



Article

First Report on Three Lesser-Known *Magelona* Species from Korean Waters: Details of All Thoracic Chaetigers and Methyl Green Staining Patterns

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Abstract: This study assessed the taxonomic statuses of three lesser-known *Magelona* F. Müller, 1858 species collected from intertidal to sublittoral habitats in Korean coastal waters, basing identification on morphological features and comparing them with their closest congeners. We present a comprehensive description and illustration of taxonomically significant and standardized characters, covering all thoracic chaetigers of three newly discovered *Magelona* species from Korea. Within the documented Korean *Magelona* species, these three species exhibit the following distinctive characteristics. *Magelona sachalinensis* Buzhinskaja, 1985, possess diminutive superior dorsal lobes in the initial four chaetigers and specialized chaetae on chaetiger 9; *Magelona lenticulata* Gallardo, 1968, is characterized by foliaceous postchaetal superior dorsal lobes in chaetigers 1–8; and *Magelona* cf. *longicornis* Johnson, 1901, is distinguished by notably elongated noto- and neuropodial postchaetal lamellae on chaetiger 9. Methyl green staining patterns showed species-specific characteristics and were confirmed to be effective in distinguishing the examined Korean species from each other and useful for making comparisons with previously reported *Magelona* species. Our study suggests that further comprehensive research on the morphological and genetic characteristics of *Magelona* species will enhance our understanding of their diversity.

Keywords: new records; polychaetes; shovelhead worms; morphological comparison; methyl green staining pattern



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1. Introduction

Magelonidae Cunningham & Ramage, 1888 [1], is a relatively small family of annelid worms comprising about 80 species. They are characterized by the presence of distinct shovel-shaped prostomia and paired papillated palps. These shovelhead worms are mostly known as sediment burrowers; however, at least 10 species have been reported to inhabit distinct tubes [2,3]. They are primarily motile surface deposit-feeders in muddy and sandy sediments, employing their flattened prostomia and eversible burrowing organs to navigate through the sediment [2,3]. Additionally, some species have been reported to have various feeding habits [2]. Magelonids generally use a pair of palps with papillae to selectively collect organic matter from sands and mud and bring it to their mouths for consumption [3,4]. Many magelonid species have distinct preferences regarding sediment, salinity, and water depth, which are the determining factors for species distributions [5,6]. Due to their ecological characteristics, magelonids have been considered an important taxon for monitoring coastal benthic ecosystem environments [5,7,8].

The family Magelonidae is recognized for predominantly inhabiting shallow waters worldwide, with the exception of the Arctic and Antarctic regions [3,5]. However, its

diversity is still underestimated in numerous seas, despite the availability of several small-scale regional taxonomic reviews [9–11]. The prostomium, thorax, and abdominal lateral pouches, pivotal defining morphological characteristics of the *Magelona* F. Müller, 1858 [12], species, are sometimes susceptible to damage during the collection process, posing challenges regarding morphological identification to the species level [13,14]. Particularly, the parapodia consist of delicate lamellae that may partially break or fold during the initial sample processing and sieving. Furthermore, the absence of additional taxonomic research following the initial report of a specific species in its type locality, accompanied by a lack of detail in historic original descriptions and illustrations, presents significant challenges to the study of species diversity within the genus *Magelona*.

In Korean waters, only three species of *Magelona* have been reported to date. Of these, *Magelona koreana* Okuda, 1937 [15], and *Magelona japonica* Okuda, 1937 [15], were originally described by Okuda [15], while *Magelona parochilis* Zhou & Mortimer, 2013 [16], was first reported in Korea by Lee et al. [17]. Additionally, in most ecological studies, Korean *Magelona* taxa have predominantly been classified as *M. japonica* or regarded as unidentified *Magelona* species without a taxonomic foundation. This is because *Magelona japonica* was the only species reported in the sole taxonomic study in Korea in the past 46 years, Paik [18], which included only a very brief description and few drawings. This study aimed to evaluate the taxonomic status of *Magelona* species in Korean waters, relying on morphological features, and to compare them with their closest congeners. To achieve this, we provide detailed descriptions and images for each species and a list of the key features of Korean *Magelona* species.

2. Materials and Methods

Sediment samples were collected from intertidal and sublittoral regions in South Korea utilizing a 0.1 m² Van Veen grab sampler (Figure 1). Samples underwent elutriation in a 1 mm sieve using filtered seawater. The organisms retained on the sieve were then anesthetized in a 1 L collecting jar containing 7% MgCl₂ (*m/v*) in a 1:1 filtered seawater:distilled water mixture. Following relaxation, the specimens were fixed in a 5% buffered formalin solution for 2 h and subsequently preserved in 80% ethanol.

The specimens were sorted and identified to the species level under a zoom stereomicroscope (SMZ745T; Nikon, Tokyo, Japan). Shirlastain A (SDLATLAS, Rock Hill, SC, USA) or methyl green stain solution (Sigma-Aldrich, Burlington, MA, USA) staining was carried out as needed to observe detailed morphological features. The specimens were immersed in a saturated solution of methyl green and 70% ethanol for a minimum of one minute, and the methyl green staining patterns (MGSP) were described and photographed after the specimens were placed into clean 70% ethanol for an additional minute.

The species-specific morphological features of the examined specimens were photographed using a camera (DS-Fi3; Nikon, Tokyo, Japan) attached to a zoom stereomicroscope. All examined materials were deposited at the Marine Biodiversity Institute of Korea (MABIK) collection in Seocheon, Republic of Korea, and at the Chonnam National University (JNU) collection in Yeosu, Republic of Korea.

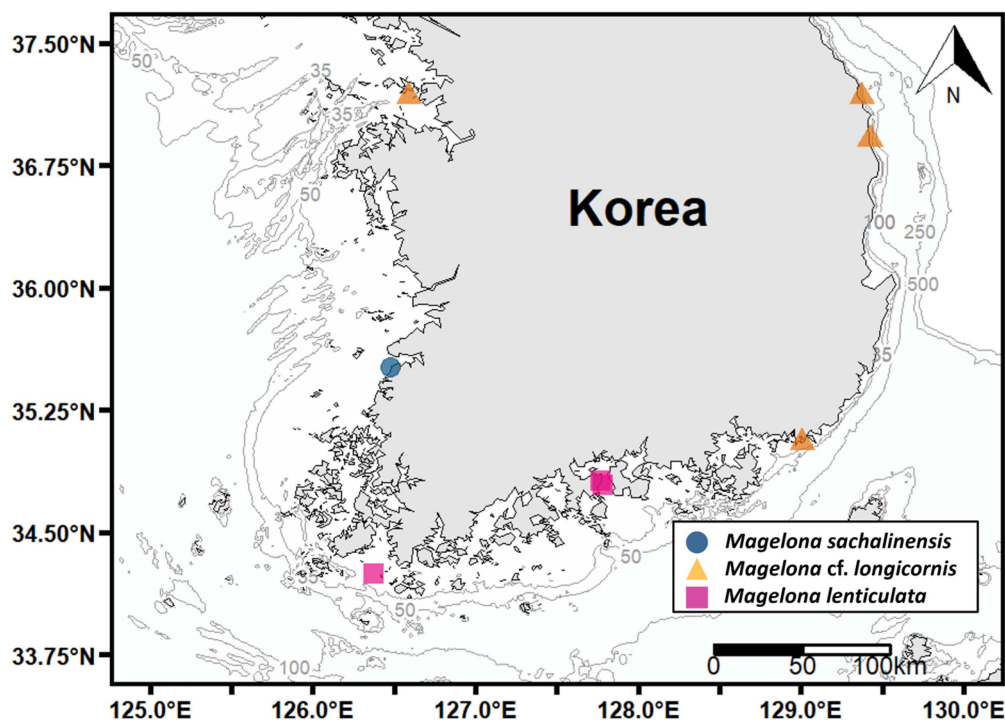


Figure 1. Map of Korea with markers indicating the collection sites. The marker colors indicate the newly reported *Magelona* species collected at each site.

3. Results

3.1. Systematics

Family: Magelonidae Cunningham & Ramage, 1888 [1].

Genus: *Magelona* F. Müller, 1858 [12].

Type species: *Magelona papillicornis* F. Müller, 1858 [12].

3.2. *Magelona sachalinensis* Buzhinskaja, 1985 [19]

Figure 2A–N and Figure 3A–D.

Magelona sachalinensis Buzhinskaja, 1985: figure 13.

3.2.1. Material Examined

MABIK NA00114596: Dongho-ri, Haeri-myeon, Gochang-gun, Jeollabuk-do, Republic of Korea (35°30′56.92″ N, 126°28′53.33″ E); intertidal zone, within 1 m depth; collected by Byoung Mi Choi, June 2012.

3.2.2. Species Diagnosis

Prostomium longer than wide, without prostomial horns. Chaetigers 1–7 similar; notopodia with low triangular prechaetal lamellae confluent with smooth-edged foliaceous postchaetal lamellae that encircle chaetae. A triangular prechaetal superior dorsal lobe present on each thoracic chaetiger; those of chaetigers 1–4 min. Neuropodia of chaetigers 1–7 with low and round pre- and postchaetal lamellae encircling the chaetae, confluent with slender ventral lamellae with pointed tips. Ventral neuropodial lamellae directly underneath chaetal bundles. Notopodia of chaetiger 8 similar to preceding chaetigers. Neuropodia of chaetiger 8 with small round prechaetal lamellae and more developed round postchaetal lamellae. Notopodial postchaetal lamellae of chaetiger 9 wide and rounded, with thin protrusion near subchaetal area. Neuropodia of chaetiger 9 with small, subtriangular prechaetal lamellae confluent with slender prechaetal ventral lamellae and more developed subtriangular postchaetal lamellae. Chaetae of chaetigers 1–8 simple

bilimbate winged capillaries; capillaries of chaetiger 9 specialized chaetae. Abdominal hooded hooks bidentate, in two groups, facing each other (*vis-à-vis*).

3.2.3. Description

Examined specimen (MABIK NA00114596) incomplete, prostomium 1.09 mm long, 0.85 mm wide; thorax (including prostomium) 5.05 mm long, 0.85 mm wide; abdomen 0.75 mm wide; total length 11.48 mm for 22 chaetigers.

Prostomium longer than wide, without prostomial horns; anterior margin round and smooth (Figure 2A,B and Figure 3A,B). Two pairs of prominent longitudinal dorsal muscular ridges present; outer pair abutting inner pair for their entire length and slightly shorter than inner pair; inner pair abutting for majority of length, diverging at both ends (Figure 2A,B). Burrowing organ not everted (Figure 3B). Eyes and nuchal organs absent. No palps retained; traces of the palps located on ventrolateral part of the prostomium.

Achaetous first segment approximately twice the length of chaetiger 1 (Figures 2A and 3A,B). Chaetigers 1–7 similar; parapodia biramous. Notopodia with low triangular prechaetal lamellae confluent with smooth-edged foliaceous postchaetal lamellae, encircling chaetae (Figure 2C–I). A triangular prechaetal superior dorsal lobe present on each chaetiger; those of chaetigers 1–4 min; slightly increasing in size toward posterior chaetigers (Figure 2C–I). Neuropodia with low and round pre- and postchaetal lamellae encircling the chaetae, cuff-like, confluent with long slender, triangular ventral lamellae with pointed tips (Figure 2C–I). Ventral lamellae underneath chaetal bundle, but in slightly prechaetal positions. Neuropodial lamellae initially shorter than notopodial lamellae, but increasing in size, and similar to chaetiger 7.

Notopodia and superior dorsal lobes of chaetiger 8 similar to those of chaetigers 5–7 (Figure 2G–J). Neuropodia of chaetiger 8 with small round prechaetal lamellae and more developed round postchaetal lamellae, confluent with slender, tapering triangular ventral lamellae (Figure 2J). Ventral lamellae shorter than preceding chaetigers (Figure 2J). Neuropodial lamellae shorter than notopodial lamellae.

Chaetiger 9 shorter and narrower in size than preceding ones (Figure 2A). Notopodial prechaetal lamellae low triangular; more developed than those of preceding chaetigers (Figure 2K). Notopodial postchaetal lamellae wide and rounded, with thin protrusions near subchaetal area (Figure 2K). Superior dorsal lobes triangular, similar to that of chaetiger 8 (Figure 2C–K). Neuropodial prechaetal lamellae developed, subtriangular (Figure 2K). Neuropodial postchaetal lamellae well developed, triangular (Figure 2K). Ventral neuropodial lamellae similar to that of chaetiger 8, in prechaetal positions (Figure 2J,K). Chaetae of chaetigers 1–8 simple bilimbate winged capillaries; capillaries of chaetiger 9 specialized chaetae, slightly longer than preceding ones (Figure 2K,M and Figure 3C). No thoracic ventral swellings observed.

Abdominal chaetigers become longer toward chaetiger 22, with spatulate lamellae; approximately equal in size on both rami; each lamella without basal constriction, with a rounded tip (Figure 2L). Small rounded postchaetal expansions present in anterior abdominal region (Figure 2L). Dorsal and ventral medial lobes short, triangular, present at inner margins of chaetal rows (Figure 2L).

Abdominal chaetae bidentate hooded hooks of similar size throughout, with a small tooth above main fang; hooks about two times longer than dorsal and ventral medial lobes (Figure 2N,O and Figure 3D). Hooks in two groups; outer group with two to four more hooks than inner group; main fangs of one group facing the other (Figure 2L). Anterior abdominal segments with 7–8 hooks per ramus. No aciculae observed. Anterior abdominal present between chaetigers 10–11. Posteriorly open abdominal lateral pouches not observed. However, this may be due to damage and loss, respectively. Pygidium unknown.

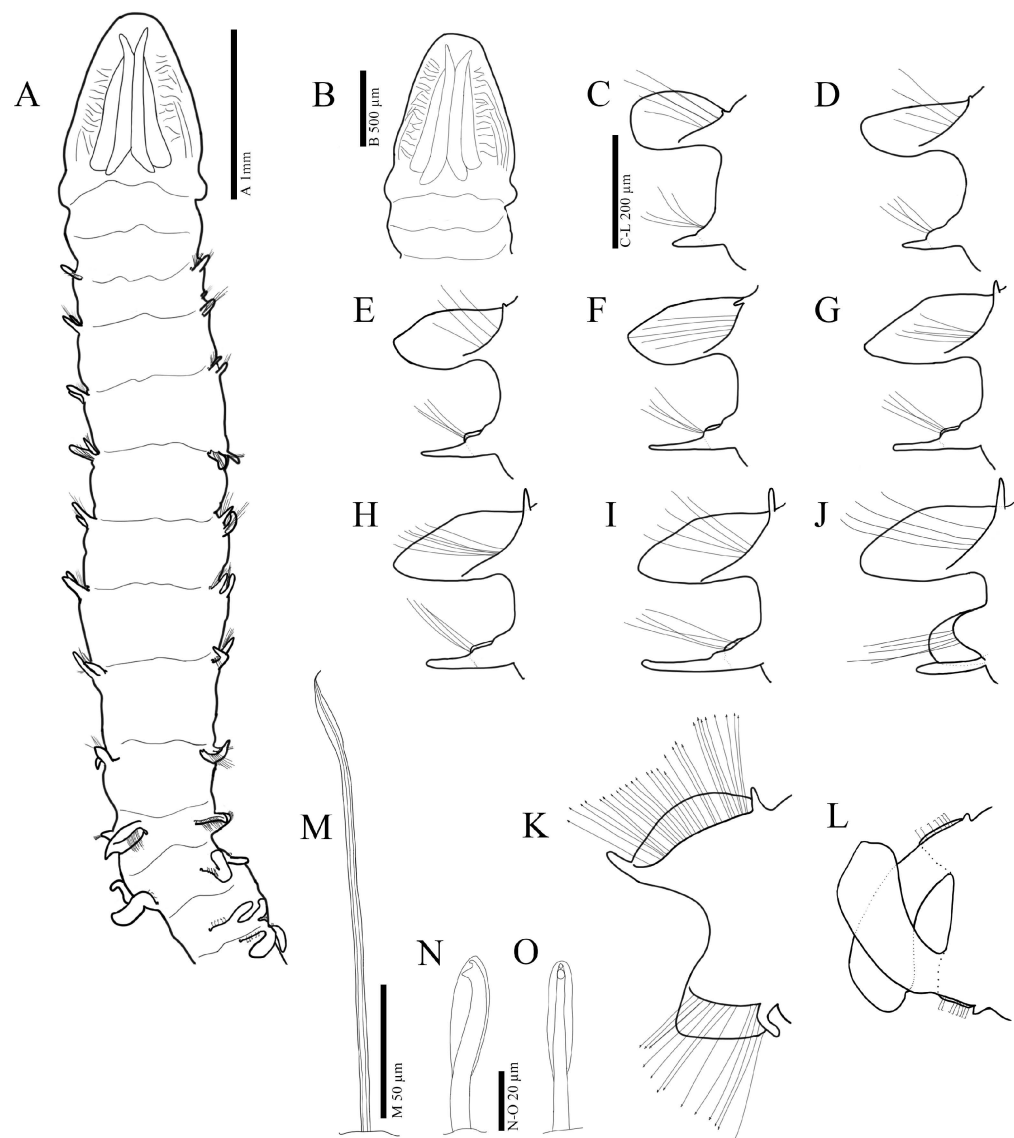


Figure 2. Illustrations of *Magelona sachalinensis* (MABIK NA00114596): (A) anterior end, dorsal view; (B) prostomium, dorsal view; (C–L) right hand parapodia from chaetigers 1–10, respectively (anterior views); (M) specialized chaeta of chaetiger 9; (N) abdominal hooded hook, lateral view; and (O) same, frontal view.

3.2.4. Methyl Green Staining Patterns

Methyl green staining is unclear in most segments, being distinct only in the first three anterior chaetigers. The dorsum of chaetigers 1–3 exhibits partial staining, resembling eyebrows, in a dark blue hue (Figure 3A,B).

3.2.5. Distribution and Ecology

The type locality of *Magelona sachalinensis* Buzhinskaja, 1985 is off south Sakhalin, but the species has not been reported in any other regions until the current study [19]. The Korean specimen of this study was sampled from a shallow intertidal station (water depth: within 1 m) in western Korea in June 2021. The surface sediment at the station was mainly muddy sand, and the salinity at the sampling location was approximately 30.

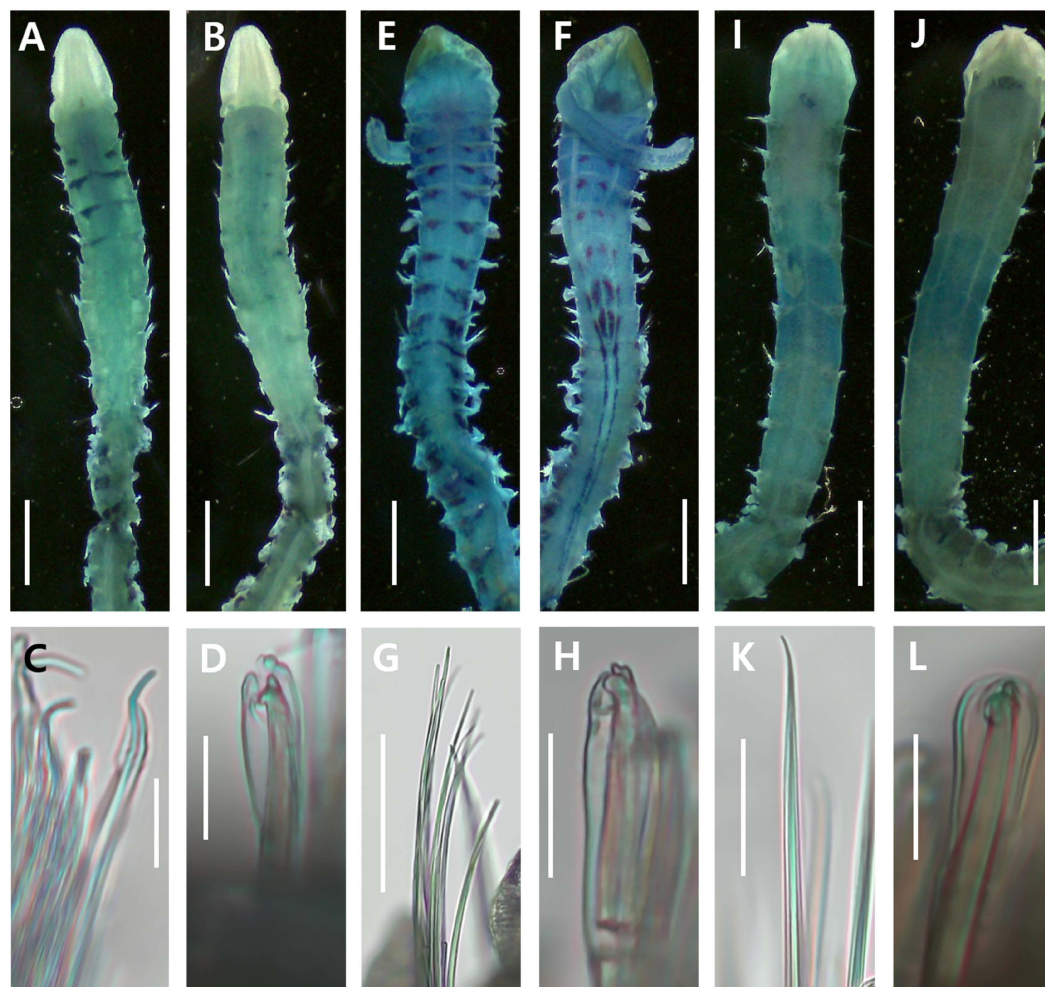


Figure 3. *Magelona sachalinensis* (A) MGSP of anterior end, dorsal view; (B) same, ventral view; (C) specialized capillary chaetae of chaetiger 9, lateral view; (D) bidentate abdominal hooded hooks, oblique frontal view. *Magelona lenticulata* (E) MGSP of anterior end, dorsal view; (F) same, ventral view; (G) bilimbate capillary chaetae of chaetiger 9, lateral view; (H) tridentate abdominal hooded hooks, oblique frontal view. *Magelona* cf. *longicornis* (I) MGSP of anterior end, dorsal view; (J) same, ventral view; (K) bilimbate capillary chaetae of chaetiger 9, lateral view; and (L) bidentate abdominal hooded hooks, oblique frontal view. scale bars: 1 mm (A,B,E,F,I,J), 100 μ m (G), 50 μ m (K), 20 μ m (C,D,H,L).

3.2.6. Remarks

This Korean specimen generally resembles members of the “*Magelona mirabilis* group”, which are characterized by a rounded prostomium lacking prostomial horns and specialized chaetae on chaetiger 9. In the Korean specimen, the specific characteristics, such as the specialized chaetae in chaetiger 9 and the remarkably small superior dorsal lobes of the first four thoracic chaetigers, align with those reported in *Magelona sachalinensis* Buzhinskaja, 1985. There is huge variation in the mucronate chaetae in this group, and it also depends on where the chaeta is in the rami. Often, those towards the outer rami are more slender, and those in the central part of the rami are more bulbous [20]. There needs to be a review of mucronate and pennoned chaetae to establish this, but these chaetae are more similar to the mirabilis group than those seen in species like *Magelona hartmanae* Jones, 1978 [21]. Buzhinskaja [19] solely characterized *M. sachalinensis* by the term “specialized chaetae”; however, the chaetae’s morphology in her illustrations closely resembles that of the Korean specimen. A re-description of *M. sachalinensis* is urgently required, although unfortunately, the whereabouts of the type material are currently unknown. This would enable the establishment of whether the SDL of chaetiger 9 of *M. sachalinensis* is present or absent. It

would also be beneficial to gain more Korean material. However, at this time, the authors consider the Korean material as *M. sachalinensis*. *Magelona sachalinensis* is close to *M. parochilis* in terms of the shape of the prostomium and parapodial lamellae, but differs in the hooded hooks (bidentate vs. tridentate, respectively) and superior dorsal lobes (rudimentary in first four chaetigers vs. tapering cirriform, respectively).

3.3. *Magelona lenticulata* Gallardo, 1968 [11]

Figure 3E–H and Figure 4A–N.

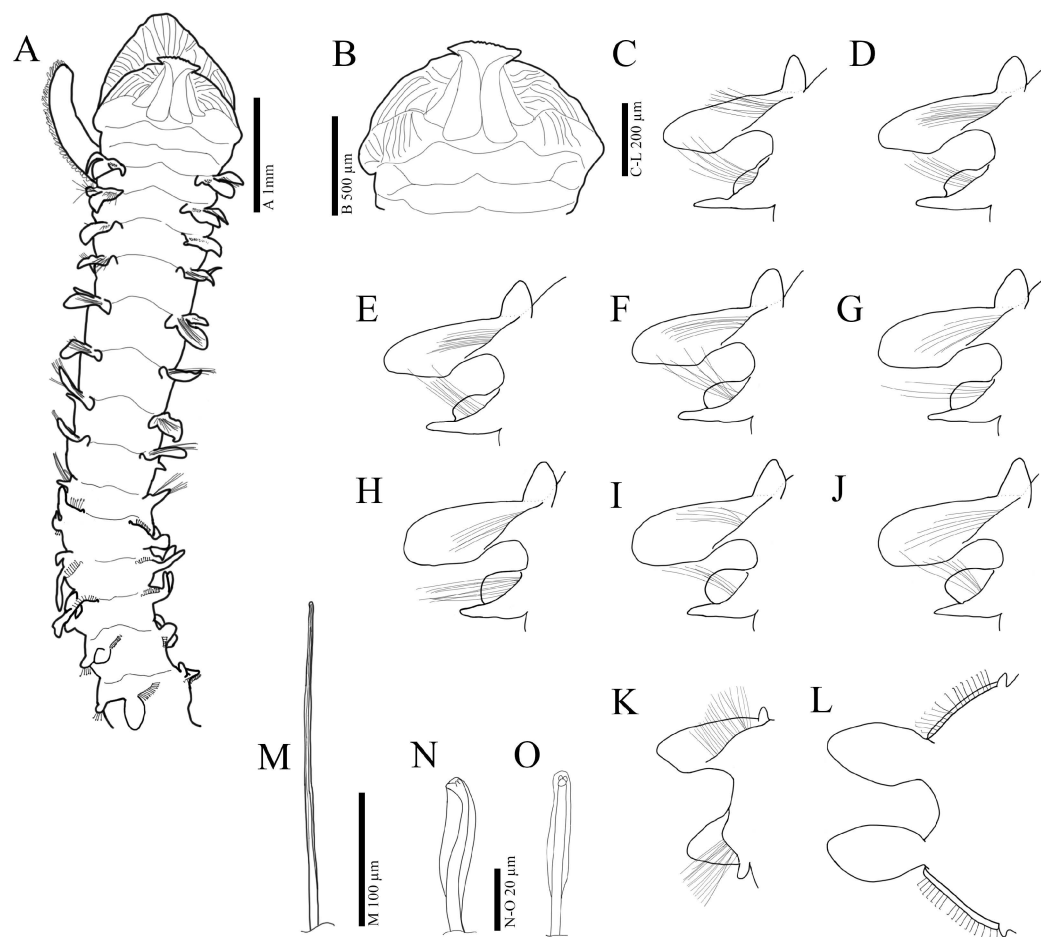


Figure 4. Illustrations of *Magelona lenticulata* (JUMA_20231011_001): (A) anterior end, dorsal view; (B) prostomium, dorsal view; (C–L) right hand parapodia from chaetigers 1–10, respectively (anterior views); (M) bilimbate capillary chaeta of chaetiger 9; (N) tridentate hooded hook, lateral view; (O) same, frontal view.

Magelona lenticulata Gallardo, 1968: figures 6–8.

3.3.1. Material Examined

JUMA_20231011_001: Sindeok-dong, Yeosu-si, Jeollanam-do, Republic of Korea (34°49′17.04″ N, 127°47′20.04″ E); subtidal zone, 17 m depth; collected by Dae Hun Kim, May 2023. MABIK NA00102191 and MABIK NA00102193: Nohwa-eup, Wando-gun, Jeollanam-do, Republic of Korea (34°16′39.61″ N, 126°22′26.85″ E); subtidal zone, 29 m depth; collected by Chan Soo Lee, December 2010. MABIK NA00123570: Manheung-dong, Yeosu-si, Jeollanam-do, Republic of Korea (34°46′17.1″ N, 127°46′10.32″ E); subtidal zone, 12 m depth; collected by Chan Soo Lee, February 2011.

3.3.2. Species Diagnosis

Prostomium wider than long, with distinct horns; anterior margin irregularly crenulate. Chaetigers 1–8 similar; notopodia with low triangular prechaetal lamellae confluent with smooth-edged, foliaceous postchaetal lamellae encircling chaetae. Postchaetal superior dorsal lobes triangular, foliaceous, partially confluent with postchaetal lamellae. Neuropodia with low triangular prechaetal lamellae and round postchaetal lamellae, encircling chaetae, cuff-like, confluent with tapered, triangular ventral lamellae. Notopodia of chaetiger 9 with low triangular prechaetal lamellae and foliaceous postchaetal lamellae. Postchaetal superior dorsal lobes short, conical, smallest of all thoracic chaetigers. Neuropodial prechaetal lamellae of chaetiger 9 low, subtriangular confluent with triangular ventral lamellae with pointed tips. Neuropodial postchaetal lamellae subtriangular, well developed. Chaetae of chaetigers 1–9 simple bilimbate winged capillaries. Abdominal hooded hooks tridentate, in two groups, facing each other.

3.3.3. Description

Figured specimen (JUMA_20231011_001) incomplete, prostomium 0.7 mm long, 1.15 mm wide; thorax (including prostomium) 3.78 mm long, 0.99 mm wide; abdomen 1 mm wide; total length 15.13 mm for 39 chaetigers. Other examined specimens: prostomia 0.67–0.83 mm long, 1.09–1.35 mm wide; thoraces (including prostomium) 4.30–5.89 mm long, 0.95–1.18 mm wide; abdomens 0.8–1 mm wide.

Prostomium wider than long, with distinct horns; anterior margin triangular, irregularly crenulate (Figure 3E,F and Figure 4A,B). Two pairs of prominent longitudinal dorsal muscular ridges present; outer pair abutting inner pair for their entire length and shorter than inner pair; inner pair abutting for majority of length, diverging at distal ends (Figure 4A,B). Burrowing organ in two voucher specimens (JUMA_20231011_001, NA00102191) almost entirely everted, heart-shaped, inferior surface with longitudinal ridges; upper surface smooth (Figures 3F and 4A). Eyes and nuchal organs absent. Palps arising ventrolaterally from base of prostomium, partially damaged in posterior end, with non-papillated basal region reaching about chaetiger 4; observable incomplete palp (from JUMA_20231011_001) with papillae reaches chaetiger 7 (Figure 3F). Papillae of palps arranged in 4–6 rows proximally; rows equally divided on either side of an indistinct longitudinal line.

Achaetous first segment one and half times the length of chaetiger 1 (Figure 4A). Chaetigers 1–8 similar; parapodia biramous. Notopodia with low triangular prechaetal lamellae confluent with smooth-edged, foliaceous postchaetal lamellae, encircling chaetae; distal end of postchaetal lamellae of chaetigers 5–8 squared, wider than preceding ones (Figure 4C–J). Postchaetal superior dorsal lobes triangular, foliaceous, partially confluent with postchaetal lamellae (Figure 4C–J). Neuropodia with low triangular prechaetal lamellae and round postchaetal lamellae, encircling chaetae, cuff-like, confluent with tapered, triangular ventral lamellae with pointed tips; postchaetal lamellae of first chaetiger smallest (Figure 4C–J). Ventral neuropodial lamellae initially in prechaetal position, becoming completely ventral by chaetiger 5, directly underneath chaetal bundle. Neuropodial lamellae shorter in size than the notopodia (Figure 4C–J).

Chaetiger 9 shorter and narrower than preceding ones (Figure 4A). Notopodial prechaetal lamellae low, triangular confluent with foliaceous postchaetal lamellae; postchaetal lamellae of chaetiger 9 smaller than preceding ones (Figure 4K). Postchaetal superior dorsal lobes short, triangular, smallest of all thoracic chaetigers (Figure 4K). Neuropodial prechaetal lamellae low, subtriangular confluent with triangular ventral lamellae with pointed tips. Postchaetal lamellae subtriangular, well developed (Figure 4K). Ventral neuropodial lobes shorter and smaller than that of chaetiger 8, directly underneath chaetal bundle (Figure 4J,K). Chaetae of chaetigers 1–9 simple bilimbate winged capillaries; neuropodial capillaries slightly longer than notopodial ones (Figures 3G and 4K,M). No thoracic ventral swellings observed.

Abdominal foliaceous lateral lamellae with slight basal constrictions, approximately equal in size on both rami (Figure 4L). Dorsal and ventral medial lobes short and triangular, present at inner margins of chaetal rows (Figure 4L).

Abdominal chaetae tridentate hooded hooks of similar size throughout, with two parallel small teeth above main fang (Figures 3H and 4N,O). Hooks in two groups; outer group usually with 1–5 more hooks than inner group; main fangs of one group facing the other; hooks one and half times longer than dorsal and ventral medial lobes (Figure 4L). Anterior abdominal segments with 13–17 hooks per ramus (Figure 4L). No aciculae observed. No abdominal pouches observed, although no posterior fragments present within the examined material. Pygidium unknown.

3.3.4. Methyl Green Staining Patterns

The methyl green staining is distinctly visible, appearing blue, in the epidermis of the four anterior thoracic chaetigers (Figure 3E,F). Anterior dorsum of chaetigers 2–9 shows partial staining resembling eyebrows in a dark blue hue, while the venter displays an oval shape on chaetigers 2–9; these oval-shaped staining patterns elongate longitudinally in posterior thorax (Figure 3E,F). A funnel-shaped staining pattern is additionally observed on the ventral surfaces of chaetigers 6–14 and along the mid-ventral lines (Figure 3F).

3.3.5. Distribution and Ecology

The type locality of *Magelona lenticulata* Gallardo, 1968, is Vietnam [11]. The Korean specimens were obtained from three subtidal stations (water depth: 12–29 m) in the southern part of Korea in February and December 2010, as well as in May 2023. The surface sediments at the stations were mainly sandy mud. The salinity range at the sampling locations was approximately 30–33.

3.3.6. Remarks

These Korean specimens appear morphologically identical to *M. lenticulata* Gallardo, 1968, in the morphological features of the prostomium, thoracic notopodia, superior dorsal lobe, capillary chaetae, and hooded hooks. However, compared to the illustrations in the original description, the Korean specimens exhibit a minor difference where the ventral lamellae of the thoracic neuropodia and the abdominal lateral lamellae are longer in length [11]. *Magelona lenticulata* is a species in urgent need of re-description to confirm certain morphological characteristics, which we now know are needed in the separation of magelonid species. The perceived minor difference between the original description and Korean material, as noted herein, may allow for separation of the material in the future. However, at the current time, the authors suggest that this should be considered as *M. lenticulata*. The original description of *M. lenticulata* does not provide confirmation of detailed characteristics for all thoracic parapodial lamellae, the arrangement and the number of abdominal hooded hooks, as well as the MGSP; therefore, we could not directly compare these characteristics with the Korean samples. *Magelona lenticulata* is easily distinguished from the three previously reported Korean species due to the crenulated anterior margin of its prostomium, round-shaped, large neuropodial postchaetal lamellae, and foliaceous superior dorsal lobes on chaetigers 1–8. Among the Northwestern Pacific species, *M. lenticulata* shares morphological similarities with *M. crenulifrons* Gallardo, 1968 [11], *M. longicornis* Johnson, 1901 [22], and *M. methae* Natewathana & Hylleberg, 1991 [10], but only *M. lenticulata* possesses tridentate abdominal hooded hooks.

3.4. *Magelona cf. longicornis* Johnson, 1901 [22]

Figure 3I–L and Figure 5A–N.

Magelona longicornis Johnson, 1901: figures 115–118.

Magelona longicornis Jones, 1971 [23]: figures 20–44.

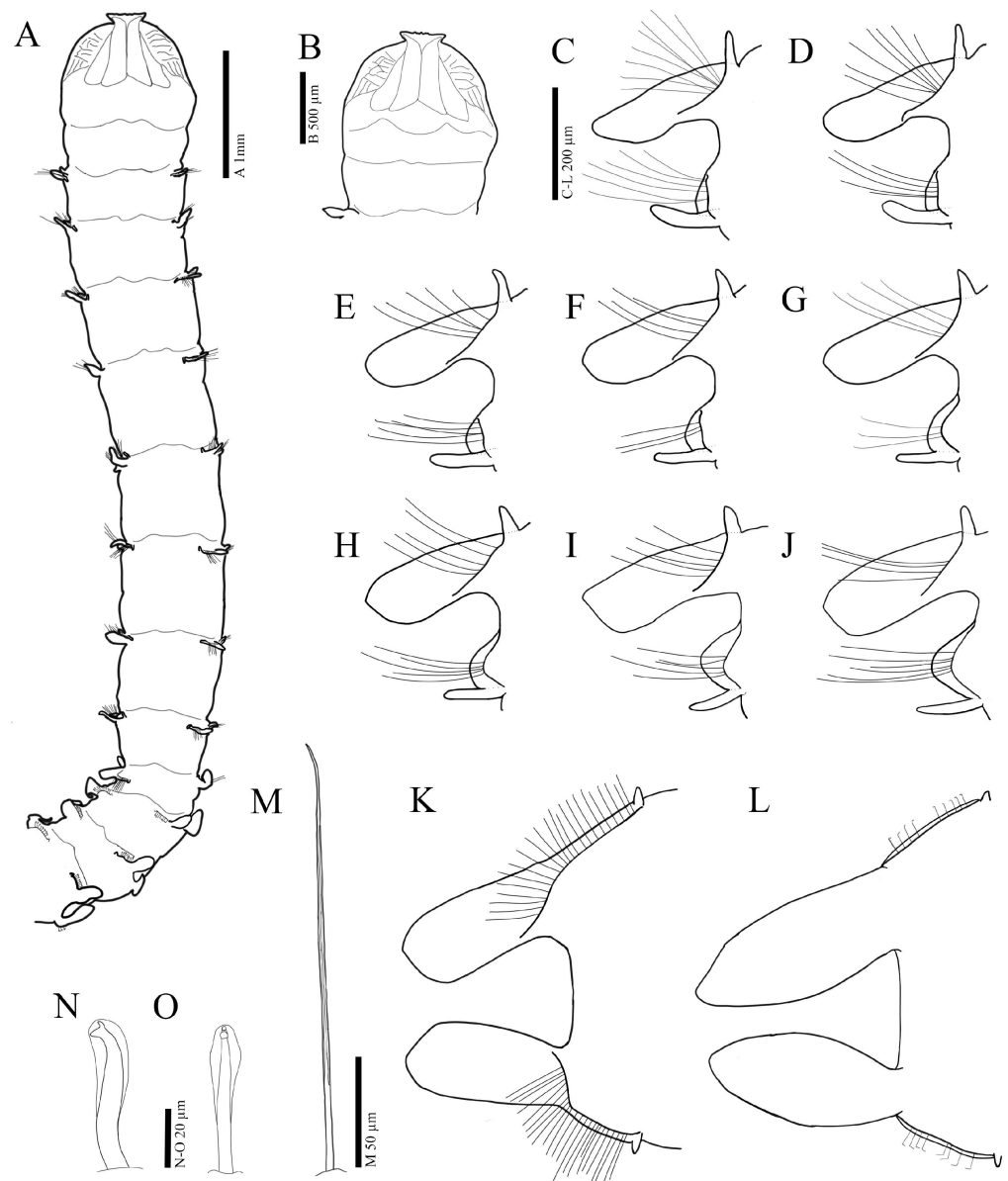


Figure 5. Illustrations of *Magelona* cf. *longicornis* (MABIK NA00114529): (A) anterior end, dorsal view; (B) prostomium, dorsal view; (C–L) right hand parapodia from chaetigers 1–10, respectively (anterior view); (M) bilimbate capillary chaeta of chaetiger 9; (N) abdominal hooded hook, lateral view; (O) same, frontal view.

3.4.1. Material Examined

MABIK NA00114529: Sanpo-ri, Nam-myeon, Uljin-gun, Gyeongsangbuk-do, Republic of Korea (36°56′31.52″ N, 129°25′22.63″ E); subtidal zone, 10 m depth; collected by Chan Soo Lee, February 2012. MABIK NA00114555: Ujeong-eup, Hwaseong-si, Gyeonggi-do, Republic of Korea (37°08′56.51″ N, 126°35′23.26″ E); subtidal zone, 7 m depth; collected by Byoung Mi Choi, February 2012. MABIK NA00114513: Saha-gu, Busan, Republic of Korea (35°04′14.61″ N, 129°00′02.54″ E); subtidal zone, 14 m depth; collected by Byoung Mi Choi, April 2012. MABIK NA00114576: Wondeok-eup, Samcheok-si, Gangwon-do, Republic of Korea (37°10′45.05″ N, 129°21′59.77″ E); subtidal zone, 37 m depth; collected by Byoung Mi Choi, July 2012.

3.4.2. Species Diagnosis

Prostomium wider than long, with distinct horns; anterior margin straight, irregularly crenulate. Chaetigers 1–8 similar. Notopodia with low triangular prechaetal lamellae confluent with smooth-edged, foliaceous postchaetal lamellae. Prechaetal superior dorsal lobes slender triangular, present on each chaetiger. Neuropodia of chaetigers 1–4 with low, triangular prechaetal lamellae and small, round postchaetal lamellae, encircling chaetae, confluent with tapered, triangular ventral lamellae. Neuropodia of chaetigers 5–8 with small, round prechaetal lamellae and more developed round postchaetal lamellae. Notopodia of chaetiger 9 with low subtriangular prechaetal lamellae and long rectangular postchaetal lamellae, located in subchaetal position. Superior dorsal lobes of chaetiger 9 small and conical. Ventral neuropodial lobes similar to superior dorsal lobes. Chaetae of chaetigers 1–9 simple bilimbate winged capillaries. Abdominal hooded hooks bidentate, in two groups, facing each other.

3.4.3. Description

Figured specimen (MABIK NA00114529) incomplete, prostomium 0.82 mm long, 1.05 mm wide; thorax (including prostomium) 6 mm long, 0.93 mm wide; abdomen 0.98 mm wide; total length 19.85 mm for 37 chaetigers. Other examined specimens: prostomia 0.71–1 mm long, 0.84–1.14 mm wide; thoraces (including prostomium) 4.65–6.83 mm long, 0.88–0.95 mm wide; abdomens 1.02–1.09 mm wide.

Prostomium slightly wider than long, with distinct horns; anterior margin straight, irregularly crenulate (Figure 3I,J and Figure 5A,B). Two pairs of prominent longitudinal dorsal muscular ridges present; outer pair abutting inner pair for their entire length and shorter than inner pair; inner pair abutting for majority of length, diverging at distal ends (Figure 5A,B). Burrowing organ not everted (Figure 3J). Eyes and nuchal organs absent. Palps arising ventrolaterally from base of prostomium, reaching chaetigers 24–26, non-papillated basal region reaching about chaetiger 3. Papillae of palps arranged in 6–8 rows proximally, rows equally divided on either side of indistinct longitudinal line.

Achaetous first segment approximately two times the length of chaetiger 1 (Figure 3I,J and Figure 5A,B). Chaetigers 1–8 similar; parapodia biramous; noto- and neuropodial lamellae slightly increasing in size on posterior thoracic chaetigers (Figure 5C–J). Notopodia with low triangular prechaetal lamellae confluent with smooth-edged, foliaceous postchaetal lamellae, encircling chaetae, located in slightly subchaetal position (Figure 5C–J). Prechaetal superior dorsal lobes slender triangular, present on each chaetiger (Figure 5C–J).

Neuropodia possess morphological differences between the anterior and posterior thorax: neuropodia of chaetigers 1–4 with low, triangular prechaetal lamellae and small, round postchaetal lamellae encircling chaetae, cuff-like, confluent with tapered, triangular ventral lamellae with pointed tips (Figure 5C–F); neuropodia of chaetigers 5–8 with small, round prechaetal lamellae and more developed round postchaetal lamellae confluent with long slender ventral lamellae (Figure 5G–J). Ventral neuropodial lamellae initially in ventral position, becoming postchaetal by chaetiger 6. Neuropodial lamellae shorter in size than the notopodial lamellae (Figure 5C–J).

Chaetiger 9 shorter and narrower in size than preceding ones (Figure 5A). Notopodia with low subtriangular prechaetal lamellae and long rectangular postchaetal lamellae, located in subchaetal position (Figure 5K). Superior dorsal lobes small, conical (Figure 5K). Neuropodia similar to notopodia. Ventral neuropodial lobes similar to superior dorsal lobes (Figure 5K). Chaetae of chaetigers 1–9 simple bilimbate winged capillaries; neuropodial capillaries slightly longer than notopodial ones (Figures 3K and 5K,M). No thoracic ventral swellings observed.

Abdominal chaetigers with foliaceous lateral lamellae of similar size in both rami; each lamella without distinct basal constriction, with low, rounded postchaetal expansion behind chaetal rows (Figure 5L). Triangular dorsal and ventral medial lobes short, present at inner margins of chaetal rows (Figure 5L).

Abdominal chaetae bidentate hooded hooks of similar size throughout, with a small tooth above main fang; hooks two to three times longer than dorsal and ventral medial lobes (Figures 3L and 5L,N,O). Hooks in two groups; both groups have same number of hooks or outer group with 1–2 more hooks than inner group; main fangs of one group facing the other (Figure 5L). Anterior abdominal segments with 6–11 hooks per ramus (Figure 5L). No aciculae observed. No abdominal pouches observed, although no posterior fragments present within examined material. Pygidium unknown.

3.4.4. Methyl Green Staining Patterns

Methyl green staining is indistinct in most segments, being distinct only on chaetigers 3–6, where the dorsum and venter are stained with a blue hue (Figure 3L,J).

3.4.5. Distribution and Ecology

The type locality of *Magelona longicornis* Johnson, 1901 is Puget Sound, and this species has been reported from Vancouver Island, British Columbia, as well as from the Bering and Chukchi Seas and Japan [23]. Its presence ranges from intertidal zones to depths of 197 m [23]. The Korean specimens were sampled from four subtidal stations (water depth: 7–37 m) across Korea in February, April, and July. The surface sediment at the stations was mainly sandy mud. The salinity range at the sampling locations was approximately 31–33. This species is thought to show indifference to disturbances in benthic environments [7].

3.4.6. Remarks

These Korean specimens almost correspond to the re-description of *M. longicornis* by Jones [23] from the type locality in the shape of the prostomium, parapodia of chaetigers 1–8, superior dorsal lobes, abdominal lateral lamellae, and hooded hooks. However, the Korean specimens exhibit slight differences from *M. longicornis* in the morphology of the noto- and neuropodial postchaetal lamellae of chaetiger 9 (rectangle vs. triangular, respectively) and in the position of the neuropodial ventral lamellae of chaetigers 6–8 (postchaetal vs. prechaetal, respectively). Additionally, in Korean specimens, the ventral neuropodial lamellae of the first few chaetigers are shorter than the notopodial lamellae of the same chaetiger, whereas they are nearly identical in length in *M. longicornis* Jones, 1971. While the re-description of *M. longicornis* by Jones [23] offers detailed illustrations of all thoracic chaetigers, it notably lacks a comprehensive description of standardized specific features of all thoracic parapodial lamellae. Considering these circumstances, the authors have determined that the taxonomic status of this Korean material is considered as *M. cf. longicornis*. *Magelona cf. longicornis* can be easily distinguished from other Korean species by its unique, distinctly elongated noto- and neuropodial postchaetal lamellae on chaetiger 9.

4. Discussion

In this study, the taxonomic identities of species observed in Korea were determined, but there were some minor challenges in the process of confirming morphological features. A crucial factor in differentiating between the species found in Korea and the approximately 80 documented *Magelona* species described in the literature was the combination of prostomium, parapodial lamella, superior dorsal lobe, and abdominal hooded hook morphologies (Table 1). Among them, the species-specific features were concentrated on the parapodial structures of the mid or last thoracic chaetiger, and the methyl green staining patterns of the reported species were also highly valuable [5,9]. However, in previous studies, these morphological characteristics were often described using different terms depending on the literature or author, potentially causing confusion. For instance, terms such as “superior dorsal lobe” (or “SDL”), “ventral neuropodial lobe” (or “VNL”), and “chaetal lamella”, crucial in species identification due to their connection to parapodial structures, have been variably or interchangeably referred to as “dorsal medial lobe” (or “DML”), “ventral medial lobe” (or “VML”), and “chaetal lobe”, respectively, in species

descriptions. Additionally, a recent study based on anatomical and ecological observations of *Magelona* species proposed that the terms commonly identified as peristomium and proboscis in other polychaeta taxa should be replaced with “achaetous first segment” and “burrowing organ”, respectively, to better align with their specific functions [5,24]. In addressing this issue, the morphological criteria and standardized terms proposed by renowned taxonomic specialists in *Magelona*, Mortimer et al. [13,24,25] and Parapar et al. [2], may be highly effective in clearing up existing confusion. Notably, their emphasis on the comprehensive illustration and detailed description of all thoracic chaetigers in taxonomic treatments stands out as a crucial contribution.

Table 1. Summary of the main morphological characters of Korean *Magelona* species (SDL, superior dorsal lobes; VNL, ventral neuropodial lamellas; ch, chaetigers).

	Prostomial Shape	Prostomial Horn	Prostomial Anterior Margin	SDL of ch 1–8	SDL/VNL on Chaetiger 9	Dentition of Hooded Hook
<i>M. japonica</i>	Wider than long	Present	Smooth	Absent	Both absent	Tridentate
<i>M. koreana</i>	Wider than long	Present	Smooth	Absent	VNL present	Tridentate
<i>M. parochilis</i>	Longer than wide	Absent	Smooth	Tapering conical	VNL present	Tridentate
<i>M. sachalinensis</i>	Longer than wide	Absent	Smooth	Tiny in ch 1–4, cirriform in ch 5–8	Both present	Bidentate
<i>M. cf. longicornis</i>	Wider than long	Present	Crenulate	Tapering conical	Both present	Bidentate
<i>M. lenticulata</i>	Wider than long	Present	Crenulate	Triangular, foliaceous	Both present	Tridentate

For some previously lesser known species including *M. lenticulata* and *M. sachalinensis* of this study, the characteristics that we now know are important in magelonid species delineation were not reported in the original descriptions, making the current study difficult [11,26–28]. This is attributed to a lack of further taxonomic research or available type material after their initial reports from the type locality. In bridging these knowledge gaps, we offer a comprehensive description and illustration of taxonomically significant and standardized characters, encompassing all thoracic chaetigers of three newly discovered *Magelona* species from Korea. This detailed morphological information is expected to be invaluable for future comparative analyses, particularly in identifying new sibling species, with a focus on East Asia and the Northwestern Pacific.

Meanwhile, DNA barcoding information could be employed as an alternative for comparative analysis to identify *Magelona* samples that have lost fragile morphological features, such as the thoracic parapodial lamellae. However, the utilization of this method is currently limited due to the availability of barcoding information for only 16 *Magelona* species in the public databases the Barcode of Life Data System and the National Center for Biotechnology Information. Similarly, methyl green staining patterns that effectively distinguish species are only recognized for approximately 43 species within the *Magelona* genus. Thus, it is challenging to employ them for comparisons across the entire genus. The lack of this valuable taxonomic information and confusion in terminology could result in the misidentification of *Magelona* species found in new localities. Hence, employing a standardized terminology and verifying additional taxonomic features, including morphological details for prostomia and all thoracic chaetigers, methyl green staining patterns, and molecular information, for undescribed species may contribute to a more accurate understanding of the diversity of *Magelona*, which exhibits a global distribution.

Key to North-Western Pacific species of *Magelona* (modified from Mortimer et al. [29])

1. Prostomium with distinct prostomial horns	2
- Prostomium without prostomial horns or with rudimentary horns	11
2. Prostomial anterior margin appearing smooth	3
- Prostomial anterior margin appearing crenulate	5
3. Dark purple pigmented band located between chaetigers 5–8	<i>M. japonica</i>
- No distinct pigmentation of the thoracic region	4
4. Prostomium wider than long, thoracic chaetigers without superior dorsal lobes	<i>M. koreana</i>
- Prostomium longer than wide, thoracic chaetigers 1–8 with superior dorsal lobes	<i>M. boninensis</i>

5. Prostomium width approximately similar to length	6
- Prostomium wider than long	7
6. Abdominal hooded hooks bidentate	<i>M. crenulifrons</i>
- Abdominal hooded hooks tridentate	<i>M. cf. cornuta</i>
7. Superior dorsal lobes present in the thorax	8
- No superior dorsal lobes present in thorax; prostomial anterior margin only minutely crenulate	<i>M. petersenae</i>
8. Abdominal hooded hooks bidentate	9
- Abdominal hooded hooks tridentate	<i>M. lenticulata</i>
9. Small superior dorsal lobes present on chaetiger 9, parapodial postchaetal lamellae of chaetiger 9 rectangle	<i>M. cf. longicornis</i>
- No superior dorsal lobes present on chaetiger 9	<i>M. methae</i>
10. Chaetiger 9 with special chaetae	11
- Chaetiger 9 bearing capillary chaetae only, as in chaetigers 1–8	14
11. Abdominal hooded hooks tridentate	12
- Abdominal hooded hooks bidentate	<i>M. sachalinensis</i>
12. Anterior thoracic notopodial lamellae with smooth or lightly crenulated upper edges	13
- Anterior thoracic notopodial lamellae with pectinate upper edges	<i>M. pectinata</i>
13. Abdominal parapodia without triangular processes at the inner margin of chaetal rows	<i>M. parochilis</i>
- Notopodial lamellae of chaetiger 8 distinctly bilobed, abdominal parapodia with triangular processes at the inner margin of chaetal rows	<i>M. tinae</i>
14. Abdominal hooded hooks polydentate	<i>M. agoensis</i>
- Abdominal hooded hooks bi- or tridentate	15
15. Thoracic notopodia with superior dorsal lobes	16
- Thoracic notopodia without superior dorsal lobes	19
16. Prostomium wider than long	17
- Prostomium longer than wide	18
17. Thoracic notopodial lamellae slender, no superior dorsal lobe on chaetiger 9	<i>M. kamala</i>
- Stout species, with distinct armor-like appearance, thoracic lamellae foliaceous, superior dorsal lobe on chaetiger 9 present	<i>M. armatis</i>
18. Prostomium only marginally longer than wide, anterior margin squared	<i>M. noppi</i>
- Prostomium length greater than width, rudimentary horns with a triangular anterior margin	<i>M. alba</i>
19. Anterior thoracic neuropodial lamellae distinctly scoop-shaped	<i>M. cf. cincta</i>
- Anterior thoracic neuropodial lamellae slender triangular	20
20. Moderate to large species with rudimentary horns, broad palps with several rows of papillae	<i>M. mickminni</i>
- Prostomial margin rounded to straight, minute species with slender palps carrying two rows of papillae	<i>M. pygmaea</i>

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