anterior end, corresponding body diameter 31–33 μm, situated at 36–39% of pharynx length (Fig. 1B). Reproductive system diorchic; two testes opposed and outstretched. Spicule (89–99 μm long) single and elongated, with transversely organized thick striated tissue (Figs. 1E, 3D). Telamons (21–27 μm long) paired, strongly rib-shaped, distally with bifurcated hook-like structures and proximally with rounded changeable projection. Gubernaculum (21–25 μm long) single, with slightly curved thin strip. A precloacal supplement (2 μm long) shows simple ventral swelling, situated at 14–18 μm in front of cloacal opening (Figs. 1D, 3D). Tail (106–125 μm long) conico-cylindrical, slightly ventrally bent; distal part slightly swollen with two terminal setae. A conspicuous ventral swelling appeared in middle of tail (Figs. 1D, 3C).

**Females.** Similar to males in general characteristics, but differ in several dimensions, tail shape, and sexual characteristics (Figs. 2A, B, D, 3F, G). Body length 2,141–

**Table 2.** Morphological and ecological characteristics of the genus *Conilia* Gerlach, 1956 including the Korean *C. sinensis*.

| Characters | Taxa | | | |
|---|---|---|---|---|
| | *Conilia divina* Gerlach, 1956 | *Conilia monospiculata* Aryuthaka, 1989 | *Conilia sinensis* Chen and Guo, 2015 | *C. sinensis* (Korean specimens) |
| Body length | M: 1,535<br>F: 1,630 | M: 1,529–1,990<br>F: 1,689–2,025 | M: 1,956–2,399<br>F: 1,883–2,080 | M: 2,349–2,586<br>F: 2,141–2,196 |
| a | M: 73<br>F: 49 | M: 52.0–80.4<br>F: 45.0–52.0 | M: 59.3–70.6<br>F: 43.3–45.9 | M: 66.8–69.4<br>F: 40.5–47.4 |
| b | M: 5.1<br>F: 5.4 | M: 5.5–6.3<br>F: 5.2–5.9 | M: 5.1–5.7<br>F: 4.7 | M: 5.5–6.3<br>F: 4.9–5.1 |
| c | M: 20.5<br>F: 15.1 | M: 14.6–16.8<br>F: 14.5–17.5 | M: 15.8–19.8<br>F: 13.8–16.5 | M: 20.6–24.0<br>F: 14.9–16.5 |
| Head diameter | M: 17<br>F: 19 | M: 17–22<br>F: 21–22 | M: 25–26<br>F: 29–33 | M: 30<br>F: 32–33 |
| Length of cephalic setae | M: 9 | M: 6–9 | M: 8–10<br>F: 8–9 | M: 8–10<br>F: 8–11 |
| Length of longer cephalic setae | M: 25 | M: 14–20 | M: 17–20<br>F: 20–22 | M: 22–26<br>F: 25–29 |
| Amphideal fovea | Absent | Present | Absent | Absent |
| Spicule length | 112 | 60–64 | 87–100 | 89–99 |
| Telamon length | 12 | 15–20 | 25–28 | 21–27 |
| No. of precloacal supplement | 4 | Absent | 1 | 1 |
| Ecological habitat | Fine sandy; Santos Beach | Seagrass bed, fine sand; intertidal zone; Amakusa, Shimoshima Island, West Kyushu, South Japan | Intertidal sandy sediment; Dongshan Island, Zhangzhou city, East China Sea | Intertidal fine sandy sediment; Mageompo Beach, Taean-gun, Korea |

All measurements are in μm.

2,196 μm; cylindrical body slightly tapered toward posterior end. Maximum body diameter 46–53 μm. Reproductive system didelphic. Two reflexed equally developed ovaries; anterior ovary situated on right side of intestine, posterior one on right side of intestine. Vulva 1,229–1,276 μm from anterior end, situated at 57–59% of total body length (Figs. 2C, 3E). Tail conical, straight, without setae or swelling. Tail 132–144 μm long, about 5.1–5.8 times of anal body diameter (Figs. 2E, 3H).

**Remarks.** The genus *Conilia* was established by Gerlach in 1956 with the type species, *Conilia divina* Gerlach, 1956. The genus is characterized by having a cuticularized elongated tubular buccal cavity, three claw-like teeth of different sizes and an oblique serrated plate, papilliform inner labial sensilla, and setiform outer labial and cephalic sensilla. The genus *Conilia* is composed of only three valid species so far (*C. divina* Gerlach, 1956, *C. monospiculata* Aryuthaka, 1989 and *C. sinensis* Chen and Guo, 2015). Morphological and ecological characteristics of the genus *Conilia* including the Korean *C. sinensis* are given in Table 2. *Conilia sinensis* was firstly described from Dongshan Island in the East China Sea. *Conilia sinensis* is distinguished from other species of the genus by having a relatively long body length, a well-developed buccal cavity, single spicule with transversely striation, rib-shaped telamons, and single precloacal supplement. *Conilia sinensis* is most like *C. divina* by possessing a long and striated spicule and the absence of amphideal fovea. However, *C. sinensis* significantly differs from *C. divina* by the longer body length (1,956–2,399 μm vs. 1,535 μm in males; 1,883–2,080 μm vs. 1,630 μm in females), the longer telamons length (25–28 μm vs. 12 μm), and the number of precloacal supplements (1 vs. 4). Moreover, *C. sinensis* has a conspicuous ventral swelling in the middle of the tail, a feature not shared by *C. divina*.

*Conilia sinensis* is also clearly distinguished from *C. monospiculata* by the longer body length (1,956–2,399 μm vs. 1,529–1,990 μm in males; 1,883–2,080 μm vs. 1,689–2,025 μm in females), the absence of amphideal fovea (present in *C. monospiculata*), the presence of single precloacal supplement (absent in *C. monospiculata*), and the longer striated spicule (87–100 μm vs. 60–64 μm).

The present Korean specimens of *C. sinensis* agree well with the original description in general features, especially

**Table 3.** Morphometrics of the Korean *Pheronous donghaiensis* specimens.

| Characters | Males | | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | mean ± sd | 1 | 2 | 3 | mean ± sd |
| Total body length | 2113 | 2004 | 2031 | 2180 | 2082 ± 69.4 | 2181 | 2197 | 2114 | 2164 ± 36.2 |
| a | 38 | 38 | 38 | 40 | 39 ± 0.9 | 37 | 37 | 37 | 37 ± 0.2 |
| b | 6 | 6 | 6 | 6 | 6 ± 0.1 | 6 | 6 | 6 | 6 ± 0.2 |
| c | 25 | 22 | 21 | 24 | 23 ± 1.4 | 21 | 20 | 18 | 20 ± 1.2 |
| Head diameter at cephalic setae level | 28 | 29 | 28 | 30 | 29 ± 0.6 | 29 | 29 | 29 | 29 ± 0.2 |
| Body diameter at pharynx level | 50 | 49 | 47 | 50 | 49 ± 1.2 | 55 | 55 | 52 | 54 ± 1.3 |
| Maximum body diameter | 55 | 53 | 54 | 54 | 54 ± 1.0 | 59 | 60 | 57 | 59 ± 1.4 |
| Length of cephalic setae | 3 | 3 | 3 | 3 | 3 ± 0.3 | 3 | 3 | 3 | 3 ± 0.1 |
| Amphideal fovea diameter | 17 | 16 | 18 | 17 | 17 ± 0.4 | 19 | 17 | 19 | 18 ± 1.1 |
| Amphideal fovea length | 9 | 10 | 10 | 9 | 10 ± 0.5 | 10 | 10 | 10 | 10 ± 0.2 |
| Buccal cavity length | 58 | 54 | 60 | 63 | 59 ± 3.3 | 62 | 61 | 62 | 62 ± 0.5 |
| Distance from anterior end to amphids | 12 | 13 | 13 | 11 | 12 ± 0.8 | 12 | 13 | 14 | 13 ± 0.9 |
| Distance from anterior end to nerve ring | 144 | 142 | 144 | 149 | 145 ± 2.5 | 151 | 146 | 151 | 149 ± 2.1 |
| Body diameter at nerve ring level | 43 | 42 | 44 | 44 | 43 ± 0.8 | 48 | 47 | 47 | 47 ± 0.3 |
| Pharynx length | 348 | 343 | 341 | 373 | 351 ± 12.7 | 357 | 364 | 369 | 364 ± 4.9 |
| Spicules length along the arc | 56 | 59 | 54 | 61 | 57 ± 2.6 | – | – | – | – |
| Spicules length along the chord | 46 | 46 | 44 | 52 | 47 ± 2.7 | – | – | – | – |
| Gubernaculum length | 28 | 24 | 25 | 28 | 26 ± 1.8 | – | – | – | – |
| Distance from anterior end to vulva | – | – | – | – | – | 1252 | 1269 | 1196 | 1239 ± 31.2 |
| Body diameter at vulva level | – | – | – | – | – | 57 | 60 | 57 | 58 ± 1.4 |
| V (%) | – | – | – | – | – | 57 | 58 | 57 | 57 ± 0.5 |
| Anal body diameter | 37 | 36 | 34 | 36 | 36 ± 0.9 | 36 | 36 | 36 | 36 ± 0.3 |
| Tail length | 84 | 89 | 95 | 90 | 90 ± 3.8 | 105 | 108 | 118 | 110 ± 5.3 |

All measurements are in μm.

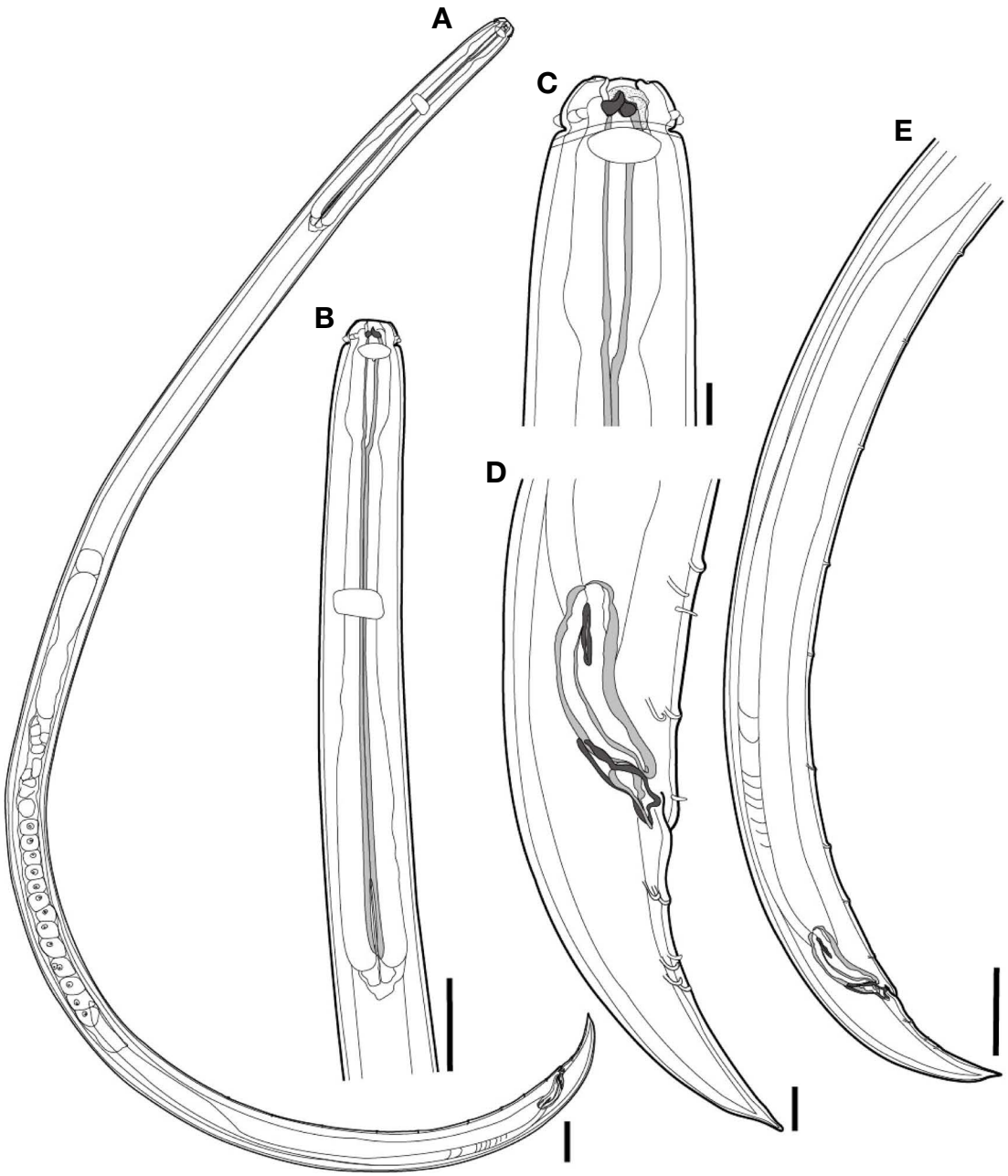



**Fig. 4.** *Pheronous donghaiensis* Chen and Guo, 2015, male in lateral view. A, Habitus; B, Anterior region; C, Head region; D, Spicule and tail region; E, Precloacal supplements and tail region. Scale bars: A, B, E, 50 μm; C, D, 10 μm.

in the detailed structure of copulatory systems in males, the presence of single precloacal supplement, and ventrally bent tail with single ventral swelling in the middle of the tail. However, the Korean specimens differ from original description by having a longer overall body length (2,349–2,568 μm vs 1,956–2,339 μm in males; 2,141–2,196 μm vs 1,883–2,080 μm in females) and slightly shorter tail length (c = 20.6–24.0 vs. c = 15.8–19.8 in males; c = 14.9–16.5 vs. c = 13.8–16.5 in females).

**Distribution.** China (Chen and Guo, 2015) and Korea (Present study).

### Genus *Pheronous* Inglis, 1966

**Type species**
*Pheronous ogdeni* Inglis, 1966

**Other species**
*Pheronous donghaiensis* Chen and Guo, 2015




**Fig. 5.** *Pheronous donghaiensis* Chen and Guo, 2015, females in lateral view. A, Habitus; B, Anterior region; C, Vulva region; D, Head region; E, Tail region. Scale bars: A–C, E, 50 μm; D, 10 μm.

***Pheronous donghaiensis* Chen and Guo, 2015**
**(Figs. 4–6; Tables 3, 4)**

*Pheronous donghaiensis* Chen and Guo, 2015, p. 156, Figs. 4, 5.

**Material examined.** One male (MABIK NA00157738), in glycerin on HS slide, was deposited in the nematode collection at the specimen conservation room of the Marine Biodiversity Institute of Korea (MABIK), Seochun,

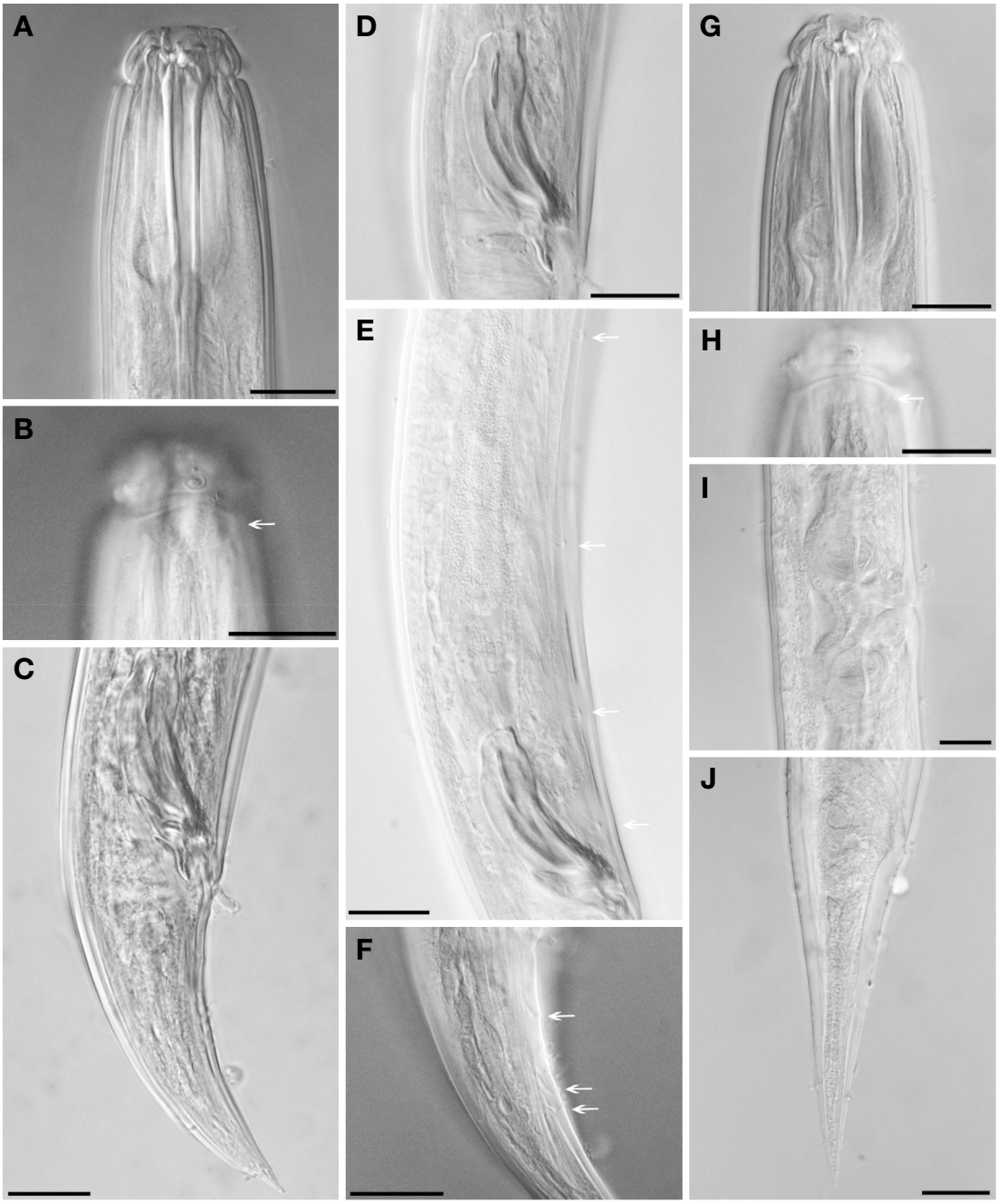



**Fig. 6.** *Pheronous donghaiensis* Chen and Guo, 2015, DIC photomicrographs of male (A–F) and female (G–J), lateral view. A, Head region; B, Head region showing amphideal fovea (white arrow); C, Tail region; D, Copulatory systems; E, Precloacal supplement (white arrow), F, Tail showing three pairs of postcloacal supplements (white arrow); G, Head region; H, Head region showing amphideal fovea (white arrow); I, Vulva region; J, Tail region. Scale bars: A–J, 20 μm.

Korea. Three males (KIOST NEM-1-2656, KIOST NEM-1-2657, KIOST NEM-1-2658) and three females (KIOST NEM-1-2659, KIOST NEM-1-2660, KIOST NEM-1-2661), in glycerin on HS slide, were deposited in the nematode collection at the specimen conservation room of the Bio-Resources Bank of Marine Nematodes (BRBMN), East Sea Research Institute, Korea Institute of Ocean Science & Technology (KIOST), Korea. All the specimens were collected from Mallipo Beach, Sowon-myeon, Taean-gun, Chungcheongnam-do, Korea, 22 June 2020 (leg. by HS Rho and H Lee).

**Habitat.** Intertidal fine sand beach (36°47′15.00″N, 126°

08′29.00″E).

**Measurements.** See Table 3 for detailed measurements and morphometric ratios.

**Description. Males.** Body long and cylindrical (2,004–2,180 μm long), tapering sharply at posterior extremity (Fig. 4A). Maximum body diameter at mid body level 53–55 μm. Cuticle smooth. Head diameter 28–30 μm wide, distinctly separated from rest of body by a constriction behind cephalic sensilla. Lip region relatively flatted, with six-minute rounded inner labial papilla. Head sensilla papilliform, six outer labial sensilla (3 μm long) and four cephalic sensilla (3 μm long) arranged in one circle, stout and blunt (Figs. 4C, 6A). Buccal cavity divided into two parts: anterior one conical shaped and posterior one cylindrical tube-shaped with enfolded cuticularized wall. Four solid curved claw-like teeth present at margin of anterior conical section and inner wall of conical section covered minute denticles in rows (Figs. 4C, 6A). Amphideal fovea pocket-shaped, about 16–18 μm wide, situated at posterior edge of cephalic groove (Fig. 6B). Anterior pharynx region surrounding buccal cavity distinctly swollen; general cylindrical structure posteriorly slightly wider toward end portion. Pharynx cylindrical, 341–373 μm long, corresponding body diameter 47–50 μm. Nerve ring located on 142–149 μm from anterior end, corresponding body diameter 42–44 μm, situated at 40–42% of pharynx length (Fig. 4B). Tail significantly tapered toward posterior end; tip of tail with a sharp point. Tail with a series of three pairs of small curved tubular supplements situated at subventral post-cloacal region in two rows (Figs. 4D, 6C, F). Reproductive system diorchic with two opposed testes. Spicules paired, consist of thick and cuticularized walls, with central septum at proximal end. Gubernaculum relatively thinner at proximal end; distal end thick with hook-shaped (Figs. 4D, 6D). Eight to nine precloacal supplements small, curved tubular-shaped, situated at subventral region in two rows (Figs. 4E, 6E).

**Females.** Similar to males in general appearance but differ in slightly longer tail length (c = 18–21 vs. c = 21–25) and sexual characteristics (Figs. 5A, B, 6G). Body 2,114–2,197 μm long; cylindrical body distinctly tapered toward posterior end. Maximum body diameter 57–60 μm. Amphideal fovea pocket-shaped, about 17–19 μm wide, 10 μm long, situated at cephalic papilla levels (Figs. 5D, 6H). Reproductive system didelphic; ovaries opposed and reflexed. Anterior ovary situated on right side of intestine,

**Table 4.** Morphological and ecological characteristics of the genus *Pheronous* Inglis, 1966 including the Korean *P. donghaiensis*.

| Characters | Taxa | | |
|---|---|---|---|
| | *Pheronous ogdeni* Inglis, 1966 | *Pheronous donghaiensis* Chen and Guo, 2015 | *P. donghaiensis* (Korean specimens) |
| Body length | M: 1,490–1,980<br>F: 1,430–1,770 | M: 1,293–2,188<br>F: 1,332–1,932 | M: 2,004–2,180<br>F: 2,114–2,197 |
| a | M: 24.0–38.8<br>F: 27.5–34.0 | M: 30.2–39.8<br>F: 31.7–39.4 | M: 37.8–40.0<br>F: 36.7–37.2 |
| b | M: 5.3–5.7<br>F: 5.0–6.5 | M: 5.7–6.4<br>F: 5.7–5.8 | M: 5.8–6.1<br>F: 5.7–6.1 |
| c | M: 22.2–26.0<br>F: 14.0–16.2 | M: 21.6–25<br>F: 16.5–17.5 | M: 21.4–25.1<br>F: 17.9–20.7 |
| Head diameter | M: 23–31<br>F: 19–27 | M: 21–27<br>F: 22–28 | M: 28–30<br>F: 29 |
| Spicule length | 35–47 | 33–46 | 54–61 |
| Gubernaculum length | 16–20 | 16–27 | 24–28 |
| No. of precloacal supplement | 4 pairs | 8–9 pairs | 8–9 pairs |
| Shape of precloacal supplement | Papillae | Tubular | Tubular |
| Ecological habitat | Beach sand in the surf zone; Near Durban, Republic of South Africa | Intertidal sandy sediment; Huangcuo coast, Xiamen City, and Dongshan Island, Zhangzhou city, East China Sea | Intertidal sandy sediment; Mallipo Beach, Taean-gun, Korea |

All measurements are in μm.

posterior one on right side of intestine (Fig. 5C). Vulva 1,196−1,269 μm from anterior end, situated at 57−58% of total body length (Fig. 6I). Tail 105−118 μm long, about 2.9−3.2 times of anal body diameter. Tail with several papillae randomly arranged and tip of tail sharp pointed (Figs. 5E, 6J).

**Remarks.** The genus *Pheronous* was established by Inglis in 1966 with the type species, *P. ogdeni*. It is distinguished from other genera of the family Ironidae by the presence of all papilliform anterior sensilla, relatively short spicules, conical tail with pointed tip, and the absence of caudal glands (Inglis, 1966; Platt and Warwick, 1983; Chen and Guo, 2015) So far, only two species, *P. ogdeni* Inglis, 1966 and *P. donghaiensis* Chen and Guo, 2015, have been described in this genus. Morphological and ecological characteristics of the genus *Pheronous* including the Korean *P. donghaiensis* are given in Table 4.

*Pheronous donghaiensis* was firstly described from intertidal sandy sediments on the Huangcuo coast, Xiamen City and Dongshan Island of the East China Sea. *Pheronous donghaiensis* is characterized by a well-developed buccal cavity with four claw-like solid teeth and minute denticles, relatively short and thick spicules with central septum, the presence of 8−9 curved tubular-shaped precloacal supplements, tail tapers to a sharp point with three small tubular supplements arranged into two rows in males, and the absence of caudal glands.

The present Korean specimens of *P. donghaiensis* are clearly distinguished from *P. ogdeni* by the relatively long body length (2,004−2,180 μm vs. 1,490−1,980 μm in males; 2,114−2,197 μm vs. 1,430−1,770 μm in females), the number of precloacal supplements (8−9 vs. 4), the shape of pre- and postcloacal supplement (curved tubular-shaped vs. papilla-shaped), and the presence of central septum in spicules (absent in *P. ogdeni*). The present Korean specimens are most like the original description by Chen and Guo (2015) in the following features, such as the shape of copulatory systems in males, the presence of 8−9 tubular precloacal and three postcloacal supplements, and the presence of thick spicules with central septum. However, the Korean specimens of *P. donghaiensis* are not in accord with the original description by the relatively longer spicules length (54−61 μm vs. 33−46 μm).

**Distribution.** China (Chen and Guo, 2015) and Korea (Present study).

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