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석사학위논문

Taxonomic Study on the Spionid Polychaetes (Annelida: Polychaeta: Spionidae) from Korean Waters

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생명과학과

이 건 혁

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한국 해역에 서식하는 얼굴갯지렁이과 다모류의 분류학적 연구

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이 논문을 이학석사학위 신청 논문으로 제출함

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ABSTRACT

Taxonomic Study on the Spionid Polychaetes (Annelida: Polychaeta: Spionidae) from Korean Waters

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The spionids are one of the large taxa of polychaetous worms that are commonly found from intertidal to deep sea, and from estuarine communities in various environments all over the world. They perform important roles as a predator and a prey in the food chain. In this study, the morphological study of the spionids was carried out to investigate the spionid polychaete fauna in Korea. In this study, 16 species in 11 genera of the spionid polychaetes are described and illustrated based on the materials collected from Korean waters at 28 localities during the periods from April 12, 2017 to October 25, 2018. The list of these species is as follows: *Atherospio* cf. *disticha* Mackie & Duff, 1986, *Atherospio* sp. nov., *Dipolydora socialis* (Schmarda, 1861), *Laonice japonica* (Moore, 1907), *Malacoceros reductus* Blake & Kudenov, 1978, *Polydora* sp. nov., *Prionospio depauperata* Imajima, 1990, *Prionospio nova* Annenkova, 1938, *Prionospio pulchra* Imajima, 1990, *Pseudopolydora kempi* (Southern, 1921), *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000, *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959, *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992, *Scolelepis victoriensis* Blake & Kudenov, 1978, *Scolelepis* sp. nov., *Spio readi* Blake, 1984. In this paper, keys to genera and species of Korean spionid polychaetes are also provided.

Introduction

The family Spionidae Grube, 1850 is one of the most abundant polychaetous worms in terms of biomass and commonly found in a variety of habitats from intertidal to deep sea (Blake and Kudenov, 1978; Meißner and Götting, 2015; Radashevsky, 2015; Abe *et al*., 2016). The spionids sometimes form dense assemblages with individuals extending their palps from burrows or tubes to filter particles from the waters; in other situations the spionids are surface deposit feeders and use the palps to sweep the sediment surface. Some polydori d, bore into calcareous substrates (boring-species) and are sometimes considered pests by the shellfish industry. A few species are opportunistic, occupying environments that are disturbed or organically enriched. Such species have life history patterns that allow them to populate available areas rapidly. The members of this group are characterized by a generally elongate body (not divided into distinct regions), a prostomium not fully fused to peristomium, the presence of a pair of grooved palps at the posterior end of the peristomium, the presence of dorsal branchiae separated or fused to the postchaetal lamellae in various degrees, and the presence of nuchal organs (Fauchald, 1977; Blake and Kudenov, 1978; Blake, 1996; Sato-Okoshi, 2000; Walker, 2011; Sato-Okoshi and Abe, 2012, 2013; Radashevsky, 2015; Abe *et al*., 2016). Currently, this family has more than 40 genera (Meißner *et al*., 2014).

Many polychaetologists have made prominent contributions to taxonomic study of spionids from East Asia. But currently, only about 40 species have been recorded from Korean waters by several authors (Paik, 1975, 1982, 1984a, 1984b, 1989; Radashevsky, 1993; Lee and Cha, 1997; Jung *et al*., 1998; Shin and Koh, 1998; Lee, 1998; Hong and Lim, 2002; Park *et al*., 2006; Sato-Okoshi *et al*., 2008, 2012, 2013, 2015; Yoon *et al*., 2009; Yokoyama and Choi, 2010; Kodama *et al*., 2012; Yu *et al*., 2012; Won *et al*., 2013; Kim *et al*., 2014, 2015; Radashevsky *et al*., 2014, 2017;

Seo *et al*., 2014; Simon and Sato-Okoshi, 2015; Choi and Yoon, 2016; Bae *et al*., 2017, 2018; Lee *et al*., 2018).

In the present study, the taxonomic study was performed to describe spionid species poorly known and newly reported species from Korean waters with illustrations and scanning electron microscopy studies. The keys for genera and species of Korean spionids are also provided.

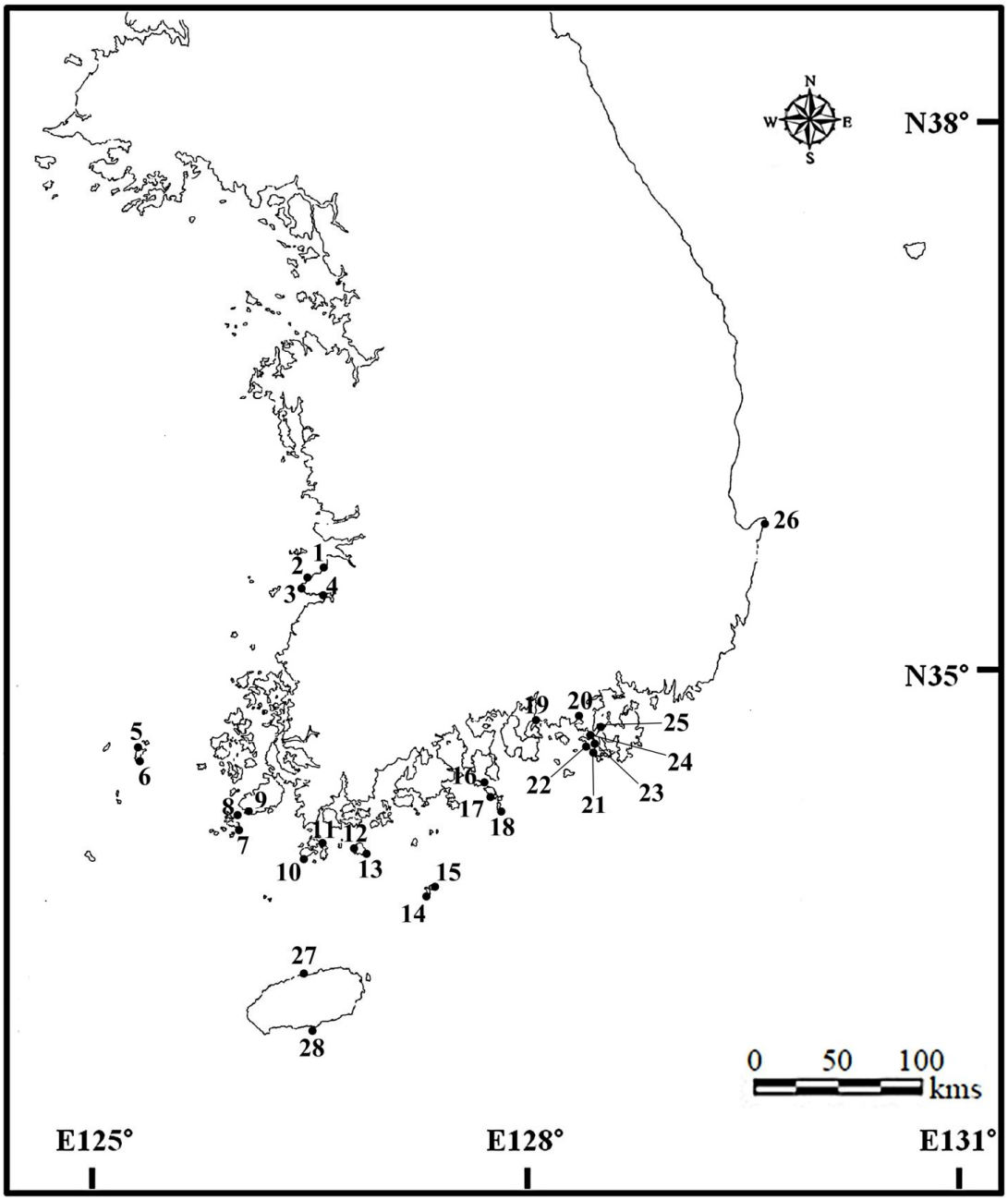

Fig. 1. Localities where the specimens were collected in this study.

Table 1. Localities of the sampling sites.

1. Jeollabuk-do: Buan-gun, Byeonsan-myeon, Unsan-ri (전라북도 부안군 변산면 운산리)
2. Jeollabuk-do: Buan-gun, Byeonsan-myeon, Mapo-ri (전라북도 부안군 변산면 마포리)
3. Jeollabuk-do: Buan-gun, Byeonsan-myeon, Gyeokpo-ri (전라북도 부안군 변산면 격포리)
4. Jeollabuk-do: Buan-gun, Jinseo-myeon, Jinseo-ri (전라북도 부안군 진서면 진서리)
5. Jeollanam-do: Sinan-gun, Heuksan-myeon, Jin-ri (전라남도 신안군 흑산면 진리)
6. Jeollanam-do: Sinan-gun, Heuksan-myeon, Sa-ri (전라남도 신안군 흑산면 사리)
7. Jeollanam-do: Jindo-gun, Jodo-myeon, Sinyuk-ri (전라남도 진도군 조도면 신육리)
8. Jeollanam-do: Jindo-gun, Jodo-myeon, Chang-yu-ri (전라남도 진도군 조도면 창유리)
9. Jeollanam-do: Jindo-gun, Imhoe-myeon, Namdong-ri (전라남도 진도군 임회면 남동리)
10. Jeollanam-do: Wando-gun, Bogil-myeon, Buhwang-ri (전라남도 완도군 보길면 부황리)
11. Jeollanam-do: Wando-gun, Soan-myeon, Gahak-ri (전라남도 완도군 소안면 가학리)
12. Jeollanam-do: Wando-gun, Cheongsan-myeon, Ji-ri (전라남도 완도군 청산면 지리)
13. Jeollanam-do, Wando-gun, Cheongsan-myeon, Dongchon-ri (전라남도 완도군 청산면 동촌리)
14. Jeollanam-do:Yeosu-si, Samsan-myeon, Geomun-ri (전라남도 여수시 삼산면 거문리)
15. Jeollanam-do: Yeosu-si, Samsan-myeon, Dongdo-ri (전라남도 여수시 삼산면 동도리)
16. Jeollanam-do: Yeosu-si, Nam-myeon, Hwatae-ri (전라남도 여수시 남면 화태리)
17. Jeollanam-do: Yeosu-si, Nam-myeon, Dumo-ri (전라남도 여수시 남면 두모리)
18. Jeollanam-do: Yeosu-si, Nam-myeon, Yeondo-ri (전라남도 여수시 남면 연도리)

19. Gyeongsangnam-do: Namhae-gun, Changseon-myeon, Danghang-ri
(경상남도 남해군 창선면 당항리)

20. Gyeongsangnam-do: Goseong-gun, Goseong-eup, Sinwol-ri
(경상남도 고성군 고성읍 신월리)

21. Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Jeorim-ri
(경상남도 통영시 산양읍 저림리)

22. Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Minam-ri
(경상남도 통영시 산양읍 미남리)

23. Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Sinjeon-ri
(경상남도 통영시 산양읍 신전리)

24. Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Hwasam-ri
(경상남도 통영시 용남면 화삼리)

25. Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri
(경상남도 통영시 용남면 삼화리)

26. Gyeongsangbuk-do: Nam-gu, Pohang-si, Guryongpo-eup, Seokbyeong-ri
(경상북도 포항시 남구 구룡포읍 석병리)

27. Jeju-do: Jeju-si, Yongdam 2-dong (제주특별자치도 제주시 용담이동)

28. Jeju-do: Seogwipo-si, Seogwi-dong (제주특별자치도 서귀포시 서귀동)

Materials and Methods

Samples were collected from muddy sand habitats of intertidal or subtidal zone in Korean waters. Specimens were extracted using sieves with pore size of 500 μm. After extraction, they were initially fixed with 5% formaldehyde-seawater solution and then transferred to 85% ethanol. Characteristics of these specimens were observed with appendages dissected in a petri dish using dissection forceps, surgical knives, and needles under stereomicroscope (SMZ1500; Olympus, Tokyo, Japan). Dissected specimens were mounted onto temporary slides using glycerol or permanent slides using polyvinyl lactophenol solution.

Methyl green staining was strongly recommended for observation of most characters by means of light microscopy. Specimens had to be transferred into water first and then dipped into a methyl green solution. The staining faded completely when specimens were returned to alcohol. Staining with Shirlastain A was also helpful for the observation under the light microscope and could be applied in either ethanol or water (Meißnera *et al*., 2011).

Drawings were made with a stereomicroscope and light microscope (LABOPHOT-2; Nikon, Tokyo, Japan) with aids of drawing tubes. Specimens for scanning electron microscopy (SEM) were dehydrated with a t-BuOH freeze dryer (VFD-21S; Vacuum Device, Ibaraki, Japan). They were mounted on stubs and coated with gold-palladium. Observations were conducted using a scanning electron microscope (SU3500; Hitachi, Tokyo, Japan).

These examined materials are deposited at Chosun University and the National Institute of Biological Resources (NIBR) in Korea.

Taxonomic Terminology and Characters of Spionids

1. Prostomium

anterior region (entire, rounded, pointed, incised, bilobed, or expanded laterally into prominent front horns), eyespot, occipital antenna, posterior region (=caruncle)

2. Peristomium

palp

3. Body

nuchal organ, nototroch, dorsal ciliated organ, dorsal crest, glandular pouch, epidermal glands, gizzard-like structure

4. Branchiae

5. Parapodium

notopodial prechaetal lamella, notopodial postchaetal lamella, interramal lamella, neuropodial prechaetal lamella, neuropodial postchaetal lamella

6. Chaetae

capillary chaeta, aristate spine, ventral sabre chaeta, falcate spine, pennoned spine, hooded hook (uni-, bi-, tri-, multidentate), recurved hook, needles-like spine

7. Pygidium

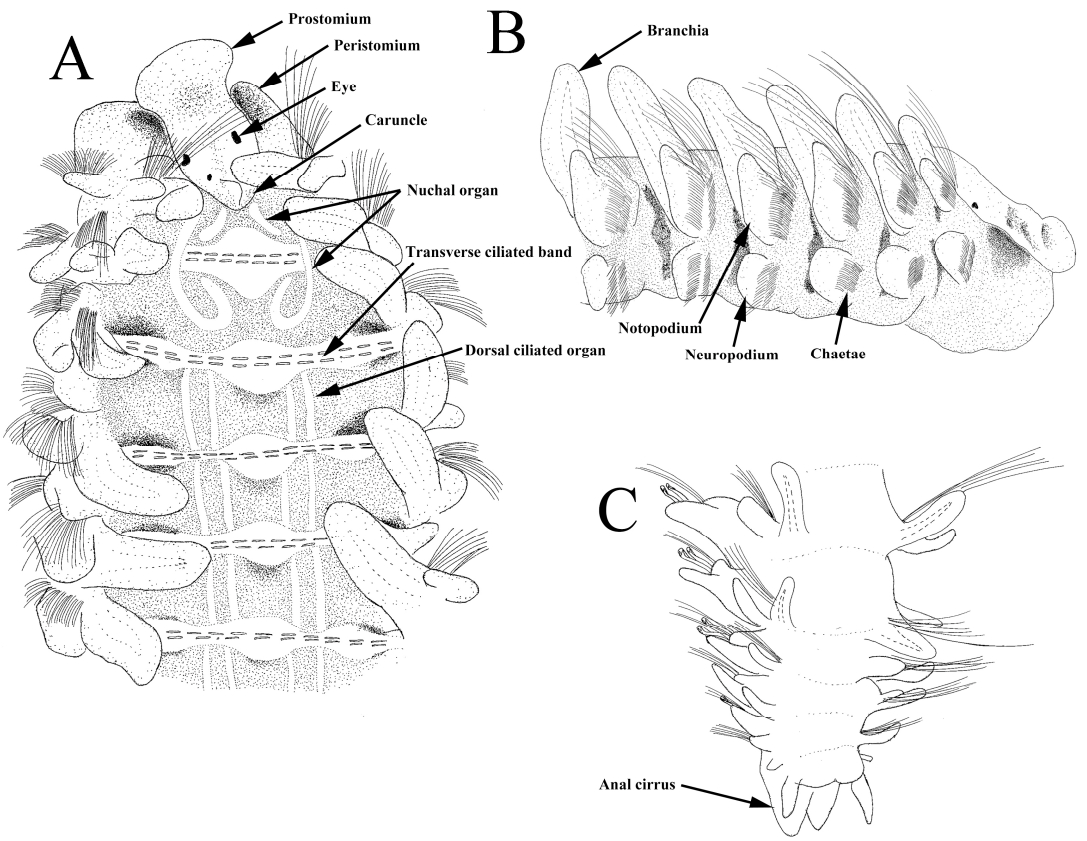

Fig. 2. Taxonomic characters of spionids. A, Anterior end, dorsal view; B, Anterior end, lateral view; C, Posterior end, dorsal view.

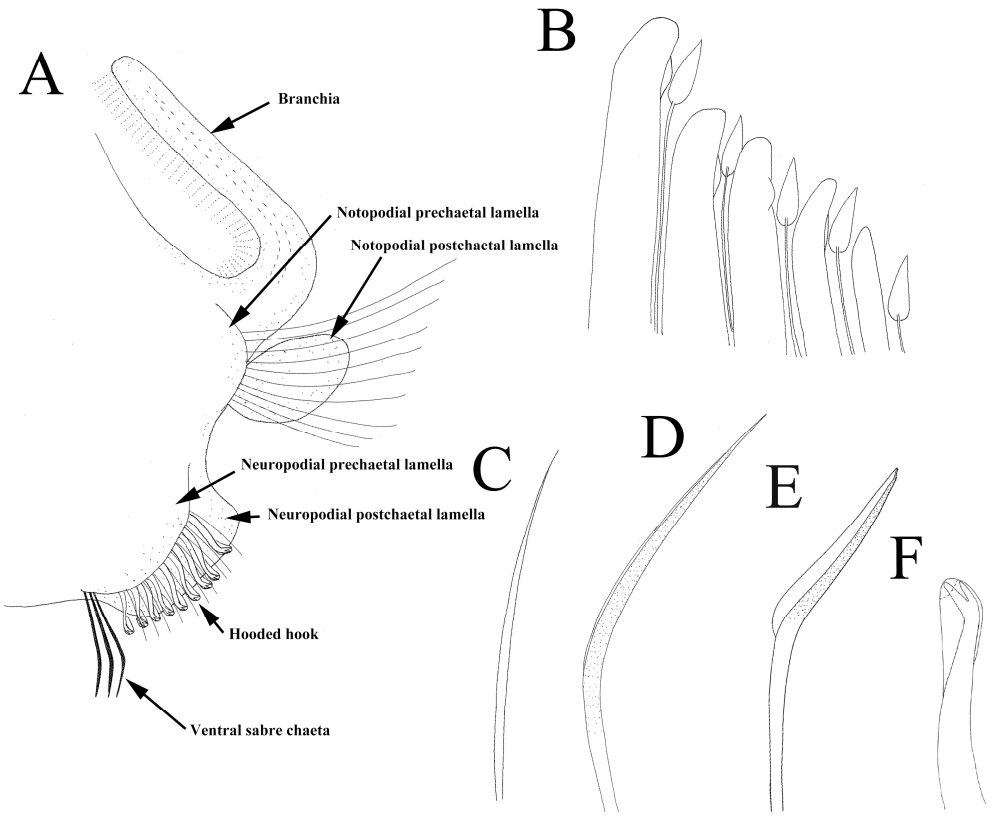

Fig. 3. Taxonomic characters of spionids. A, Parapodium, front view; B, Modified spines (falcate) with companion chaetae (pennoned) on fifth chaetiger in polydorids; C, Capillary chaeta; D, Ventral sabre chaeta; E, Pennoned spine; F, Hooded hook.

Results and Discussion

Phylum Annelida Lamarck, 1809

Class Polychaeta Grube, 1850

Subclass Sedentaria Lamarck, 1818

Infraclass Canalipalpata Rouse & Fauchald, 1997

Order Spionida Grube, 1850

Suborder Spioniformia Fauchald, 1997

Family Spionidae Grube, 1850

Genus *Aonides* Claparède, 1864

1. *Aonides oxycephala* (Sars, 1862)

Genus *Atherospio* Mackie & Duff, 1986

2. *Atherospio* cf. *disticha* Mackie & Duff, 1986

3. *Atherospio* sp. nov.

Genus *Boccardia* Carazzi, 1893

4. *Boccardia polybranchia* (Haswell, 1885)

Genus *Boccardiella* Blake & Kudenov, 1978

5. *Boccardiella hamata* (Webster, 1879)

Genus *Dipolydora* Verrill, 1881

6. *Dipolydora socialis* (Schmarda, 1861)

Genus *Laonice* Malmgren, 1867

7. *Laonice japonica* (Moore, 1907)

Genus *Malacoceros* Quatrefages, 1843

8. *Malacoceros reductus* Blake & Kudenov, 1978

Genus *Polydora* Bosc, 1802

9. *Polydora brevipalpa* Zachs, 1933

10. *Polydora cornuta* Bosc, 1802

11. *Polydora limicola* Annenkova, 1934

12. *Polydora* sp. nov.

Genus *Prionospio* Malmgren, 1867

13. *Prionospio* cf. *aucklandica* Augener, 1923

14. *Prionospio depauperata* Imajima, 1990

15. *Prionospio japonicus* Okuda, 1935

16. *Prionospio krusadensis* Fauvel, 1929

17. *Prionospio membranacea* Imajima, 1990

18. *Prionospio multibranchiata* Berkeley, 1927

19. *Prionospio nova* Annenkova, 1938

20. *Prionospio saccifera* Mackie & Hartley, 1990

21. *Prionospio paradisea* Imajima, 1990

22. *Prionospio pulchra* Imajima, 1990

Genus *Pseudopolydora* Czerniavsky, 1881

23. *Pseudopolydora antennata* (Claparède, 1869)

24. *Pseudopolydora kempi* (Southern, 1921)

25. *Pseudopolydora paucibranchiata* (Okuda, 1937)

26. *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000

Genus *Rhynchospio* Hartman, 1936

27. *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959

Genus *Scolelepis* Blainville, 1828

28. *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992

29. *Scolelepis victoriensis* Blake & Kudenov, 1978

30. *Scolelepis* sp. nov.

Genus *Spio* Fabricius, 1785

31. *Spio readi* Blake, 1984

Order Terebellida Rouse & Fauchald, 1997

Family Ampharetidae Malmgren, 1866

Subfamily Ampharetinae Malmgren, 1866

Genus *Paramphicteis* Caullery, 1944

32. *Paramphicteis weberi* (Caullery, 1944)

Subcalss Polychaeta incertae sedis

Family Saccocirridae Czerniavsky, 1881

Genus *Pharyngocirrus* Di Domenico, Martínez, Lana and Worsaae, 2014

33. *Pharyngocirrus gabriellae* (Marcus, 1946)

Phylum Annelida Lamarck, 1809

Class Polychaeta Grube, 1850

Subclass Sedentaria Lamarck, 1818

Infraclass Canalipalpata Rouse & Fauchald, 1997

Order Spionida Grube, 1850

Suborder Spioniformia Fauchald, 1997

Family Spionidae Grube, 1850

Key to genera of Spionidae from Korean waters

1. Branchiae absent; first neuropodia with large crook-like spines in addition to capillaries.....
…….....…*Spiophanes*

- Branchiae present; first neuropodia with only capillaries…….....2

2. Heavy spines and capillaries on chaetiger 5.....……....……..……....……...…….3

- Only capillaries on chaetiger 5…..……...…..……...…….…8

3. Modified spines at neuropodia on chaetiger 5…….…….....……....*Atherospio*

- Modified spines at notochaetae on chaetiger 5….……..……..……...……...…4

4. Neuropodial hooks from chaetiger 8; upper part of hook shaft with constriction, lower part of hook shaft bent at about right angle. Branchiae from chaetiger 7……..*Pseudopolydora*

- Neuropodial hooks from chaetiger 7; upper part of hook shaft with or without constriction, lower part of hook shaft slightly curved. Branchiae from chaetigers 2–10…….…...5

5. Branchiae from chaetiger 2…….....……6

- Branchiae from chaetigers 7–10…….……..7

6. Notopodia of chaetiger 5 with heavy falcate spines alternating with bilimbate-tipped companion chaetae……...…...*Boccardiella*

- Notopodia of chaetiger 5 with heavy falcate spines and brush-toppedspines……..…...*Boccardia*

7. Chaetiger 1 with notochaetae. Upper part of hook shaft without constriction……...*Dipolydora*

- Chaetiger 1 without notochaetae. Upper part of hook shaft with constriction...…….....*Polydora*

8. Branchiae throughout most of body length…….....9

- Branchiae limited to anterior half of body…….....13

9. Head anteriorly conical and distally pointed, sometimes truncate……...…*Scolelepis*

- Head anteriorly wide, truncate to conical but not distally pointed……..……....……10

10. Prostomium greatly expanded anteriorly, T-shaped or with fronto-lateral horns. Pygidium with two or more pairs of cirri……..11

- Prostomium narrow to slightly expanded anteriorly, without fronto-lateral horns. Pygidium with two pairs of cirri……...……..……...12

11. Branchiae from chaetiger 1. Nuchal organs entire……...……....*Malacoceros*

- Branchiae from chaetiger 2. Nuchal organs metameric……...…*Rhynchospio*

12. Branchiae from chaetiger 1. Nuchal segmental metamers double pairs each composed of two halves of an oval structure separated anteriorly and posteriorly by narrow gaps……..*Spio*

- Branchiae from chaetiger 2. Nuchal segmental metamers single pairs of crescents or straight bands on a segment……...……..*Micropsio*

13. Occipital antenna present. Nuchal organs extending beyond chaetiger 4. Branchiae over most of anterior body……..……..……..…*Laonice*

- Occipital antenna present or absent. Nuchal organs over 1–4 anterior chaetigers or absent. Branchiae limited to first 20 chaetigers……..……..…14

14. Prostomium conical with narrow and rounded tip anteriorly. Occipital antenna present or absent……...…*Aonides*

- Prostomium broadly rounded to truncate anteriorly, sometimes with fronto-lateral horns. Occipital antenna absent……...……..……..15

15. Branchiae from chaetiger 1; transverse ridge present between branchial bases at first branchiae……...……...…...*Paraprionospio*

- Branchiae from chaetiger 2; transverse ridge absent……...….....*Prionospio*

Genus *Aonides* Claparède, 1864

Aonides Claparede, 1864: 505; Foster 1971: 65–66; Blake and Kudenov 1978: 189; Imajima 1989: 214; Blake 1996: 100; Brito *et al*., 2006: 60; Radashevsky, 2015, 638.

Type species: *Aonides auricularis* Claparede, 1864 [=*Nerine oxycephala* Sars, 1862], by monotypy.

Diagnosis: A slender and threadlike body. Prostomium conical, tapered both anteriorly and posteriorly. Eyes present or absent. Occipital antenna present or absent. Peristomium poorly developed. Branchiae apinnate, cirrifrom, present from chaetiger 2 (sometimes from chaetiger 3), limited to a variable number of anterior body. Hooded hooks present. Pygidium with anal cirri.

1. *Aonides oxycephala* (Sars, 1862)

Nerine oxycephala Sars, 1862: 64.

Aonides oxycephala: Fauvel, 1927: 29–40, fig. 13a–e; Ramos, 1976: 11–20, figs. 1–2; Blake and Kudenov, 1978: 189–191; Hutchings and Turvey, 1984: 7–8; Imajima 1989: 215–217, fig. 2a–q; Jirkov, 2001: 286–287.

Material examined. 20 specimens, Jeollanam-do: Wando-gun, Cheongsan-myeon, Dongchon-ri (126°54'35"E, 34°11'06"N), 23 Aug 2017; 10 specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Gyeokpo-ri (126°28′03″E, 35°38′05″N), 17 May 2018, muddy sand from intertidal to 47m depth.

Description. Complete individual up to 20 mm long, 0.4 mm wide for 80 chaetigers. No pigmentation on body and palps. Prostomium long, anteriorly sharply conical, posteriorly narrowed and pressed into chaetiger 1 but not extending over it as a caruncle. Short finger-like antenna present on posterior most part of prostomium. Ciliary bands or patches of nuchal organs absent on

posterior sides of prostomium. Two pairs of eyes arranged trapezoidally. Peristomium reduced to small ring around mouth. Palps as long as 5–15 chaetigers, with frontal longitudinal groove lined with fine cilia (Figs 4A–B, 5A–B).

Chaetiger 1 with capillaries and small postchaetal lamellae in both rami. Postchaetal lamellae on succeeding chaetigers elongated, leaf-like in both rami. Dorsal crests, lateral pouches, and ventral flaps absent (Figs 4C–D, 5A–C).

Hooks in neuropodia from chaetigers 25–31, up to six in a series among capillaries. Hooks in notopodia from chaetigers 30–36, up to five in a series, accompanied by alternating capillaries. Hooks in both rami in anterior parapodia bidentate, with upper tooth situated at almost right angle to main fang. All chaetae with minute spinelets. Ventral sabre chaetae absent (Figs 4C–D, 4F–G, 5C–D).

Branchiae apinnate, from chaetiger 2, 17–20 pairs, completely separated from notopodial postchaetal lamellae (Figs 4A–B, 5A–B).

Dorso-lateral dense bands of short cilia from chaetiger 1 to chaetiger 21, fewer in small individuals. Each band of cilia extending between successive notopodia (Fig 5A–B).

Pygidium with 6–8 cirri (Fig 4E).

Methyl green staining pattern: Inconspicuous; anterior part of prostomium, peristomium, postchaetal lamellae, and pygidium most intensely stained. Bands of dots scattered on borders of chaetigers until posterior end.

Remarks. Ramos (1976) had shown that the usefulness of branchial distributions and the first appearanece of hooded hooks is inadequate to distinguish the *Aonides* species (Ramos, 1976; Blake and Kudenov, 1978; Brito *et al*., 2006). Brito *et al*. (2006) suggested two kinds of group in *Aonides* based on the type of hooded hooks. The group characterized by having the bidentated hooded hooks contains four species, *Aonides californiensis* Rioja, 1947, *A. mayaguezensis* Foster, 1969, *A. oxycephala* (Sars, 1862) and *A. glandulosa* Blake, 1996. In this group, *A. oxycephala* can be distinguished from other *Aonides* species by the morphologic feature of anal cirri: pygidium with

2–12 anal cirri in *A. oxycephala* while four anal cirri of two different sizes in *A. californiensis* and *A. mayaguezensis*, and four anal cirri of subequal size in *A. glandulosa* (Rioja, 1947; Foster, 1969; Ramos, 1976; Blake, 1996; Brito *et al*., 2006).

The present materials from Korean waters agree well with the description of *A. oxycephala* from Spanish waters by Ramos (1976), based on the following diagnostic characteristics: (1) a pointed prostomium (not broad and blunt), (2) bidentate hooded hooks in both rami, and (3) a pygidium with 6–8 anal cirri (Ramos, 1976; Imajima, 1989; Blake, 1996; Jirkov, 2001; Brito *et al*., 2006).

Habitat. The coast of Catalonia (Ramos, 1976), intertidal zone in Japan (Imajima, 1989), gravel and pebbles in Norwegian Sea (Jirkov, 2001). In this study, the Korean materials were collected from intertidal to subtidal zones at 47m depth.

Distribution. Norway (type locality), Australia, China, Japan, Korea, North Polar Basin, Spain.

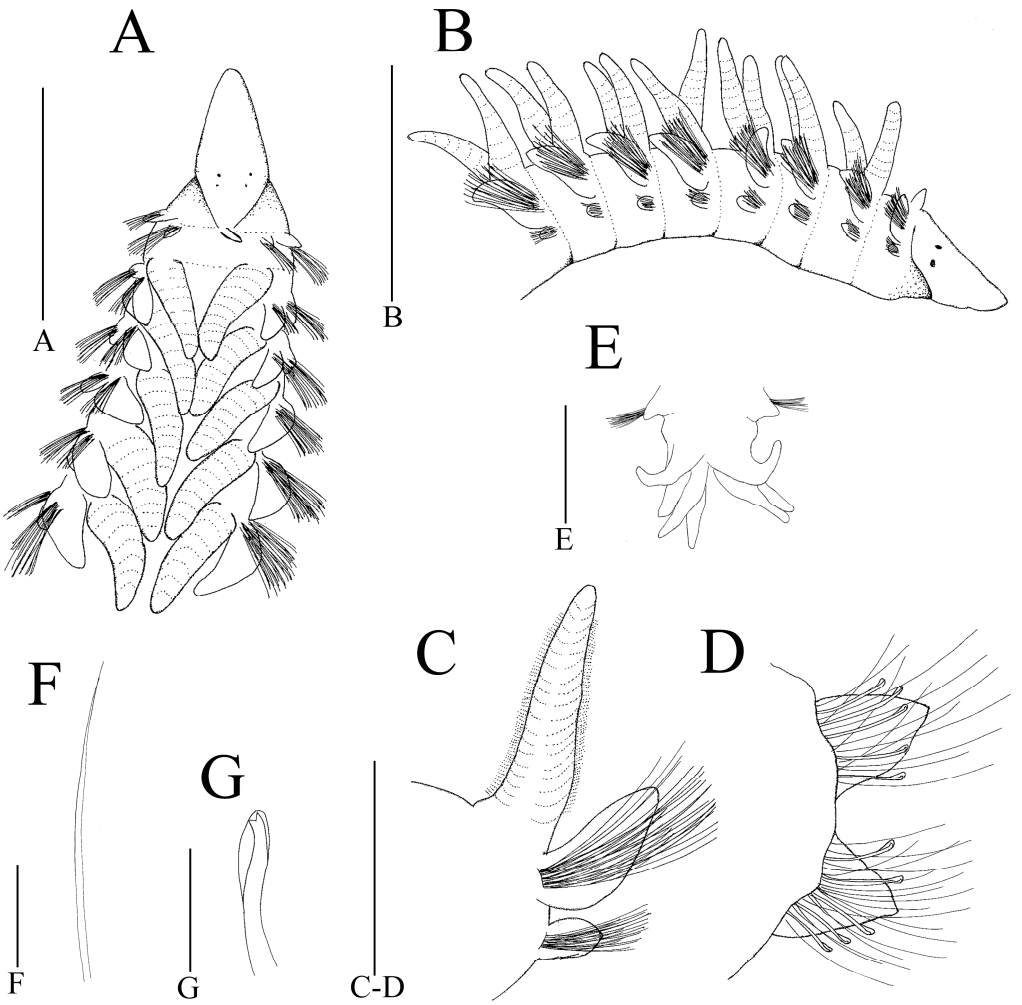

Fig. 4. *Aonides oxycephala* (Sars, 1862). A, Anterior end with six chaetigers, dorsal view; B, Anterior end with eight chaetigers, lateral view; C, Anterior view of chaetiger 5; D, Anterior view of posterior chaetiger; E, Posterior end with seven cirri; F, Capillary chaeta; G, Hooded hook. Scale bars: A–B=0.5 mm, C–D=0.3 mm, E=0.2 mm, F–G=0.03 mm.

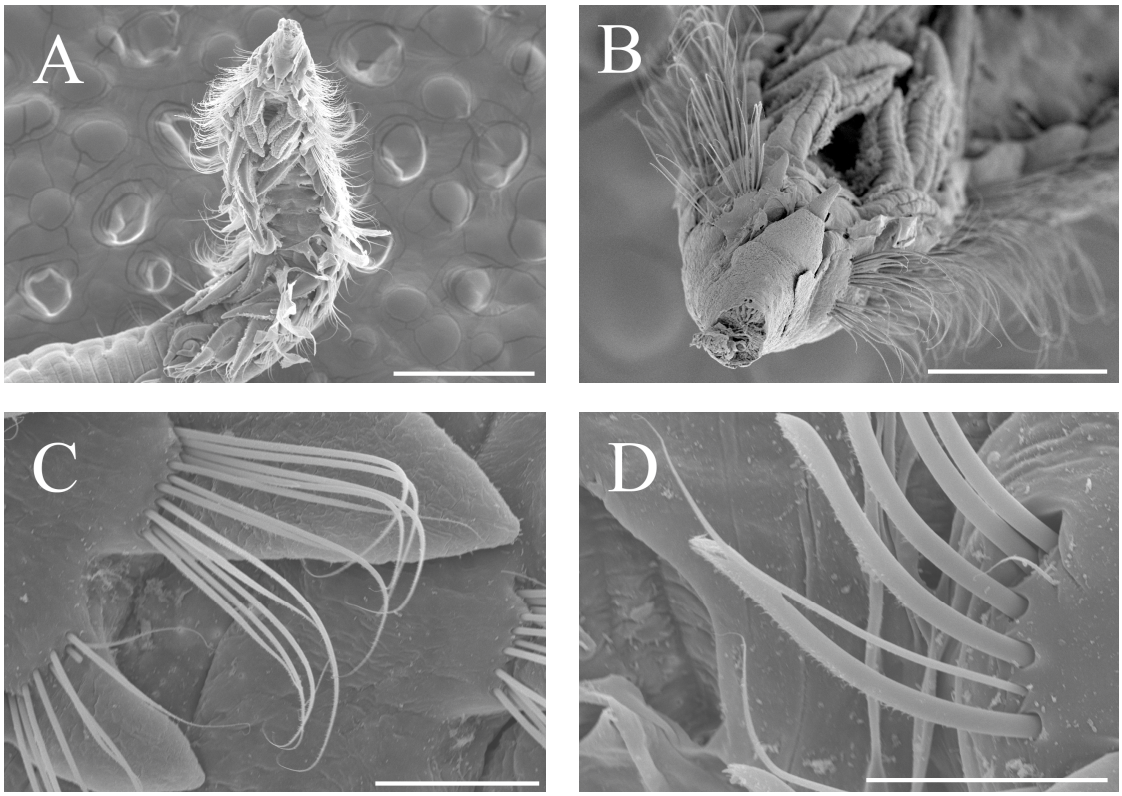

Fig. 5. Scanning electron microscopy photographs of *Aonides oxycephala* (Sars, 1862). A, Anterior end, dorsal view; B, Anterior end, front view; C, Capillary chaetae; D, Hooded hooks with accompanied capillaries. Scale bars: A=0.5 mm, B=0.2 mm, C=0.05 mm, D=0.04 mm.

Genus *Atherospio* Mackie & Duff, 1986

Atherospio Mackie and Duff, 1986: 140; Meiβner and Bick 2005: 116; Blake and Maciolek, 2018: 188–193.

Type species: *Atherospio disticha* Mackie & Duff, 1986, by monotypy.

Diagnosis: Prostomium incised anterioly, not extending into prominent caruncle. Occipital antenna present or absent. Nuchal organs present or absent. Branchiae from chaetiger 7, completely fused to notopodial postchaetal lamellae. Chaetigers 4–5, 4–6, or chaetiger 5 with modified chaetae in neuropodia being falcate and pointed or aristate spines. Hooded hooks uni- or bidentate, secondary tooth below main fang. Ventral sabre chaetae absent.

2. *Atherospio* cf. *disticha* Mackie & Duff, 1986

Atherospio disticha Mackie & Duff, 1986: 139–149, figs. 1–4.

Material examined. Five specimens, Jeju-do: Seogwipo-si, Seogwi-dong (126°33'08"E, 33°13'50"N), 18 Jul 2018. All specimens incomplete collected from muddy sand of subtidal zone at 46m depth.

Description. Body expanded and dorsoventrally flattened for first 6–7 chaetigers with widest segments three times wider than long, then body narrowing, becoming cylindrical in cross-section; middle of body segments about as wide as long. Colour of alcohol fixed specimens light tan, without any pigmentation. Incomplete specimens up to 8 mm long, 0.2 mm wide (Figs. 6A–B, 7A).

Prostomium short, expanded, incised on anterior margin, sometimes curved downward anteriorly, not extending over it as a caruncle; digitiform, short occipital antenna arising from posterior margin. Two pairs of reddish black eyespots arranged trapezoidally, comprising one pair

of median eyes and one pair of lateral eyes situated anteriorly and set wider apart. Subtriangular nuchal organs as paired grooves present posterior margin of prostomium. Palps arising lateral to prostomium; each palp relatively short, cylindrical, with shallow ventral groove. Peristomium inflated, fused to chaetiger 1 ventrally; papillae absent (Figs. 6A–B, 7A).

Chaetigers 1–6 with well-developed noto- and neuropodial postsetal lamellae; notopodial lamellae foliate and folded; neuropodial lamellae initially short, triangular, becoming more rounded and elliptical; from chaetiger 7, notopodia fully fused with branchiae; podial lobes of post-branchial chaetigers triangular, broad. Neuropodial lamellae elliptical, rounded through branchial region, then becoming triangular and tapering to narrow tip.

Branchiae present on chaetigers 7–15, broad, flattened, with lateral undulating membrane fully fused with notopodial lamellae. Transverse ciliary bands extending across dorsum between branchiae (Figs. 6A–E, 7A–D).

All chaetigers with capillaries and postchaetal lamellae in both rami. Aristate spines present on neuropodia of chaetigers 4–5 or 4–6 (one specimen present at chaetigers 4–5, four specimens present on chaetigers 4–6 that only present on left neuroparapodium at chaetiger 6); aristate spines with fringed tip of bristles and terminate in a thin mucron, arranged in double row. Neuropodial hooded hooks present from chaetigers 17–19, number up to four per neuropodium; each neuropodial hook with a curved narrow tip; most hooks with a low rounded subapical knob or protuberance on convex side of shaft. Hooks accompanied by very fine capillaries. Ventral sabre chaetae absent (Figs. 6C–I, 7B–C).

Pygidium not present in fragmented specimens from Korean waters.

Genital pouches absent.

Methyl green staining pattern: No special pattern detected

Remarks. The present materials from Korean waters closely resemble the original description of *Atherospio disticha* Mackie & Duff, 1986 from the west coast of Scotland on the following diagnostic characteristics: (1) double row of aristate spines in anterior chaetigers, (2) the presence

of occipital antenna, (3) the absence of peristomial papillae, (4) branchiae present from chaetiger 7 and fully fused to notopodial lamellae, and (5) bidentate neuropodial hooded hooks with curved shaft. But there is a difference between the Scottish and Korean materials in the distribution of chaetiger with aristate spines: aristate spines on chaetigers 4–5 in Scottish material vs. present on chaetigers 4–6 (only left side neuropodia at chaetiger 6) (Mackie and Duff, 1986; Blake, 1983, 1996; Blake and Arnofsky, 1999; Meiβner and Bick 2005; Blake and Maciolek, 2018). Probably, the number of chaetigers with aristate spines is variable depending on the specimen sizes.

Another species in this genus, *Atherospio guillei* (Laubier & Ramos, 1974) was referred to this genus due to the characteristics of prostomium, neurochaetae on chaetiger 5, branchiae, unidentate curved hooks, and pygidium by Meiβner and Bick (2005). *Atherospio* species collected in Korean waters is easily distinguished from this species by the presence of aristate spines on chaetigers 4–5 instead of only chaetiger 5, the absence of peristomial papillae, and the presence of occipital antenna (Laubier and Ramos, 1974; Mackie and Duff, 1986; Meiβner and Bick 2005; Blake and Maciolek, 2018).

Habitat. Shallow (27 m) muddy habitat in a Scottish sea loch (Mackie and Duff, 1986). In this study, the Korean materials were collected from muddy sand in subtidal zone at 46m depth.

Distribution. Scotland (type locality), Korea.

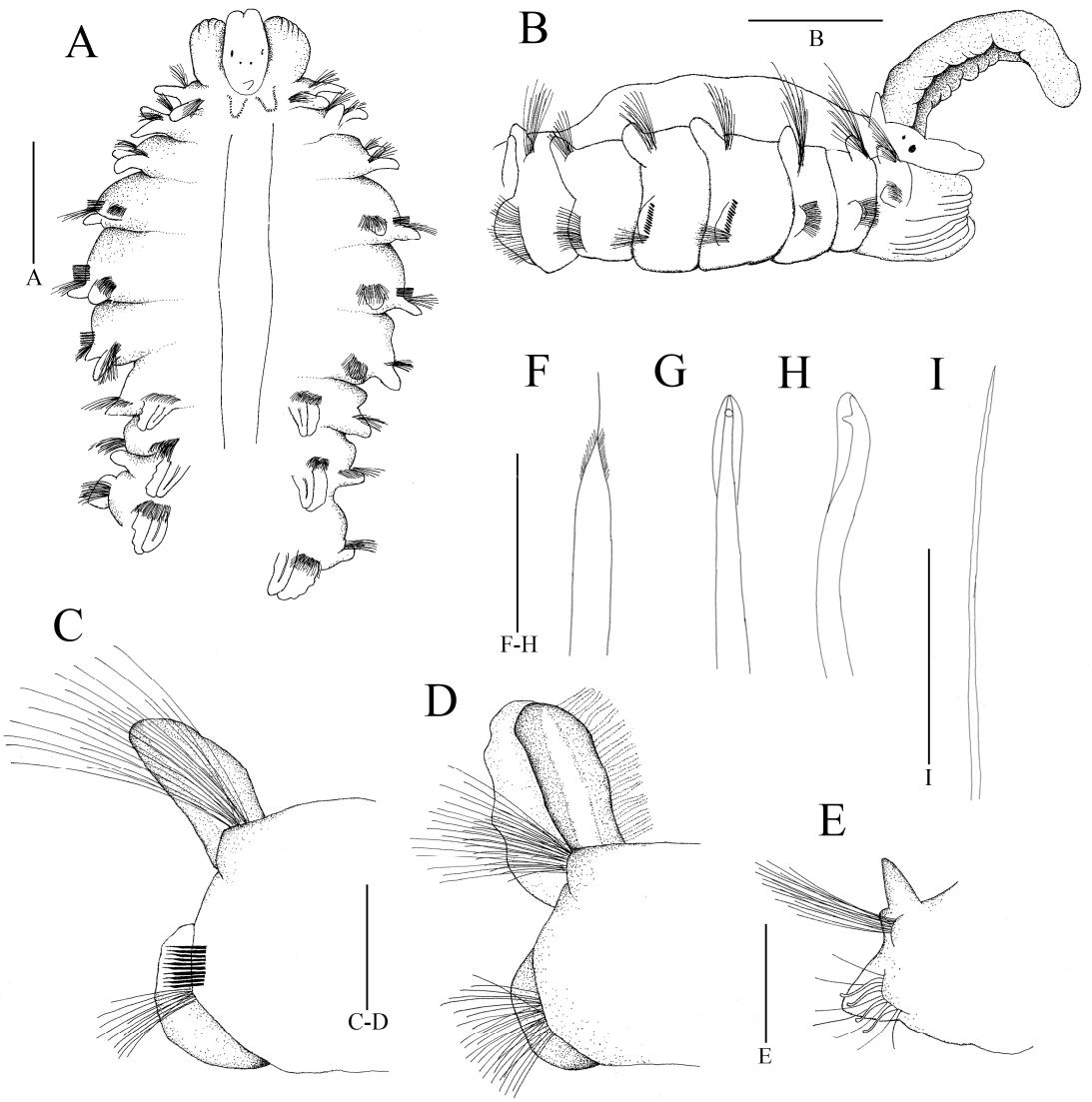

Fig. 6. *Atherospio* cf. *disticha* Mackie & Duff, 1986. A, Anterior end with nine chaetigers, dorsal view; B, Anterior end with seven chaetigers, lateral view; C, Anterior view of chaetiger 4; D, Anterior view of chaetiger 7; E, Anterior view of posterior chaetiger; F, Aristate spine from chaetiger 5; G, Front view of neuropodial hooded hook; H, Lateral view of neuropodial hooded hook; I, Capillary chaeta. Scale bars: A–B=0.5 mm, C–E=0.3 mm, F–H=0.05 mm, I=0.2 mm.

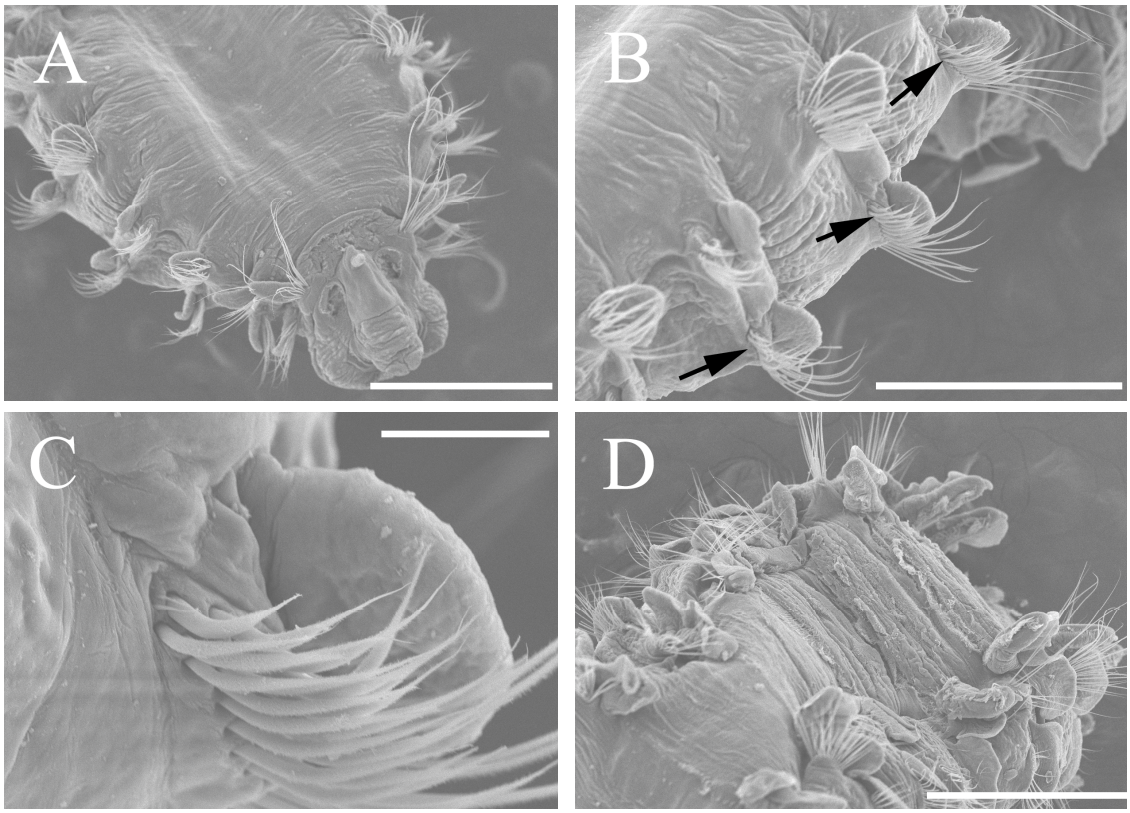

Fig. 7. Scanning electron microscopy photographs of *Atherospio* cf. *disticha* Mackie & Duff, 1986. A, Anterior end, dorsal view; B, Front view of chaetigers 4–6 with aristate chaetae in neuropodia; C, Aristate chaetae in neuropodia of chaetiger 5; D, Branchiae. Scale bars: A–B=0.5 mm, C=0.05 mm, D=0.4 mm.

3. *Atherospio* sp. nov.

Type materials. Type locality: South Korea, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°25'13"E, 34°53'03"N), 20 Sep 2017, collected from mud flats, intertidal. **Holotype:** imcomplete specimen. **Paratype:** one incomplete specimen on stub for SEM observation. **Non-type materials:** one specimen, collection details same as type materials.

Description. Holotype: incomplete specimen up to 3 mm long and 0.2 mm wide for 18 chaetigers. Body expanded and dorsoventrally flattened for first 6–7 chaetigers with widest segments three times wider than long, then body narrowing, becoming cylindrical in cross-section; middle of body segments about as wide as long. Colour of alcohol fixed specimens light tan, without any pigmentation (Figs. 8A–B, 7A).

Prostomium short, expanded, incised on anterior margin and curved downward anteriorly, not extending over it as a caruncle; digitiform, short occipital antenna arising from posterior margin. Two pairs of reddish black eyespots arranged trapezoidally, comprising one pair of median eyes and one pair of lateral crescent eyes situated anteriorly and set wider apart. Nuchal organs not observed. Palps arising lateral to prostomium; each palp relatively short, cylindrical, with shallow ventral groove. Peristomium inflated, fused to chaetiger 1 ventrally; papillae absent (Figs. 8A–B, 9A).

Chaetigers 1–6 with well-developed noto- and neuropodial postsetal lamellae; notopodial lamellae foliate and folded; neuropodial lamellae initially short, triangular, becoming more rounded and elliptical; from chaetiger 7, notopodia fully fused with branchiae; podial lobes of post-branchial chaetigers triangular, broad. Neuropodial lamellae elliptical, rounded through branchial region, then becoming triangular and tapering to narrow tip (Figs. 8A–C, 9A, 9C).

Branchiae present on chaetigers 7–18, broad, flattened, with lateral undulating membrane fully fused with notopodial lamellae. Transverse ciliary bands extending across dorsum between branchiae (Figs. 8A–C, 9C).

All chaetigers with capillaries and postchaetal lamellae in both rami. Aristate spines present on neuropodia of chaetiger 5 only; aristate spines with fringed tip of bristles and terminate in a thin mucron, arranged in double row. Neuropodial hooded hooks present from chaetiger 18, number up to four per neuropodium; each neuropodial hook with a curved narrow tip; most hooks with a low rounded subapical knob or protuberance on convex side of shaft. Hooks accompanied by very fine capillaries. Ventral sabre chaetae absent (Figs. 8D–E, 9B, 9D).

Pygidium not present in fragmented specimens from Korean waters.

Genital pouches absent.

Methyl green staining pattern: No special pattern detected

Remarks. The genus *Atherospio* Mackie & Duff, 1986 is closely related to the genus *Pygospiopsis* Blake, 1983 in having an incised prostomium, large and broad branchiae from chaetiger 7 that are fused to some degree with the notopodial lamellae, and neuropodial hooks with a secondary tooth on the concave side of the shaft (not surmounting the main fang on the convex side). But species of *Atherospio* can be distinguished from those of *Pygospiopsis* by branchiae present from chaetiger 7 vs. present anterior to chaetiger 7 in various branchial patterns in *Pygospiopsis* (Mackie and Duff, 1986; Blake, 1983, 1996; Blake and Arnofsky, 1999; Meiβner and Bick 2005; Blake and Maciolek, 2018).

Atherospio sp. nov. can be distinguished from other two *Atherospio* species, *Atherospio disticha* Mackie & Duff, 1986 from Scotland and *Atherospio guillei* (Laubier & Ramos, 1974) from the Mediterranean Sea, by the number of chaetiger with modified spines and the morphological features of modified spines: aristate spines only present on chaetiger 5 in new species vs. present on chaetigers 4–5 in *A. disticha*, and vs. heavy and thin spines on chaetiger 5 in *A. guillei* (Laubier and Ramos, 1974; Mackie and Duff, 1986; Meiβner and Bick 2005; Blake and Maciolek, 2018).

Habitat. In this study, new species collected from intertidal zone of muddy sand habitat.

Distribution. Samhwa-ri, Yongnam-myeon, Tongyeong-si, Gyeongsangnam-do, Korea.

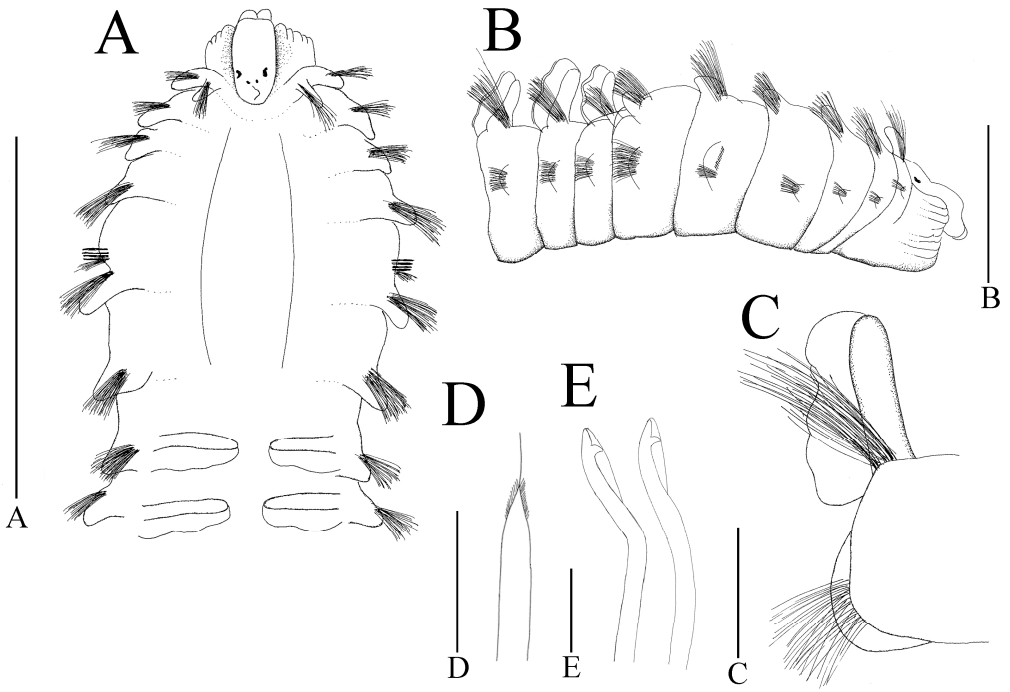

Fig. 8. *Atherospio* sp. nov., holotype. A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with nine chaetigers, lateral view; C, Anterior view of chaetiger 7; D, Aristate spine from chaetiger 5; E, Neuropodial hooded hooks. Scale bars: A=1.0 mm, B=0.5 mm, C=0.3 mm, D–E=0.03 mm.

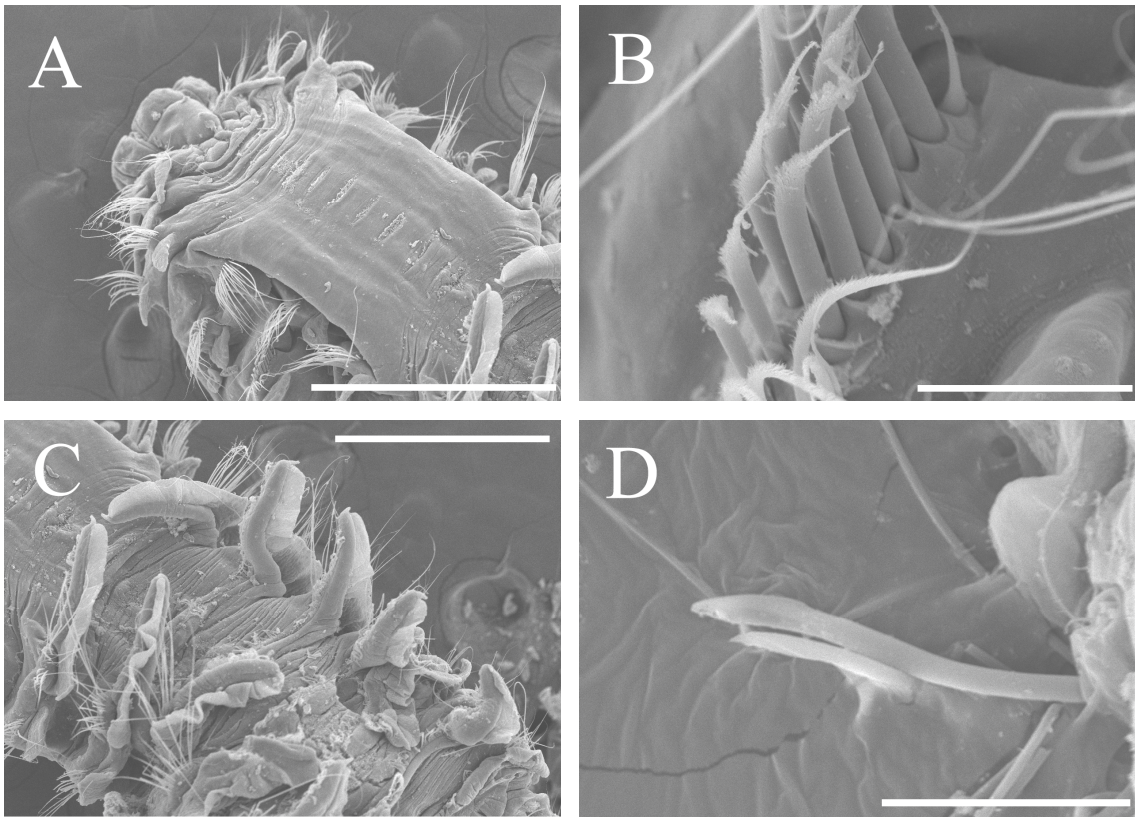

Fig. 9. Scanning electron microscopy photographs of *Atherospio* sp. nov., paratype. A, Anterior end, dorsal view; B, Aristate chaetae in neuropodia of chaetiger 5; C. Branchiae; D, Hooded hook in neuropodium. Scale bars: A=0.5 mm, B=0.04 mm, C=0.4 mm, D=0.04 mm.

Table 2. Taxonomic characteristics of *Atherospio* species.

Species	Prostomium	Occipital antenna	Nuchal organs	Peristomial Papillae	Branchiae	Anterior neurochaetae	Neuropodial hooks	Distribution	References
***A. disticha* Mackie & Duff, 1986**	Bilobed, sometimes downward anteriorly	Short	Present	Absent	7–12: broad, fully fused to dorsal lamellae	Chaetigers 4–5 with double row of aristate spines	Bidentate hooks with narrow, curved shaft	West coast of Scotland, 27 m	Mackie and Duff 1986
***A.* cf. *disticha* from Korean waters**	Bilobed anteriorly	Short	Present	Absent	7–15: broad, fully fused to dorsal lamellae	Chaetigers 4–6 with double row of aristate spines (only left neuropodia on chaetiger 6)	Bidentate hooks with narrow, curved shaft	Kroean, 46m	Present study
***A. guillei* (Laubier & Ramos, 1974)**	Bilobed anteriorly	Absent	Present	Present	7–13: long, thick, fully fused to dorsal lamellae	Chaetiger 5 with 2–3 heavy spines and 3 thin spines	Unidentate and bidentate with curved shaft; hood absent	North Sea, 38–41 m; Mediterrean Sea, 44–99 m	Laubier and Ramos 1974; Meiβner and Bick 2005
***Atherospio* sp. nov. from Korean waters**	Bilobed and curved downward anteriorly	Short	Not observed	Absent	7- 18: broad, fully fused to dorsal lamellae	Only chaetiger 5 with double row of aristate spines	Bidentate hooks with narrow, curved shaft	Korea, intertidal zone	Present study

Genus *Boccardia* Carazzi, 1893 유령얼굴갯지렁이속

Boccardia Haswell, 1885; Blake and Kudenov, 1978: 235–236; Delgado-Blas, 2008: 4.

Type species: *Boccardia polybranchia* (Haswell, 1885), by monotypy.

Diagnosis: Prostomium rounded or incised anteriorly, extending posteriorly as caruncle. Branchiae present from chaetigers 2–4 and posteriorly from chaetiger 6, throughout most of body length. Notochaetae on chaetiger 1 present or absent. Chaetiger 5 with two types of heavy spines; simple and falcate spines, and brush-topped spines. Neuropodial hooded hooks from chaetigers 7–8.

Key to the species of *Boccardia* Carazzi, 1893 from Korean waters.

1. Prostomium rounded anteriorly; notochaetae of chaetiger 1 present……...…....*B. proboscidea*
 - Prostomium incised anteriorly; notochaetae of chaetiger 1 absent.…….…….*B. polybranchia*

4. *Boccardia polybranchia* (Haswell, 1885) 털유령얼굴갯지렁이

Polydora (*Leucodore*) *polybranchia* Haswell, 1885.

Polydora polybranchia: Söderström, 1920: 256, fig. 167.

Polydora (*Boccardia*) *polybranchia*: Fauvel, 1927: 58–59; Okuda, 1937.

Boccardia polybranchia: Imajima and Hartman, 1964: 279; Day, 1967: 463–464; Blake and Kudenov, 1978: 236–238; Blake, 1983: 248; Simon *et al*., 2010: 585–598.

Material examined. One specimen, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26′8″E, 34°53′18″N), 20 Oct 2017.

Diagnosis. Prostomium anteriorly bifid slighly, extending posteriorly to end of chaetiger 2 as a caruncle. Black eyes as paired, arranged trapezoidally. Branchiae present from chaetiger 6, throughout most of body length; about 10 branchiae broad, short, and succeeding branchiae cirriform, longer than anterior ones. Chaetiger 1 reduced, without notochaetae. Chaetiger 5 modified, larger than neighboring chaetigers with two types of spines; simples and falcate spines and brush-topped spines. Neuropodial hooded hooks from chaetiger 7, accompanied by capillaries. Special notochaetae in posterior chaetigers absent.

Habitat. In this study, Korean material was collected from muddy sand intertidal.

Distribution. Australia (type locality), Argentina, Biarritz, Brazil, Chile, China, English Channel, France, Gulf of Naples, Iberian Peninsula, Japan, Korea, Peru, South Africa, South America, Sraits of Magellan, Tierra del Fuego.

Genus *Boccardiella* Blake & Kudenov, 1978

Boccardiella Blake & Kudenov, 1978: 264–265.

Type species: *Boccardiella hamata* (Webster, 1879), by monotypy.

Diagnosis: Prostomium rounded or incised anteriorly, extending posteriorly as caruncle. Chaetiger 1 without notochaetae. Branchiae present from chaetigers 2–4 and posteriorly from chaetiger 6, throughout most of body length. Chaetiger 5 modified with one type of heavy spine with companion chaetae. Bidentate hooded hooks from chaetiger 7 without constriction on shaft.

5. *Boccardiella hamata* (Webster, 1879) 유령얼굴갯지렁이

Polydora hamata Webster, 1879: 251.

Polydora (*Boccardia*) *uncata*: Okuda, 1937: 238, figs. 16–17.

Polydora uncata: Imajima and Hartman, 1964: 281; Paik, 1982: 805, pl. 20b; 1989: 455, fig. 166.

Boccardiella hamata: Blake and Kudenov, 1978: 264; Sato-Okoshi, 2000: 446–447; Zhou *et al*., 2010: 1–15, fig. 1G–Q; Kerchhof and Faasse, 2014: 1–9, figs. 7–8.

Material examined. One specimen, Jeollanam-do: Yeosu-si, Samsan-myeon, Dongdo-ri (127°21'28"E, 34°02'28"N), 29 Jun 2017.

Diagnosis. Prostomium anteriorly bifid slighly, extending posteriorly to end of chaetiger 3 as a low caruncle. Black eyes as paired, arranged trapezoidally. Branchiae present on chaetiger 2, 3, and 6, throughout most of body length. Notochaetae of chaetiger 1 absent. Chaetiger 5 modified, larger than neighboring chaetigers with simple and falcate spines. Neuropodial hooded hooks bidentate, from chaetiger 7, accompanied by capillaries. Special recurved hooks besides capillaries

in posterior chaetigers present.

Habitat. In this study, Korean material was collected from muddy sand intertidal.

Distribution. USA (type locality), Australia, Japan, Korea, North Sea, Pacific.

Genus *Dipolydora* Verrill, 1881

Dipolydora Verrill, 1881; 320; Blake, 1996: 181; Radashevsky, 2015: 643.

Type species: *Polydora concharum* Verrill, 1879, designated by Verrill (1881).

Diagnosis: Prostomium rounded or incised anteriorly. Eyes present or absent. Chaetiger 1 with notochaetae. Chaetiger 5 modified with one type of heavy spines with or without companion chaetae. Neuropodial hooded hooks bidentate from chaetigers 7–17, with recurved shaft, without constriction. Pygidium disclike, cuff-shaped, with 2, 3, or 4 lobes of various forms, or with 4 or more small papillae. Anterior part of digestive tract sometimes with enlarged, thick gizzard-like structure.

Key to the species of *Dipolydora* Verrill, 1881, from Korean waters

1. Branchiae from chaetiger 6; Neuropodial hooded hooks from chaetigers 12–17....*D.commensalis*
 - Branchiae from chaetigers 7–10; Neuropodial hooded hooks from chaetiger 7……...…….2
2. Posterior notopodial needle-like spines present……..…….....*D. bidentata*
 - Posterior notopodial with long capillaries, spines absent……....……..…3
3. Caruncle extending beyond chaetiger 5 in adult specimens……...….……...4
 - Caruncle not extending beyond chaetiger 5……...……..…...……..….....6
4. Without dorsal black pigments in adult specimens; bores into calcareous substrate (boring species) ……..……..……...……..*D. carunculata*
 - With dorsal pigments; not bores into calcareous substrate (non-boring species)……..*D. socialis*
5. Pygidium with three lobes or three lobes continuous…….…….……6
 - Pygidium with four lobes……...…….…...7
6. Branchiae from chaetigers 8–9; pygidium with three lobes……..……...….*D. trilobata*
 - Branchiae from chaetigers 9–10; pygidium with three lobes, occasionally three lobes continuous and obscure……..……...……*D. giardi*

7. Caruncle extending to chaetiger 3; branchiae from chaetigers 9–10…….....….*D. alborectalis*

- Caruncle extending to middle to end of chaetiger 4; branchiae from 8……*D. concharum*

6. *Dipolydora socialis* (Schmarda, 1861)

Leucodore socialis Schmarda, 1861: 64–65, fig. 209a–c.

Polydora socialis: Hartman, 1961: 147–148, figs. 1–2; Blake, 1971: 20–23, figs. 13–14; Blake and Kudenov, 1978: 248–250, fig. 38d–e; Sato-Okoshi and Okoshi, 1997: 486.

Dipolydora socialis: Blake, 1996: 189–192, fig. 4.34; Sato-Okoshi, 2000: 446; Sato-Okoshi and Takatsuka, 2001: 494–495.

Material examined. Three specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Unsan-ri (126°30′37″E, 35°39′54″N), 14 Jun 2018.

Description. Anterior fragments for 40 chaetigers, up to 12 mm long, 1.0 mm wide. Transverse black bands or irregular spots present on dorsal side at anterior margin of chaetigers. Pigmentations on palps and ventral side absent.

Prostomium incised anteriorly, extending posteriorly to middle of chaetiger 8 as a low caruncle; black scarce pigments present behind eyes. One pair of black eyes present. Occipital antenna absent. Peristomium fused to chaetiger 1 ventrally. Nuchal organs continuing posteriorly as two ciliated strips on lateral sides of caruncle (Figs. 10A–B, 11A).

Chaetiger 1 with capillaries and well develop postchaetal lamellae in both rami. Winged notopodial capillaries gradually becoming longer, thinner and less numerous along midbody chaetigers. Modified spines in posterior chaetigers absent (Figs. 10A–B, 11A).

Chaetiger 5 greatly larger than chaetiger 4 or 6, with 8–10 dorsal superior winged capillaries, 7–8 heavy falcate spines, and 12–15 ventral winged capillaries. Falcate spines simple, without

lateral teeth or flange, arranged in oblique semicircular row alternating with pennoned companion chaetae. Hooks in neuropodia from chaetiger 7, up to seven in a series, accompanied by 1–5 inferior capillaries until chaetiger 18. Hooks bidentate, shaft slightly curved, without constriction (Fig. 10C–E).

Branchiae from chaetiger 8, flattened, with the surfaces oriented paralled to body axis, separated from notopodial postchaetal lamellae (Figs. 10A–B, 11A).

Pygidium not present in fragmented specimens from Korean waters.

Gizzerd-like structure present between oesophagus and intestine in chaetigers 31–34, consisting of anterior transparent muscular part and shorter posterior opaque secretory part white colour.

Methyl green staining pattern: Anterior part of prostomium, peristomium, neuropodial postchaetal lamellae most intensively stained; some deep blue spots scattered on posterior part of peristomium ventrally. Dots scattered on meddle regions of chaetigers 1–5 and bands of scattered dots on borders of chaetigers 6–22 intensively stained ventrally; scattered dots on borders of chaetigers 6–25 laterally (Fig. 11A–B).

Remarks. *Dipolydora socialis* was originally described from the eastern Pacific (Chile) and reported as the widespread species in boreal and temperate seas (Schmarda, 1861; Blake, 1971, 1996). The specimens in the present study agree well with the previous descriptions of *D. socialis* from North America (Blake, 1971, 1996; Sato-Okoshi and Okoshi, 1997), Australia (Blake and Kudenov, 1978), and Japan (Sato-Okoshi, 2000) on the following diagnostic characteristics: (1) curuncle extending beyond chaetiger 5, (2) the presence of black pigments on dorsal side, and (3) non-boring individuals (living in muddy sand habitat).

Dipolydora socialis closely resemble two species, *D. carunculata* and *D. malanopalpa*, in having bifid prostomium, caruncle extending beyond chaetiger 5, branchiae from chaetiger 8, and gizzard-like structure. However, *D. socialis* is distinguished from these two species by the presence of black pigment on the dorsal side (present in *D. socialis* vs. absent on adult specimens

in *D. carunculata*), the specific pigmentation (absent in *D. socialis* vs. present in *D. carunculata*), and habitat (crevices of calcareous substrata or mud flats (non-boring species) in *D. socialis* vs. calcareous substrata (boring species) in *D. carunculata* (Radashevsky, 1993; Blake, 1996; Sato-Okoshi, 2000; Sato-Okoshi and Takatsuka, 2001; Manchenko and Radashevsky, 2002). Blake (1971) reported *D. socialis* sometimes as a boring species living in calcareous substrate in North American waters. But Sato-Okoshi (2000) reported *D. socialis* from Japnaese waters as non-boring species living on crevices of shells or rocks, and muddy habitats. Thus, we presumed *D. socialis* from East Asia as non-boring species rather than boring.

Habitat. Mud in crevices of shells and mud flats (Sato-Okoshi, 2000), crevices of rocks (Blake, 1996). In Korean waters, our materials were collected from muddy sand flats intertidal zone.

Distribution. Chile (type locality), Australia, Faulkland Islands, Gulf of Mexico, Japan, Korea, North America.

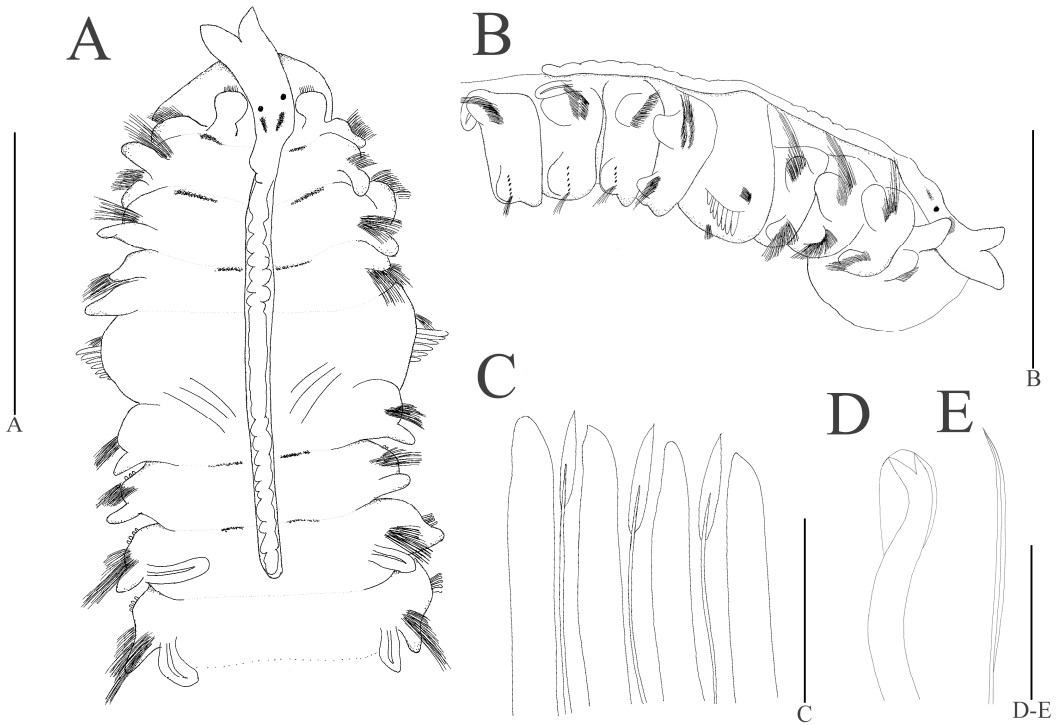

Fig. 10. *Dipolydora socialis* (Schmarda, 1861). A, Anterior end with nine chaetigers, dorsal view; B, Anterior end with nine chaetigers, lateral view; C, heavy spines with companion chaetae; D, Neuropodial hooded hook of chaetiger 7; E, Ventral inferior capillary chaeta of chaetiger 7. Scale bars: A–B=1.0 mm, C=0.05 mm, D–E=0.03 mm.

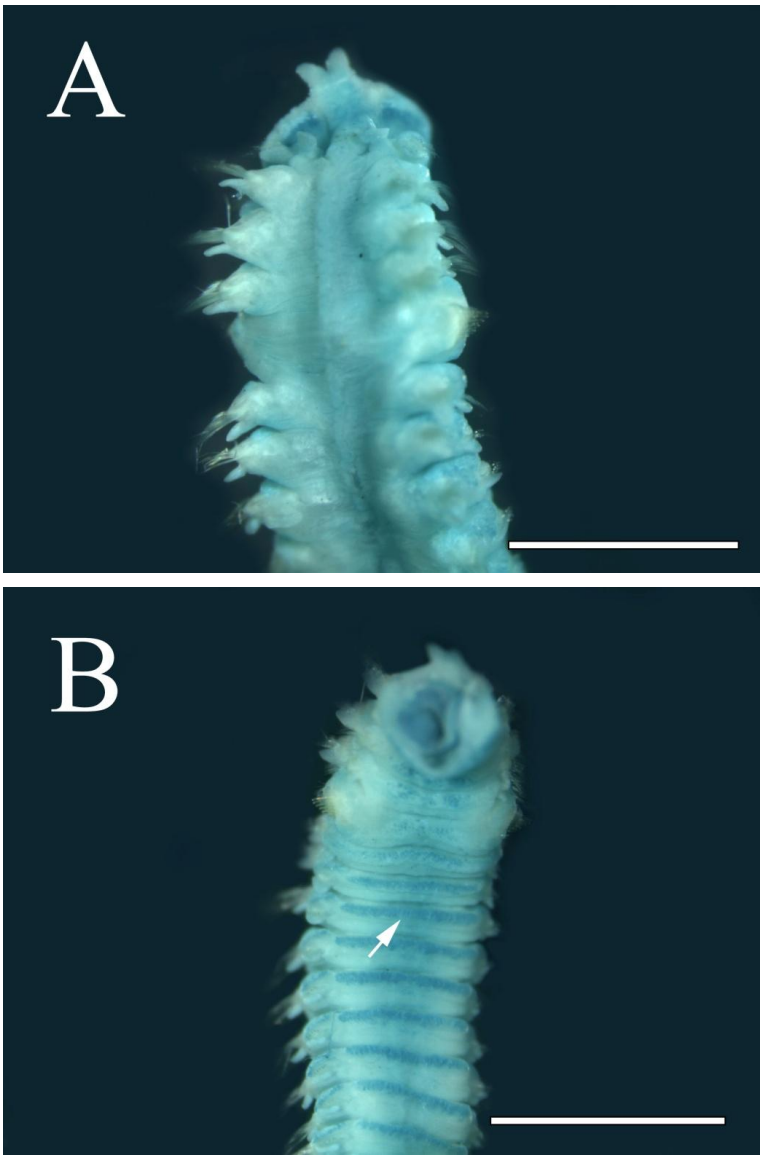

Fig. 11. *Dipolydora socialis* (Schmarda, 1861) stained with methyl green. A. Anterior end, dorsal view, showing scattered dots on anterior part of prostomium and peristomium; B. Anterior end, ventral view, showing bands of scattered dots (arrow). Scale bars: A–B=1.0 mm.

Genus *Laonice* Malmgren, 1867 납작얼굴갯지렁이속

Laonice Malmgren, 1867: 200; Söderström 1920: 220; Foster 1971: 69; Blake and Kudenov 1978: 204–205; Maciolek 2000: 533–536; Sikorski 2003: 317; Sikorski, *et al*., 2017: 962; Sikorski and Pavlova, 2018: 172.

Spionides Webster & Benedict, 1887: 735. Fide Söderström 1920: 227.

Aricideopsis Johnson, 1901: 413. Fide Hartman 1959: 377.

Type species: *Nerine cirrata* M. Sars, 1851 (by monotypy).

Diagnosis: Prostomium anteriorly rounded or slightly concave, T-shaped or sometimes skittle-shaped, often fused with peristomium by antero-lateral corners. Branchiae from chaetiger 2, present on a number of anterior chaetigers. Occipital antenna present or absent. Caruncle often well pronounced and long, often accompanied by nuchal organ on dorsal surface extending along several anterior chaetigers. Nuchal organs present along several anterior chaetigers. Hooded hooks with primary hood only, absent in notopodia. Genital pouches present on a varying number of chaetigers and appear as folds between the neuropodia of neighbouring segments.

Key to the species of the genus *Laonice* from Korean waters

1. Prostomium fused to peristomium only at antero-lateral corners; low transdorsal membrances present on posterior chaetigers……...…….....……...*L. japonica*

- Prostomium fully fused to peristomium; transdorsal membrances absent……..… *L. cirrata*

7. *Laonice japonica* (Moore, 1907)

Spionides japonicas Moore, 1907: 204–206, pl. 16, figs. 1–33.

Laonice japonica: Banse and Hobson, 1968: 25.

Material examined. Korea: 27 specimens, Jeju-do: Seogwipo-si, Seogwi-dong (126°33'08"E, 33°13'50"N), 18 Jul 2018. All specimens incomplete collected from subtidal zones at 46m depth.

Description. Incomplete specimens up to 15.0 mm long and 1.5 mm wide. Colour of alcohol fixed specimens whitish-brownish without any pigmentation.

Prostomium blunt, anteriorly rounded, entire or very slightly indented, without frontal or lateral horns. Caruncle extending to chaetiger 1. One pair of large reddish-brown eyes, bar or crescent shape. Nuchal organ extending to chaetigers 15–16. Finger-like occipital antenna present on posterior part of prostomium, behind eyes. Peristomium obviously fused to prostomium only antero-lateral corners (Fig. 12A–B).

Notopodial postchaetal lobes well developed leaf-like from chaetiger 1, becoming more rounded and gradually reduced to small rounded lobes. Neuropodial postchaetal lobes leaf-like from chaetiger 1, becoming gradually ventrally rounded and reduced in size on posterior chaetigers. Branchiae present from chaetiger 2 on about half of the following chaetigers. Branchiae separated from notopodial lamellae throughout; first branchiae slightly shorter than notopodial lamellae, longer than notopodial lamellae on succeeding chaetigers; longest on chaetigers 5–10, becoming shorter after chaetiger 25, disappeared in middle part of body. Low transversal dorsal membranes connecting the notopodial postchaetal lobes present from chaetigers 35–37. Genital pouches from chaetiger 4 to almost chaetigers (Figs. 12C, 13E–G, 14A).

All capillaries in two rows. Hooks in neuropodia from chaetiger 35, up to nine in a series, with accompanied capillaries. Hooks bidetate with one small apical tooth above the main fang. Ventral sabre chaetae from chaetigers 17–23, one per neuropodium in inferior position (Figs.13E–K, 14B).

Pygidium with papillae (Fig.13D).

Methyl green staining pattern: No special pattern detected. Anterior part of prostomium, peristiomium, and nuchal organs intensively stained. Postchaetal lamellae and branchiae on anterior and middle chaetigers intensively stained. Stained dots scattered on anterior and middle chaetigers ventrally.

Remarks. The specimens examined in the present study agree well with the original description of *Laonice japonica* (Moore, 1907) based on the following diagnostic characteristics: (1) having a prostomium fused to peristomium only at antero-lateral corners, (2) genital pouches present from chaetiger 4 invariably, (3) nuchal organ extending to chaetigers 15–16, (4) the presence of low transversal dorsal membranes on the posterior chaetigers, and (5) having two vertical rows of capillaries on the entire chaetigers (Moore, 1907; Banse and Hobson, 1968; Sikorski and Pavlova, 2016; Sikorski *et al*., 2017). However, the Korean materials of *L. japonica* have some minor differences from the Japanese materials in the first appearance of sabre chaetae and the number of sabre chaetae per neuropodium: sabre chaetae present on chaetigers 17–23 instead of 11, and sabre chaetae present only one per neuropodium instead of two (Moore, 1907; Banse and Hobson, 1968; Radashevsky and Lana, 2009; Sikorski and Pavlova, 2016; Sikorski *et al*., 2017).

Distribution of genital pouches, fusion degree of prostomium and peristomium, and the presence of transdorsal membrances are the significant characteristics to define *Laonice* species (Radashevsky and Lana, 2009; Sikorski and Pavlova, 2016, 2018; Sikorski *et al*., 2017). *Laonice japonica* closely resembles *L.* (*Norgensia*) *rasmusseni* Sikorski & Pavlova, 2018 from North America in having genital pouches present from chaetiger 4, nuchal organ extending to chaetigers 15–16, and low transversal dorsal membranes. But *L. japonica* is distinguished from North American species in having a prostomium fused to peristomium at antero-lateral corners, two rows of capillaries, and one pair of eyespots (vs. prostomium un-fused, three rows of capillaries in the anterior chaetigers, and two pairs of eyespots in *L.* (*N.*) *rasmusseni*) (Moore, 1907; Banse and Hobson, 1968; Sikorski and Pavlova, 2016; Sikorski *et al*., 2017). Also, *L. japonica* closely resemble a wide distributed species, *Laonice antarcticae* Hartman, 1953, in having genital pouches

present from chaetiger 4 and un-fused prostomium, but differs in the presence of transdorsal membrances and having branchiae as long as notopodial lamellae (vs. the absence of transdorsal membrances and very short branchiae not exceeding notopodial lamellae in *L. antarcticae*) (Moore, 1907; Banse and Hobson, 1968; Blake, 1983; Maciolek, 2000; Radashevsky and Lana, 2009; Sikorski and Pavlova, 2016, 2018; Sikorski *et al*., 2017).

In Korean waters, only one wide distributed species, *Laonice cirrata* (M. Sars, 1851), was reported and *L. japonica* can be easily distinguished from this species in having a prostomium fused to peristomium only at antero-lateral corners instead of fully fused to peristomium, and the presence of low transdorsal membrances on the posterior chaetigers (Moore, 1907; Banse and Hobson, 1968; Paik, 1982, 1989; Sikorski and Pavlova, 2016, 2018; Sikorski *et al*., 2017).

Habitat. Japanese materials were collected from the bottoms of green muddy sand to 61 fathoms (about 110m) depth. In this study, the Korean materials were collected from muddy sand in subtidal zone (about 46m depth).

Distribution. Japan (type locality), Korea.

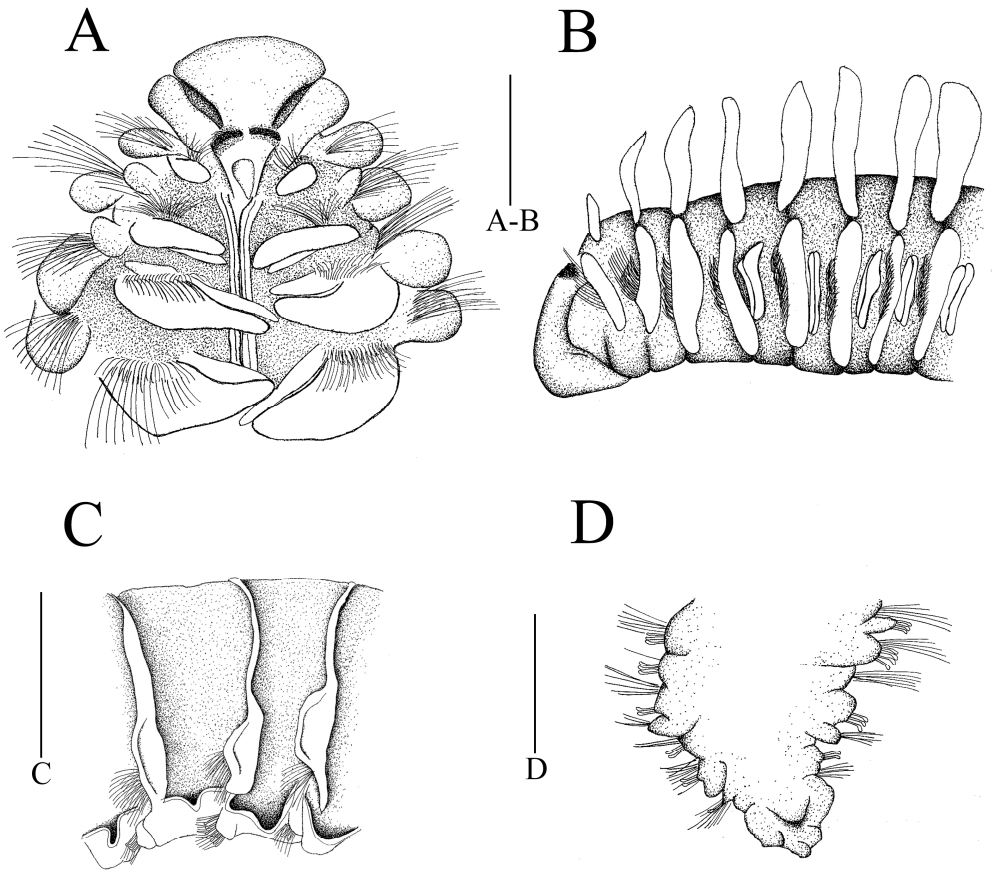

Fig. 12. *Laonice japonica* (Moore, 1907). A, Anterior end with four chaetigers, dorsal view; B, Anterior end with eight chaetigers without notochaetae and branchiae, lateral view; C, Transdorsal membranes on chaetigers 41–43; D, Posterior end. Scale bars: A–D=0.5 mm.

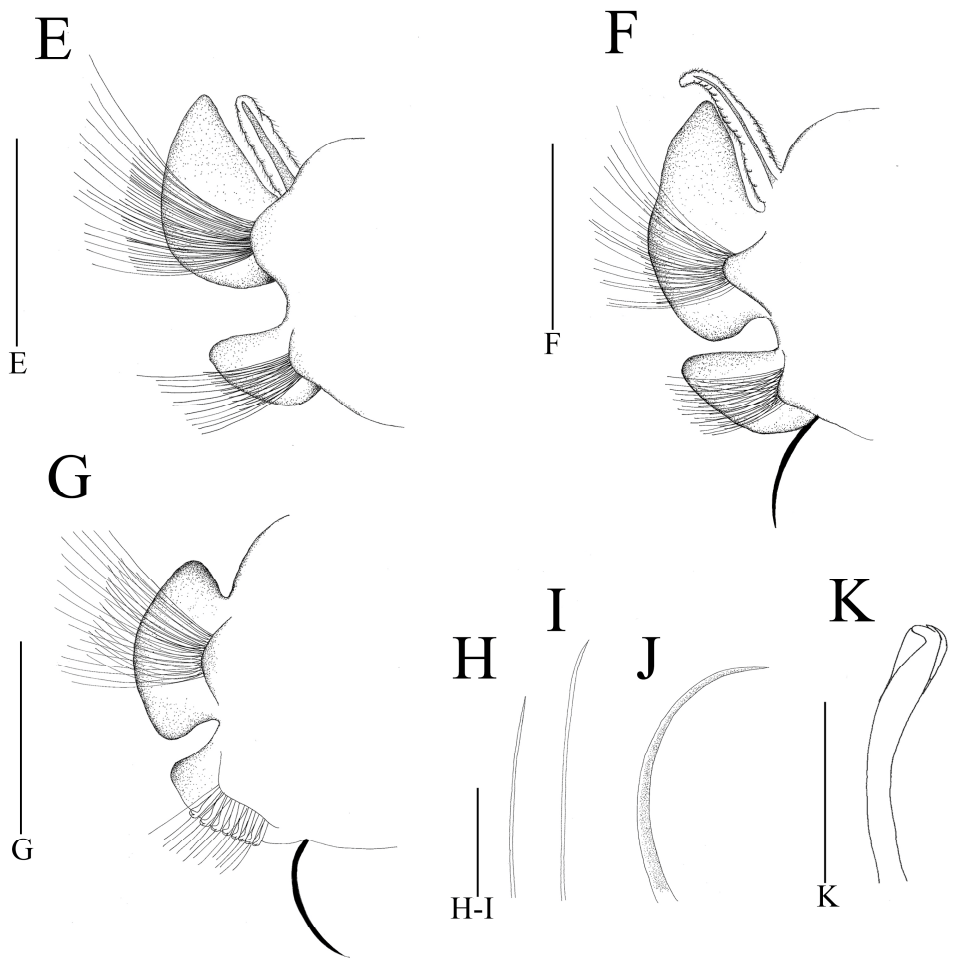

Fig. 13. *Laonice japonica* (Moore, 1907). E, Anterior view of chaetiger 2; F, Anterior view of chaetiger 25; G, Anterior view of chaetiger 28; H, Notopodial chaeta of anterior row; I, Notopodial chaeta of posterior row; J, Ventral sabre chaeta; K, Neuropodial hooded hook, lateral view. Scale bars: E–G=0.6 mm, H–J=0.2 mm, K=0.1 mm.

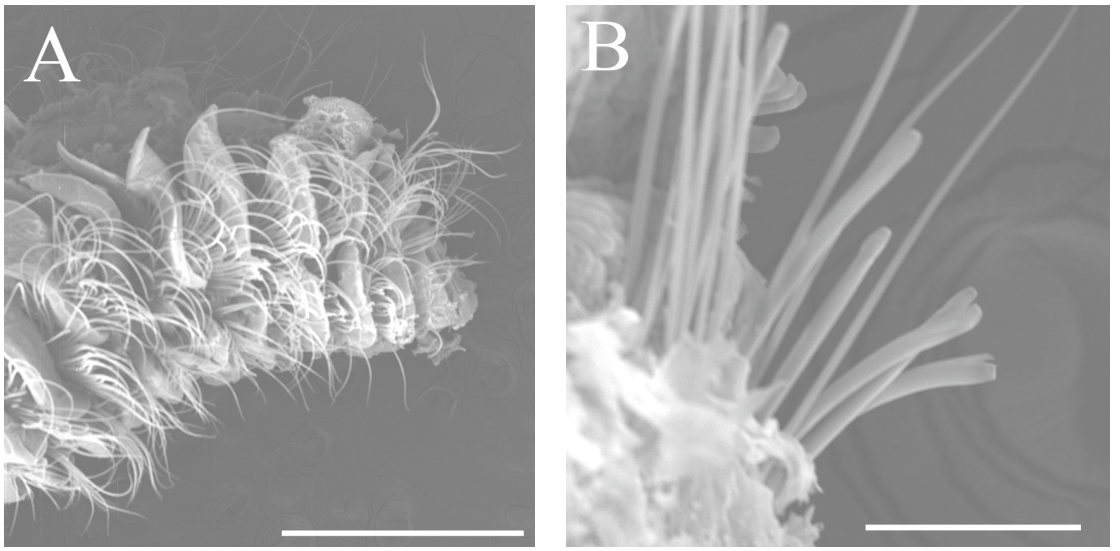

Fig. 14. Scanning electron microscopy photographs of *Laonice japonica* (Moore, 1907). A, Anterior end, lateral view; B, Capillaries and neuropodial hooded hooks. Scale bars: A=1.0 mm, B=0.1 mm.

Genus *Malacoceros* Quatrefages, 1843

Malacoceros Quatrefages, 1843; Fauchald, 1977: 24; Blake and Kudenov, 1978: 195; Imajima, 1991: 5; Blake, 1996: 105; Hourdez *et al*., 2006: 594; Delgado-Blas and Díaz-Díaz, 2013: 182–183.

Type species: *Spio vulgaris* Johnston 1827, designated by Pettibone 1963.

Diagnosis: Prostomium broad anteriorly, T-shaped, triangularshaped, bell-shaped; broadly rounded along anterior margin. Occipital antenna absent. Caruncle entire, trilobed or button-like; small lateral nuchal organs consisting of two small rounded patches of cilia, extending to anterior margin of chaetiger 2. Cirriform branchiae from chaetiger 1 to the end or nearly the end of the body. Hooded hooks uni-, bi-, tri- or quadridentate. Ventral Sabre chaetae present.

8. *Malacoceros reductus* Blake & Kudenov, 1978

Malacoceros reductus Blake & Kudenov, 1978: 197–198, Fig. 13.

Material examined. 50 specimens, Jeollanam-do: Wando-gun, Cheongsan-myeon, Dongchon-ri (127°18'16"E, 34°1'11"N), 27 May 2017; 10 specimens, Jeollanam-do: Wando-gun, Cheongsan-myeon, Ji-ri (126°51'40"E, 34°11'40"N), 22 Aug 2017. All specimens examined incomplete collected from muddy sand of subtidal zones.

Description. All specimens incomplete, up to 20.0 mm long and 2.0 mm wide. Colour of alcohol fixed specimens whitish-brown without any pigmentation.

Prostomium bell-shaped with distinct lateral horns, with medial weak incision anteriorly; prostomium posteriorly extended into low indistinct caruncle which terminates at the end of

chaetiger 1. Two pairs of black eyes arranged trapezoidally, anterior pair crescent-shaped, posterior pair rounded. Occipital antenna absent. Peristomium moderately developed, forming low lateral wings partially encompassing prostomium posteriorly. Nuchal organs not unambiguously discernable. Dorsal crests absent but transverse ciliary bands across dorsum in well-preserved specimens present until posterior chaetigers (Fig.15A).

Chaetiger 1 reduced, with small elongate notopodial lamellae and smaller rounded neuropodial lamellae. Dorsal branchiae present from chaetiger 1 until the end of fragment; elongate, almost fused, distally free from notopodial postchaetal lamellae on anterior chaetigers, and becoming basally fused on posterior chaetigers; first branchiae distinctly shorter than succeeding branchiae; longest branchiae on chaetigers 4–10, after about chaetiger 10 branchiae decreasing in length. Interparapodial lateral pouches absent (Figs.15A–D, 16A).

Parapodia on chaetiger 1 small and positioned slightly more dorsally than on following chaetigers. Notopodial postchaetal lamellae elongate, becoming subtriangluar and shorter on posterior chaetigers; neuropodial postchaetal lamellae rounded on anterior chaetigers, then becoming more flattened on posterior chaetigers (Figs.15A–D, 16A).

Chaetae in anterior and middle chaetigers capillaries with non granulations, arrnaged in two rows. Hooks in neuropodia from chaetiger 30, up to seven in series, without accompanied capillaries. Hooks tidentate with two small blunt teeth above ball-shape main fang. Ventral sabre chaetae from chaetiger 30, up to three in inferior position (Figs.15B–G, 16B).

Pygidium not present in fragmented specimens from Korean waters.

Methyl green staining pattern: Inconspicuous. Anterior part of prostomium, peristomium intensively stained; margins of postchaetal lamellae and branchiae of anterior and middle chaetigers intensively stained.

Remarks. Korean materials of the present study agree well with the original description of the species based on the following diagnostic characteristics: (1) a prostomium with lateral horns (not latero-frontal horns), (2) the presence of caruncle, (3) a peristomium forming lateral wings, (4)

reduction of chaetiger 1 prominently, (5) branchiae almost fused to notopodial lamellae on anterior chaetigers and basally fused on the posterior chaetigers, and (6) hooded hooks blunt tridentate (Blake and Kudenov, 1978; Delgado and Díaz, 2013). However, the Korean materials of *M. reductus* have some minor differences from the Australian materials in the first appearance of hooded hooks and ventral sabre chaetae: hooded hooks and ventral sabre chaetae present from chaetiger 30 in the Korean materials while chaetiger 20 in the Australian materials (Blake and Kudenov, 1978; Delgado and Díaz, 2013).

Two *Malacoceros* species, *M. indicus* (Fauvel, 1928) and *M. samurai* Hourdez *et al*., 2006, have been reported in East Asia, and *M. reductus* is easily distinguished from these two species in having a prostomium with lateral horns, reduction of chaetiger 1, and branchiae almost fused to notopodial lamellae on the anterior chaetigers (Blake and Kudenov, 1978; Imajima, 1991; Hourdez *et al*., 2006; Williams, 2007; Delgado-Blas and Díaz-Díaz, 2013).

Habitat. Burwood Beaches (Blake and Kudenov, 1978). In this study, our materials were collected from subtidal (47m depth).

Distribution. Australia (type locality), Korea.

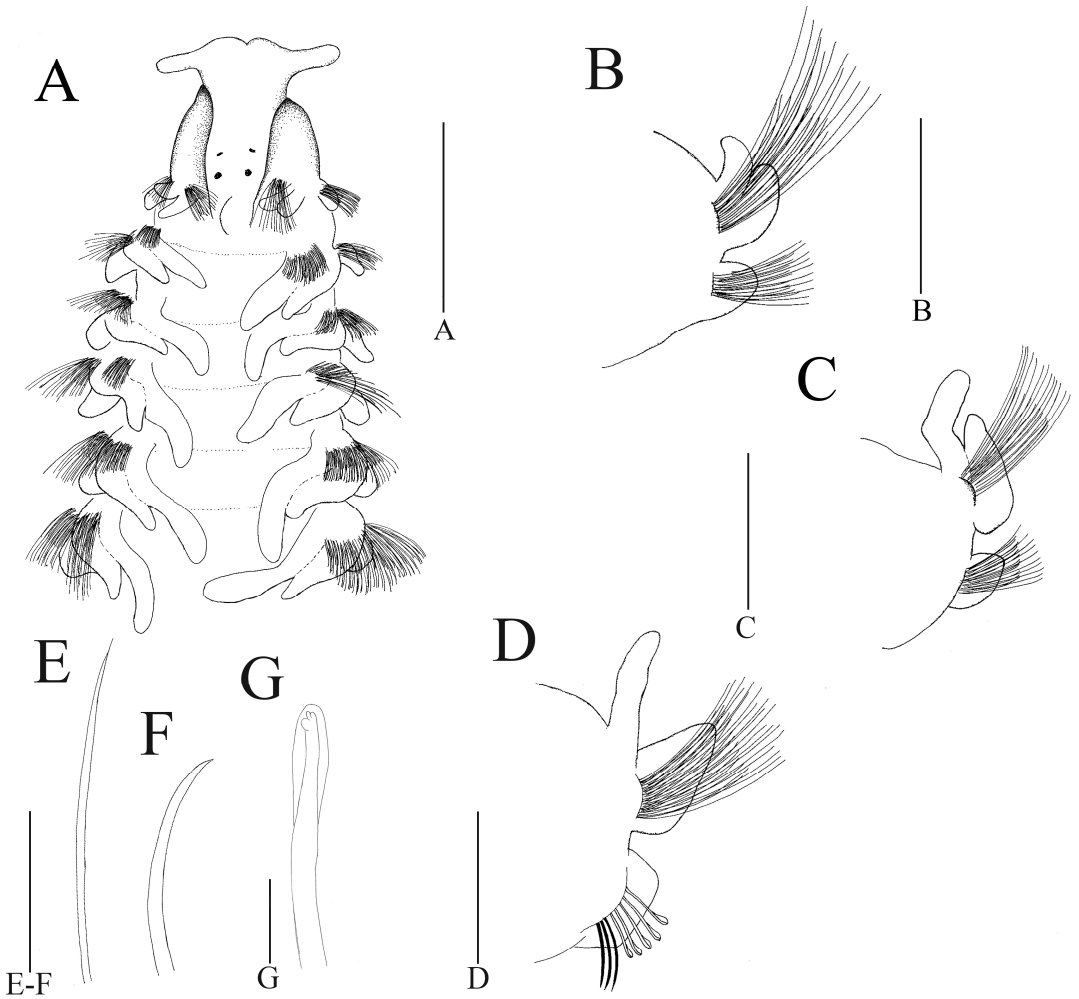

Fig. 15. *Malacoceros reductus* Blake & Kudenov, 1978. A, Anterior end with six chaetigers, dorsal view; B, Anterior view of chaetiger 1; C, Anterior view of chaetiger 2; D, Anterior view of chaetiger 38; E, Capillary chaeta; F, Ventral sabre chaeta; G, Neuropodial hooded hook. Scale bars: A=0.5 mm, B–D=0.3 mm, E–F=0.1 mm, G=0.03 mm.

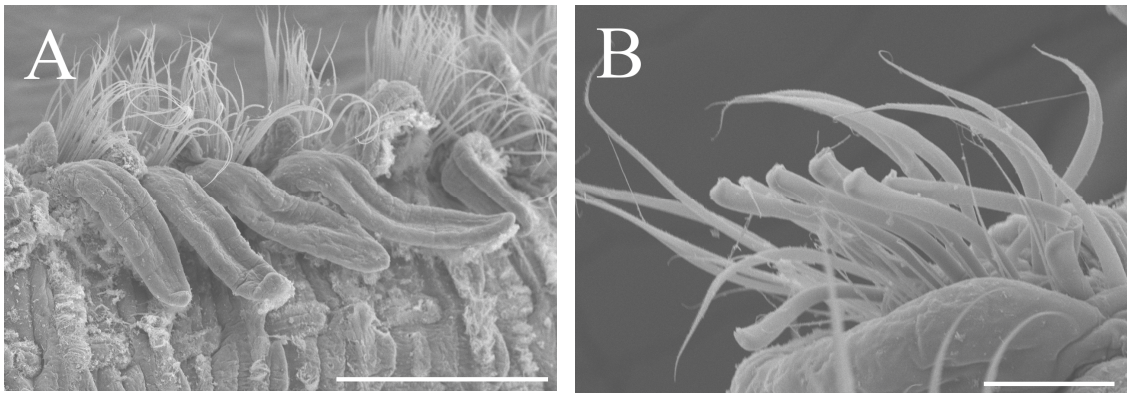

Fig. 16. Scanning electron microscopy photographs of *Malacoceros reductus* Blake and Kudenov, 1978. A, Middle chaetigers, dorsal view; B, Capillaries and neuropodial hooded hooks. Scale bars: A=0.4 mm, B=0.05 mm.

Genus *Microspio* Mesnil, 1896

Microspio Mesnil, 1896; Blake and Kudenov, 1978: 232; Maciolek, 1990: 1128; Blake, 1996: 160; Bick and Meißnera, 2011: 50–51; Meißnera and Gotting, 2015: 399.

Mesospio Gravier, 1911: 100.

Type species:

Microspio Mesnil, 1896: *Spio mecznikowianus* Claparède, 1869, designated by Söderström, 1920: 247.

Mesospio Gravier, 1911: *Mesospio moorei* Gravier, 1911, by monotypy.

Diagnosis: Prostomium rounded or incised anteriorly. Occipital antenna present or absent. Nuchal organ with short median and long lateral ciliary bands, extending to chaetiger 2 or 3. Metameric dorsal ciliated organs present. Branchiae from chaetiger 2, limited to anterior chaetigers or continuing to posterior end of the body. Hooded hooks bi-, tri-, or multidentate. Ventral sabre chaetae present. Pygidium with 2−4 anal cirri.

Genus *Paraprionospio* Caullery, 1914 모자예쁜얼굴갯지렁이속

Paraprionospio Caullery, 1914: 355; Foster, 1971: 100–102; Maciolek, 1985: 372; Wilson, 1990: 266; Yokoyama, 2007: 255–256; Delgado-Blas and Carrera-Parra, 2018: 7.

Type species: *Prionospio pinnata* Ehlers, 1901, designated by Caullery 1914.

Diagnosis: Prostomium fusiform with rounded, truncated or blunt pointed anteriorly. Branchiae three pairs on chaetigers 1–3, all pinnate. Transverse ridge between branchial bases on chaetiger 1. Neuropodial hooded hooks geniculate, from chaetiger 9, and accompanied by capillaries and 1–2 ventral sabre chaetae. Notopodial hooded hooks not geniculate, present from middle chaetigers. Muscular gizzard present.

Key to the species of *Paraprionospio* Caullery, 1914 from Korea waters.

1. Small papilla on posterior margin of peristomium. Conic processes present in basal region of first branchiae. Semitransparent dorsal cuticle absent.....….....*P. coora*

- Small papilla absent. Conic processes absent from basal region of first branchiae. Semi-transparent dorsal cuticle present……....…...…....*P. pinnata*

Genus *Polydora* Bosc, 1802 긴얼굴갯지렁이속

Polydora Bosc, 1802; 150; Fauchald, 1977: 24; Blake and Kudenov, 1978: 245–247; Blake, 1996: 167; Delgado-Blas, 2008: 11; Read, 2010: 85.

Type species: *Polydora cornuta* Bosc, 1802, by monotypy.

Diagnosis: Prostomium rounded or incised anteriorly. Branchiae from chaetiger 7. Chaetiger 1 without notochaetae. Chaetiger 5 modified with one type of heavy spines with or without companion chaetae; spines falcate. Neuropodial hooded hooks present from chaetiger 7. Special notochaetae in posterior chaetigers present or absent.

Key to the species of *Polydora* Bosc, 1802 from Korean waters.

1. Occipital antenna absent……..……..……..……...2
 - Occipital antenna present……..……..……5
2. Prostomium rounded anteriorly…….....*P. brevipalpa*
 - Prostomium weakly incised anteriorly……..…….....3
3. Black pigmentation absent on body; palp pigment indistinct only narrow black line present along groove ……...……...……*P. websteri*
- Black pigmentation on anterior part of body; palp pigment distinct……4
4. Heavy spines on chaetiger 5 with one triangular lateral tooth……... ……....…*P. limicola*
 - Heavy spines on chaetiger 5 with two accessory structures…..…….……*P. haswelli*
5. Dorsal superior capillaries on chaetiger 5 present……...*P. hoplura*
 - Dorsal superior capillaries on chaetiger 5 absent……...…6
6. Neurochaetae on chaetiger 5 absent……*P. cornuta*
 - Neurochaetae on chaetiger 5 present……..…..……..*P. aura*

9. *Polydora brevipalpa* Zachs, 1933 긴얼굴갯지렁이

Polydora ciliata brevipalpa Zachs, 1933: 129.

Polydora ciliata: Okuda, 1937: 230, fig. 9; Imajima and Hartman, 1964: 283.

Polydora variegate Imajima and Sato, 1984: 57–62, figs 2–26; Mori *et al*., 1985: 371; Sato-Okoshi *et al*., 1990: 61–66.

Polydora brevipalpa: Radashevsky, 1993: 28–31; Blake, 1996: 173; Sato-Okoshi and Abe, 2012; Ye *et al*., 2018: 1–11, figs 2–3.

Material examined. One specimen, Jeollanam-do: Yeosu-si, Nam-myeon, Dumo-ri (127°44'11"E, 34°30'25"N), 12 Apr 2017.

Diagnosis. Prostomium anteriorly rounded, extending posteriorly to middle of chaetiger 3 as a low caruncle. Occipital antenna absent. Chaetiger 5 heavy spines on with lateral flange accompanied with pennoned chaetae; superior notochaetae absent; winged ventral capillaries present. Branchiae from chaetiger 7. Hooded hooks in neuropodia from chaetiger 7. Special spines in posterior notopodia absent. Pygidium a flaring disc, dorsally open.

Distribution. Japan (type locality), China, Korea.

10. *Polydora cornuta* Bosc, 1802

Polydora cornuta Bosc, 1802: 150–153, pl. 5, figs. 7–8; Blake and Maciolek, 1987: 11–15, fig. 1; Tena *et al*., 1991: 32–35, fig. 3; Blake, 1996: 171, fig. 1; Radashevsky and Hsieh, 2000a: 203–217, fig. 3; Radashevsky, 2005: 1–24, figs. 1–4; Boltacheva and Lisitskaya, 2007: 33–35, fig. 1; Dağli and Ergen, 2008: 231–233, fig. 3; Simboura *et al*., 2008: 123–124, fig. 2; Selifonova, 2011: 48, fig. 1; Radashevsky and Selifonova, 2013: 263–264.

Polydora amarincola Hartman, 1936: 49, figs. 6–10.

Polydora ligni Webster, 1879: 1987, pl.5, figs. 45–47; Blake, 1971: 5–6, figs. 1–2.

Polydora littorea Verrill, 1881: 301.

Material examined. Korea: 50 specimens. Jeollabuk-do: Buan-gun, Byeonsan-myeon, Unsan-ri (126°30′37″E, 35°39′54″N), 14 Jun 2018. All specimens collected from gravel sand.

Description. Complete specimens about 12 mm long and 0.8 mm wide. Irregular black spots often present on dorso-lateral sides of present from chaetiger 6. Bright-yellow pigmentations present both prostomium and peristomium.

Prostomium anteriorly bifid, extending posteriorly to end of chaetiger 3 as a low caruncle. Nuchal organs ciliary bands on sides of caruncle. Two pairs eyes arranged trapezoidally; anterior pair larger than posterior ones. Cirriform occipital antenna on caruncle usually prominent, at level of chaetiger 1, occasionally short. Palps as long as 15–35 chaetigers, with longitudinal groove lined with fine frontal cilia, latero-frontal motile compound cilia bordering groove (Figs. 17A–B, 18A–B).

Chaetiger 1 with well developed cirriform postchaetal lamellae in both rami; notochaetae absent; short capillaries present in neuropodia. Prechaetal lamellae absent in all parapodia. Parapodial lobes and postchaetal lamellae well developed on anterior chaetigers except chaetiger 5, gradually reducing on posterior chaetigers. Posterior notopodia with only capillaries (Figs. 17A–B, 18A–C).

Chaetiger 5 greatly enlarged, overlapping chaetiger 6 dorsally, with 8–9 heavy modified spines alternating with delicate companion chaetae, postchaetal lamellae lacking. Dorsal superior and ventral capillaries absent. heavy spines and companion chaetae arranged in a slightly curved horizontal or oblique double row; heavy spines falcate with lateral tooth; companion chaetae broomlike, closely adhering to convex side of heavy falcate spines (Figs. 17A–D, 18A–C).

Hooks in neuropodia from chaetiger 7, up to 15 in a series, not accompanied by capillaries.

Hooks bidentate, with shaft slightly curved, having constriction on upper part. Modified spines in posterior notopodia absent (Figs. 17E–F, 18D).

Branchiae from chaetiger 7, full-sized at the first appearance or shorter on chaetiger 7 than on chaetiger 8, gradually diminishing in size on posterior part of body and absent on 5 posteriormost chaetigers. Branchiae flattened, with surfaces oriented parallel to body axis, free from notopodial postchaetal lamellae (Fig. 17A–B).

Lateral ciliated organs as small pits with non-motile cilia between noto- and neuropodia on all chaetigers but 4 and 5.

Glandular pouches from chaetiger 7, diminishing in size after chaetiger 11 or 12, single throughout.

Gizzard-like structure absent in digestive tract.

Pygidium disk-shape with dorsal gap (Fig. 17C).

Methyl green staining pattern: Posterior part of peristoium slightly stained ventrally. Bands of scattered dots on borders of chaetigers 6–16 intensively stained laterally and ventrally (Fig. 19).

Remarks. Blake and Maciolek (1987) concluded that *Polydora ligni* is the junior synonym of *Polydora cornuta* Bosc, 1802 base on the morphological characteristics (shape of prostomium, eye pattern) and the same habitats (collected from rock crevices, wood, and shells) from South Carolina near to the original type location, Fort Johnson. They designated a neotype of this species and redescribed it. (Bosc, 1802; Blake and Maciolek, 1987).

The specimens examined in the present study agree well with the description of *P. cornuta* by Blake and Maciolek (1987) based on the following diagnostic characteristics: (1) the absence of superior notochaetae and neurochaetae on chaetiger 5, (2) modified spines on chaetiger 5 with broomstick-like companion chaetae (companion chaetae are closely adhering to convex side of spines), (3) the absence of modified spines in the posterior notopodia, (4) the presence of occipital antenna, and (5) caruncle extending to chaetiger 3 (Bosc, 1802; Blake and Maciolek, 1987; Blake, 1996; Radashevsky, 2005; Radashevsky and Hsieh, 2000a; Rice *et al*., 2008; Zhou *et al*., 2010; Ye

et al., 2015).

In East Asia, *P. cornuta* closely resemble to *P. bioccipitalis* Blake and Woodwick, 1972 from Chinese waters by the absence of superior notochaetae and neurochaetae on chaetiger 5, the absence of modified spines in the posterior notopodia, and the presence of occipital antenna. However, the Korean materials can be distinguished by caruncle extending to the end of chaetiger 3 vs. beyond chaetiger 5 in *P. bioccipitalis*, and heavy spines on chaetiger 5 with one lateral tooth vs. two teeth and one flange in *P. bioccipitalis* (Blake and Woodwick, 1972; Blake and Kudenov, 1978; Blake and Maciolek, 1987; Radashevsky and Hsieh, 2000a; Radashevsky, 2005; Zhou *et al*., 2010; Ye *et al*., 2015).

Habitat. Fine sand (Radashevsky, 2005), salt marsh intertidal and sandy mud (Radashevsky, 2005), silty mud and shrimp pond (Zhou *et al*., 2010), muddy sand bottom and on bivalve (Radashevsky, 2005), tube of the Polychaete *Diopatra sugokai*, soft muddy bottoms in estuarine, and coastal intertidal zone (Radashevsky and Hsieh, 2000a); low intertidal, mud between sea grass, and on tubes of the Surpulid *Mercierella enigmatica* (Bosc, 1802; Radashevsky, 2005). In Korean waters, our materials were collected from gravel sand (depth 5m).

Distribution. USA(type locality), Argentina, Australia, Black Sea, Brazil, Caribbean Sea, China, Gulf of Mexico, India, Japan, Korea, northern and southern Europe, Pacific coast of Russia.

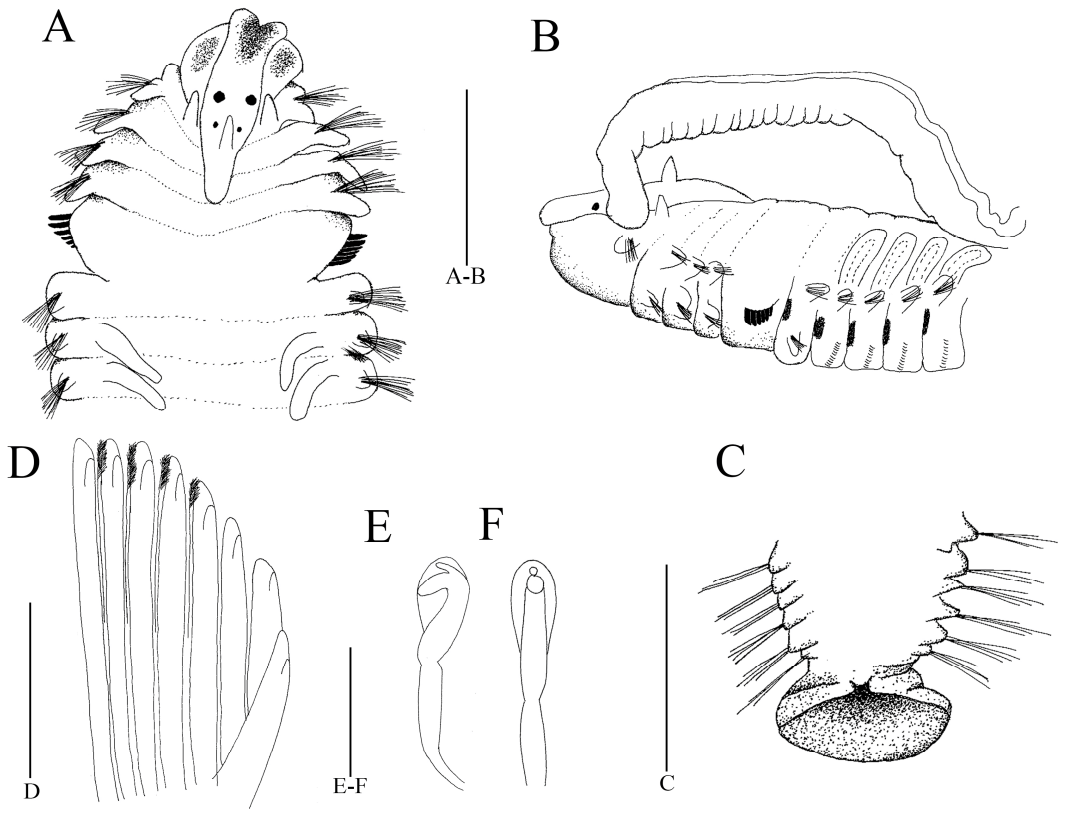

Fig. 17. *Polydora cornuta* Bosc, 1802. A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with 10 chaetigers, lateral view; C, Posterior end; D, heavy spines with companion chaetae; E, Neuropodial hooded hook, lateral view; F, Neuropodial hooded hook, front view. Scale bars: A–C=0.5 mm, D=0.1 mm, E–F=0.03 mm.

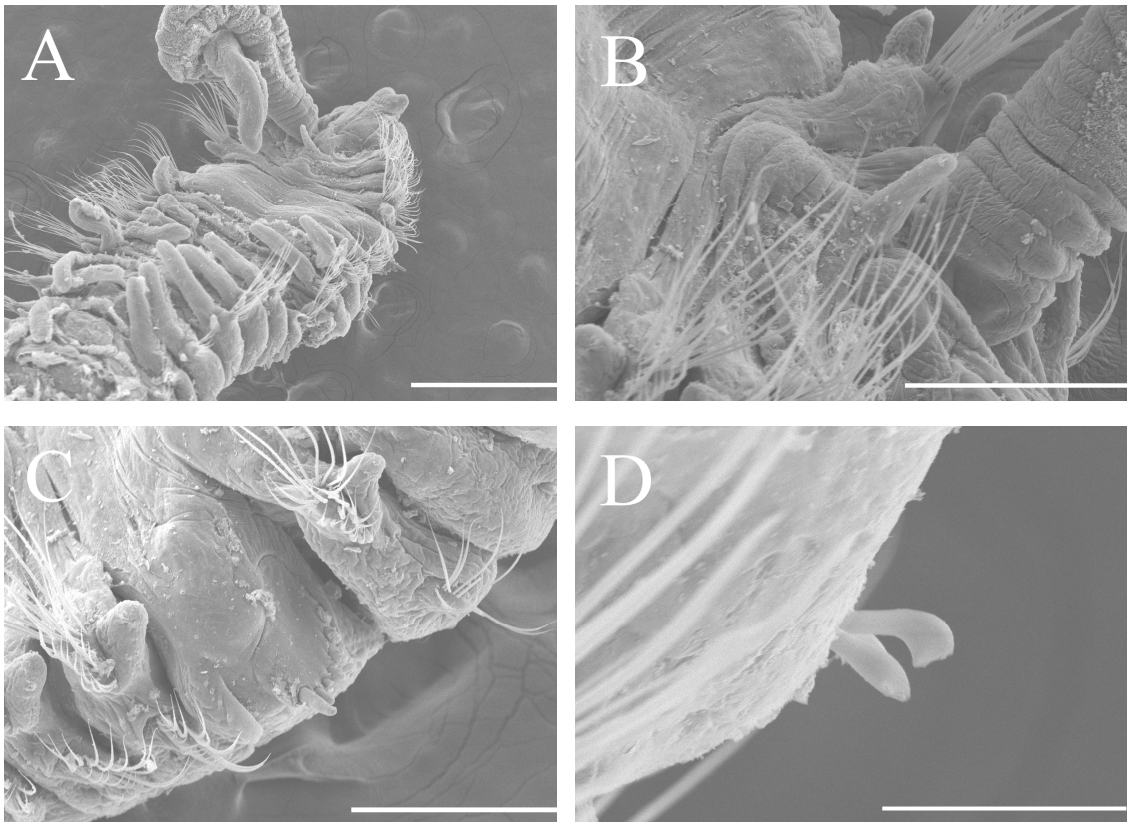

Fig. 18. Scanning electron microscopy photographs of *Polydora cornuta* Bosc, 1802. A, Anterior end, dorsal view; B, Occipital antenna, lateral view; C, Chaetigers 4–6, lateral view; D, Hooded hooks. Scale bars: A=0.5 mm, B–C=0.2 mm, D=0.05 mm.

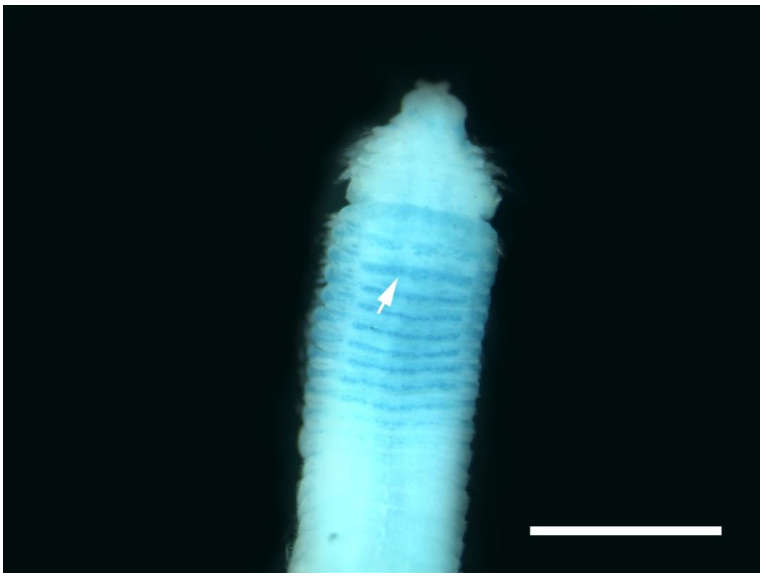

Fig. 19. *Polydora cornuta* Bosc, 1802 stained with methyl green, ventral view, showing bands of scattered dots (arrow) on chaetigers 6–16. Scale bar: 1.0 mm.

11. *Polydora limicola* Annenkova, 1934 한이빨긴얼굴갯지렁이

Polydora ciliata limicola Annenkova, 1934: 325, fig. 5.

Polydora limicola: Hartman, 1961: 98–99; Manchenko and Radashevsky, 1993: 543–548; Blake, 1996: 173; Sato-Okosh *et al*., 2012: 82–90.

Material examined. Six specimens, Jeollanam-do: Sinan-gun, Heuksan-myeon, Sa-ri (125°24'52"E, 34°38'36"N), 28 Sep 2018.

Diagnosis. Prostomium anteriorly bifid, extending posteriorly to middle of chaetiger 4 as a low caruncle. Occipital antenna absent. Chaetiger 5 heavy spines on with lateral flange accompanied with pennoned slender chaetae; winged superior and ventral capillaries present. Branchiae from chaetiger 7. Hooded hooks in neuropodia from chaetiger 7. Special spines in posterior notopodia absent. Pygidium a flaring disc, dorsally open.

Distribution. Russia (type locality), Japan, Korea, USA.

12. *Polydora* sp. nov.

Type materials. Type locality: South Korea, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26'58"E, 34°53'18"N), 20 Sep 2017, collected from mud flats, intertidal. **Holotype:** imcomplete specimen. **Paratype:** nine imcomplete specimens; one complete specimen on stub for SEM observation. **Non-type material:** five specimens, collection details same as type materials**.** Colorless in alcohol fixed specimens without any pigmentation.

Description. Holotype: imcomplete, a small-sized species about 2.0 mm long and 0.3 mm wide

with 18 chaetigers. Prostomium incised anteriorly, extending posteriorly to end of segment 2 as a low caruncle. Two pairs of small black eyes arranged trapezoidally; lateral eyes situated anteriorly and set wider apart, slightly larger than median eyes. Occipital antenna absent. Nuchal organs not observed. Palp missing (Figs. 20A–B, 21A–B).

Chaetiger 1 with well developed cirriform postchaetal lamellae in both rami; notochaetae absent; short capillaries present in neuropodia. Prechaetal lamellae absent in all parapodia. Parapodial lobes and postchaetal lamellae well developed on anterior chaetigers except chaetiger 5, gradually reducing on posterior chaetigers. Posterior notopodia with only capillaries (Figs. 20A–B, 21A–B).

Chaetiger 5 greatly enlarged, about twice as large as chaetiger 4 and 6, with up to 5–6 heavy modified spines alternating with delicate companion chaetae, postchaetal lamellae lacking. Dorsal superior capillaries invariably absent. heavy spines and companion chaetae arranged in a slightly curved. heavy spines falcate, with lateral tooth and narrow thin subdistal longitudinal flange or keel positioned laterally on main fang distal to lateral tooth, alternating with foliaceous companion chaetae. 5–6 winged ventral capillaries present (Figs. 20A–C, 21A–C).

Hooded hooks in neuropodia from chaetiger 7, up to 12 in a vertical series, not accompanied by capillaries. Hooks bidentate, with shaft slightly curved, having constriction on upper part (Figs. 20D–E, 21D).

Branchiae from chaetiger 7, nearly full-sized on chaetigers 7–9, gradually diminishing in size on posterior part of body. Branchiae flattened, with surfaces oriented parallel to body axis, free from notopodial postchaetal lamellae (Figs. 20A–B, 21A–B).

No gizzard-like structure present in digestive tract.

Pygidium not present in fragmented specimen from Korean waters.

Methyl green staining pattern: Posterior part of peristoium stained ventrally. Bands of scattered dots on borders from chaetiger 6 to middle chaetigers intensively stained laterally and ventrally.

Remarks. The *Polydora* species collected from burrows in Korean waters closely resemble 12 species (*P. aura* Sato-Okoshi, 1998; *P. curiosa* Radashevsky, 1994; *P. fusca* Radashevsky & Hsieh, 2000; *P. glycymerica* Radashevsky, 1993; *P. hornelli* Willey, 1905; *P. latispinosa* Blake & Kudenov, 1978; *P. nanomon* Orensky & Williams, 2009; *P. robi* Williams, 2000; *P. spondylana* Mohammad, 1973; *P. umangivora* Williams, 2001; *P. variegata* Imajima & Sato, 1984; and *P. vulgaris* Mohammad, 1972) in having chaetiger 5 with only dorsal superior capillaries, not posterioventral capillaries (Table 3). Among them, *P. fusca* reported from Taiwan is most closely resembled the materials of present study in having a bilobed prostomium, caruncle extending to the end of chaetiger 2, and being non-boring species (tube-dweller). However, the present new species is distinguished from the Taiwan species by the absence of occipital antenna, having heavy spines with lateral flange instead of lateral tooth, the absence of black spots on the entire body surface, and the absence of needles-like spines in the posterior parapodia.

Habitat. This species collected from muddy sand, tube-dweller (non-borer species).

Distribution. Samhwa-ri, Yongnam-myeon, Tongyeong-si, Gyeongsangnam-do, Korea.

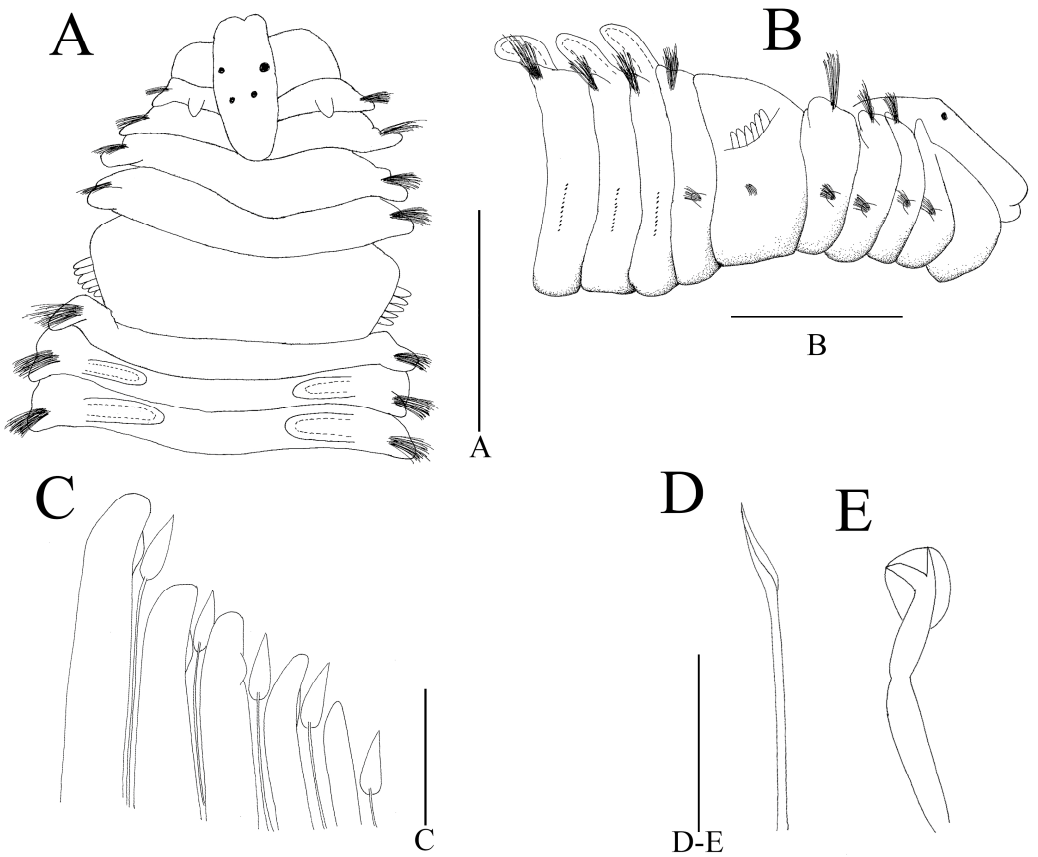

Fig. 20. *Polydora* sp. nov., holotype. A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with nine chaetigers, lateral view; C, Heavy spines with companion chaetae; D, Neurochaeta on chaetiger 5, lateral view; E, Neuropodial hooded hook, lateral view. Scale bars: A=0.5 mm, B=0.3 mm, C–F=0.03 mm.

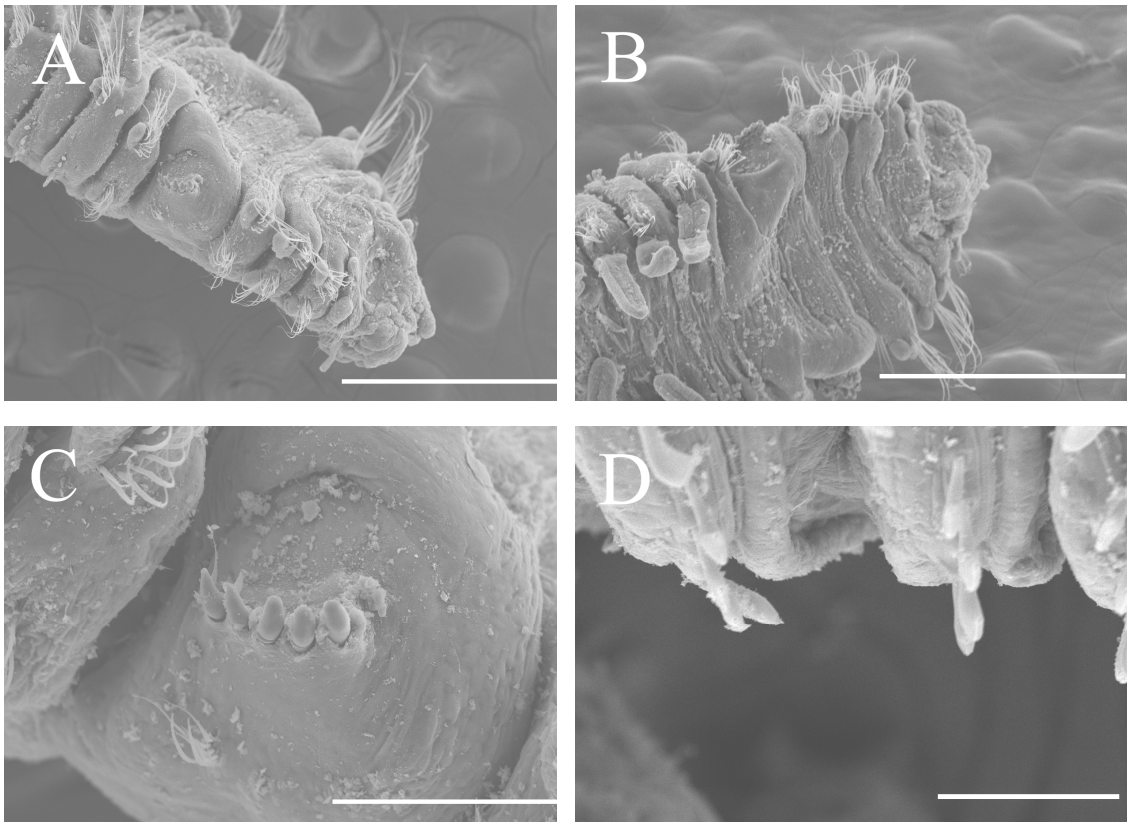

Fig. 21. Scanning electron microscopy photographs of *Polydora* sp. nov., paratype. A, Anterior end, dorsal view; B, Occipital antenna, lateral view; C, Chaetigers 4–6, lateral view; D, Hooded hooks. Scale bars: A=0.5 mm, B–C=0.2 mm, D=0.05 mm.

Table 3. Some morphological characteristics of *Polydora* species those have neurochaetae on chaetiger 5 and not have superior notochaetae. References: 1, Sato-okoshi (1998); 2, Sato-Okoshi and Abe (2012); 3, Radashevsky (1994); 4, Radashevsky and Hsieh (2000); 5, Radashevsky (1993); 6, Willey (1905); 7, Blake and Kudenov (1978); 8, Orensky and Williams (2009); 9, Williams (2009); 10, Mohammad (1973); 11, Williams (2001); 12, Imajima and Sato (1984); 13, Mohammad (1972); 14, Present study.

Species	Prostomium (anterior edge)	Occipital antenna	Caruncle (maximal length)	Heavy spines on chaetiger 5	Modified spines in posterior notopodia	Pygidium	Habitat	Distribution	References
***P. aura* Sato-Okoshi, 1998**	Incised	Present	Middle or end of chaetiger 3	Lateral flange	Needle-like	Flaring disc	Shell-borer	Japan	1, 2
***P. curiosa* Radashevsky, 1994**	Rounded	Absent	Front of chaetiger 2	Lateral tooth	Absent	Cup-shape	Shell-borer	Japan	3
***P. fusca* Radashevsky & Hsieh, 2000**	Incised	Present	End of chaetiger 2	Lateral tooth	Needle-like	Cup-shape	Tube-dweller	Taiwan	4
***P. glycymerica* Radashevsky, 1993**	Incised	Present	Middle of chaetiger 2	Lateral flange	Absent	Flaring disc	Shell-borer	Japan	5
***P. hornelli* Willey, 1905**	Incised	Present	Chaetiger 2	Lateral flange	Absent	?	Shell-borer	South Africa	6
***P. latispinosa* Blake & Kudenov, 1978**	Incised	Present	End of chaetiger 2	Lateral flange	Needle-like	Flaring disc	Shell-borer	Australia	7
***P. nanomon* Orensky & Williams, 2009**	Incised	Present	End of chaetiger 2	2 lateral teeth	Absent	Nub-like	Shell-borer	Jamaica	8
***P. robi* Williams, 2000**	Rounded	Present	Middle of chaetiger 2	Lateral flange	Needle-like	With digitiform cirri	Shell-borer	Indo-West Pacific	9

Table 3. (continued).

Species	Prostomium (anterior edge)	Occipital antenna	Caruncle (maximal length)	Heavy spines on chaetiger 5	Modified spines in posterior notopodia	Pygidium	Habitat	Distribution	References
***P. spondylana* Mohammad, 1973**	Rounded	Absent	End of chaetiger 4	Lateral flange	Absent	Flaring disc	Shell-borer	Kuwait	10
***P. umangivora* Williams, 2001**	Rounded	Absent	Chaetiger 1–2	Lateral tooth	Absent	Cup-shape	Shell-borer	The Philippines	11
***P. variegata* Imajima & Sato, 1984**	Rounded	Absent	Middle of chaetiger 3	Lateral flange	Absent	Flaring disc	Shell-borer	Japan	12
***P. vulgaris* Mohammad, 1972**	Incised	Present	Chaetiger 2	Lateral flange	Needle-like	Flaring disc	Shell-borer	Kuwait	13
***Polydora* sp. nov. from Korean waters**	Incised	Absent	End of chaetiger 2	Lateral flange	Absent	?	Tube-dweller	Korea	14

Genus *Prionospio* Malmgren, 1867 예쁜얼굴갯지렁이속

Prionospio Malmgren, 1867: 201; Blake and Kudenov 1978: 211–212; Maciolek 1985: 329–332; Wilson 1990: 245–246; Radashevsky, 2015: 648.

Type species: *Prionospio steenstrupi* Malmgren, 1867, by monotypy.

Diagnosis: Prostomium broadly rounded to truncate anteriorly, sometimes with fronto-lateral horns. Occipital antenna absent. Nuchal organs U-shaped over 1–4 chaetigers. Caruncle well pronounced. Branchiae pinnate or appinate, from chaetiger 2, limited to first 20 chaetigers. Dorsal crest present or absent. Hooded hooks in both rami, uni- to multidentate. Ventral sabre chaetae present or absent. Pygidium with thin, long middorsal cirrus and short, thick ventral cirri.

Key to the species of the genus *Prionospio* from Korean waters

1. Branchiae apinnate only……2
 - Branchiae pinnate only or both apinnate and pinnate……4
2. Branchiae four pairs……*P. japonicus*
 - Branchiae more than four pairs ……3
3. Branchiae longest pair extend over 2–3 segments……*P. multibranchiata*
 - Branchiae longest pair extend over 6–8 segments……*P. pulchra*
4. Branchiae pinnate only……5
 - Branchiae both apinnate and pinnate……6
5. Notochaetae on chaetiger 1 absent……*P. krusadensis*
 - Notochaetae on chaetiger 1 present……*P.* cf. *aucklandica*
6. Only one pair of branchiae pinnate……7
 - Both first and fourth pairs of branchiae pinnate……8
7. Branchiae pinnate on chaetiger 2……*P. saccifera*

- Branchiae pinnate on chaetiger 5……..……..……*P. nova*

8. Caruncle extending to posterior end of chaetiger 1…….....….....….*P. membranacea*

- Caruncle extending to posterior end of chaetiger 2……...…….……9

9. Dorsal crests from chaetiger 7……..……...……...……*P. depauperata*

- Dorsal crests from chaetiger 11…...……...…….…...……*P. paradisea*

13. *Prionospio* cf. *aucklandica* Augener, 1923

Prionospio aucklandica Augener, 1923: 69–70, fig. 24; 1926: 158–159, fig. 1; Wilson, 1990: 247; Radashevsky, 2015: 653–655, fig. 11.

Prionospio (*Aquilaspio*) *aucklandica*: Blake and Kudenov, 1978: 221–222, fig. 25b–g.

Aquilaspio aucklandica: Foster 1971 (Part.): 106; Hutchings and Turvey, 1984: 8–9.

Material examined. Two specimens, Jeollanam-do: Yeosu-si, Nam-myeon, Dumo-ri (127°43'46"E, 34°31'29"N), 13 Mar 2013; seven specimens, Jeollanam-do: Wando-gun, Bogil-myeon, Buhwang-ri (126°30'58"E, 34°7'22"N), 25 Jul 2017.

Description. Complete specimens up to 15mm long, 1.0mm wide. Colorless in alcohol fixed specimens without any pigmentation.

Prostomium narrow, rounded anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle; posterior part of caruncle pressed into anterior part of chaetiger 2 towards level of nototroch, thus caruncle appearing as extending until middle of chaetiger 2. Occipital antenna absent. Two pairs of small red eyes arranged trapezoidally; lateral eyes situated anteriorly and set wider apart, slightly larger than median eyes. Nuchal organs U-shaped ciliary bands on lateral sides of caruncle. Posterior dorsal parts of peristomium fused to notopodial lamellae of chaetiger 1 forming prominent ear-shaped structures. Palps missing (Fig. 22A–B).

Chaetiger 1 with short capillaries in neuropodia and postchaetal lamellae in both rami; notopodial postchaetal lamellae fused to posterior dorsal parts of peristomium forming ear-shaped

structures; 2–3 capillaries present on lower part of notopodium. Notopodial lamellae of chaetigers 2–4 triangular, small on chaetiger 2, largest on chaetiger 4; lamellae smaller and rounded on succeeding chaetigers. Dorsal crests, lateral pouches and ventral flaps absent (Fig. 22A–C).

Ventral sabre chaetae in neuropodia from chaetiger 10, one in a tuft, with narrow fine granulation on distal half of shaft (Fig. 22D).

Hooks in notopodia from about chaetiger 30, four in a group among capillaries. Hooks in neuropodia from chaetigers 18–19, up to six in a series, accompanied by alternating capillaries and inferior sabre chaetae throughout. Hooks with 3–5 pairs of small upper teeth arranged above main fang on lateral view, with inner and outer hoods; shaft slightly curved (Fig. 22E).

Three pairs of pinnate branchiae on chaetigers 2–4; branchiae of chaetiger 2 longest; all branchiae cylindrical, with longitudinal bands of cilia along inner and outer sides (Fig. 22A–B).

Nototrochs with short cilia present between branchial bases on chaetigers 2 and 3.

Pygidium with thin, long middorsal cirrus and one pair of short and thick ventral cirri.

Methyl green staining pattern: Inconspicuous. Anterior part of prostomium, peristomium intensively stained; postchaetal lamellae and branchiae of anterior and middle chaetigers intensively stained.

Remarks. Augener (1923) originally described the species from Aukland, New Zealand as *Prionospio aucklandica* in having three pairs of pinnate branchiae on chaetigers 2–4, sabre chaetae from chaetiger 10, and hooded hooks in neuropodia from chaetiger 19 (Augener, 1923, 1926). This characteristics share with *Prionospio krusadensis* Fauvel, 1929 from Krusadai Island, India and some authors (Foster, 1971; Blake and Kudenov, 1978) considered this species to be a junior synonym of *P. aucklandica*. However, Imajima (1990) gave a possibility of the separated two valid species by the presence of notochaetae on chaetiger 1 and distribution of largest notochaetae at the anterior chaetigers. Comparison of several characteristic features in this species described by some authors was provided in table 4 (Augener, 1923; Foster, 1971; Blake and Kudenov, 1978; Hutchings and Turvey, 1984; Wilson, 1990; Radashevsky, 2015).

Prionospio with three pairs of pinnate branchiae from Korean waters is well accorded with the descriptions of *P. aucklandica* by Blake and Kudenov (1978). They are characterized by two pairs of small eyes, three pairs of pinnate branchiae on chaetigers 2–4, the presence of notochaetae on chaetiger 1, sabre chaetae consistently starting from chaetiger 10, and by the absence of dorsal crests, folds and lateral pouches. Due to the lack of types and detailed re-description in the species, we considered the species wfrom Korean waters more close to *P. aucklandica* rather than the sibling species of *P. krusadensis*.

Habitat. Sand and algae (Augener, 1923), coral sand and rubble at 6–16 m depth (Radashevsky, 2015), sandy mud (Blake and Kudenov 1978), intertidal and subtidal sediments including seagrass beds, among coralline algae (Hutchings and Turvey, 1984). In this study, the Korean materials were collected from intertidal zone of muddy sand habitat.

Distribution. Auckland Island (type locality), New Zealand. Australia, Korea.

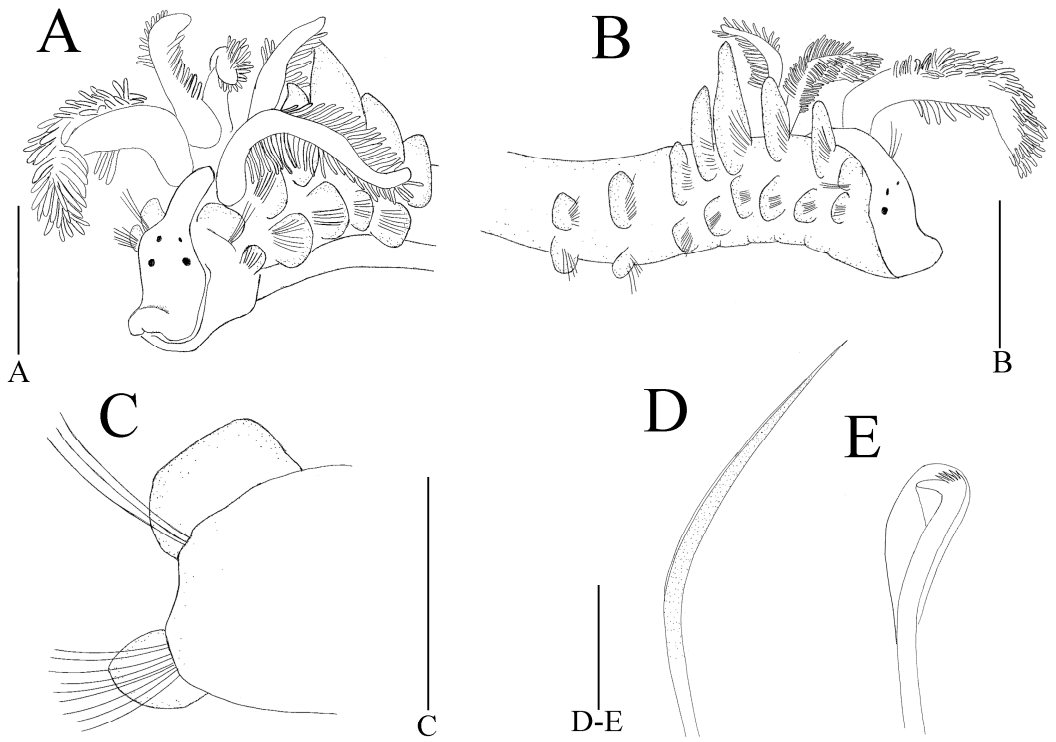

Fig. 22. *Prionospio* cf. *aucklandica* Augener, 1923. A, Anterior end with six chaetigers, front view; B, Anterior end with eight chaetigers, lateral view; C, Annterior view of chaetiger 1; D, Ventral sabre chaeta; E, Neuropodial hooded hook, lateral view. Scale bars: A–B=0.5 mm, C=0.3 mm, D–E=0.03 mm.

Table 4. Some morphological characteristics of *Prionospio aucklandica* Augener, 1923 described in the previous studies. References: Augener (1923), Foster (1971), Blake and Kudenov (1978), Hutching and Turvey (1984), Wilson (1990), Radashevsky (2015), and in this study.

Locality	Notochaetae on chaetiger 1	Largest notopodia on anterior chaetigers	Dorsal crests	First appearance of neuropodial hooded hooks	First appearance of notopodial hooded hooks	Mophology of hooded hooks	First appearance of ventral sabre chaetae
Auckland Island in New Zealand by Augener (1923)	?	?	?	?	?	Three pairs of small teeth above main fang	chaetiger 10
Gulf of Mexico and the Caribbea Sea by Foster (1971)	Present	?	Present	Chaetigers 18–20	Chaetigers 30–31	?	?
New South Wales and Victoria by Blake and Kudenov (1978)	Present	Probably chaetiger 5 (described in figure 25b)	Absent (re-examined by Wilson (1990))	Chaetigers 17–18	Chaetigers 27–30	Five pairs of small teeth above main fang	Chaetiger 10
Southern Australia by Hutching and Turvey (1984)	Absent	Chaetiger 4	Absent	Chaetigers 15–18	Chaetigers 25–33	Five pairs of small teeth above main fang	Chaetigers 10–11
Eastern and Southern Australia by Wilson (1990)	?	?	?	Chaetigers 18–22	Chaetigers 27–36	?	Chaetiger 10
Queensland in Australia by Radashevsky (2015)	Absent	Chaetiger 5	Absent	Chaetigers 16–21	Chaetigers 23–38	Three pairs of small teeth above main fang	Chaetiger 10
Korean waters in this study	Present	Chaetiger 4	Absent	Chaetigers 18–19	Chaetigers 29–30	Five pairs of small teeth above main fang	Chaetiger 10

14. *Prionospio depauperata* Imajima, 1990

Prionospio depauperata Imajima, 1990c:114–118, figs. 6–7; Dagli and Çinar, 2009: 120, fig. 2.

Material examined. One specimen, Jeollanam-do: Yeosu-si, Samsan-myeon, Dongdo-ri (127°22'65"E, 34°04'21"N), 06 Jun 2017.

Description. Specimen incomplete, up to 1.0 mm long and 0.2 mm wide. Body pigmentation absent.

Prostomium wide, truncate anteriorly, extending posteriorly to end of chaetiger 2 as a prominent caruncle. Occipital antenna absent. Two pairs of red eyes arranged trapezoidally, comprising one pair of large crescent-shaped median eyes and one pair of small lateral eyes situated anteriorly and set wider apart. Nuchal organs U-shaped ciliary bands on each side of caruncle. Posterior dorsal part of peristomium fused to notopodial lamellae of chaetiger 1 not forming prominent structures. Palps missing (Fig. 23A).

Chaetiger 1 with short capillaries and small postchaetal lamellae in both rami; notopodial lamellae not fused to posterior dorsal parts of peristomium. Notopodial lamellae of chaetigers 3–5 largest, triangular, gradually becoming smaller and rounded on succeeding chaetigers. Neuropodial postchaetal lamellae of chaetiger 2 rounded, not elongated ventrally (Fig. 23A).

Moderate dorsal crest present on chaetigers 7–13, Lateral pouches and ventral flaps absent.

Hooks in notopodia from chaetigers 40, up to nine in a series among capillaries. Hooks in neuropodia from chaetigers 16, up to nine in a series, accompanied by capillaries throughout. Hooks multidentate, with five pairs of thin, long upper teeth arranged in a row above main fang, with inner and outer hoods; shaft slightly bent. Sabre chaetae neuropodia from chaetiger 10, up to two, with narrow limbation and fine dense granulation on distal end of shaft (Fig. 23B–C).

Four pairs of branchiae on chaetigers 2–5; those on chaetigers 2 and 5 pinnate, with numerous long digitiform pinnae regularly arranged on lateral and posterior sides; pinnae of branchiae on

chaetiger 5 present less than half of length of branchiae. Those on chaetigers 3 and 4 apinnate, stout flattened triangles, with surfaces oriented perpendicular to body axis, similar in length to notopodial lamellae (Fig. 23A).

Nototrochs present between branchial bases on chaetigers 3 and 4. Short transverse curved band of short cilia present between chaetigers 3 and 4.

Pygidium not present in fragmented specimen from Korean waters.

Methyl green staining pattern: No special pattern detected. Dorsal crests are well discernible in stained specimen.

Remarks. The specimens examined in the present study agree well with the original description of *Prionospio depauperata* Imajima, 1990 based on the following diagnostic characteristics: (1) the presence of low dorsal folds on chaetigers 7–13, (2) the first and fourth branchiae pinnate, the second and third apinnate, (3) pinnules of the fourth branchiae only present on the basal part, and (4) caruncle extending to base of chaetiger 2 (Imajima, 1990c; Dagli and Çinar, 2009).

Prionospio species with four pairs of branchiae which are pinnate on chaetigers 2 and 5 and apinnate on chaetigers 3 and 4, have conventionally been combined into the *P. steenstrupi* group (Radashevsky, 2015). Thirty-six species have been classified in this group, 12 species summarized by Maciolek (1985: table 3, species 1–12); six species reported from Japan by Imajima; nine species from Andaman Sea by Hylleberg and Nateewathana (1991); one species from by Sigvaldadóttir and Mackie (1993); two species from California by Blake (1996); one species from South China by Zhou and Li (2009); four species from Caribbean Region by Delgado-Blas (2015); and one species from Great Barrier Reef by Radashevsky (2015) (Maciolek, 1985; Sigvaldadóttir and Mackie, 1993; Blake, 1996; by Hylleberg and Nateewathana, 1991; Zhou and Li, 2009; Delgado-Blas, 2015; Radashevsky, 2015). In this group, *P. depauperata* closely resemble *P. oligopinnulata* Delgado-Blas, 2015 from Mexico in having prostomium truncate anteriorly, the absence of interparapodial pouches, and dorsal crest present from chaetiger 7. However, the Korean materials differ from the Mexican specimens by the length of the first branchiae (similar to

the fourth branchiae in the Korean materials vs. much longer than the fourth branchiae in the Mexican specimens), forming low folds on chaetigers 7–8 in the Korean materials vs. high dorsal crests in the Mexican specimens, and hooded hooks with five pairs of small teeth above main tooth in the Korean materials vs. four pairs in the Mexican specimens (Imajima, 1990c; Dagli and Çinar, 2009; Delgado-Blas, 2015; Radashevsky, 2015).

Habitat. 8–920m depth (Imajima, 1990c), muddy sand substratum at 23m depth (Dagli and Çinar, 2009). In Korean waters, our materials were collected from muddy sand.

Distribution. Japan (type locality), Korea, Turkey.

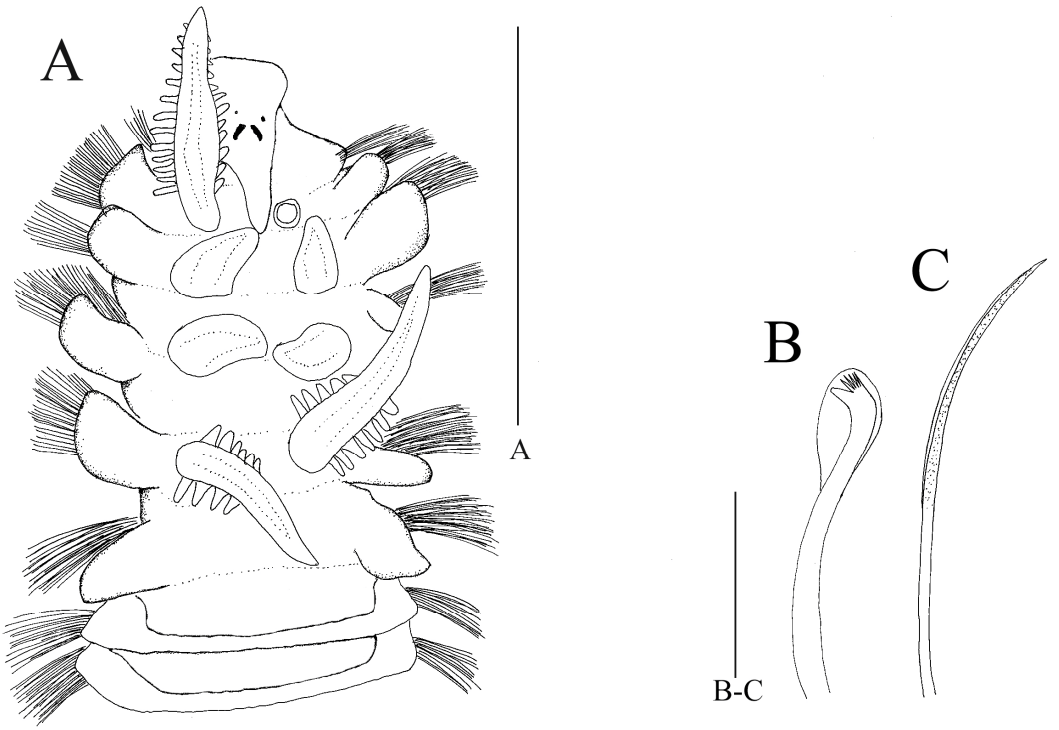

Fig. 23. *Prionospio depauperata* Imajima, 1990. A, Anterior end with eight chaetigers, dorsal view; B, Hooded hook; C, Ventral sabre chaeta. Scale bars: A =1.0 mm, B–C=0.03 mm.

15. *Prionospio japonicus* Okuda, 1935 매끈예쁜얼굴갯지렁이

Prionospio japonicus Okuda, 1935: 241–243, fig. 1; 1937: 242, fig. 19; Imajima and Hartman, 1964: 284.

Prionospio (*Minuspio*) *japonicus*: Paik, 1975: 419; 1982: 807, pl. 20k–l; 1989: 463, fig. 173; Zhou and Li, 2009: 118–119, fig. 2a–g.

Minuspio japonica: Foster, 1971: 107.

Material examined. 10 specimens, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26'58"E, 34°53'18"N), 20 Sep 2017; nine specimens, Gyeongsangnam-do: Goseong-gun, Goseong-eup, Sinwol-ri (128°20'13"E, 34°56'49"N), 20 Sep 2017.

Diagnosis. Prostomium wide, truncate anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle. Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae on chaetigers 2–5, all appinate. Notochaetae on chaetiger 1 present. Dorsal crests or ridges absent. Hooks in notopodia from chaetigers 28–35, up to two in a series among capillaries. Hooks in neuropodia from chaetigers 20, up to seven in a series, accompanied by inferior capillaries. Hooks multidentate, with 4–5 pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetiger 10.

Habitat. Muddy bottom, brackish lakes (Okuda, 1935, 1937), sandy mud 12−15m depth (Zhou and Li, 2009). In this study, our materials were collected from muddy sand.

Distribution. Japan (type locality), China, Korea, Mexico.

16. *Prionospio krusadensis* Fauvel, 1929 깃예쁜얼굴갯지렁이

Prionospio krusadensis Fauvel, 1929: 50, 180–186; Imajima and Hartman, 1964: 284; Paik, 1982, 807, pl. 20i–J; 1984: 152; 1989: 462, fig. 172.

Prionospio (*Aquilaspio*) *krusadensis*: Okuda, 1937: 244–246, fig. 21; Imajima, 1990a: 5, fig. 3a–n; Dagli and Cinar, 2009: 13–16, fig. 6.

Material examined. Five specimens, Jeollanam-do: Wando-gun, Bogil-myeon, Buhwang-ri (126°30'58"E, 34°07'22"N), 25 Jul 2017; one specimen, Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Minam-ri (128°25'25"E, 34°46'11"N), 17 Sep 2017; 30 specimens, Gyeongsangnam-do: Tongyeong-si, Sanyang-eup Sinjeon-ri (128°26'56"E, 34°46'58"N), 19 Sep 2017; one specimen, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Hwasam-ri (128°25'13"E, 34°53'03"N), 20 Sep 2017; one specimen, Gyeongsangbuk-do: Nam-gu, Pohang-si, Guryongpo-eup, Seokbyeong-ri (129°34'51"E, 36°01'05"N), 19 Sep 2017.

Diagnosis. Prostomium narrow and rounded anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle. Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae on chaetigers 2–4, all pinnate. Notochaetae on chaetiger 1 absent. Dorsal crests absent. Hooks in notopodia from chaetigers 34–35, up to five in a series among capillaries. Hooks in neuropodia from chaetigers 20, up to eight in a series, accompanied by inferior capillaries. Hooks multidentate, with five pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetiger 10.

Habitat. Intertidal to 33m depth (Imajima, 1990a), sandy substratum at 4 m depth (Dagli and Cinar, 2009). In Korean waters, our materials were collected from muddy sand.

Distribution. India (type locality), China, Japan, Korea, Turkey.

17. *Prionospio membranacea* Imajima, 1990

Prionospio (*Prionospio*) *membranacea* Imajima, 1990c: 128–130, figs. 14–15; Jung *et al*., 1998: 223, fig. 5.

Material examined. 15 specimens, Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Sinjeon-ri (128°20'13"E, 34°56'49"N), 20 Sep 2017; five specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Gyeokpo-ri (126°28'08"E, 35°37'21"N), 18 Jun 2018.

Diagnosis. Prostomium broadly rounded to truncate anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle. Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae on chaetigers 2–5; those on chaetigers 2 and 5 pinnate, chaetigers 2 and 5 apinnate. Notochaetae on chaetiger 1 present. Dorsal crests present on chaetiger 7. Hooks in notopodia from posterior chaetigers, up to four in a series among capillaries. Hooks in neuropodia from chaetigers 15, up to six in a series, accompanied by inferior capillaries. Hooks multidentate, with five pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetiger 10.

Habitat. Intertidal zone (Imajima, 1990c), muddy sediments in subtidal shallow waters (Jung *et al*., 1998). In this study, our materials were collected from muddy sand intertidal zone.

Distribution. Japan (type locality), China, Korea, Thailand.

18. *Prionospio multibranchiata* Berkeley, 1927

Prionospio multibranchiata Berkeley, 1927: 414, pl. 1, fig. 1.

Minuspio multibranchiata: Foster, 1971: 108, figs. 262–275.

Prionospio (*Minuspio*) *multibranchiata*: Maciolek, 1985: 365–367, fig. 15; Imajima, 1990b: 130–

134, figs. 8a–e, 9a–h; Jung *et al*., 1998: 218, fig. 2; Zhou and Li, 2009: 119–120, fig. 2h–j.

Material examined. 10 specimens, Jeollanam-do: Yeosu-si, Samsan-myeon, Dongdo-ri (127°22'65"E, 34°04'21"N), 06 Jun 2017; 15 specimens, Jeollanam-do: Yeosu-si, Samsan-myeon, Dongdo-ri (127°23'12"E, 34°03'32"N), 27 Jun 2017; 13 specimens, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Hwasam-ri (128°26'58"E, 34°53'18"N), 20 Sep 2017; seven specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Mapo-ri (126°29'22"E, 35°39'32"N), 14 Aug 2018.

Diagnosis. Prostomium rounded anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle. Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae on chaetigers 2–12, all appinate. Notochaetae on chaetiger 1 present. Dorsal crests present on chaetigers 11–13.Hooks in notopodia from chaetiger 28, up to five in a series among capillaries. Hooks in neuropodia from chaetigers 16–17, up to 10 in a series, accompanied by inferior capillaries. Hooks multidentate, with four pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetigers 12–13.

Habitat. Intertidal to 30m depth (Maciolek, 1985), intertidal to 83m depth (Imajima, 1990b), muddy sand, mud bottoms at 2–10 depth (Jung *et al*., 1998), Sandy mud with debris, silty mud (Zhou and Li, 2009). In this study, Korean materials were collected from muddy sand intertidal zone.

Distribution. British Columbia (type locality), Canada, China, Japan, Korea, Mexico, USA.

19. *Prionospio nova* Annenkova, 1938

Prionospio nova Annenkova, 1938: 175–176, figs. 11–12.

Material examined. Korea: one specimen, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Gyeokpo-ri (126°29'05.6"E, 35°38'54.1"N), 3 Mar 2018, muddy sand, intertidal zone.

Description. Body about 5.0 mm in length and about 0.4 mm in width. Body pigmentation absent.

Prostomium subtriangular, broad anteriorly with incision deeply on anterior margin, and extending postoriorly to middle of chaetiger 2 as a prominent caruncle. Occipital antenna absent. Two pairs of red eyes arranged trapezoidally; anterior eyes crescent-shaped and posterior eyes rounded. Nuchal organs ciliary bands on sides of caruncle. Peristomium separated from prostomium, not forming dorso-lateral wings. Palps missing (Fig. 24A–B).

Branchiae four pairs on chaetigers 2–5; those on chaetigers 2–4 apinnate, flattened, and shorter than notopodial postchaetal lamellae. Branchiae on chaetiger 5 slightly flattened to cylindrical, longer than branchiae on previous chaetigers, each with digitiform pinnules arranged on inner lateral sides (Fig. 24A–B).

Chaetiger 1 with capillaries in both rami; notopodial lamellae semicircular and neuropodial postchaetal lamellae rounded. Notopodial postchaetal lamellae of chaetiger 2 and succeeding chaetigers leaf-like and neuropodial postechaetal lamellae semi-oval, elongated posteriorly (Fig. 24A–B).

Low dorsal crests present from chaetiger 19 on a series of succeeding chaetigers. Lateral pouches and ventral flaps absent (Fig. 24D–C).

Capillaries on notopodia non-granulated, arranged in three rows. Neuropodial hooded hooks from chaetiger 20, up to eight in a series with accompanied capillaries; neuropodial hooded hooks bidentate, one tooth above main fang. Notopodial hooded hooks not observed in incomplete specimen. Ventral sabre chaetae in neuropodia from chaetiger 11 with with narrow limbation and fine dense granulation (Fig. 24E–F).

Pygidium not present in fragmented specimens from Korean waters.

Methyl green staining pattern: Inconspicuous. Anterior part of prostomium, peristomium intensively stained; postchaetal lamellae and branchiae of anterior and middle chaetigers intensively stained.

Remarks. Foster (1969, 1971) mentioned that *Prionospio nova* Annenkova, 1938 from Japanese waters is considered to be indeterminable at the species level due to the poor original descriptions. And he suggested that *Prionospio pygmaeus* Hartman, 1961 might be a synonym of *P. nova* until additional comparable materials from Japanese waters provided. *Prionospio* species belong to *Apoprionospio* group (those of branchiae four pairs, apinnate on chaetigers 2–4 and pinnate on chaetiger 5) were collected from Korean waters and this species agree with original description of *P. nova* by the shape of prostomium and the first appearance of neuropodial hooded hooks rather than *P. pygmaeus* Hartman, 1961 from Chinese waters (only these two *Apoprionospio* species were reported from East Asia). The specimens from Korean waters can be distinguished from *P. pygmaeus* by incision at the anterior margin of prostomium instead of small peak, neuropodial hooded hooks present from chaetigers 19–20 instead of 14–15, one tooth above main fang in hooded hooks instead of 6–8, and the presence of dorsal crests. Annenkova (1938) did not provide detailed description of apical teeth of neuropodial hooded hooks and the presence of dorsal crests in his description, and these characteristic features were provided by the Korean specimens in this paper.

Eight *Prionospio* species [*P. caspersi* Laubier, 1962, *P. cerastae* Radashevsky, 2015, *P. dayi* (Foster, 1969), *P. nova*, *P. pygmaeus*, *P. saldanha* Day, 1961, *P.tridentata* Blake & Kudenov, 1978, and *P.vermillionensis* Fauchald, 1972] are sharing those branchiae four pairs, apinnate on chaetigers 2–4 and pinnate on chaetiger 5 (*Apoprionospio* group) shown in Table 5 (Annenkova, 1938; Day, 1961, 1973; Hartman, 1961; Wu and Chen, 1964; Foster, 1969, 1971; Light, 1969, 1978; Fauchald, 1972; Blake and Kudenov, 1978; Maciolek, 1985; Radashevsky, 2015; Delgado-Blas *et al*., 2018). Aong them, *P. nova* closely resembles *P. saldanha* from South Africa in having

ventral sabre chaetae, bidentate hooded hooks, and dorsal crests present from chaetiger 19. However, the former species differ from the latter species by a broad prostomium with small distal incision while rounded without incision in *P. saldanha* (Annenkova, 1938; Day, 1961; Maciolek, 1985).

Conclusion. Presently, Eight *Prionospio* species belong to *Apoprionospio* group were reported (Annenkova, 1938; Day, 1961, 1973; Hartman, 1961; Wu and Chen, 1964; Foster, 1969, 1971; Light, 1969, 1978; Fauchald, 1972; Blake and Kudenov, 1978; Maciolek, 1985; Radashevsky, 2015; Delgado-Blas et al., 2018). Among them, *Prionospio nova* was considered to be an invalid species due to the lack of types and the brief original description of this species. In this paper, *P. nova* is proved to be a valid species by the detailed description of morphological characteristics (neuropodial hooded hooks and dorsal crests), and comparison of several characteristics to other seven species in *Apoprionospio* group was provided in table 1.

Habitat. Fine sandy soil (Annenkova, 1938). In Korean waters, our material was collected from muddy sand intertidal.

Distribution. Japan (type locality), Korea.

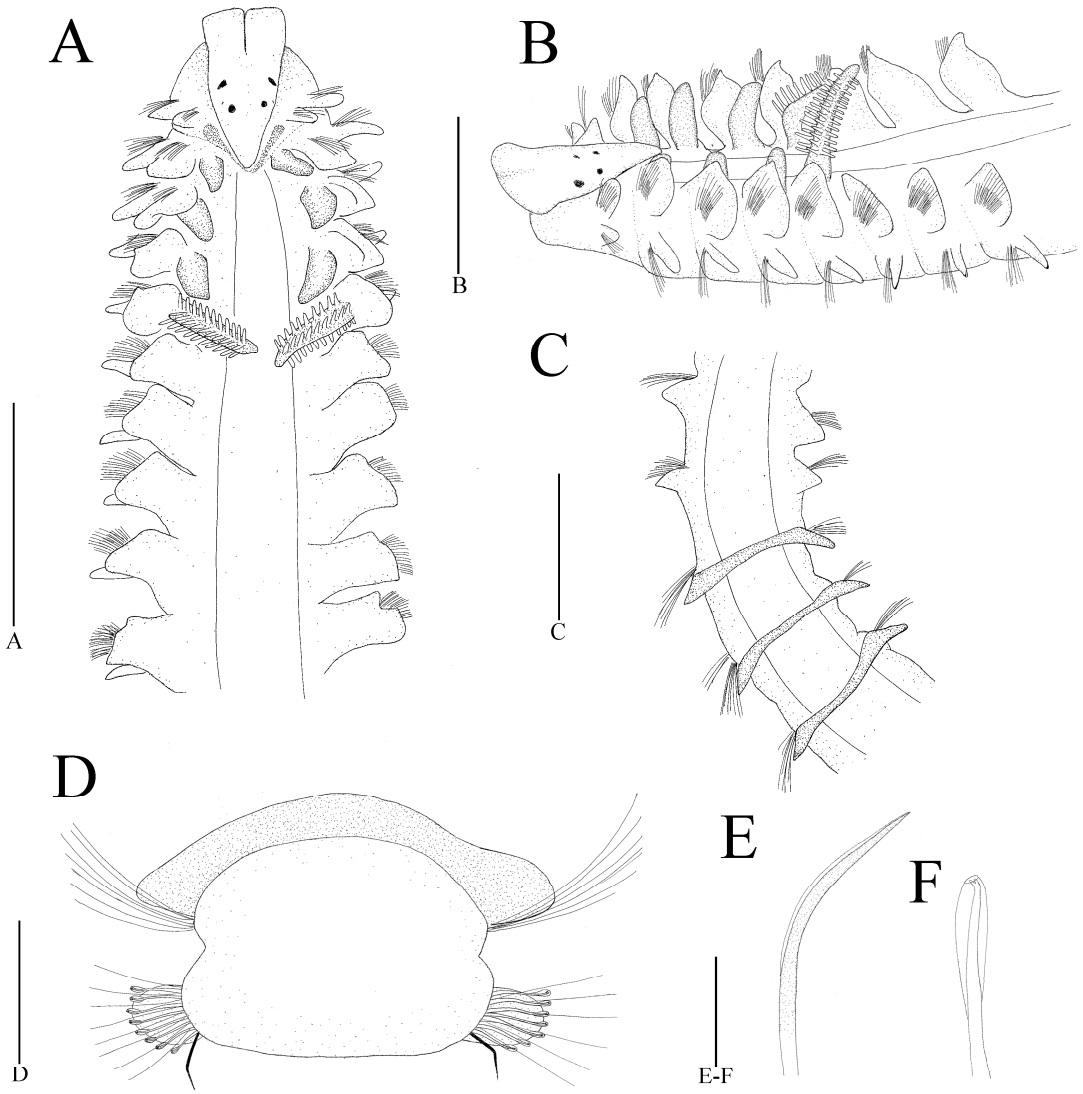

Fig. 24. *Prionospio nova* Annenkova, 1938. A, Dorsal view of prostomium with 10 chaetigers; B, Lateral view of anterior end with eight chaetigers; C, Dorsal view of chaetigers 17–21; D, Anterior view of chaetiger 27; E, Ventral sabre chaeta of chaetiger 27; F, Neuropodial hooded hook of chaetiger 27. Scale bars: A–C=0.5 mm, D=0.2 mm, E–F=0.03 mm

Table 5. Some morphological characteristics of *Prionospio* species with four pairs of branchiae, apinnate branchiae on chaetigers 2–4 and pinnate branchiae on chaetiger 5 (*Apoprionospio* group). References: 1, Maciolek, 1985; 2, Delgado-Blas *et al*., 2018; 3, Radashevsky, 2015; 4, Foster, 1969; 5, Foster, 1971; 6, Annenkova, 1938; 7, Hartman, 1961; 8, Wu and Chen, 1964; 9, Light, 1978; 10, Foster, 1969; 11, Day, 1961; 12, Day, 1973; 13, Blake and Kudenov, 1978; 14, Fauchald, 1972; 15, Present study.

Species	Anterior margin of prostomium	Peristomium	First appearance of sabre chaetae	First appearance of neuropodial hooded hooks	Apical teeth of neuropodial hooded hooks	First appearance of dorsal crests	Distribution	Reference
***P. caspersi* Laubier, 1962**	Broad to weakly concave	Wings absent	Chaetiger 11	Chaetigers 18–19	1	Chaetiger 7 only	Caribbean Sea, Venice; Iberian Peninsula	1, 2
***P. cerastae* Radashevsky, 2015**	Fronto-lateral horns	Wings absent	Absent	Chaetigers 10–15	5	Absent	Australia	3
***P. dayi* (Foster, 1969)**	Broad with small distal peak	With low lateral wings	Chaetiger 11	Chaetigers 15–18	2–5	Chaetiger 7 only	North Carolina, Texas	1, 4, 5, 12
***P. nova* Annenkova, 1938**	Broad with incised deeply	Wings absent	Chaetiger 11	Chaetigers 19–20	1	Chaetiger 19	Japan, Korea	6, 15
***P. pygmaeus* Hartman, 1961**	Broad with small distal peak	With low lateral wings	Chaetiger 11	Chaetigers 14–15	6–8	Absent	China, South California, Mexico, Virginia	1, 7, 8, 9, 10
***P. saldanha* Day, 1961**	Rounded	With low lateral wings	Chaetiger 12	Chaetigers 13–20	1	Chaetiger 19	South Africa	11
***P.tridentata* Blake & Kudenov, 1978**	Concave to deeply incised	Wings absent	Chaetiger 11	Chaetigers 19	2	Chaetiger 7	Australia	13
***P.vermillionensis* Fauchald, 1972**	Broad	With well developed wings	?	?	?	?	California	14

20. *Prionospio saccifera* Mackie & Hartley, 1990

Prionospio saccifera Mackie & Hartley, 1990: 366–371, figs. 3–4; Çinar and Ergen, 1999: 107–109, fig. 2.

Prionospio (*Prionospio*) *saccifera*: Jung *et al*., 1998: 216–226, fig. 3; Dagli and Çinar, 2009: 11–12; Zhou and Li, 2009: 126, fig. 5e–f.

Material examined. One specimen, Jeollanam-do: Yeosu-si, Nam-myeon, Yeondo-ri (127°48'34"E, 34°27'13"N), 17 Jun 2017; six specimens, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26'38"E, 34°53'20"N), 17 Sep 2017.

Diagnosis. Prostomium rounded anteriorly, extending posteriorly to end of chaetiger 1 as a prominent caruncle. Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae from chaetiger 6, all appinate. Notochaetae on chaetiger 1 present. Dorsal crests present on chaetigers 11–13. Hooks in notopodia from chaetigers 42–50, up to eight in a series among capillaries. Hooks in neuropodia from chaetigers 20–21, up to two in a series, accompanied by inferior capillaries. Hooks multidentate, with four pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetigers 19–20.

Habitat. Muddy sediments of 11–21m depth in Hong Kong, muddy bottom of 43–49m in Red Sea (Mackie and Hartley, 1990), sand, muddy sand, and sandy mud bottom of 2–20m depth (Jung *et al*., 1998), sandy mud bottoms of 65–85m depth (Çinar and Ergen, 1999), Silty mud (Zhou and Li, 2009), sandy mud substratum at 25 m depth (Dagli and Çinar, 2009). In Korean waters, our materials were collected from muddy sand intertidal.

Distribution. Hong Kong and Red Sea (type locality), China, Japan, Indian Ocean, Korea,

Mediterranean Sea, Western Pacific.

21. *Prionospio paradisea* Imajima, 1990

Prionospio (*Prionospio*) *paradisea* Imajima, 1990c: 130–134, figs. 16–17; Jung *et al*., 1998: 216–226, fig. 6.

Material examined. One specimen, Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Jeorim-ri (128°24'29"E, 34°44'51"N), 24 Mar 2014.

Diagnosis. Prostomium bell-shaped, anteriorly wide, blunt to concave, extending posteriorly to end of chaetiger 1 as a prominent caruncle Occipital antenna absent. Two pairs of eyes arranged trapezoidally. Four pairs of branchiae on chaetigers 2–5; those on chaetigers 2 and 5 pinnate, chaetigers 2 and 5 apinnate. Notochaetae on chaetiger 1 present. Hooks in notopodia from posterior chaetigers, up to eight in a series among capillaries. Hooks in neuropodia from chaetigers 14–15, up to five in a series, accompanied by inferior capillaries. Hooks multidentate, with five pairs of thin, long upper teeth arranged in two vertical rows above main fang, with inner and outer hoods. Ventral sabre chaetae from chaetiger 10.

Habitat. 5–730m depth (Imajima, 1990c), muddy sasnd and muds of 10–20m depth (Jung *et al*., 1998). In Korean waters, our materials were collected from muddy sand intertidal.

Distribution. Japan (type locality), Korea.

22. *Prionospio pulchra* Imajima, 1990 긴아가미예쁜얼굴갯지렁이 (신칭)

Prionospio (*Minuspio*) *pulchra* Imajima, 1990b: 68–71, figs. 6–7.

Prionospio pulchra: Moreira *et al*., 2000: 233–239, figs. 2–4; Lee *et al*., 2018: figs. 1, 3A–C.

Material examined. 12 specimens, Gyeongsangnam-do: Namhae-gun, Changseon-myeon, Danghang-ri (128°0′54″E, 34°53′58″N), 31 Jul 2014; three specimens, Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26′8″E, 34°53′18″N), 20 Oct 2017; three specimens, Goseong-gun, Goseong-eup, Sinwol-ri (128°20′13″E, 34°56′49″N), 20 Oct 2017. All specimens incomplete and collected from muddy sand of subtidal zones.

Description. Body slender, about 10 mm in length and about 0.2 mm in width. Colorless in alcohol.

Prostomium subtriangular with five marginal peaks, rounded anteriorly, and tapering posteriorly. Eyes two pair, bar or crescent shape; posterior pair larger than anterior pair. Caruncle extending to base of chaetiger 1. Peristomium separated from prostomium, but fused to chaetiger 1, with well-developed lateral wings (Figs. 25A–B, 26A).

Branchiae apinnate and slender, remarkably long, and about 10 pairs beginning from chaetiger 2; longest pairs on chaetigers 2–5 (Figs. 25A–B, 25C, 26A).

First chaetiger with neuropodial lamellae but without notopodial postchaetal lamellae; neuropodial lamellae distinctly small (Fig. 25C).

Notopodial lamellae separated from branchiae, subtriangular on anterior chaetigers (except chaetiger 1), and becoming rudimentary on posterior chaetigers. Neuropodial postchaetal lamellae smaller than notopodial lamellae, rounded on anterior chaetigers, and becoming rudimentary on posterior chaetigers (Figs. 25C–E, 26A).

Anterior chaetigers with capillaries only, arranged in three longitudinal rows. Hooded hooks with three pairs of small teeth above main fang; notopodial hooded hooks beginning from posterior chaetigers 28–30 and up to three per fascicle; neuropodial hooded hooks beginning from

chaetiger 14 and up to seven per fascicle. Ventral sabre chaetae beginning from chaetiger 11 (Figs. 25E–H, 26B–C) [Lee *et al*., 2018].

Methyl green staining pattern: Inconspicuous. Anterior part of prostomium, peristomium intensively stained; postchaetal lamellae and branchiae of anterior and middle chaetigers intensively stained.

Remarks. The specimens examined in the present study agree well with the original description of *Prionospio pulchra* Imajima, 1990 based on the following diagnostic characteristics: (1) the presence of remarkably long and apinnate branchiae, (2) having notopodial chaetae at the first chaetiger, and (3) the presence of ventral sabre chaetae from chaetiger 11 (Imajima, 1990b).

Wilson (1990) originally described *Prionospio tatura* Wilson, 1990 from Australian waters. This species shows remarkably long and apinnate branchiae. The first chaetiger has notopodial chaetae and the ventral sabre chaetae begin from chaetigers 9–12, which are significant features of *P. pulchra* (Imajima, 1990b; Wilson, 1990). However, *P. pulchra* clearly differs from the Australian species in the morphological features of branchiae and hooded hooks: the longest pairs of branchiae are present on chaetigers 2–5 (vs. on chaetiger 2 only in *P. tatura*); three pairs of small teeth above main fang of hooded hooks (vs. four pairs in *P. tatura*) (Imajima, 1990b; Wilson, 1990).

In Korean waters, *P. pulchra* resembles *P. multibranchiata* Berkeley, 1927 in having about 10 pairs of branchiae (Imajima, 1990b; Jung *et al*., 1998). However, these two species clearly differ from each other in the development of branchiae: the longest pair extend over 6–8 segments in *P. pulchra* vs. 2–3 segments in *P. multibranchiata* (Imajima, 1990b; Parapar *et al*., 1995; Jung *et al*., 1998) [Lee *et al*., 2018].

Habitat. Japanese materials were collected from the intertidal zone to 67 m depth. In Korean waters, materials were collected from the intertidal zone [Lee *et al*., 2018].

Distribution. Japan (type locality), Australia, Korea, Spain.

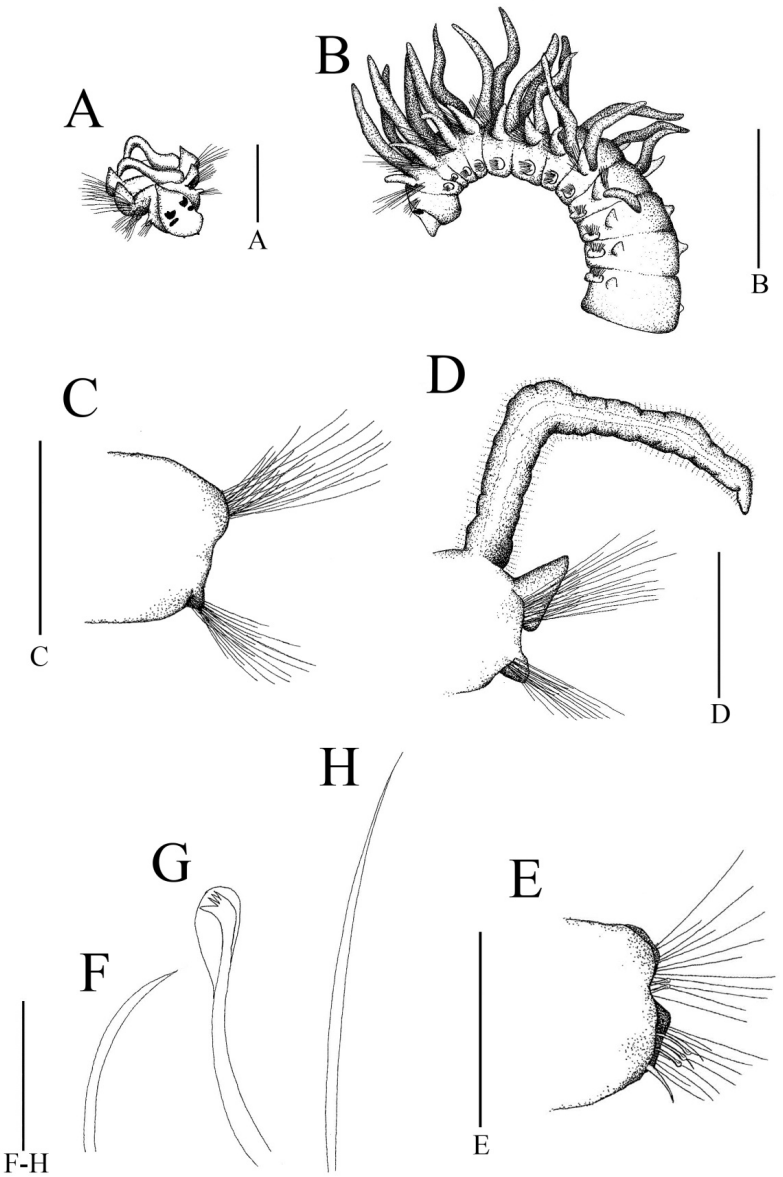

Fig. 25. *Prionospio pulchra* Imajima, 1990. A, Dorsal view of prostomium and three chaetigers; B, Lateral view of anterior end; C, Anterior view of chaetiger 1; D, Anterior view of chaetiger 2; E, Anterior view of posterior chaetiger; F, Ventral sabre chaeta; G, Lateral view of neuropodial hooded hook; H, Notopodial capillary chaeta. Scale bars: A=0.5 mm, B=1.0 mm, C–E=0.3 mm, F–H=0.03 mm [Lee *et al*., 2018].

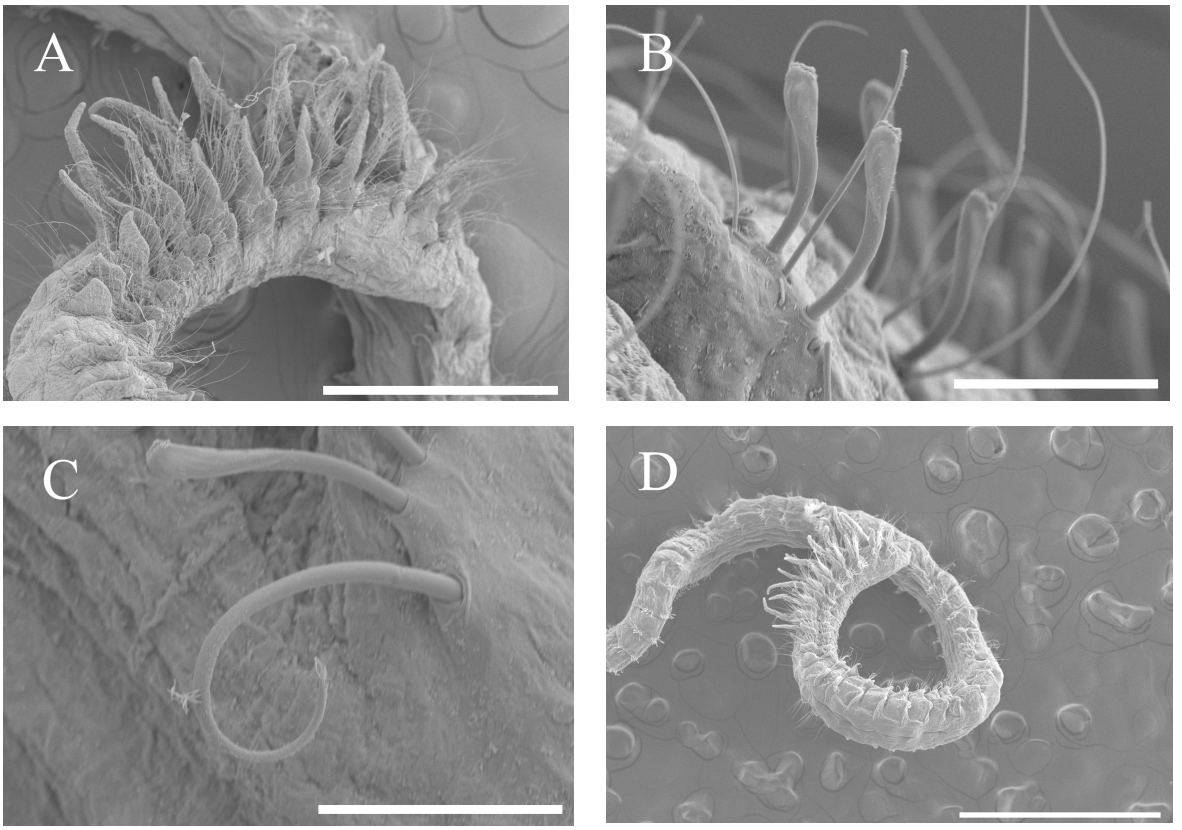

Fig. 26. Scanning electron microscopy photographs of *Prionospio pulchra*. A, Lateral view of anterior end; B, Lateral view of neuropodial hooded hooks; C, Ventral sabre chaeta. D, Lateral view of entire body. cale bars: A=0.4 mm, B–C=0. 3 mm, D=1.0 mm [Lee *et al*., 2018].

Genus *Pseudopolydora* Czerniavsky, 1881 선녀얼굴갯지렁이속

Pseudopolydora Czerniavsky, 1881: 362; Blake and Kudenov 1978: 267; Blake 1996: 202, Radashevsky, 2015: 680.

Polydora (*Carazzia*): Fauvel 1927: 48.

Polydora (*Pseudopolydora*): Hartmann-Schröder 1971: 317; 1996: 322.

Type species: *Polydora antennata* Claparede, 1868, by monotypy.

Diagnosis: Prostomium rounded or incised anteriorly, extending posteriorly as a low caruncle. Occipital antenna present or absent. Chaetiger 1 without notochaetae. Chaetiger 5 with two types of notopodial modified spines; simple spines and pennoned spines. Branchiae from chaetiger 7. Neuropodial hooded hooks from chaetiger 8.

Key to the species of *Pseudopolydora* Czerniavsky, 1881 from Korean waters

1. Prostomium rounded anteriorly……...….....*P. paucibranchiata*
 - Prostomium bilobed anteriorly…….…….……..……...2
2. Caruncle extending beyond chaetiger 5; black pigments absent on dorsal side in fixed specimens…….*P. antennata*
 - Caruncle not extending beyond chaetiger 5; black pigments present on dorsal side…….…....3
3. Caruncle extending middle of chaetiger 3; two rows of black spots present on dorsal side; ventral pigmentation absent……..…….....*P. kempi*
 - Caruncle extending middle of chaetiger 4; black reticulated pigments present on dorsal side; two rows of black spots present on ventral side…….....*P. reticulate*

23. *Pseudopolydora antennata* (Claparède, 1869) 선녀얼굴갯지렁이

Polydora (*Carazzia*) *antennata* Claparède, 1869; Okuda, 1937; 237, fig. 15.

Pseudopolydora antennata: Imajima and Hartman, 1964: 286–287; Woodwick, 1964: 149, fig. 2.7–2.8; Hutchings and Turvey, 1984: 16, fig. 6; Paik, 1982: 806; 1989: 458–459; Sato-Okoshi, 2000: 448; Zhou *et al*., 2010: 7–8, fig. 3A–H; Simon *et al*., 2017: 4.

Material examined. One specimen, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Samhwa-ri (128°26′8″E, 34°53′18″N), 20 Oct 2017.

Diagnosis. Prostomium anteriorly bifid, extending posteriorly to end of chaetiger 6 as a low caruncle. Nuchal organs ciliary bands on sides of caruncle. Short occipital antenna present on caruncle. Two pairs of small black eyes arranged trapezoidally. Notochaetae on chaetiger 1 absent. Chaetiger 5 same size as chaetigers 4 and 6, with four dorsal superior winged capillaries, two kinds of notopodial modified spines arranged in a double J-shaped series; Anterior-row notochaetae enlarged pennon spines and posterior-row notochaetae simple falcate spines. Branchiae from chaetiger 7. Bidentate hooks in neuropodia from chaetiger 8. Special notochaetae in posterior chaetigers absent. Pygidium notched on both dorsal and ventral median portions.

Habitat. Muddy substratum between crevices of shore rock (Okuda, 1937), serpentine creek (Hutchings and Turvey, 1984), mud in algal holdfast, mud flats, and mud in crevices of sandstone rocks (Sato-Okoshi, 2000), intertidal sand flats and crevices of shore rock (Zhou *et al*., 2010). In this study, material was collected from the muddy sand intertidal.

Distribution. Mediterranean (type locality), Australia, China, North Pacific, Gulf of Naples, Indian Ocean, Italy, Japan, Korea, South Africa.

25. *Pseudopolydora kempi* (Southern, 1921) 두점박이선녀얼굴갯지렁이 (신칭)

Polydora (Carazzia) kempi Southern, 1921: 636–638, fig. 20.

Pseudopolydora kempi var. Okuda, 1937: 233–236, figs. 13–14.

Pseudopolydora kempi japonica Imajima & Hartman, 1964, 287.

Pseudopolydora kempi: Blake and Woodwick, 1975: 118–124; Blake and Kudenov, 1978: 268–269; Zhou *et al*., 2010: 8–9; Hiebert *et al*., 2015: 218–222.

Pseudopolydora cf. *kempi japonica*: Radashevsky and Hsieh, 2000b: 221–223, fig. 3.

Pseudopolydora cf. *kempi*: Sato-Okoshi, 2000: 448; Abe *et al*., 2016: 658–658, fig. 2.

Material examined. Korea: 10 spcimens, Jeju-do: Jeju-si, Yongdam 2-dong (126°29′24″E, 33°31′10″N), 28 Apr 2011; 25 specimens, Jeollabuk-do: Buan-gun, Jinseo-myeon, Jinseo-ri (126°60′43″E, 35°58′62″N), 14 Aug 2014; eight specimens, Jeollanam-do: Jindo-gun, Imhoe-myeon, Namdong-ri (126°9′25″E, 34°21′37″N), 30 Mar 2018; five specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Gyeokpo-ri (126°28′03″E, 35°38′05″N), 14 May 2018; one specimen, Jeollanam-do: Jindo-gun, Jodo-myeon, Chang-yu-ri (126°1′50″E, 34°18′20″N), 25 Oct 2018.

Description. Body flattened anteriorly and cylindrical posteriorly, complete specimens up to 20.0 mm long and 2.0 mm wide. Dorsal, paired, black spots present on chaetigers 3–12. Transverse, lateral, black bands present on chaetigers 2–13 (Figs. 27A–B, 28A).

Prostomium anteriorly bifid, extending posteriorly to middle of chaetiger 3 as a low caruncle; nuchal organs ciliary bands on sides of caruncle. Occipital antenna present on caruncle; black spot on caruncle behind occipital tentalcle. Four black eyes arranged trapezoidally. Palps as long as 20 segments, with longitudinal groove lined with fine cilia (Figs. 27A–B, 28A).

Chaetiger 1 with short notopodial postchaetal lamellae and well developed neuropodia; winged capillary neurochaetae present and notochaetae absent. Notochaetae arranged three rows on

chaetigers 3–10 (except chaetiger 5); anterior row with short and broadly winged chaetae, median row with slender and narrowly limbate chaetae, and posterior row with markedly elongate slender slightly limbate chaetae (Figs. 27D–F, 28B).

Chaetiger 5 same in size as chaetigers 4 and 6, with 5 dorsal superior winged capillaries, two kinds of notopodial modified spines arranged in a double J-shaped series, and about 20 ventral winged capillaries; spines in anterior row (outer) pennoned with curved, pointed tips, about 22 in series and spines in posterior (inner) row simple, falcate, about 15 in series (Figs. 27G–H, 28C).

Hooks in neuropodia from chaetiger 8 to posterior end, not accompanied by capillaries; Hooks bidentate, upper part of shaft with constriction, lower part of shaft bent at right angle (Figs. 27I, 28D).

Branchiae on chaetigers 7–24, full-sized from chaetigers 8–10, free from notopodial postchaetal lamellae. Transverse ciliary bands extending across dorsum between branchiae (Figs. 27A–B, 28A).

Glandular pouches from chaetiger 1, single throughout.

Gizzard-like structure in digestive tract absent.

Pygidium large flaring disc with dorsal gap and without dorsolateral process (Fig. 27C).

Methyl green staining pattern: Anterior part of prostomium and peristomium intensively stained. Margins of branchiae and postchaetal lamellae also stain intensively. Scattered dots of chaetigers 5–13 most intensively stained ventrally. Some transverse ciliary bands between branchiae stained. Pygidium completely deep blue after staining.

Remarks. The original description of *Pseudopolydora kempi* (Southern, 1921) from brackish waters in India was so brief based on the incomplete specimens. Presently, there is no type material exists in this species (Southern, 1921; Radashevsky and Hsieh, 2000b; Sato-Okoshi, 2000; Abe *et al*., 2016). Imajima and Hartman (1964) established a new subspecies, *Pseudopolydora kempi japonica*, from Japanese population base on the body length, the extension of caruncle, and the number of branchiae (Okuda, 1937; Imajima and Hartman, 1964; Radashevsky and Hsieh,

2000b; Abe *et al*., 2016). But Sato-Okoshi (2000) regarded the Japanese population as *P*. cf. *kempi* because the length of caruncle can be variable and is often related to the body length as like in other polydorids. And they did not find distinct morphological difference between *P. kempi* and *P. kempi japonica* (Radashevsky and Hsieh, 2000b; Sato-Okoshi, 2000; Abe *et al*., 2016).

The specimens examined in the present study agree well with the description of *P. kempi* by Sato-Okoshi (2000) and Abe *et al* (2016), based on the following diagnostic characteristics: (1) a prostomium bilobed anteriorly, (2) the presence of occipital antenna, (3) caruncle extending to the middle of chaetiger 3, (4) segment 5 less modified, similar to chaetigers 4 and 6 in size and shape, and (5) the presence of two rows of black spots on the dorsal side.

Habitat. Serpentine Creek and sand bank (Blake and Kudenov, 1978), sand flat from intertidal to subtidal (Zhou *et al*., 2010); intertidal sand flat (Abe *et al*., 2016); muddy habitats (Radashevsky and Hsieh, 2000b); mud sediments in bays and estuaries (Blake and Woodwick, 1975). In this study, the Korean materials were collected from muddy sand from intertidal to 10 m depth.

Distribution. India (type locality), Australia, British Columbia, China, Japan, Korea, Mozambique, Taiwan, USA.

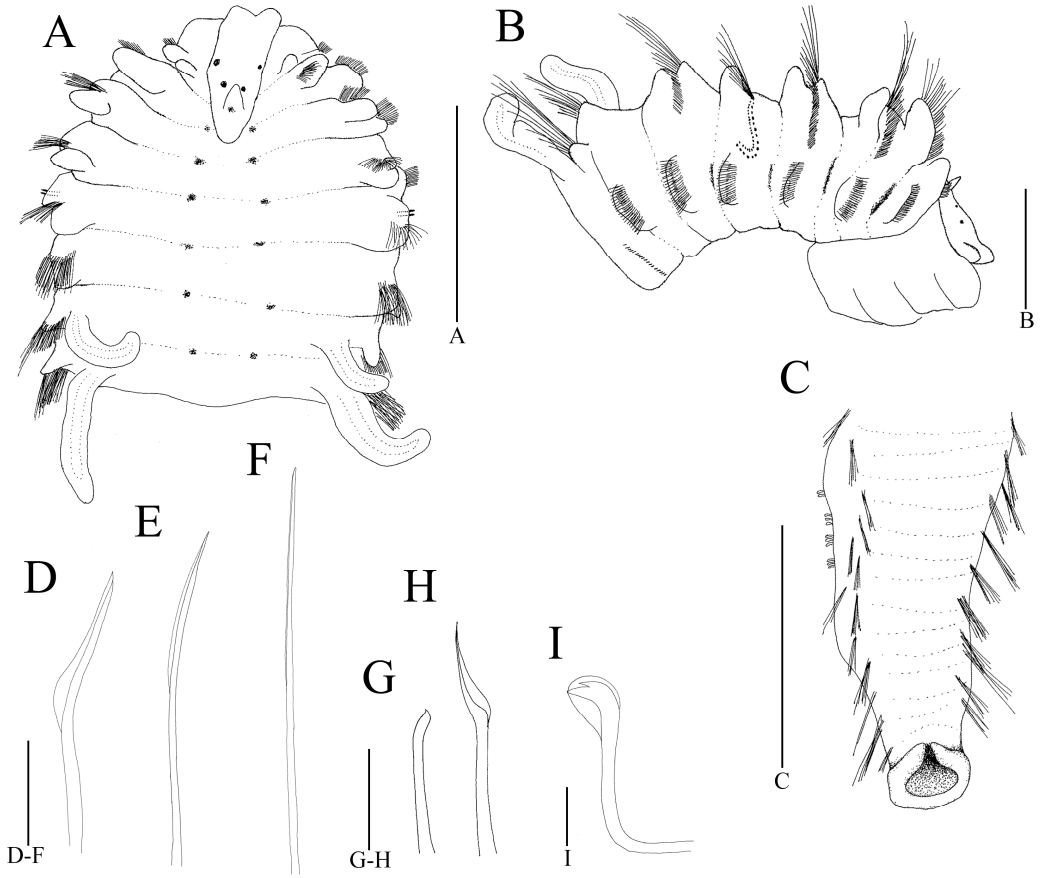

Fig. 27. *Pseudopolydora kempi* (Southern, 1921). A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with eight chaetigers, lateral view; C, Posterior end; D, Anterior row with short and broadly winged chaetae; E, Median row with slender and narrowly limbate chaetae; F, Posterior row with markedly elongate slender slightly limbate chaetae; G, Inner falcate spine of chaetiger 5; H, Outer pennoned spine of chaetiger 5; I, Hooded hook. Scale bars: A=1.0 mm, B=0.5 mm, C=2.0 mm, D–F=0.05 mm, G–H=0.6 mm, I=0.03 mm.

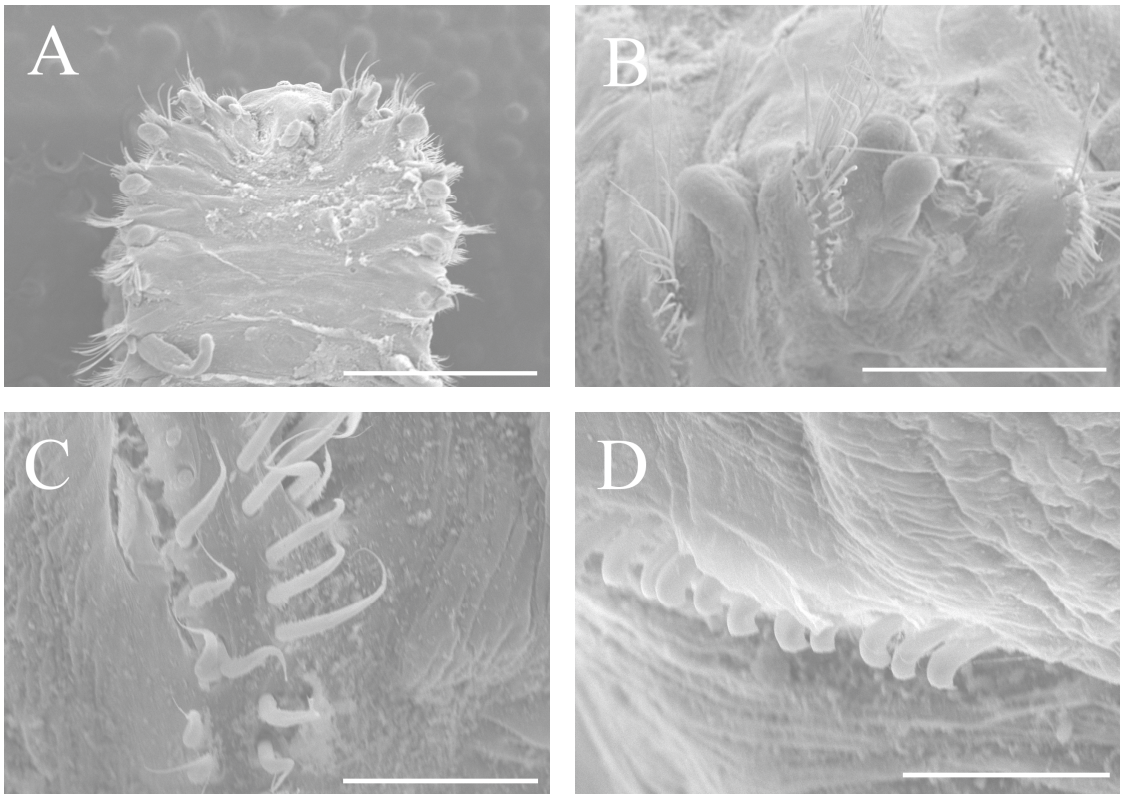

Fig. 28. Scanning electron microscopy photographs of *Pseudopolydora kempi* (Southern, 1921). A, Anterior end, dorsal view; B, Chaetigers 4–6, lateral view; C, Chaetiger 5, lateral view; D, Hooded hooks. Scale bars: A=1.0 mm, B=0.3 mm, C–D=0.05 mm.

25. *Pseudopolydora paucibranchiata* (Okuda, 1937) 둥근선녀얼굴갯지렁이

Polydora (*Carazzia*) *paucibranchiata* Okuda, 1937: 231–233, figs. 11–12.

Pseudopolydora paucibranchiata: Imajima and Hartman, 1964: 288; Light, 1977: 71–72; Blake and Kudenov, 1978: 268; Hutchings and Turvey, 1984: 17, fig. 7; Paik, 1984a: 196–197; 1989: 459–460; Radashevsky, 1993: 50–53, fig. 27; Radashevsky and Hsieh, 2000b: 223; Sato-Okoshi, 2000: 448–449; Zhou *et al*., 2010: 9–10, fig. 3P–V.

Pseudopolydora cf. *paucibranchiata*: Radashevsky, 2015: 681–682, fig. 30.

Material examined. One specimen, Jeollanam-do: Yeosu-si, Nam-myeon, Hwatae-ri (127°44'07"E, 34°34'58"N), 25 Jun 2017; 15 specimens, Gyeongsangnam-do: Tongyeong-si, Sanyang-eup, Sinjeon-ri (128°26'56"E, 34°46'58"N), 19 Sep 2017; four specimens, Gyeongsangnam-do: Tongyeong-si, Yongnam-myeon, Hwasam-ri (128°25'13"E, 34°53'03"N), 30 Sep 2017; seven specimens, Jeollanam-do: Jindo-gun, Imhoe-myeon, Namdong-ri (128°09'25"E, 34°21'37"N), 30 Mar 2018.

Diagnosis. Prostomium anteriorly rounded, extending posteriorly to end of chaetiger 3 as a low caruncle. Nuchal organs ciliary bands on sides of caruncle. Short occipital antenna present on caruncle. Two pairs of small black eyes arranged trapezoidally. Notochaetae on chaetiger 1 absent. Chaetiger 5 same size as chaetigers 4 and 6, with four dorsal superior winged capillaries, two kinds of notopodial modified spines arranged in a double J-shaped series; Anterior-row notochaetae enlarged pennon spines and posterior-row notochaetae simple falcate spines. Branchiae from chaetiger 7. Bidentate hooks in neuropodia from chaetiger 8. Special notochaetae in posterior chaetiger absent. Pygidium disc-like, dorsally wide open.

Habitat. Currubene creek (Blake and Kudenov, 1978), mud tubes in soft bottoms (Radashevsky and Hsieh, 2000b), mud flats (Sato-Okoshi, 2000), mud tubes in intertidal flaat with soft bottoms

(Zhou *et al*., 2010), fine coral sand at 14m depth. In this study, the Korean materials were collected from muddy sand from intertidal to 10 m depth.

Distribution. Japan (type locality), Australia, California in USA, China, Korea, Mediterranean Sea, New Zealand, North-western Sapin, Taiwan.

26. *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000

Pseudopolydora reticulata Radashevsky & Hsieh, 2000b: 229–231, figs. 8, 11b; Zhou *et al*., 2010: 10.

Pseudopolydora cf. *reticulata*: Abe *et al*., 2016: 652, fig. 2a–c.

Material examined. 15 specimens, Jeollanam-do: Jindo-gun, Jodo-myeon, Sinyuk-ri (126°4'45"E, 34°17'4"N), 25 Oct 2018.

Description. Body flattened anteriorly and cylindrical posteriorly, complete specimens about 10mm long and 1mm wide. Body yellowish-white with black reticulated pigments present on dorsal side of chaetiger 1 to middle chaetigers; longitudinal black band present along midline of caruncle behind occipital antenna. Small, paired, ventral black spots present along posterior edge of anterior chaetigers. Dorsal, ventral, and lateral pigmentation often disappear in preserved materials (Figs. 29A–B, 30C).

Prostomium anteriorly bifid, extending posteriorly to middle of chaetiger 4 as a low caruncle. Nuchal organs ciliary bands on sides of caruncle. Occipital antenna present on caruncle. Four black eyes arranged trapezoidally. Palps as long as 10–15 segments, with longitudinal groove lined with fine cilia (Figs. 29A–B, 30C).

Chaetiger 1 with short notopodial postchaetal lamellae and well developed neuropodia; winged

capillary neurochaetae present and notochaetae absent. Anterior row notopochaetae of chaetigers 3, 4, 6, and 7 slightly modified, arranged in weak J-shape rows resembling arrangement of chaetiger 5; notochaetae varying in shape from short to long, curved to straight, and broadly to faintly limbate in anterior chaetigers. Anterior row of notochaetae at chaetigers 3–7 heavily curved, pennoned compared with those of chaetigers 2 and 7 onwards, and greatly modified on chaetiger 5 (Figs. 29A–B, 30C).

Chaetiger 5 same in size as chaetigers 4 and 6, with 5 dorsal superior winged capillaries, two kinds of notopodial modified spines arranged in a double J-shaped series, and about 20 ventral winged capillaries; spines in anterior row (outer) pennoned with curved, pointed tips, about 20 in series and spines in posterior (inner) row simple, falcate, about 15 in series (Figs. 29A–B, 30F–G).

Hooks in neuropodia from chaetiger 8 to posterior end, not accompanied by capillaries; Hooks bidentate, upper part of shaft with constriction, lower part of shaft bent at right angle (Figs. 29C, 30E).

Branchiae on chaetigers 7–20, full-sized from chaetigers 8–10, free from notopodial postchaetal lamellae.

Glandular pouches from chaetiger 1, largest and paired on either side in chaetigers 6 and 7, single on either side in other chaetigers (Figs. 29A, 30C).

Gizzard-like structure in digestive tract absent.

Pygidium large flaring disc with dorsal gap and erect process on each dorsolateral side (Fig. 30D).

Methyl green staining pattern: Anterior part of prostomium and peristomium intensively stained; margins of branchiae and postchaetal lamellae also stain intensively. Scattered stained dots across dorsum on chaetiger 2 onwards and transverse ciliary bands between branchiae on middle chaetigers stained dorsally. Stained dots scattered in middle parts of chaetigers 1–5 and bands of scattered dots of chaetigers 6–14 most intensively stained ventrally. Pygidium completely deep blue after staining (Fig. 31A–B).

Remarks. The specimens examined in the present study agree well with the original description of *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000 based on the following diagnostic characteristics: (1) the presence of reticulate, netlike pigmentation on the dorsal side of the anterior chaetigers, (2) the presence of black band on the caruncle, (3) the presence of two rows of small spots on the ventral side of the anterior chaetigers, (4) the presence of pygidium with dorso-lateral extensions, and (5) the anterior row of notopodial spines on chaetiger 5 without subdistal constriction. The original materials have a longer caruncle than Korean and Japanese materials in spite of their smaller sizes (Radashevsky and Hsieh, 2000b; Abe et al., 2016).

Pseudopolydora reticulate very closely resembles *P. bassarginensis* (Zachs, 1933) from Japanese waters in having the reticulate, netlike pigmentation on the dorsal side of the anterior chaetigers. However, *P. reticulate* differs from *P. bassarginensis* in the presence of black paired spots on the ventral side of anterior chaetigers (clearly shown in the Korean materials). Abe *et al*. (2016) tentatively identified this species as *P.* cf. *reticulate* due to the brief original description and uncertain status of *P. bassarginensis* (Zachs, 1933, Radashevsky and Hsieh, 2000b; Zhou *et al*., 2010; Abe *et al*., 2016).

Habitat. Muddy sand tubes in soft bottoms of brackish water environment (Radashevsky and Hsieh, 2000b), intertidal sand flat and muddy sand tubes in soft bottoms of brackish water (Zhou *et al*., 2010), intertidal, sand flat (Abe *et al*., 2016). In this study, the Korean materials were collected from muddy sand intertidal zones.

Distribution. Taiwan (type locality), China, Japan, Korea.

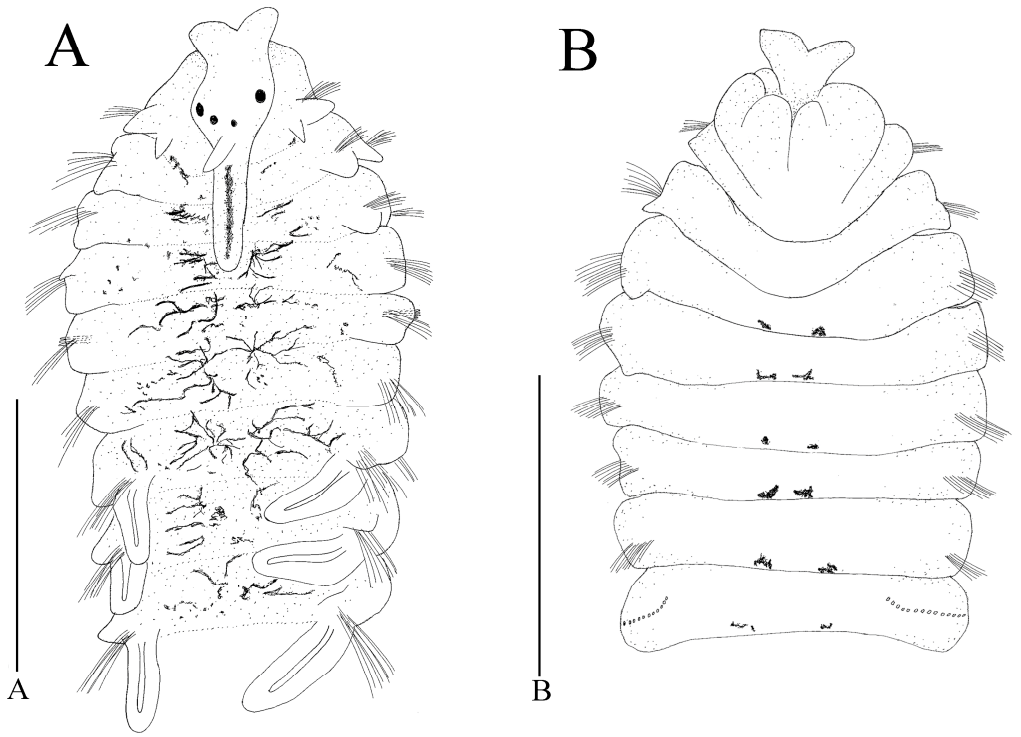

Fig. 29. *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000. A, Anterior end with nine chaetigers, dorsal view; B, Anterior end with eight chaetigers, ventral view. Scale bars: A–B=1.0 mm.

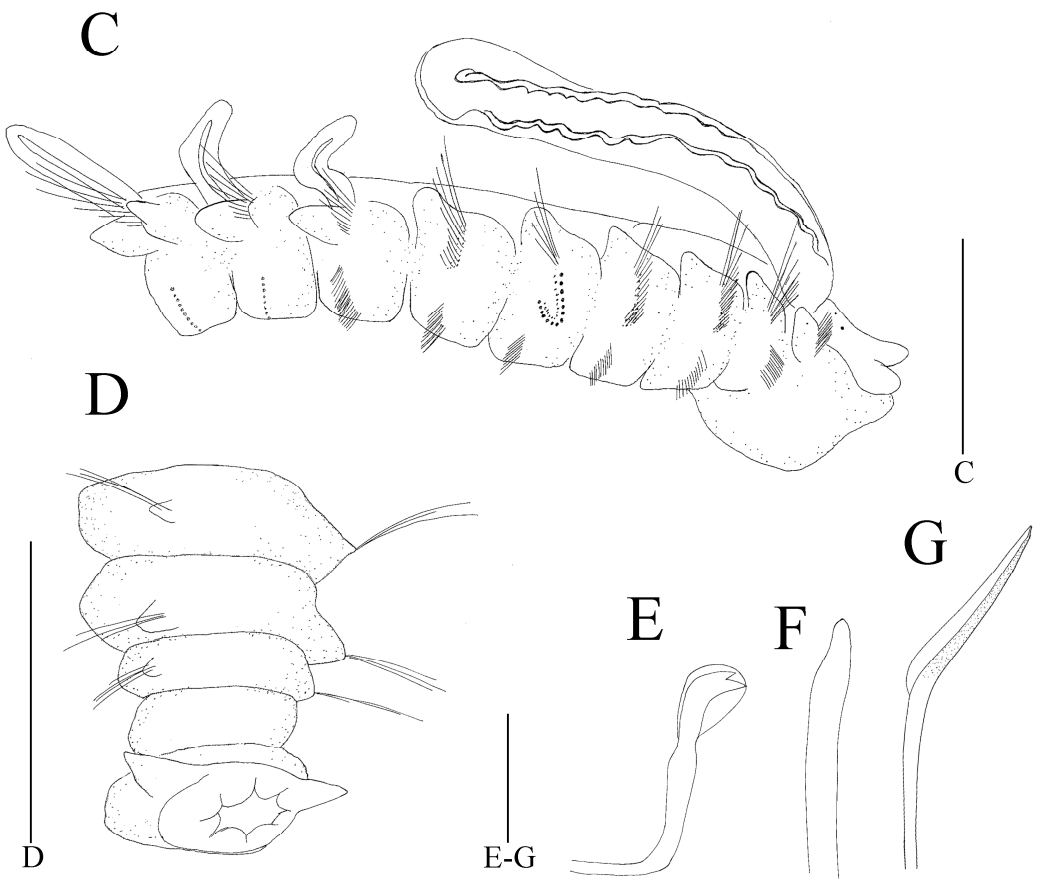

Fig. 30. *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000. C, Anterior end with nine chaetigers, lateral view; D, Posterior end; E, Neuropodial hooded hook; F, Inner falcate spine of chaetiger 5; G, Outer pennoned spine of chaetiger 5. Scale bars: C=0.3 mm, D=0.5 mm, E–G=0.03 mm.

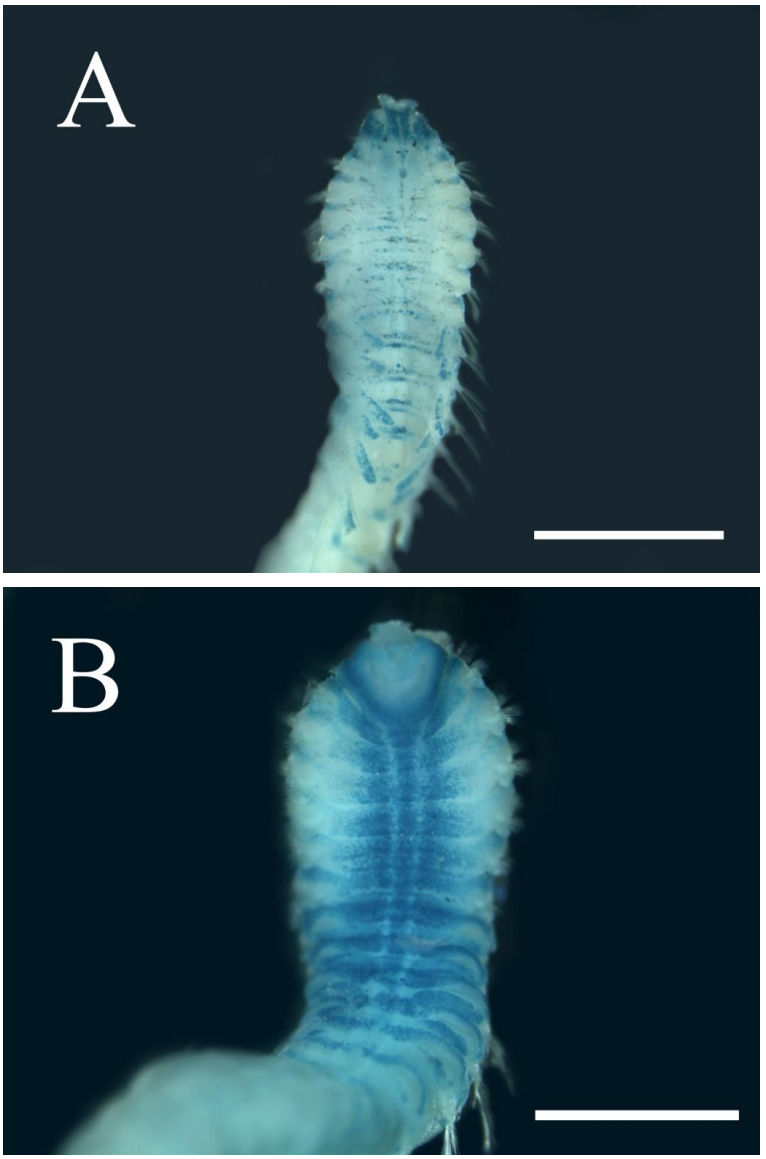

Fig. 31. *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000 stained with methyl green. A. Anterior end, dorsal view; B. Anterior end, ventral view. Scale bars: A=0.5 mm, B=0.3 mm.

Genus *Rhynchospio* Hartman, 1936

Rhynchospio Hartman, 1936: 51; Fauchald 1977: 25; Blake and Kudenov 1978: 198–199; Imajima, 1991: 9; Radashevsky 2007: 996, 2015: 684.

Malacoceros (*Rhynchospio*): Pettibone 1963: 98–99; Foster 1971: 48.

Type species: *Rhynchospio arenincola* Hartman, 1936, by monotypy.

Diagnosis: Prostomium with fronto-lateral horns. Occipital antenna absent. Cirriform branchiae from chaetiger 2 to almost end of the body. Nuchal organs metameric. Notochaetae all capillaries. Hooded hooks in neuropodia uni-, bi-, tri- or quadridentate. Ventral sabre chaetae present. Pygidum with more than two pairs of cirri.

27. *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959

Rhynchospio asiatica Chlebovitsch, 1959: 175–176, fig. 5; Tarakanova, 1974: 119–120; Kussakin, 1974: 352.

Malacoceros (*Rhynchospio*) *arenincolus asiaticus*: Buzhinskaja, 2013: 58.

Material examined. 40 specimens, Jeollanam-do: Yeosu-si, Samsan-myeon, Geomun-ri (127°35′02″E, 34°03′64″N) 6 Jul 2017; two specimens, Jeollanam-do: Wando-gun, Cheongsan-myeon, Dongchon-ri (127°54′35″E, 34°11′06″N) 23 Aug 2017, two specimens, Jeollanam-do: Wando-gun, Soan-myeon, Gahak-ri (126°30′35″E, 34°09′40″N) 7 Jul 2017, muddy sand, collected from subtidal zones.

Description. Specimens complete up to 10mm long, 0.3 mm wide at anterior end. Cuticle and epithelium thin, worms extremely fragile and break easily during handling and fixation. Colorless in alcohol fixed specimens without any pigmentation.

Prostomium with two conical fronto-lateral horns, bearing small knobs with short non-motile cilia. Caruncle low, indistinct, levelled in end of chaetiger 1. Occipital antenna absent. Two pairs of small red eyes arranged trapezoidally; lateral large crescent eyes, situated anteriorly and set wider apart; median eyes small; eyes red in living and fixed specimens. Nuchal organs metameric; first pair of metamers on chaetiger 1 as curved ciliary bands on lateral sides of low caruncle; successive metamers as one pair of ciliary bands on posterior half of each chaetiger present through length of body. Palps as long as 5–10 chaetigers, with frontal longitudinal groove lined with fine cilia, fronto-lateral compound cilia situated on sides of groove and beating towards the groove, and short transverse bands of long cilia regularly arranged on inner lateral side on distal half of each palp (Fig. 32A).

Chaetiger 1 with long capillaries and small postchaetal lamellae in both rami. Posterior notopodia with only capillaries. Notopodial postchaetal lamellae elongated; neuropodial lamellae short and rounded (Fig. 32A).

Sabre chaetae in neuropodia from chaetiger 16, up to three, with fine granulation on distal half of shaft (Fig. 32C–D).

Hooks in neuropodia from chaetiger 16, up to six in a series, accompanied by 1–4 alternating capillaries and inferior sabre chaetae throughout. Hooks with only outer hood, tridentate, with two small upper teeth arranged in line above main fang; uppermost tooth tiny in hooks in anterior neuropodia, prominent in hooks in posterior neuropodia (Fig. 32D, 32E).

Branchiae from chaetiger 2 through most part of body, free from notopodial postchaetal lamellae, flattened, with surfaces orientated parallel to body axis, each with nototrochs as two rows of short cilia running along inner surface (Fig. 32A–C).

Pygidium with two ventral thick cirri and up to five pairs of thinner and longer dorsal cirri (Fig. 32F.

Simultaneous hermaphrodite with sperm from chaetigers 11–12 and oocytes from chaetiger 16.

Methyl green staining pattern: Anterior part of prostomium and peristomium intensively stained; some stain also on anterior of chaetiger 1. Margins of branchiae and margins of postchaetal

lamellae of anterior and middle

chaetigers also stain. Scattered stained cells across dorsum on chaetigers 1–7.

If specimens transferred from methyl green solution into distilled water, metameric lateral nuchal organs from chaetiger 1 and nototrochs as two rows of short cilia discernible dorsally on anterior chaetigers (Fig. 33).

Remarks. Three species in *Rhynchospio glutaea* complex, *R. glutaea* (Ehlers, 1897), *R. arenincola* Hartman, 1936, and *R. asiatica* Chlebovitsch, 1959, originally described from the Strait of Magellan in Chile, California, and South Kurile Islands, respectively, are closely similar to each other in adult morphology. Radashevsky *et al*. (2014) examined the molecular analysis of these sibiling *Rhynchospio* species collected from Chile, Californica, South Kriles Island, Vietnam, and South Korea by using the data of mitochondrial *16S* rDNA, nuclear *18S*, *28S* rDNA, and *Histone 3*. They concluded that *Rhynchospio* species collected from South Korea is a separated species from *R. glutaea*, *R. arenincola*, and *R. asiatica*, and most close to *R. asiatica* from South America.

Habitat. Muddy sand (Radashevsky *et al*., 2014). In this study, the Korean materials were collected from the subtidal zone (46 m depth).

Distribution. Russia (type locality), China, Japan, Korea.

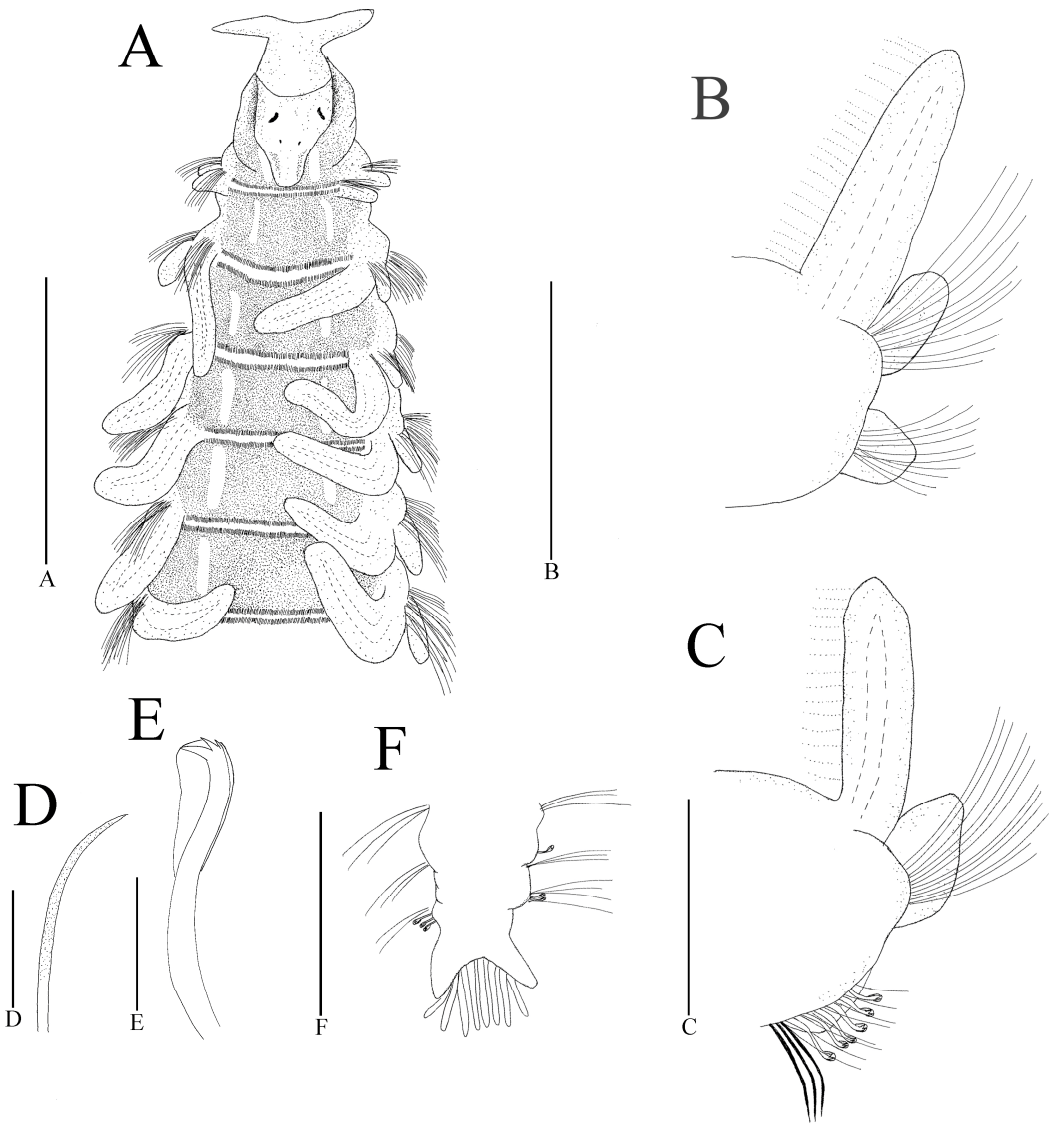

Fig. 32. *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959. A, anterior dorsal view with six chaetigers; B, Anterior view of chaetiger 2; C, Anterior view of chaetiger 16; D, Ventral sabe chaeta; E, Neuropodial hooded hook; F, Posterior end. Scale bars: A=0.5 mm, B=0.2 mm, C=0.3 mm, D=0.1 mm, E=0.03 mm, F=0.5 mm.

Fig. 33. *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959 stained with methyl green, showing metameric lateral nuchal organs (arrow) well observable in stained specimens. Scale bar: 0.5 mm.

Genus *Scolelepis* Blainville, 1828 넓적얼굴갯지렁이속

Scolelepis Blainville, 1828: Blake and Kudenov, 1978: 175–176; Maciolek, 1987: 17; Imajima, 1992: 1–2; Rocha and Pavia, 2012: 386; Zhou *et al*., 2009: 38; Sikorski, 1994: 280; Meißnera and Gotting, 2015: 386; Sikorski and Pavlova, 2015: 10.

Type species: *Lumbricus squamata* Müller, 1806, by monotypy.

Diagnosis: Prostomium pointed or truncate anteriorly, extending posteriorly as a caruncle. Occipital antenna present or absent. Peristomium well-developed, with or without lateral wings encompassing prostomium partially. Nuchal organs and metameric dorsal ciliated organs not discernable. Branchiae from chaetiger 2 to almost end of body; completely fused to notopodial lamellae or distally free in anterior chaetigers. Hooks with 0–3 apical teeth with a falcate or straight shaft (subgenus *Scolelepis*) or multidentate with large main fang, several apical teeth and curved shaft (subgenus *Parascolelepis*). Pygidium with oval disc or multilobed.

Key to the species of *Scolelepis* Blainville, 1828 from Korean waters

1. Hooded hooks with 0–2 apical teeth, with straight shaft…….……...…2

- Hooded hooks multidentate with curved shaft……...…….…….*S.* (*P.*) *yamaguchii*

2. Branchiae fully fused to notopodial lamellae on anterior chaetigers; prostomium elongate.....…...
……...*S. victoriensis*

- Branchiae almost fused to notopodial lamellae (free tips)……...3

3. Prostomium sagittate; occipital antenna present…….…….. *S.* (*S.*) *sagittaria*

- Prostomium conical; occipital antenna absent…….……..…*S.* (*S.*) *kudenovi*

28. *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992 화살촉넓적얼굴갯지렁이 (신칭)

Scolelepis (*Scolelepis*) *sagittaria* Imajima, 1992: 13–16, figs. 8–10; Lee *et al*., 2018: figs. 2, 3D–F.

Material examined. Korea: 30 specimens, Jeollanam-do: Yeosu-si, Samsan-myeon, Deokchon-ri (127°18′16″E, 34°1′11″N), 27 May 2017; two specimens, Wando-gun, Cheongsan-myeon, Dongchon-ri (127°18′27″E, 34°1′21″N), 27 Jun 2017. All specimens incomplete and collected from muddy sand of subtidal zones.

Description. Body flattened, about 10.0 mm in length and about 1.0 mm in width.

Prostomium sagittate, elongate, and pointed anteriorly; eyes two pairs, present on posterior region. Occipital antenna present. Peristomium separated from prostomium and forming lateral wings (Figs. 34A, 35A–B).

Branchiae elongate and tapered into pointed tip with pigmented glands, beginning from chaetiger 2 to posterior end; branchiae longer than notopodial lamellae (Figs. 34A–F, 35A–B).

First chaetiger reduced, without branchiae (Figs. 34A–B, 35A–B).

Notopodial lamellae elongated and almost fused to branchiae on anterior chaetigers; tips of lamellae separated from branchiae. Notopodial lamellae basally fused to branchiae on posterior chaetigers. Neuropodial lamellae divided into interramal lamellae and ventral lamellae on posterior chaetigers; interramal lamellae flattened and ventral neuropodial lamellae conical (Figs. 34A–F, 35A–B).

Anterior chaetigers with broadly limbate and heavily granulated capillaries, arranged in two rows. Neuropodial hooded hooks bi- or tridentate, beginning from chaetiger 32, and up to 10 per fascicle. Notopodial hooded hooks tridentate with two small apical teeth, present on posterior chaetigers, and up to six per fascicle (Figs. 34G–K, 35C–D) [Lee *et al*., 2018].

Methyl green staining pattern: Inconspicuous. Prostomium, peristomium, branchiae and postchaetal lamellae most intensely stained.

Remarks. Imajima (1992) originally described *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992 from Japanese waters based on the following diagnostic characteristics: (1) having a sagittate prostomium, (2) the presence of occipital antenna, (3) the presence of notochaetae on chaetiger 1, (4) branchiae partially fused to the notopodial lamellae, and (5) the presence of tridentate notopodial hooded hooks and the presence of bi- or tridentate neuropodial hooded hooks. In this respect, the Korean materials of *Scolelepis* agree well with the original description of *S.* (*S.*) *sagittaria*. However, the Korean materials of *S.* (*S.*) *sagittaria* have a minor difference from the Japanese materials in the number of notopodial hooded hooks as follows: the notopodial hooded hooks are up to six per fascicle in the Korean materials vs. up to four per fascicle in the Japanese materials (Imajima, 1992).

In Korean waters, *S.* (*S.*) *sagittaria* resembles *S.* (*S.*) *kudenovi* in having the notopodial chaetae on the first chaetiger and the branchiae almost fused to the notopodial lamellae on the anterior chaetigers. However, the former is easily distinguishable from the latter by the sagittate prostomium instead of conical, the presence of the occipital antenna, and notopodial hooded hooks tridentate instead of bidentate (Imajima, 1992; Choi and Yoon, 2016) [Lee *et al*., 2018].

Habitat. Japanese materials were collected from the intertidal zone to 50 m depth. In Korean waters, materials were collected from the subtidal zone to 20 m depth [Lee *et al*., 2018].

Distribution. Japan (type locality), Korea.

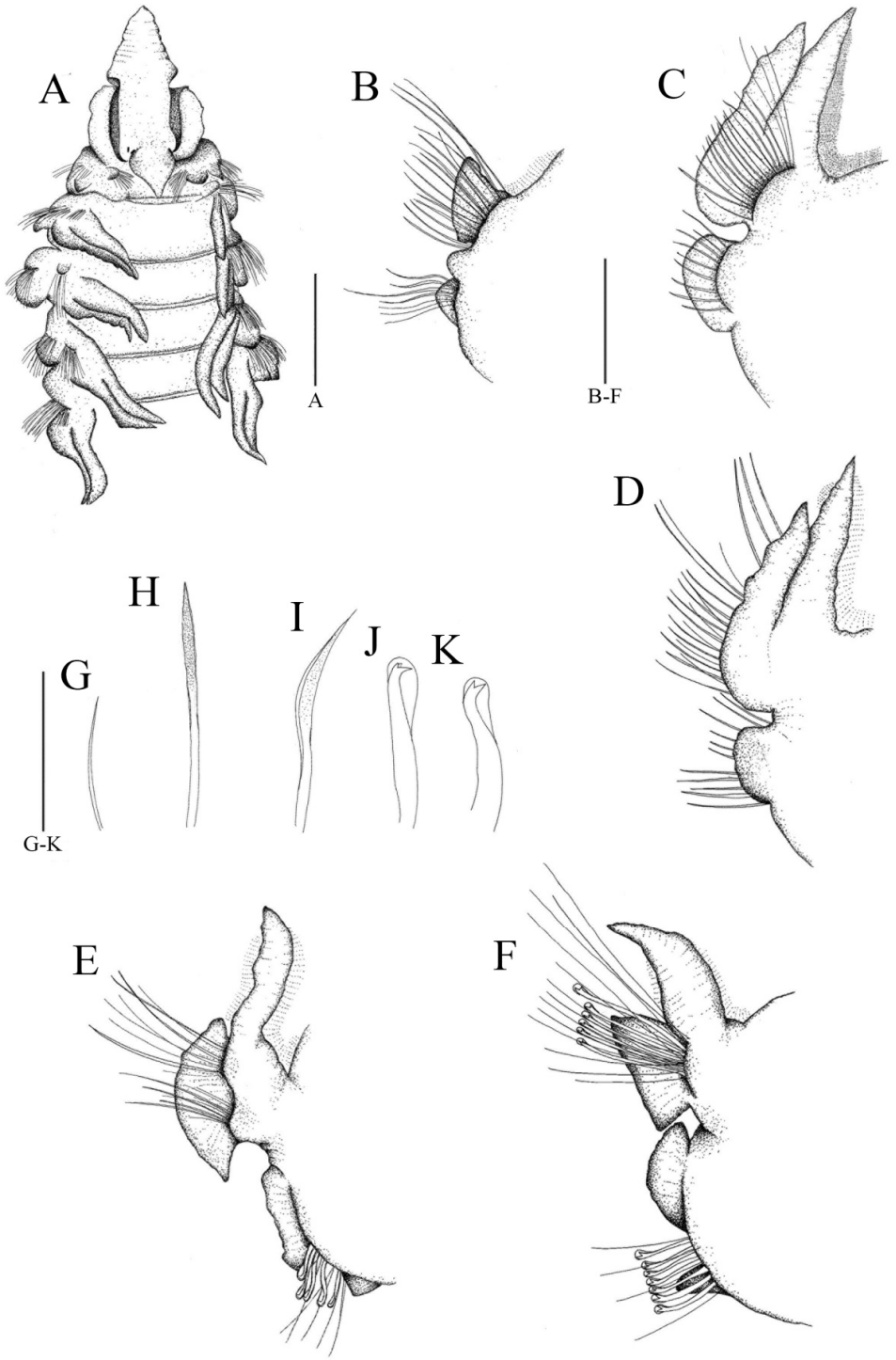

Fig. 34. *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992. A, Anterior end, dorsal view; B, Anterior view of first chaetiger; C, Anterior view of chaetiger 2; D, Posterior view of chaetiger 2; E, Anterior view of chaetiger 40; F, Anterior view of posterior chaetiger; G, Notopodial chaeta in anterior row of posterior chaetiger; H, Notopodial chaeta in posterior row of posterior chaetiger; I, Neuropodial limbate chaeta in posterior row of chaetiger 5; J, Notopodial hooded hook in posterior chaetiger; K, Neuropodial hooded hook in posterior chaetiger 40. Scale bars: A=1.0 mm, B–F=0.3 mm, G–K=0.02 mm.

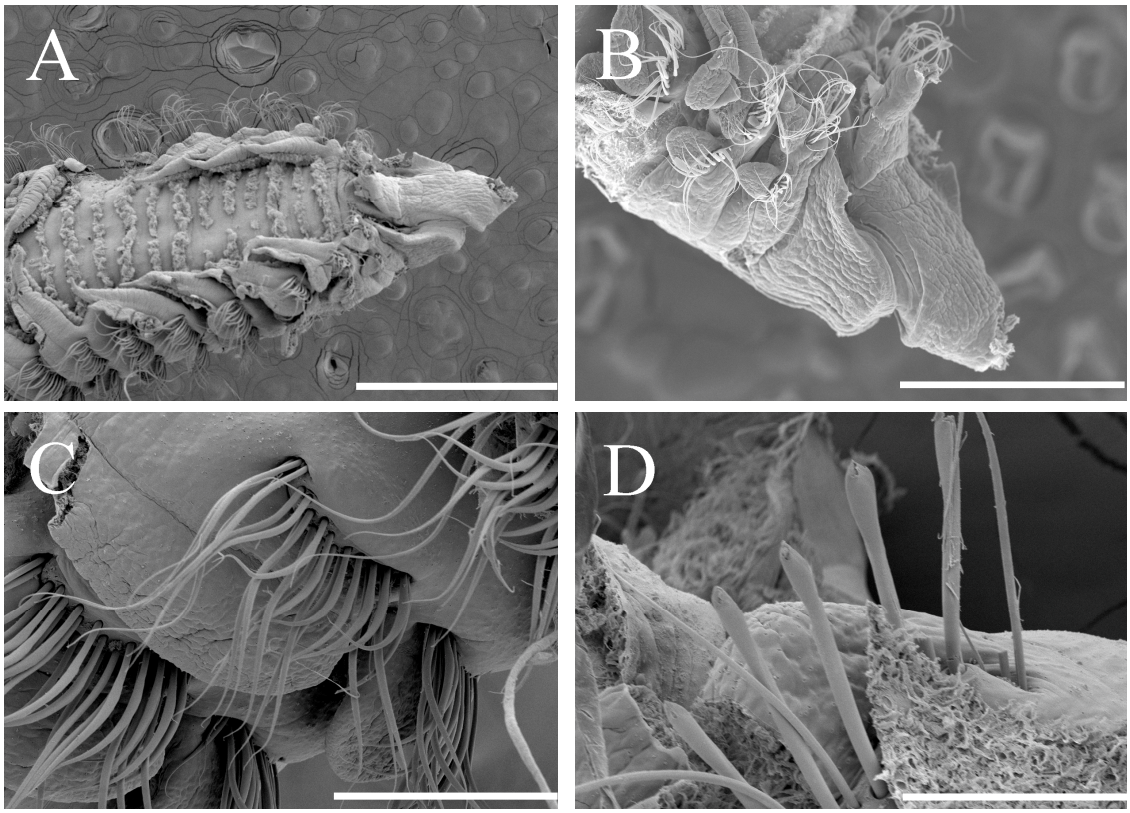

Fig. 35. Scanning electron microscopy photographs of *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992. A, Anterior end with seven chaetigers, dorsal view; B, Anterior end with three chaetigers, lateral view; C, Capillariy chaetae; D, Hooded hooks. Scale bars: A=1.0 mm, B=0.5 mm, C=0.2 mm, D=0.1 mm.

29. *Scolelepis victoriensis* Blake & Kudenov, 1978

Scolelepis victoriensis Blake & Kudenov, 1978: 189, fig. 9.

Material examined. Three specimens, Jeollanam-do: Wando-gun, Soan-myeon, Gahak-ri (126°38'49"E, 34°10'06"N), 26 Jul 2017. All specimens incomplete collected from muddy sand of subtidal zone.

Description. Large size, body about 55.0 mm long and 4.0 mm wide. Colour of alcohol fixed specimens dark-brown without any pigmentation.

Prostomium anteriorly pointed, projecting over peristomium, narrow with slight constriction and forming rounded lobe at level of chaetiger 1, caruncle attached to dorsum. Two pairs of black eyes arranged trapezoidally; anterior pair larger than posterior pair. Nuchal organs in labyrinth pattern, present on dorsal side of chaetiger 2. Occipital antenna absent. Peristomium moderately developed, forming low lateral wings partially encompassing prostomium posteriorly (Figs. 36A–B, 37A–C).

Notopodial ramus of chaetiger 1 reduced, without notochaetae, small rounded lamella dorsally to the neuropodia present and larger rounded neuropodial lamellae. Branchiae from chaetiger 2, present throughout length of fragment. Notopodial lamellae elongate, folded, completely fused to notopodial postchaetal lamellae on anterior chaetigers and deeply notched at level of middle branchiae after chaetiger 29; notch becoming deeper on middle chaetigers and forming rounded or ball-shape process on tip of notopodial posterior lamellae; with short row of cilia on inner edge of notopodial postchaetal lamellae on anterior chaetigers. Branchiae disappear from chaetiger 74. Notopodial prechaetal lamellae becoming elongate on posterior chaetigers (Figs. 36A–F, 37A–E).

Anterior chaetae all capillaries without or with very narrow sheath; arranged in two rows in both rami, capillaries in anterior row slightly shorter, with very fine inconspicuous granulations. Hooks in neuropodia from chaetiger 27, 15–18 per neuropodium, with accompanied capillaries in inferior position; Inferior capillaries in position of sabre chaetae from chaetiger 2, in hook-bearing

chaetigers with 6 segments present. Hooks bidentate with apical tooth above main fang with apical opening (Figs. 36G–H, 37F).

Pygidium not present in fragmented specimens from Korean waters.

Methyl green staining pattern: Inconspicuous. Prostomium, peristomium, branchiae and postchaetal lamellae most intensely stained.

Remarks. The specimens examined in the present study agree well with the original description of *Scolelepis victoriensis* Blake & Kudenov, 1978 based on the following diagnostic characteristics: (1) the absence of notopodial chaetae on chaetiger 1, (2) branchiae completely fused to notopodial postchaetal lamellae on the anterior chaetigers, (3) the absence of occipital antenna, (4) the presence of nuchal cilia on chaetiger 2, and (5) a morphological characteristics feature of bidentate hooded hooks (thin apical tooth above main fang) (Blake and Kudenov, 1978). Additionally, Blake and Kudenov (1978) mentioned that this species is very unusual in *Scolelepis* by having nuchal cilia and a thin apical tooth above main fang on hooded hooks. However, the Korean materials of *S. victoriensis* have some minor differences from the Australian materials as follows: ventral sabre chaetae up to eight per fascicles instead of five, capillaries without minute spinelets, and hooded hooks present from chaetiger 27 instead of 25 (Blake and Kudenov, 1978).

Zhou *et al*. (2009) mentioned that the absence of notochaetae, and branchiae completely fused to notopodial lamellae on the anterior chaetigers are very unique among *Scolelepis* species. There are seven *Scolelepis* species [*S*. (*P*.) *papillosa* (Okuda, 1937), *S*. (*P*.) *texana* Foster, 1971, *S*. (*S*.) *aitutakii* Gibbs, 1972, *S*. (*S*.) *cantabra* (Rioja, 1918), *S*. (*S*.) *variegata* Imajima, 1992, *S. phyllobranchia* Blake & Kudenov, 1978, *S. victoriensis*, and *S. viridis* Blake & Kudenov, 1978] possessing these unique characteristics. *Scolelepis victoriensis* is clearly distinguished from remaining other six species in having nuchal cilia on chaetiger 2, the absence of occipital antenna, and bidentate hooded hooks with thin (not stout) apical tooth above main fang (Rioja, 1918; Okuda, 1937; Foster, 1971; Gibbs, 1972; Blake and Kudenov, 1978; Blake, 1983; Maciolek, 1987; Imajima, 1992; Eibye-Jacobsen, 1997; Zhou *et al*., 2009; Surugiu, 2016).

Habitat. In this study, the Korean materials were collected from the subtidal zone (46 m depth).

Distribution. Australia (type locality), Korea.

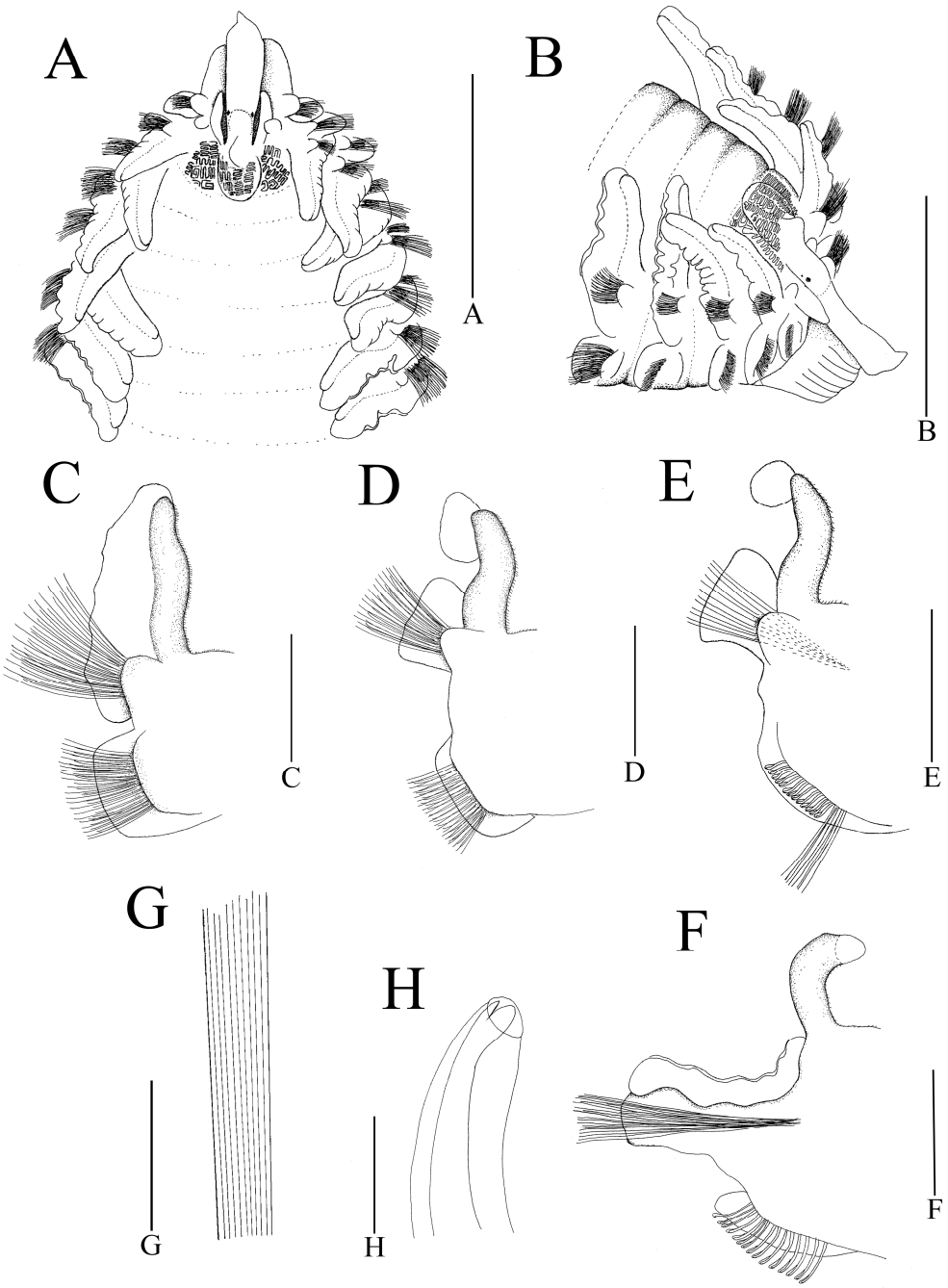

Fig. 36. *Scolelepis victoriensis* Blake & Kudenov, 1978. A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with five chaetigers, lateral view; C, Anterior view of chaetiger 4; D, Anterior view of chaetiger 29; E, Anterior view of chaetiger 29; F, Anterior view of chaetiger 80; G, Lateral view of capillary chaeta; H, Lateral view of neuropodial hooded hook. Scale bars: A–B=2.0 mm, C–E=1.0 mm, F=0.5 mm, G–H=0.03 mm.

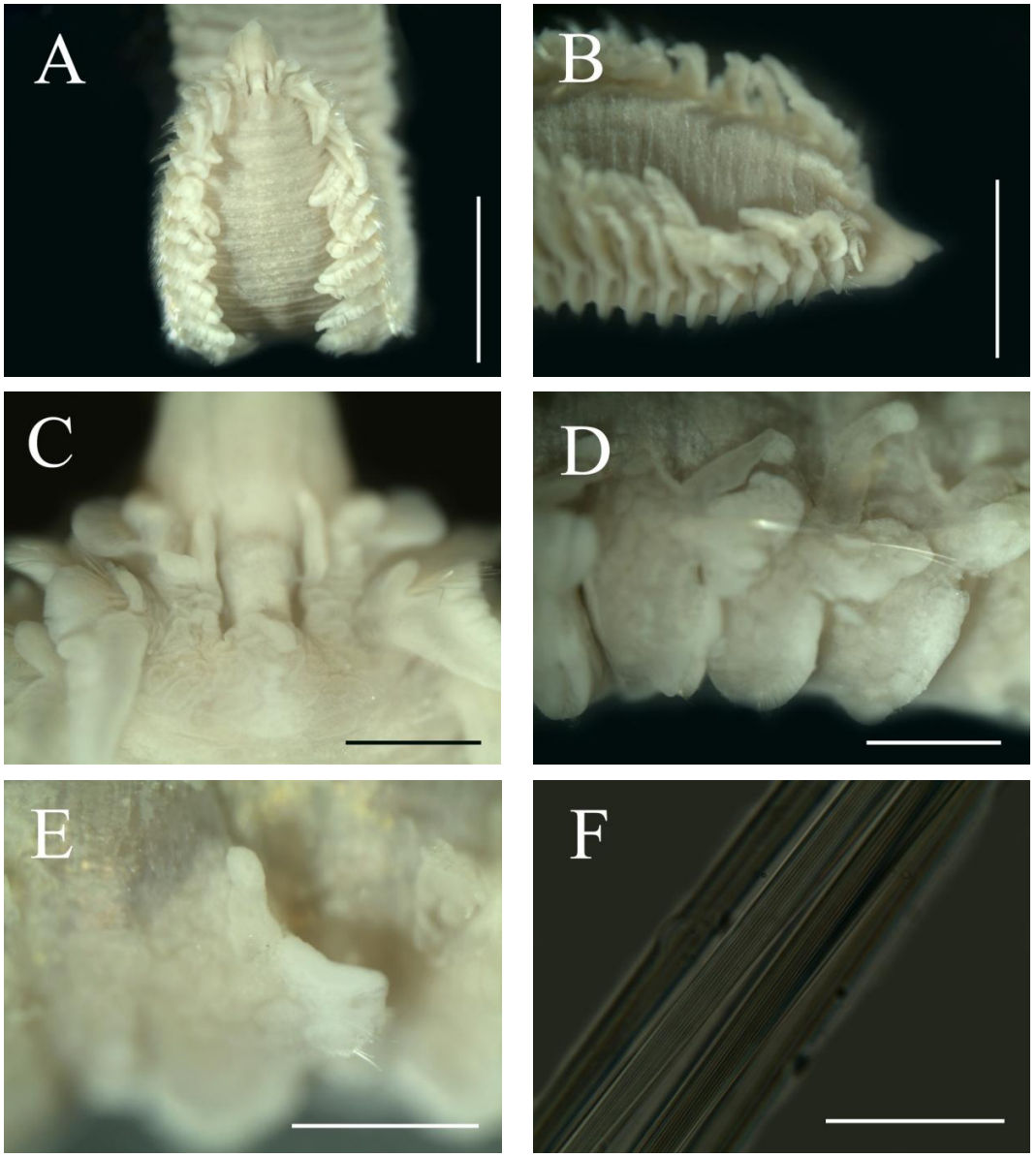

Fig. 37. *Scolelepis victoriensis* Blake & Kudenov, 1978. A, Anterior end, dorsal view; B, Anterior end, lateral view; C, Caruncle and uchal cilia, dorsal view; D, Middle chaetigers; E, Posterior chaetiger; F, Capillary chaetae. Scale bars: A=5.0 mm, B=2.0 mm, C–E=0.5 mm, F=0.04 mm.

30. *Scolelepis* sp. nov.

Material examined. Type locality: South Korea, Jeollanam-do: Jindo-gun, Jodo-myeon, Chang-yu-ri (126°1'59"E, 34°18'43"N), 25 Oct 2018, collected from intertidal soft bottom. **Holotype:** imcomplete specimen. **Paratype:** two imcomplete specimens. **Non-type materials:** one specimen, collection details same as type materials. Colorless in alcohol fixed specimens without any pigmentation.

Description. Holotype. Specimen incomplete, anterior fragments of 35 chaetigers, up to 12 mm long, 1.0 mm wide.

Prostomium anteriorly slightly truncated, posteriorly extended into pointed, erect caruncle which is not attached to dorsum. Two pairs of black eyes arranged trapezoidally, anterior pair further apart; anterior pair larger than posterior one. Nuchal cilia present on sides of caruncle. Occipital antenna absent. Peristomium moderately developed forming low lateral wings partially encompassing prostomium posteriorly. Palps missing (Fig. 38A–B).

Chaetiger 1 reduced, with small elongate notopodial lamellae and larger rounded neuropodial lamellae; notochaetae absent (Figs. 38A–B).

Branchiae from chaetiger 2, present throughout length of fragment; partially fused, distally free from notopodial postchaetal lamellae; from about chaetiger 20 branchiae separation becoming more conspicuous. Branchiae longer than notopodial lamellae on chaetigers 2–5, about the same length from chaetiger 6. Notopodial postchaetal lamellae foliate and folded, neuropodial postchaetal lamellae rounded anteriorly (Figs. 38A–B, 39D–G).

Anterior chaetae all capillaries without or with very narrow sheath, with very fine inconspicuous granulations, arranged in two rows in both rami; neuropodia of chaetigers with slightly granulated capillaries in two rows. Neuropodial hooded hooks present from chaetiger 20, tridentate with apical teeth above main fang, with slightly curved shaft, hooks numbering up to 12

per fascicle; accompanied capillaries absent. Ventral sabre chaetae absent (Figs. 38C, 39G).

Pygidium not present in fragmented specimens from Korean waters.

Methyl green staining pattern: Inconspicuous. Prostomium, peristomium, branchiae and postchaetal lamellae most intensely stained.

Remarks. The new species in the genus *Scolelepis* from Korean waters is characterized by a prostomium truncated anteriorly, the absence of notochaeta on chaetiger 1 and occipital antenna, branchiae distally free from notopodial postchaetal lamellae, and bidentate neuropodial hooded hooks present from chaetiger 20. The absence of notochaetae on chaetiger 1 and occipital antenna, and branchiae not fully fused to notopodial postchaetal lamellae are shared with the following seven *Scolelepis* species: *S.* (*S.*) *dicha* Hutchings Frouin & Hily, 1998, *S.* (*S.*) *laciniata* Eibye-Jacobsen, 1997, *S. bullibranchia* Rossi, 1982, *S. burkovskii* Sikorski, 1994, *S. goodbodyi* (Jones, 1962), *S. perrieri* (Fauvel, 1902), and *S. williami* (de Silva, 1961) (table. 6) (Fauvel, 1902; de Silva, 1961; Jones, 1962; Pettibone, 1963; Rossi, 1982; Maciolek, 1987; Eibye-Jacobsen, 1997; Hutchings *et al*., 1998; Sikorski,1994; Jirkov, 2001; Delgado-Blas, 2006; Rocha *et al*., 2009). Among them, the new species closely resemble *S.* (*S.*) *laciniata* from Thaiand in having branchiae distally free from notopodial postchaetal lamellae and bidentate hooded hooks. But the new species clearly differs in having a prostomium slightly truncated anteriorly instead of being pointed, peristomium moderately developed forming low lateral wings instead of the absence, and neuropodial hooded hooks present from chaetiger 20 instead of 24–26 (Eibye-Jacobsen, 1997).

The new species is also very similar to *Scolelepis* (*Scolelepis*) sp. from Australia reported by Meißnera and Gotting (2015) in the following characteristics: a prostomium slightly truncated anteriorly, the absence of notochaeta on chaetiger 1, the absence of occipital antenna, branchiae distally free from notopodial lamellae, and neuropodial hooded hooks present from chaetiger 20. However, the new species differ from the Australian specimens by branchiae longer than notopodial lamellae on chaetiger 2–5, about the same length after chaetiger 6 in Korean species vs. the branchiae about the same length on chaetigers 2–12, longer after chaetiger 13 in the Australian

specimens; and neuropodial hooded hooks tridentate in the Korean species vs. bidentate in the Australian specimens (Meißnera and Gotting, 2015).

Habitat. In this study, the new species were collected from muddy sand in the intertidal zone located at Jodo-myeon in the Southern coast of Korea.

Distribution. Jodo-myeon, Jindo-gun, Jeollanam-do in South Korea.

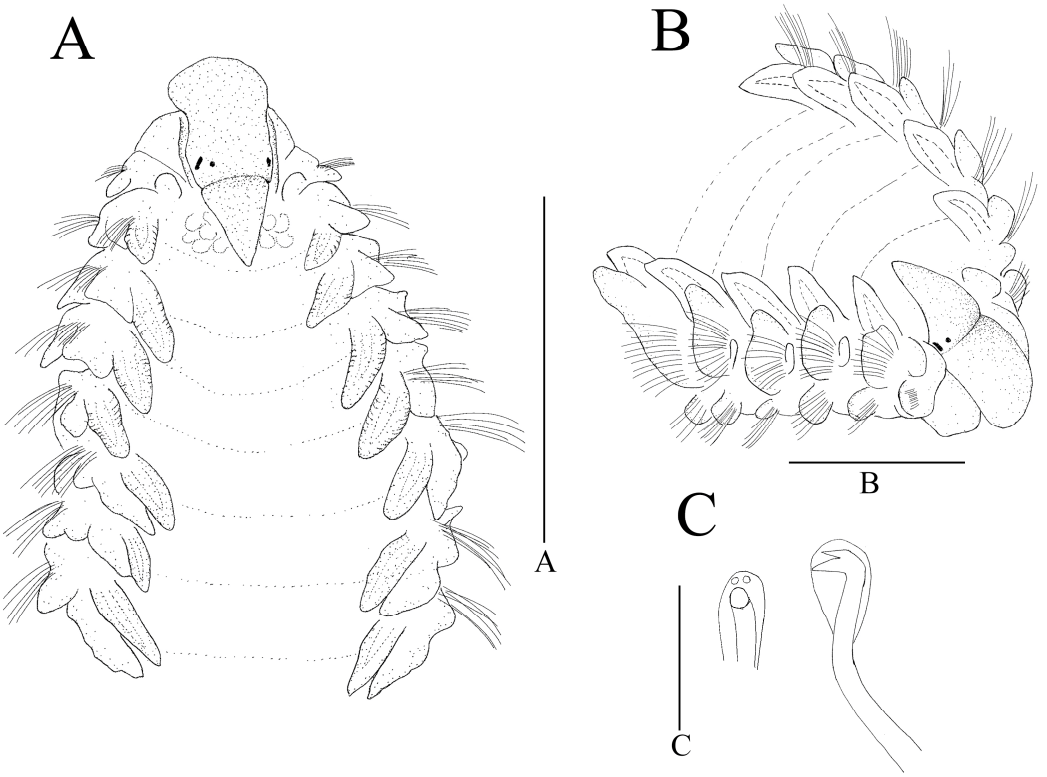

Fig. 38. *Scolelepis* sp. nov., holotype. A, Anterior end with eight chaetigers, dorsal view; B, Anterior end with six chaetigers, lateral view; C, Neuropodial hooed hooks, front and lateral view. Scale bars: A=1.0 mm, B=0.5 mm, C=0.03 mm.

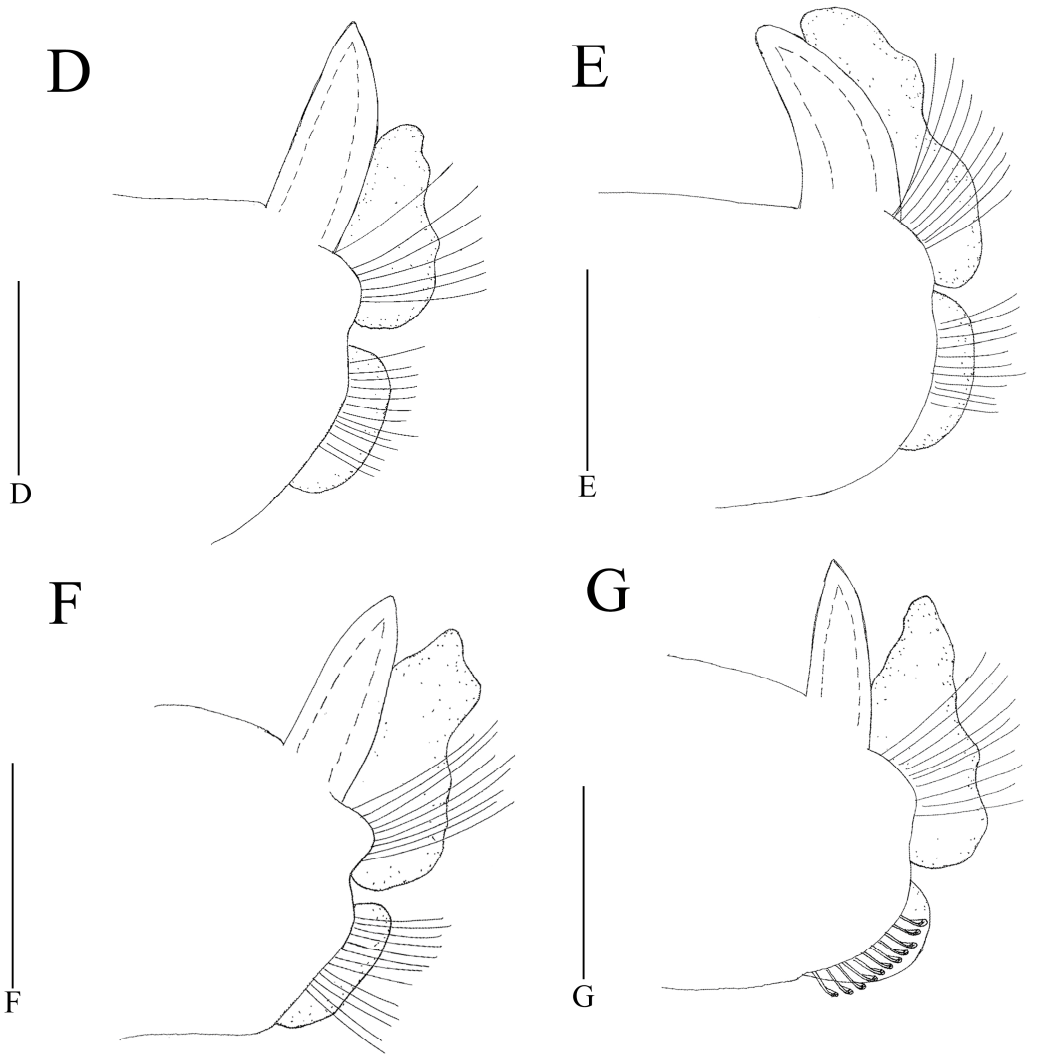

Fig. 39. *Scolelepis* sp. nov., holotype. D, Anterior view of chaetiger 5; E, Anterior view of chaetiger 10; F, Anterior view of chaetiger 15; G, Anterior view of chaetiger 20. Scale bars: D–G=0.3 mm.

Table 6. Some morphological characteristics of *Scolelepis* species without notochaetae on chaetiger 1 and occipital antenna, and with branchiae not fully fused to notopodial postchaetal lamellae.

Species	Prostomium	Morphologic features of branchiae on anterior chaetigers	First appearance of neuropodial hooded hooks	Mophologic features of hooded hooks	Distribution	References
***Scolelepis* (*Scolelepis*) *dicha* Hutchings, Frouin & Hily, 1998**	Pointed anteriorly	Fused basally to notopodial lamellae	Chaetiger 31	Bidentate	Tahitian beaches in USA	Hutchings *et al*., 1998
***Scolelepis* (*Scolelepis*) *laciniata* Eibye-Jacobsen, 1997**	Pointed anteriorly	Distally free from notopodial lamellae	Chaetigers 24–26	Bidentate	Phuket Island in Thailand	Eibye-Jacobsen, 1997
***Scolelepis bullibranchia* Rossi, 1982**	Pointed anteriorly	Fused basally to notopodial lamellae	Chaetigers 32–47	Tridentate	California in USA	Rossi, 1982
***Scolelepis burkovskii* Sikorski, 1994**	Pointed anteriorly	Fused basally to notopodial lamellae	Chaetigers 17–19	Tridentate	Arctic Ocean, Barents Sea	Sikorski, 1994; Jirkov, 2001
***Scolelepis goodbodyi* (Jones, 1962)**	Pointed anteriorly	Fused basally to notopodial lamellae	About chaetiger 28	Tridentate	Brazil, Grand Caribean, Sea Jamaica	Jones, 1962; Delgado-Blas, 2006; Rocha *et al*., 2009
***Scolelepis perrieri* (Fauvel, 1902)**	Pointed anteriorly	Fused basally to notopodial lamellae	Chaetigers 30–32	Bidentate	Casamance	Fauvel, 1902; Pettibone, 1963 (part.)
***Scolelepis williami* (de Silva, 1961)**	Pointed anteriorly	Distally free from notopodial lamellae	Posterior to chaetiger 40	Bidentate	Sri Lankan in south Asia	de Silva, 1961; Pettibone, 1963 (part.); Maciolek, 1987;
***Scolelepis* (*Scolelepis*) sp. from Lizard Island, Australia**	Slightly truncated anteriorly	Distally free from notopodial lamellae	Chaetiger 20	Bidentate	Australia	Meißnera and Gotting, 2015
***Scolelepis* sp. nov. from Korean waters**	Slightly truncated anteriorly	Distally free from notopodial lamellae	Chaetiger 20	Tridentate	Korea	In this study

Genus *Spio* Fabricius, 1785 달걀얼굴갯지렁이속

Nereis Fabricius, 1780: 307.

Spio Fabricius, 1785: 264–265; Fauchald, 1977: 25; Blake and Kudenov, 1978: 226–227; Maciolek, 1990: 1111; Blake 1996: 157; Bick *et al*., 2010: 162; Meißnera *et al*., 2011: 6–7; Sikorski and Andrey, 2013: 173–174.

Type species: *Nereis filicornis* Müller, 1776, designated by Söderström, 1920: 245.

Diagnosis: Prostomium anteriorly rounded or slightly incised, frontal or lateral horns absent. Occipital antenna absent, but posterior portion of prostomium may be raised or inflated. Nuchal organs with ciliated bands of different shapes and lengths posterolateral and posterior to prostomium, extending to chaetiger 2 or 3. Metameric dorsal ciliated organs present. Branchiae from chaetiger 1 to almost end of body; completely separate from or basally fused with notopodial lamella, often reduced in size on chaetiger 1. Hooded hooks in Neuropodia present. Ventral sabre chaetae present. Pygidium with four anal cirri.

Key to the species of the genus *Spio* from Korean waters

1. Branchiae reduced on chaetiger 1; neuropodial hooded hooks from chaetiger 23……..*S. borealis*
 - Branchiae not reduced on chaetiger 1; neuropodial hooded hooks from chaetiger 11…....*S. readi*

31. *Spio readi* Blake, 1984

Spio filicornis: Paik, 1985: 807–808, 1989: 465–466, fig. 175.

Spio readi Blake, 1984: 153–155, fig. 3.

Material examined. 25 specimens, Jeollanam-do: Wando-gun, Cheongsan-myeon, Ji-ri (126°1'59"E, 34°18'43"N), 22 Aug 2017; 20 specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Mapo-ri (126°29'25.9"E, 35°39'14.7"N), 17 Mar 2018; 55 specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Unsan-ri (126°30'45.1"E, 34°40'03.6"N), 18 Mar 2018; 90 specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Unsan-ri (126°31'26.5"E, 35°40'45.2"N), 18 Mar 2018; 60 specimens, Jeollanam-do: Sinan-gun, Heuksan-myeon, Jin-ri (125°25'38.0"E, 34°41'20.0"N), 16 May 2018.

Description. Complete specimens up to 20 mm long and 1.0 mm wide. Reddish-brown pigmentations on body.

Anterior part of prostomium anteriorly rounded; posterior part of prostomium with high, narrow, keel-shaped elevation, beginning in front of anterior pair of eyes and terminating on chaetiger 1. Two pairs of red eyes arranged trapezoidally, comprising one pair of large crescent-shaped median eyes and one pair of small lateral eyes situated anteriorly and set wider apart. Prostomium distinctly separated from peristomium by furrow; peristomial palps comparatively short, reaching chaetiger 6 to 8 at maximum with brown pigment along the margin of food groove (Figs. 40A–C, 42A–B).

Nuchal organs U-shaped due to posterior fusion of median and lateral ciliated bands, pair of median ciliated bands extending 1st tcb on chaetiger 2; pair of lateral ciliated bands long and recurved, going back to 1st tcb, outwards curved in the range of 1st tcb on chaetiger 2. Metameric dorsal ciliated organs double paired, beginning from between branchiae 3 and 4, and posterior extending up to chaetigers 31–43. Ventral epidermal glands (white dots) two pairs per chaetiger, present from chaetiger 3 to chaetigers 39–42 (Figs. 40A–B, 42A–B).

Branchiae from chaetiger 1, continuing to almost the end of body, only last 1–3 chaetigers without branchiae; first branchiae about one-third shorter and narrower than those on following chaetigers, becoming thinner and shorter posteriorly; last two to five branchiae distinctly shorter than notopodial postchaetal lamellae; branchiae with narrow base, tapering distally, with cilia on inner and a furrow on outer side; branchiae on anterior chaetigers basally fused with notopodial postchaetal lamellae, separated from lamellae on posterior chaetigers (Figs. 40A–B, 41H–K).

First notopodium shifted dorsally. Notopodial postchaetal lamellae on anterior chaetigers oval; notopodial postchaetal lamellae becoming smaller and rounded on middle chaetigers, elongated lobe-like on posterior chaetigers, straighten up on very last chaetigers without branchiae. Neuropodial postchaetal lamellae on anterior chaetigers rounded, becoming smaller on posterior chaetigers (Figs. 40A–B, 41H–K).

Notopodial chaetae all capillaries with narrow sheaths, arranged in two rows; chaetae of anterior row short, broad and posterior row longer, thinner; additional superior fascicle of very long, thin capillaries without granulations. Neuropodia with rows of capillaries with granulations and hooded hooks as well as an inferior fascicle of capillaries; bidentate hooded hooks present from chaetiger 11, number up to 10 per neuropodium. Inferior fascicle with 2–5 long, thin, limbate capillaries without granulations from chaetiger 1, replaced by 2–3 ventral sabre chaetae from about chaetiger 18; sabre chaetae with granulations (Fig. 40D–G, 41J).

Pygidium with four anal cirri; lateral pair elongate and ventral pair flattened and broad (Fig. 41K).

Methyl green staining pattern. Anterior part of prostomium and peristomium stained prominently; some deep blue spots scattered on posterior part of prostomium. Margins of postchaetal lamellae and branchiae of anterior and middle chaetigers intensively stained; in posterior chaetigers postchaetal lamellae, branchiae, and anal cirri completely deep blue after staining.

If specimens transferred from methyl green solution into distilled water, two pairs of ventral epidermal glands discernible ventrally from chaetiger 3 to chaetigers 39–42. These dots are

arranged in a row (Fig. 43A–B).

Remarks. Paik (1975, 1989) reported the *Spio* species commonly found in the southern sea of Korea as *Spio filicornis* (O. F. Müller, 1776) which was considered as a widespread species in the previous studies (Maciolek, 1990; Worsaae, 1999; Sikorski, 2001; Bick *et al*., 2010). But Meißner *et al*. (2011) designated the neotype of *S. filicornis* and concluded that no longer be regarded as a species of world-wide distribution. Thus, *Spio* species recorded as *S. filicornis* from Korean waters needed to be reexamined by using the mateirals found in the southern sea of Korea.

The materials from Korean waters agree well with the original description of *Spio readi* Blake, 1984 from New Zealand waters based on the following diagnostic characteristics: (1) U-shaped of nuchal organs on chaetiger 2, (2) well developed branchiae on chaetiger 1, (3) bidetate neuropodial hooded hooks which present from about chaetiger 11, (4) pattern of pigmentation on peristiomium is similar, and (5) prostomium free from prostomium. However, there is a difference from the Korean materials in the morphological feature of pygidium: one pair of cirri located on lateral side slender and cirriform, and the other pair located on the ventral side broad and flattened in the Korean materials vs. four anal cirri are all broad and flattened in the New Zealand materials. Also, Blake (1984) did not describe the ventral epidermal glands which did not observable well without staining prosess, so we provided the detailed description of this characteristic by the Korean specimens stained with methyl green.

Several authors mentioned that the shape and extension of both nuchal and dorsal ciliated organs are useful taxonomic characteristics in the genus *Spio* (Bick, 2005; Meißner and Blank, 2009; Bick *et al*., 2010; Meißner *et al*, 2011). There are five species [*S. armata* (Thulin, 1957), *S. decorata* Bobretzky, 1870, *S. martinensis* Mesnil, 1896, *S. singularis* Blake & Kudenov, 1978, and *S. symphyta* Meißner *et al*., 2011] closely resemble *S. readi* in having U-shaped of nuchal organs on chaetiger 2 However, *S. readi* can be distinguished from these five species by a prostomium free from peristiomium, branchiae well developed on chaetiger 1, bidenate hooded hooks, dorsal ciliated organs extending to the middle of chaetigers, and two pairs of ventral epidermal glands

(Bobretzky, 1870; Mesnil, 1896; Thulin, 1957; Blake and Kudenov, 1978; Blake, 1984; Bick *et al*., 2010; Meißner *et al*, 2011).

Another *Spio* species reported in Korean waters, *S. borealis*, originally reported from Japanese waters, and *S. readi* differs from this species in having branchiae similar to succeeding branchiae in size instead of distinctly reduced, and neuropodial hooded hooks present from chaetiger 11 instead of 23 (Okuda, 1937; Paik, 1975, 1989; Blake, 1984; Meißner *et al*, 2011).

Conclusion. We reexamined the *Spio* species commonly found in southern of Korea, reported as *Spio filicornis* by paik (1975, 1989), and concluded that this Korean species is no longer belong to *S. filicornis* but *S. readi* by the following reasons: nuchal organs are U-shaped on chaetiger 2 in *S. readi* vs. straight on chaetiger 2 in *S. filicornis*, metameric dorsal ciliated organs extending up to about chaetiger 31 in *S. readi* vs. about chaetiger 11 in *S. filicornis*; two pairs of ventral epidermal glands present from chaetiger 3 to chaetigers 39–42 in *S. readi* vs. 1–6 pairs of ventral epidermal glands present on chaetigers 4–20 in *S. filicornis*, and neuropodial hooded hooks present in numbering 9–10 in *S. readi* vs. 5–9 in *S. filicornis*; pattern of pigmentation on peristiomium well accorded with original description of *S. filicornis* rather than *S. filicornis* (Fabricius, 1780, 1785; Paik, 1975, 1989; Blake, 1984; Meißner *et al*, 2011).

Habitat. Intertidal to 105m (Blake, 1984). In this study, the Korean materials were collected from muddy sand, intertidal to 20m depth.

Distribution. New Zealand (type locality), Korea.

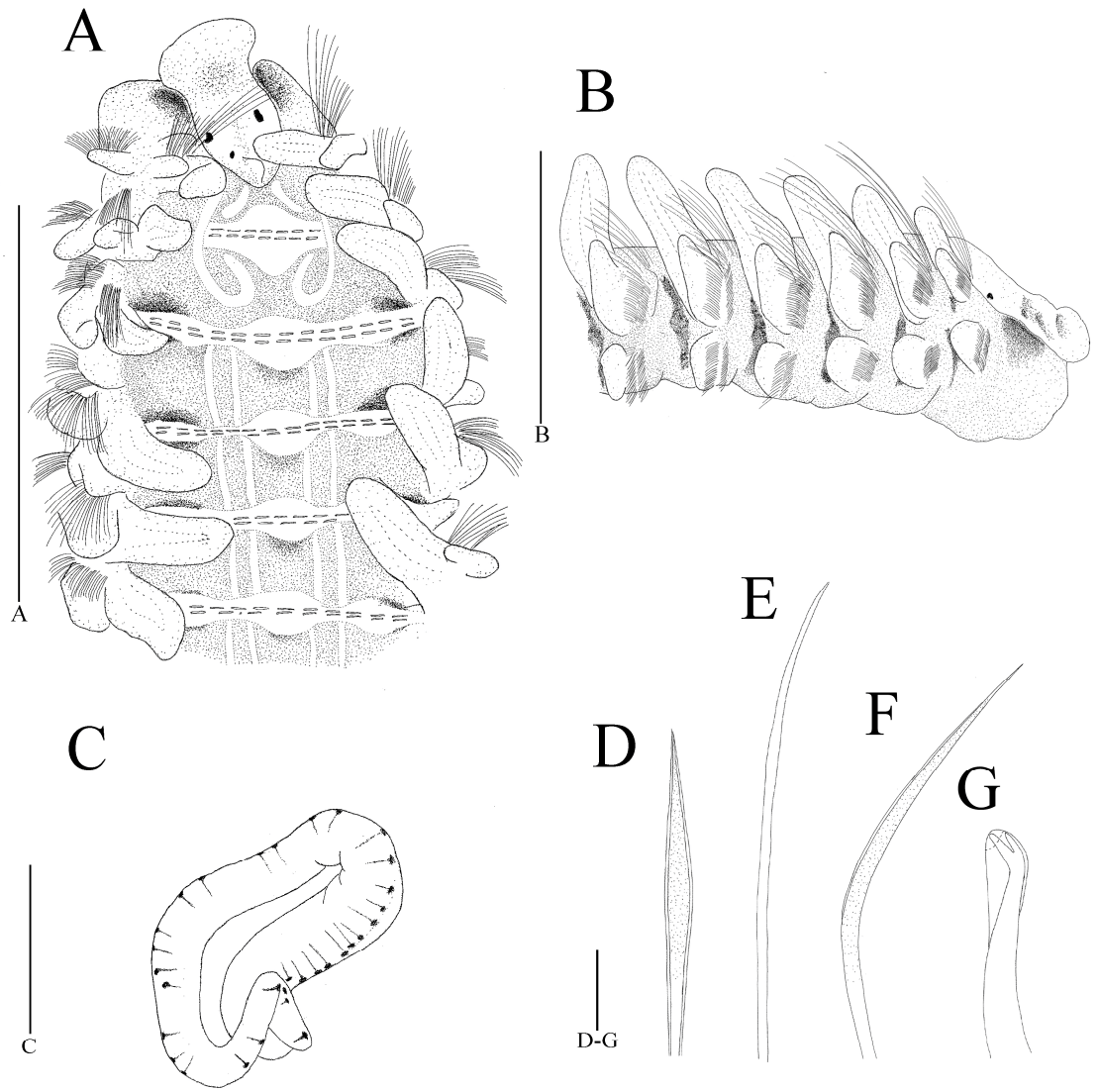

Fig. 40. *Spio readi* Blake, 1984. A, Anterior end with six chaetigers, dorsal view; B, Anterior end with six chaetigers, lateral view; C, Peristomial palp; D, Posterior neurochaeta; E, Long posterior notochaeta; F, Ventral sabra chaeta from chaetiger 27; G, Neuropodial hooded hook; Scale bars: A–B=1.0 mm, C=0.5 mm, D–G=0.03 mm.

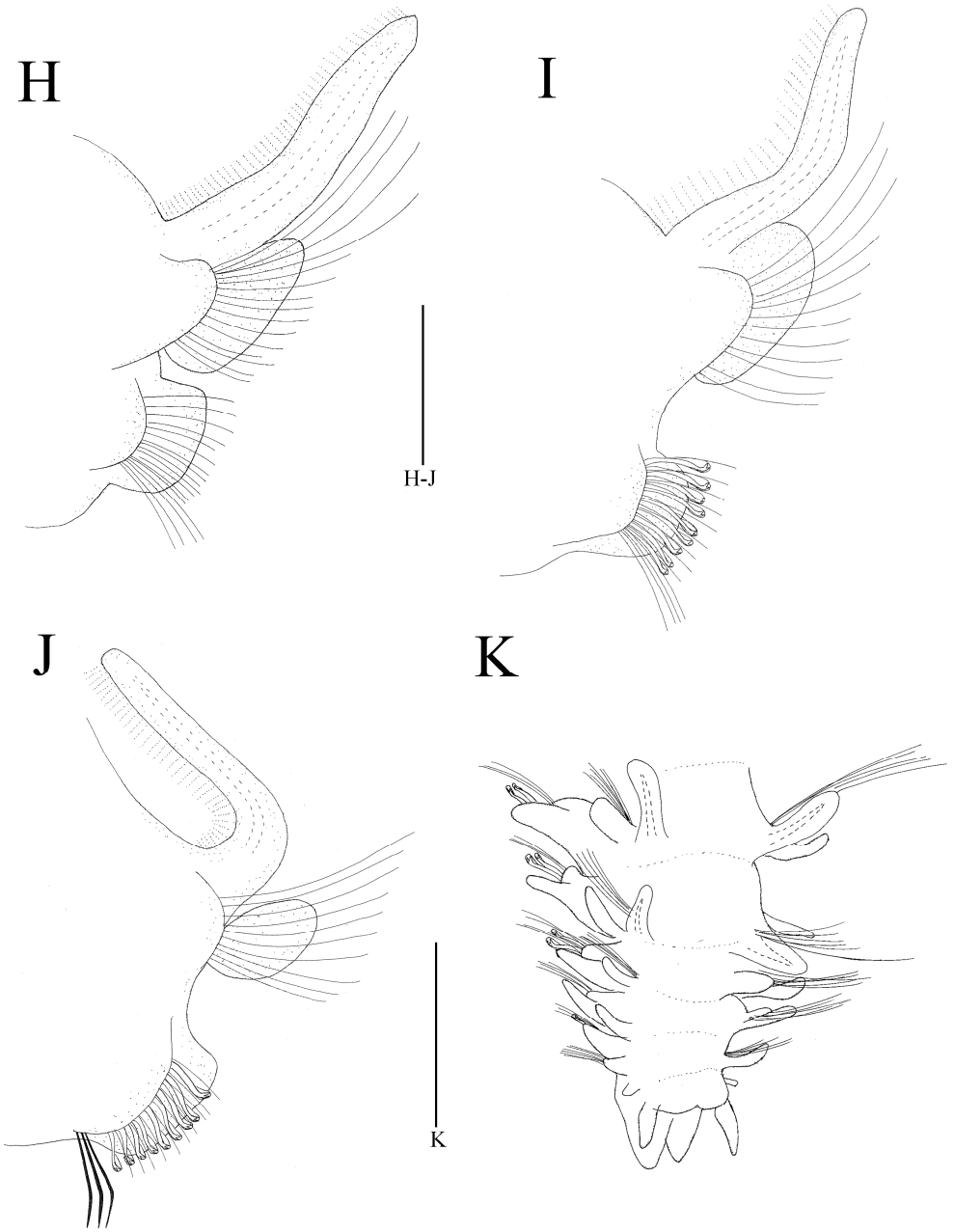

Fig. 41. *Spio readi* Blake, 1984. H, Anterior view of parapodium from chaetiger 2; I, Anterior view of parapodium from chaetiger 11; J, Anterior view of parapodium from chaetiger 27; K, Dorsal view of posterior end. Scale bars: H–J=0.2 mm, K=0.5 mm.

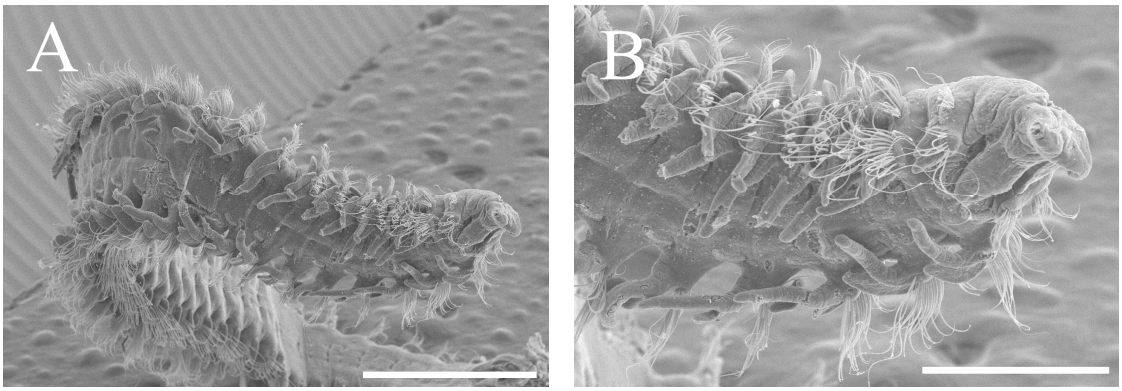

Fig. 42. Scanning electron microscopy photographs of *Spio readi* Blake, 1984. A, Anterior end, dorsal view; B, Anterior and with seven chaetigers, dorsal view. Scale bars: A=1.0 mm, B=0.5 mm.

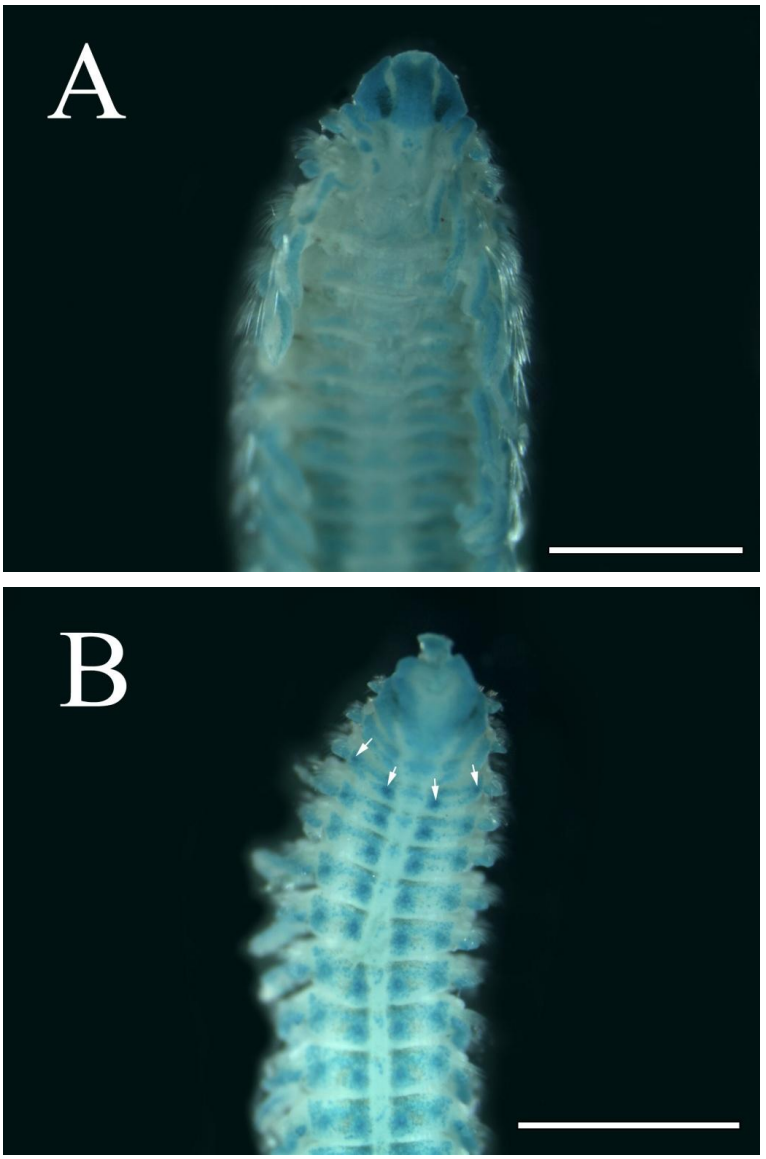

Fig. 43. *Spio readi* Blake, 1984 stained with methyl green. A. Anterior end, dorsal view, nuchal organ and dorsal ciliated organs well observable in stained specimen; B. Anterior end, ventral view, with pattern of ventral epidermal glands (arrows) discernible in stained specimen. Scale bars: A–B=1.0 mm.

Order Terebellida Rouse & Fauchald, 1997

Family Ampharetidae Malmgren, 1866

Key to genera of Ampharetidae from Korean waters

1. Three or four anterior segments with vertical rows of minute acicular chaetae…...……..*Melinna*

 - Minute acicular chaetae absent……..…….....2

2. Prostomium with paired longitudinal glandular ridges and nuchal ridges…….3

 - Prostomium without paired longitudinal glandular ridges and nuchal ridge…….4

3. All buccal tentacles smooth; branchiae cirriform……...*Amphicteis*

 - Most of buccal tentacles pinnate; branchiae foliose……*Paramphicteis*

4. Buccal tentacles pinnate……..*Ampharete*

 - Buccal tentacles smooth……..……....……...6

5. Thorax with 11–14 uncinigers…….....……..*Amage*

 - Thorax with 14–17 uncinigers.....*Amphisamytha*

Subfamily Ampharetinae Malmgren, 1866

Genus *Paramphicteis* Caullery, 1944

32. *Paramphicteis weberi* (Caullery, 1944)

Amphicteis weberi Caullery, 1944: 83–85, fig. 67.

Paramphicteis weberi (Caullery, 1944): Reuscher *et al*., 2015: 936–938, fig. 6.

Material examined. Four specimens, Jeollabuk-do: Buan-gun, Byeonsan-myeon, Mapo-ri (126°29'22"E, 35°39'32"N), 14 Aug 2018, collected from gravel sand from intertidal zone.

Description. Specimens complete about 13.0 mm long and about 3.0 mm wide. Brownish-purple spots on entire body surface in alcohol fixed specimens.

Prostomium with paired longitudinal glandular ridges slightly curving anteriorly; not separated posteriorly. Paired nuchal ridges separated by wide median gap; arranged at narrow angle to each other. Eyes absent. Buccal tentacles almost pinnate; with two vertical rows of digitiform filaments (Figs. 44A–C, 45A–C).

Paleae of segment II as long as following notochaetae, slightly thicker than notochaetae, and numbering up to nine (Figs. 44A, 45A).

Branchiae four pairs and all foliose arranged in two transverse rows in segments III and IV, and separated by wide median gap; first (inner) and second (outer) branchiae arranged in anterior row, and third (inner) and fourth (outer) branchiae arranged in posterior row (Figs. 44A–B, 45C).

Notopodia with capillary notochaetae present from segment III and present in 17 chaetigers; tuberculate ventral cirri on notopodia. Neuropodial tori with uncini present from segment IV and present in 14 chaetigers; dorsal lobe present on neuropodia. Continuous ventral shields distinct to thoracic unciniger 10, faint in thoracic uncinigers 11. Elevated or modified notopodia absent. Intermediate uncinigers absent. Abdominal uncinigers present in 15 segments; pinnules with digitiform dorsal cirus (Figs. 44D–F, 45D–E).

Notochaetae limbate, arranged in two rows, and present from segment III. Thoracic uncini with 4–5 teeth above rostral tooth arranged in one row (Figs. 44G–I, 45F).

Pygidium with terminal anus and one pair of lateral cirriform anal cirri (Fig. 44F).

Remarks. Jirkov (2011) suggested that the genus *Paramphicteis* is junior synonym of *Amphicteis* in having prostomium with paired longitudinal glandular ridges and nuchal ridges. However, Reuscher *et al*. (2015) concluded that these two genera should be separated due to the presence of pinnate buccal tentacles and foliose branchiae. Additionally, the presence of chaetae in segment II is now specific character, no longer generic diagnose. Thus, *Paramphicteis weberi* (Caullery, 1944) transferred from group of *Amphicteis* (Mackie, 1994; Jirkov, 2008, 2011; Imajima, 2009; Reuscher *et al*., 2015; Parapar *et al*., 2012).

The present materials from Korean waters agree well with the original description of *P. weberi*

from Indonesia based on the following diagnostic characteristics: (1) the presence of prostomial glandular ridges and nuchal ridges, (2) most of buccal tentacles pinnate, (3) at least two pair of branchiae foliose, (4) the presence of paleae on segment II, and (5) paleae similar length with following notochaetae. Only the first two pairs of branchiae were preserved in Caullery's specimens (other pairs missing). Recently, Reuscher *et al*. (2015) proved that all four pairs are foliose by observation of Japanese specimens. They also reported a minor difference between the original specimens and the Japanese materials in the number of abdominal uncinigers: 14 uncinigers in the original materials vs. 15 in the Japanese materials (also 15 in the Korean materials) (Caullery, 1944; Reuscher *et al*., 2015).

In East Asia, three *Paramphicteis* species, *P. angustifolia* (Grube, 1878), *P. sinensis* (Sui and Li, 2014), and *P. weberi*, from China and Japan were recorded. *P. weberi* can be easily distinguished from other two *Paramphicteis* species by the presence of chaetae on segment II vs. absence in *P. angustifolia* and *P. sinensis* (Grube, 1878; Caullery, 1944; Imajima *et al*., 2012; Sui and Li, 2014; Reuscher *et al*., 2015).

Habitat. Intertidal zone and 185m depth (Reuscher *et al*., 2015). In this study, the Korean materials were collected from muddy sand, intertidal to 5m depth.

Distribution. Indonesia (type locality), Japan, Korea.

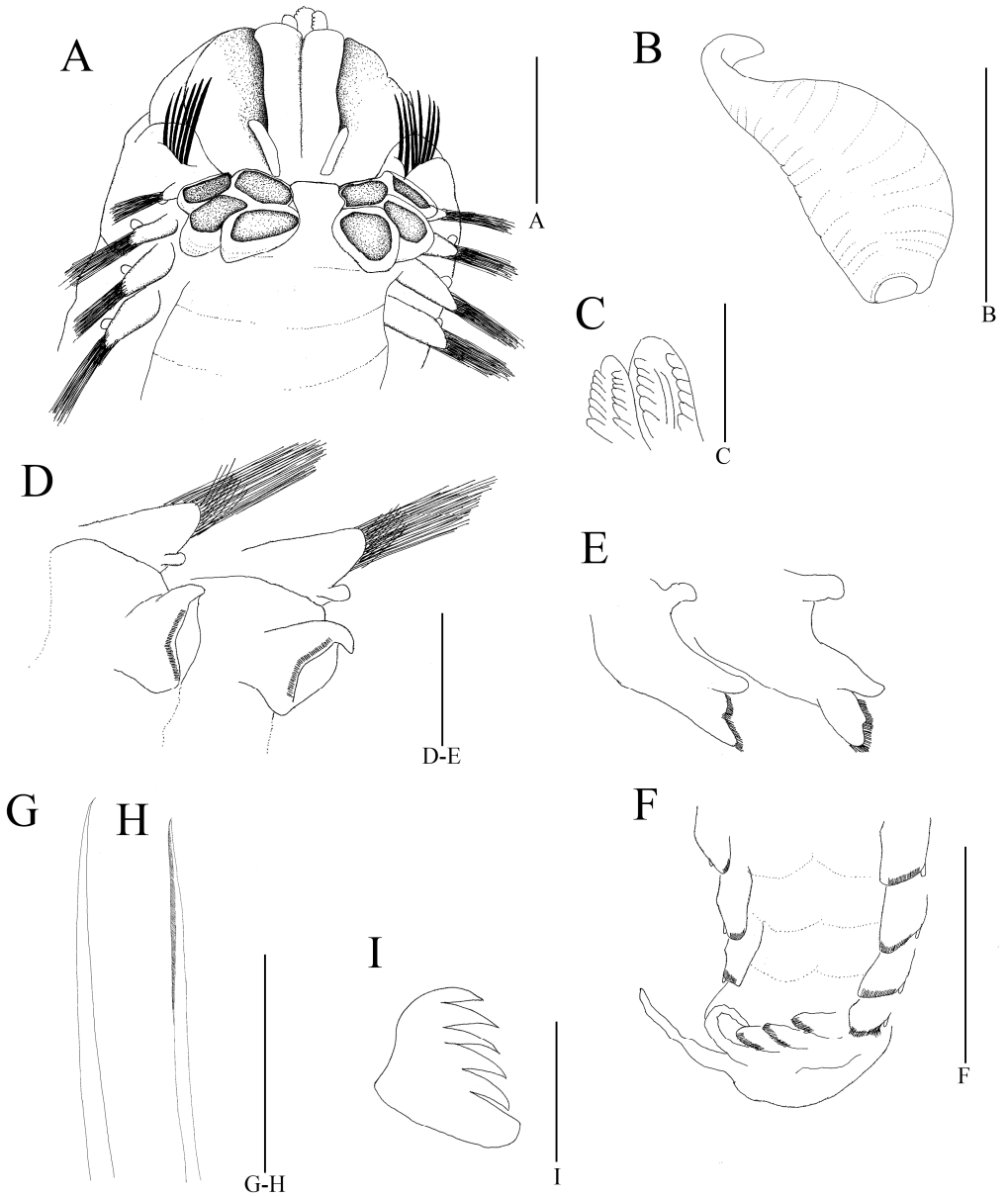

Fig. 44. *Paramphicteis weberi* (Caullery, 1944). A, Anterior end, dorsal view; B, Branchia; C, Buccal tentacles; D, Thoracic parapodia; E, Abdominal parapodia; F, Posterior end, ventral view; G, Palea; H, Limbate notochaeta; I, Thoracic uncinus. Scale bars: A–B =1.0 mm, C=0.3 mm, D–E=0.5 mm, F=1.0 mm, G–H=0.8 mm, I=0.03 mm.

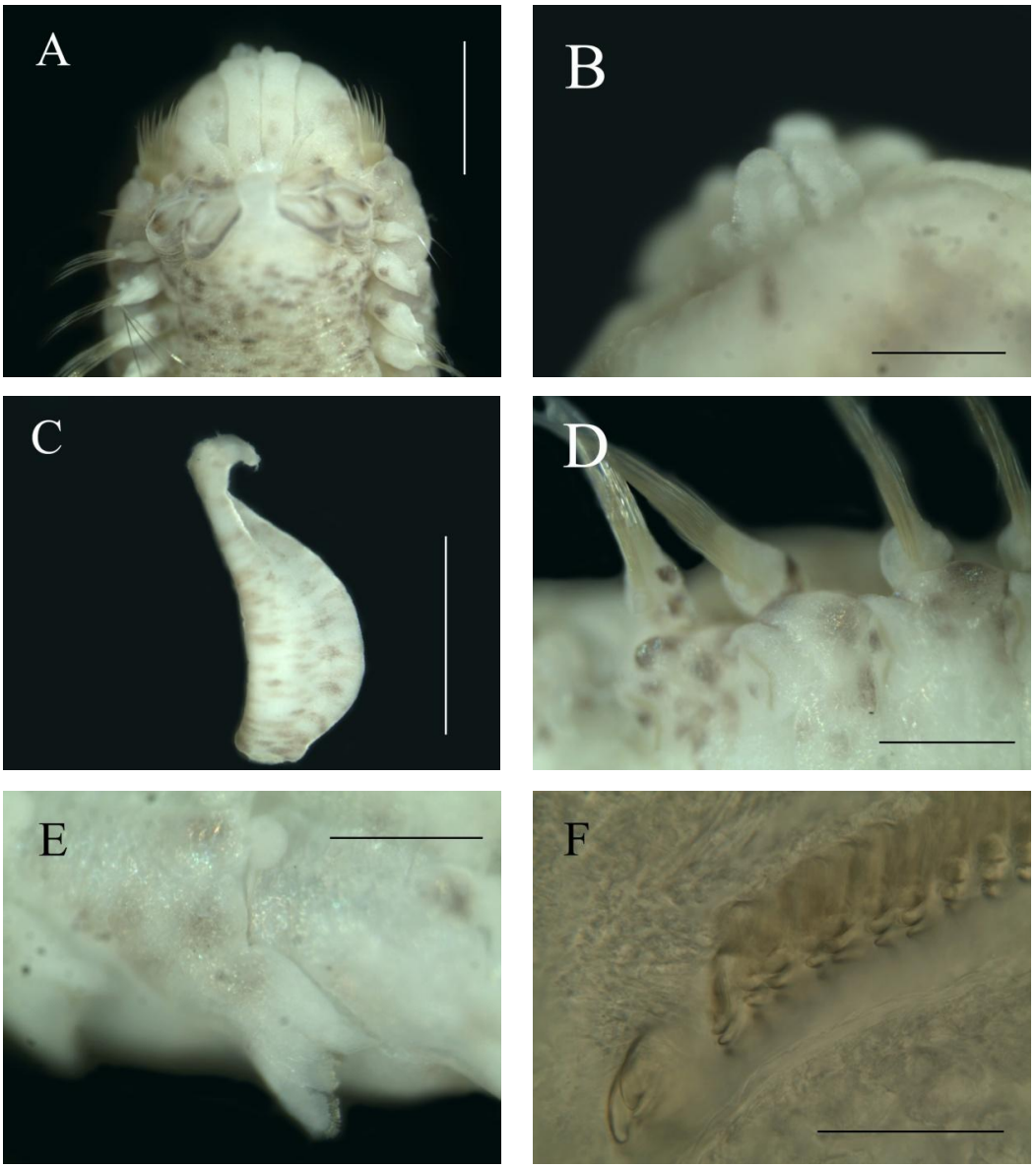

Fig. 45. *Paramphicteis weberi* (Caullery, 1944). A, Anterior end, dorsal view; B, Buccal tentacles; C, Branchia; D, Thoracic parapodia, ventral view; E, Abdominal parapodia, lateral view; F, Thoracic uncinus; G, Posterior end, ventral view. Scale bars: A=1.0 mm, B=0.28 mm, D=0.5 mm, E=0.3 mm, F=0.04 mm.

Subcalss Polychaeta incertae sedis

Family Saccocirridae Czerniavsky, 1881

Genus *Pharyngocirrus* Di Domenico, Martínez, Lana and Worsaae, 2014

33. *Pharyngocirrus gabriellae* (Marcus, 1946)

Saccocirrus gabriellae Marcus, 1946: 2–6, pl. 1–2; 1962: Wu and Yang, 1962: 169–179, figs. 1–3; Wu *et al*., 1980: 132–148, figs. 4–9.

Pharyngocirrus gabriellae Di Domenico *et al*., 2014: 115–121, figs. 2–3.

Material examined. Seven specimens, Jeollanam-do: Wando-gun, Soan-myeon, Gahak-ri (126°38'49"E, 34°10'06"N), 26 Jul 2017.

Description. Specimens all females, slender and threadlike body, about 15.0 mm long and about 0.2 mm wide in complete specimens, last three segments achaetous. Colour of alcohol fixed specimens light-tan without any pigmentation.

Prostomium rounded with one pair of eyes. Palps reaching to chaetiger 7, with scattered non-motile tufts of short cilia. Longitudinal ciliary bands absent. Peristomium broad, separated from prostomium, and with one pair of tentacular ampullae; tentacular ampullae short, extending in antero-lateral parts of peristomium. Mouth on the ventral side with two laterals lips, lined by two longitudinal ciliary patches. Dorsal nuchal organs densely ciliated, arranged in furrows between prostomium and peristomium. Ventral muscular pharynx (pharyngeal bulb) ventral to oesophagus, extending in chaetigers 1–3. Esophagus cylindrical and extending in chaetigers 2–12. Intestine extending from chaetiger 13 to posterior end (Figs. 46A–B, 47A–C).

Parapodia unirramous and retractile, present on laterally at each body segment with tree types of chaetae: (1) 1–2 longest capillary chaetae thin and lyrate, (2) three long bifid medium chatae with two equeal lateral prongs provided with 2–3 denticles, and (3) 1–2 short thin chaetae notched

terminally (Figs. 46E, 47D).

Pygidium with two lobes with 8–10 ventral adhensive ridges. Anus opening terminally between lobes (Fig. 46D).

Females with unilateral ovaries at the left side of the gut, from chaetigers 17–18 to almost posterior end, each ovary with 10–20 oocytes (Fig. 46C).

Methyl green staining pattern: No special pattern detected

Remarks. The specimens examined in the present study agree well with the original description of *Pharyngocirrus gabriellae* (Marcus, 1946) based on the following diagnostic characteristics: (1) the presence of equal bifid chaetae, (2) the presence of unilateral gonads, (3) the absence of tufts of long cilia on palps, (4) the absence of posterior lip of mouth (Wu and Yang, 1962; Wu *et al*., 1980; Jouin and Rao, 1987; Di Domenico *et al*., 2014). However, the Korean materials have a minor difference from the original materials in the distribution of ovaries: present from chaetigers 17–18 in the Korean materials vs. from chaetigers 29–35 in Brazilian materials

The Genus *Pharyngocirrus* is characterized by the presence of a pharyngeal bulb, a ventral ciliation, the presence of unilateral gonads, long chaetae with deeply bifurcated tips, and medium sized chaetae distally divided with fine serrations and contains 12 species up to date (Wu and Yang, 1962; Jouin, 1971; Martin, 1977; Brown, 1981; Sasaki, 1981; Sasaki and Brown, 1983; Jouin and Rao, 1987; Bailey-Brock *et al*., 2003; Di Domenico *et al*., 2014). Among them, *P. gabriellae* closely resemble *Pharyngocirrus uchidai* Sasaki, 1981 in having equal bifid chaetae, oocytes at the left side of the gut, and the absence of ventral groove. However, *P. gabriellae* is clearly distinguished from this species in the absence of scattered tufts of cilia on prostomium, peristomium, and palps, and the absence of posterior lip of mouth (Wu and Yang, 1962; Wu *et al*., 1980; Sasaki, 1981; Jouin and Rao, 1987; Di Domenico *et al*., 2014; Park *et al*., 2019).

Habitat. Littoral zone (Wu *et al*., 1980). Intertidal between rocks in tidal pools and sandy sediments with redox layer (Di Domenico *et al*., 2014). In this study, the Korean materials were

collected from the subtidal zone (46 m depth).

Distribution. Brazil (type locality), China, Japan, Korea.

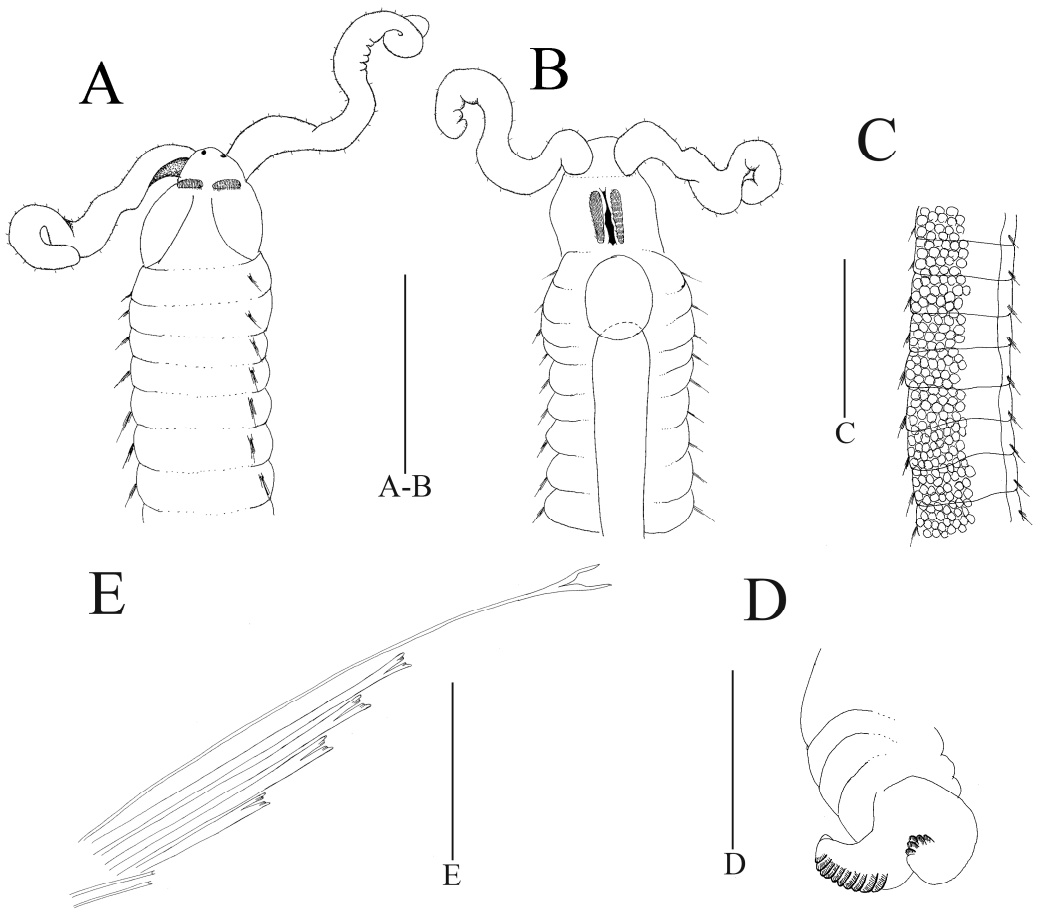

Fig. 46. *Pharyngocirrus gabriellae* (Marcus, 1946). A, Anterior end with seven chaetigers, dorsal view; B, Anterior end with nine chaetigers, ventral view; C, Middle chaetiger with unilateral ovaries; D, Posterior end; E, Three types of chaetae: one longest capillary chaeta, four long bifid medium chatae, and two short chaetae. Scale bars: A–B =1.0 mm, C=1.5 mm, E=0.03 mm, D=0.5 mm.

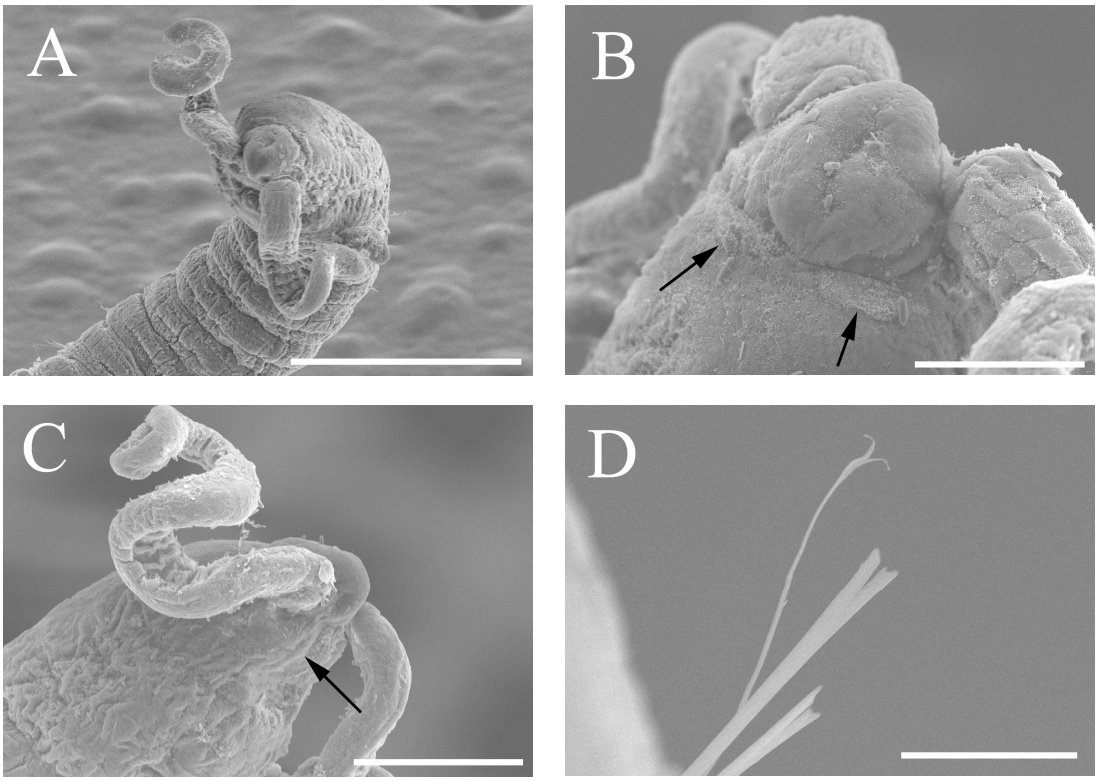

Fig. 47. Scanning electron microscopy photographs of *Pharyngocirrus gabriellae* (Marcus, 1946). A, Anterior end, front view; B, Nuchal organs, dorsal view of anterior end; C, Mouth ciliate patches, ventral view of anterior end; D, One longest capillary chaeta and two medium chaetae. Scale bars: A=0.5 mm, B=0.1 mm, C=0.2 mm, D=0.02 mm.

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국문 초록

한국 해역에 서식하는 얼굴갯지렁이과 다모류의 분류학적 연구

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얼굴갯지렁이류는 전세계적으로 조간대부터 조하대까지 다양한 환경에서 높은 밀도로 서식하는 큰 분류군 중 하나로서, 생태계 내에서 포식자 및 피식자로서의 중요한 역할을 하는 것으로 알려져 있다. 이 연구의 목적은 한국해역에서 서식하는 얼굴갯지렁이류의 다양성을 밝히기 위해 수행되었다. 2017 년 4 월 12 일부터 2018 년 10 월 25 일까지 총 28 개 지역에서 채집이 수행되었고, 11 속에 속하는 총 16 종의 얼굴갯지렁이류 신종후보 및 한국미기록종을 확인하였으며 이들에 대한 자세한 기재와 도판을 작성하였다. 16 종의 목록은 다음과 같다: *Atherospio* cf. *disticha* Mackie & Duff, 1986, *Atherospio* sp. nov., *Dipolydora socialis* (Schmarda, 1861), *Laonice japonica* (Moore, 1907), *Malacoceros reductus* Blake & Kudenov, 1978, *Polydora* sp. nov., *Prionospio depauperata* Imajima, 1990, *Prionospio nova* Annenkova, 1938, *Prionospio pulchra* Imajima, 1990, *Pseudopolydora kempi* (Southern, 1921), *Pseudopolydora reticulata* Radashevsky & Hsieh, 2000, *Rhynchospio* aff. *asiatica* Chlebovitsch, 1959, *Scolelepis* (*Scolelepis*) *sagittaria* Imajima, 1992, *Scolelepis victoriensis* Blake & Kudenov, 1978, *Scolelepis* sp. nov., *Spio readi* Blake, 1984.

이와 더불어 본 논문에서는 한국산 얼굴갯지렁류의 종과 속에 대한 검색표를 제시하였다.