Journal of Species Research 12(1):68-89, 2023

Unrecorded species of Korean invertebrates discovered through the project of 'Discovery of Korean Indigenous Species' II

Su-Jung Ji[1], Chuleui Jung[2], Hyun Woo Bang[3], Min Ok Song[4], Jongwoo Jung[5], Seong Myeong Yoon[6], Seunghwan Lee[7], Seoyoung Keum[2,8], Hee-Min Yang[1], Dongmin Lee[9], Geon Hyeok Lee[1,6], Jaeseok Oh[7], Kichoon Kim[11], Hansol Park[9], Heejin Moon[3], Omid Joharchi[2], Yeseul Kang[9], Keeseon S. Eom[9], Kyung Jin Lee[10], Ye Eun[10], Taeho Kim[10], Ivana Karanovic[11,*], Jeounghee Lee[12,13,*], Seongjun Choe[9,*] and Gi-Sik Min[1,*]

[1]*Department of Biological Sciences and Bioengineering, Inha University, Incheon 22212, Republic of Korea*
[2]*Department of Plant Medicals, Andong National University, Andong 36729, Republic of Korea*
[3]*Division of Biomedical Engineering & Biotechnology, College of Science & Technology, Mokwon University, Daejeon 35349, Republic of Korea*
[4]*Department of Biology, Gangneung-Wonju National University, Gangneung 25457, Republic of Korea*
[5]*Department of Science Education, Ewha Womans University, Seoul 03760, Republic of Korea*
[6]*Department of Biology, Chosun University, Gwangju 61452, Republic of Korea*
[7]*Insect Biosystematics Laboratory, Department of Agricultural Biotechnology, College of Agriculture and Life Sciences, Seoul National University, Seoul 08826, Republic of Korea*
[8]*Silkworm and Insect Management Center, Agricultural Resource Management Institute, Gyeongbuk Provincial Government, Sangju 37110, Republic of Korea*
[9]*Department of Parasitology, Parasite Research Center and International Parasite Resource Bank, School of Medicine, Chungbuk National University, Cheongju 28644, Republic of Korea*
[10]*Animal Resources Division, National Institute of Biological Resources, Incheon 22689, Republic of Korea*
[11]*Department of Life Science, College of Natural Sciences, Hanyang University, Seoul 04763, Republic of Korea*
[12]*The Division of EcoCreative, Ewha Womans University, Seoul 03760, Republic of Korea*
[13]*Marine Biological Resource Institute, Sahmyook University, Seoul 01795, Republic of Korea*

**Correspondent: ivana@hanyang.ac.kr; jongwoo@ewha.ac.kr; parasite@chungbuk.ac.kr; mingisik@inha.ac.kr*

This is the second catalog listing unrecorded invertebrates discovered during the research project 'Discovery of Korean Indigenous Species'. The data to compile the catalog were primarily gathered from the final reports of the project, between 2013 and 2021. We present 38 previously undocumented species, belonging to four phyla (Platyhelminthes, Annelida, Rotifera and Arthropoda). Samples were collected from intertidal coastal waters, soil, freshwater ponds, reservoirs and hosts in South Korea. In this study, we provide brief taxonomic information, including collection site (GPS), diagnosis, specimen vouchers, figures of representative individuals and the Korean name newly assigned, for each species. All data were reviewed and updated by experts working on the respective taxonomic group. The aim of the present study is to publish species that have been previously reported through the project. Upon publication, these species will be added to the 'National Species List of Korea', curated by the National Institute of Biological Resources (NIBR).

Keywords: biodiversity, Far East, new records, taxonomy

© 2023 National Institute of Biological Resources
DOI:10.12651/JSR.2023.12.1.068

Introduction

Since it launched in 2006, the 'Discovery of Korean Indigenous Species' has become the most representative research project of the National Institute of Biological Resources (NIBR), with the aim to study the biodiversity of the Korean Peninsula. According to NIBR reports, 3,789 new or unrecorded animal species (excluding insects and vertebrates), including 749 protozoans and 3,040 other invertebrates, have been discovered through this project since its beginning (NIBR, 2021). For species to be registered on the 'National Species List of Korea', they have to

be published in any approved taxonomic journal. Unfortunately, only 1,604 (52.8%) invertebrates (other than protozoa) have been officially registered, and the others remain at the 'candidate species' status. Therefore, continuous efforts are warranted to increase registration rates through publication.

This work aimed to register the Korean unrecorded invertebrate species discovered through the 'Discovery of Korean Indigenous Species' project in the 'National Species List of Korea'. Compared with a previous publication (Song *et al*., 2017), which included only a simple species list, the present study provides additional taxonomic information such as synonyms, specimen vouchers, diagnoses, and representative figures for each listed species. Herein, we include only 38 invertebrate species, excluding protozoa, and unrecorded protozoans are currently under preparation for another publication. Note that new species are not included in the present article.

Materials and Methods

This is the second catalog listing unrecorded invertebrates discovered during the research project 'Discovery of Korean Indigenous Species'. The data to compile the catalog were primarily gathered from the final reports of the project, between 2006 and 2021. We present 38 previously undocumented species, belonging to four phyla (Platyhelminthes, Annelida, Rotifera and Arthropoda). Samples were collected from intertidal coastal waters, soil, freshwater ponds, reservoirs and host in South Korea. For each species, we provide brief taxonomic information, including collection site (GPS), diagnosis, specimens vouchers and figures of representative individuals. All data were reviewed and updated by experts working on the respective taxonomic group. The aim of the present study is to publish species that have been previously reported through the project. Upon publication, these species will be added to the 'National Species List of Korea', curated by the National Institute of Biological Resources (NIBR).

Results

A total of 38 species belonging to four phyla were identified. Arthropoda had the highest number of species (18), followed by Rotifera (8), Annelida (7), and Platyhelminthes (5). Among these, 14 genera are new to South Korea. In addition, we assigned a Korean name to each species.

List of species

Phylum Platyhelminthes 편형동물문
Class Cestoda Butschli, 1889 조충강

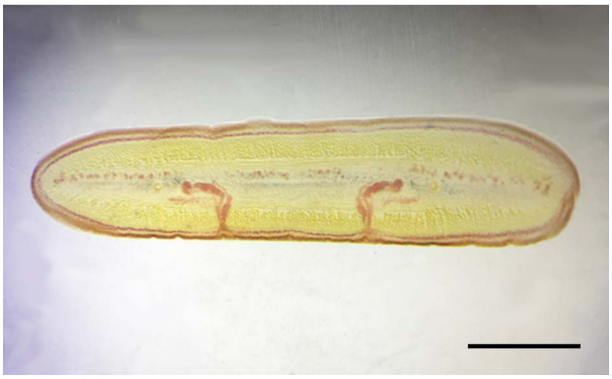


Fig. 1. Cross section of *Digramma interrupta* (Rudolphi, 1810) Dubinina, 1953, larval worm. Scale bar = 2 mm.

Order Diphyllobothriidea Kuchta, Scholz, Brabec and Bray, 2008 열두조충목
Family Diphyllobothriidae Lühe, 1910 열두조충과
Genus *Digramma* Cholodkovsky, 1915

1. *Digramma interrupta* (Rudolphi, 1810) Dubinina, 1953 (Fig. 1) 두줄도랑조충 (신칭)
Ligula interrupta Rudolphi, 1810.

Material examined. Chilgok-gun (36°00′37″N, 128° 23′39″E), Korea; by autopsy of freshwater fish; collected by YS Kang, DM Lee, SJ Choe and HS Park on 3 March 2016.
Deposition. NIBRIV0000866465, NIBRIV0000866466.
World distribution. China, Japan, Russia and Korea.
Diagnosis. Creamy colored. Total length of the larva 335–780 mm (average: 441 mm), the total width 7.0–11.5 mm (average: 8.6 mm). The scolex part is slightly narrow, a single groove observed. The reproductive complex grooves are observed in two lines on the dorsal and ventral side (compared to one line in with genus *Ligula*) and started from about 56 mm later from the scolex and extended to the posterior part of the body.
Remarks. The first description of *Digramma interrupta* (= *Ligula interrupta*) was by Rudolphi (1810). The worms are found in the body cavity of cyprinids (eg. *Hemiculter*, *Abramis*, *Carassius* and common carps) in Korea, China, Japan and Russia.

Class Trematoda Rudolphi, 1808 흡충강
Order Echinostomida Looss, 1899 극구흡충목
Family Echinostomatidae Looss, 1899 극구흡충과
Genus *Echinostoma* Rudolphi, 1809 극구흡충속

2. *Echinostoma stantschinskii* Semenov, 1927 (Fig. 2) 갈고리극구흡충 (신칭)
Echinostoma stantschinskii caudatum Yamaguti, 1939.

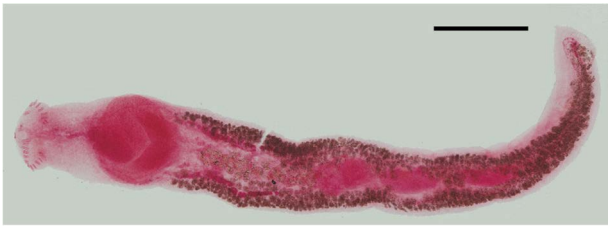


Fig. 2. *Echinostoma stanchinskii* Semenov, 1927. Semichon's acetocarmine stained specimen. Scale bar = 1 mm.



Fig. 3. Adult worm of *Derogenes minor* Looss, 1901. Stained with Iron-hematoxylin solution. Scale bar = 50 μm.



Fig. 4. Adult worm of *Proctoeces maculatus* (Looss, 1901) Odhner, 1911. Stained with Semichon's acetocarmine stain. Scale bar = 1 mm.

Material examined. Cheongju-si (36°37′23.3″N, 127°21′25.7″E), Korea; collected by SJ Choe on 8 March 2011.
Deposition. NIBRIV0000326025, NIBRIV0000326026.
World distribution. Belarus, Czech Republic, Japan, Russia and Korea.
Diagnosis. Body thin and flat, posterior third of the body curved ventrally. Collar well developed, armed with 31 single rowed spines. Oral sucker oval, subterminal. Ventral sucker cup shaped, well developed. Cirrus sac anterodorsal to ventral sucker. Forebody short. Vitelline follicles issued from ventral sucker to end of the body. Uterus occupied 2/4 region of body. Testes elongated, tandem, located at 3/4 region of body.
Remarks. Yamaguti (1939) described and named as a subspecies, *E. s. caudatum* from *Tringa hypoleucos* in Ise Province of Japan. However, the characters suggested by Yamaguti seem not enough to be a valid species. Thus, we regarded his species as a synonym of *E. stantschinskii*.

Order Plagiorchiida La Rue, 1957 사고흡충목
Family Derogenidae Nicoll, 1910
Genus *Derogenes* Lühe, 1900

3. *Derogenes minor* Looss, 1901 (Fig. 3)
뭉게구름난황흡충(신칭)

Material examined. Pohang-si; collected from Spiny red gurnard, *Chelidonichthys spinosus*, purchased at Jukdo Market; collected by YS Kang and DM Lee on 3 May 2017.
Deposition. NIBRIV0000879447.
World distribution. Adriatic Sea and East Sea of Korea.
Diagnosis. Body slender, maximum width at the level of the ventral sucker. The body is slender, fusiform with a sharply pointed posterior end, while the anterior end appears to be more rounded due to the oral sucker. Ventral sucker approximately one and a half times larger than oral sucker. The testes are tandem to slightly oblique, near the edge of the ventral sucker. The two vitelline are larger than other glands.
Remarks. This is the only report of this species since its first report in 1901 and it morphological features match well Looss's original description, such as short vitelline lobe. *Derogenes minor* seems like it has a blind seminal receptacle instead of the Laurel's canal and seminal receptacle.

Family Fellodistomidae Nicoll, 1909
Genus *Proctoeces* Odhner, 1911

4. *Proctoeces maculatus* (Looss, 1901) Odhner, 1911 (Fig. 4) 곤봉흡충(신칭)
Proctoeces subtenuis (Linton, 1907) Hanson, 1950.

Material examined. Busan-si, Seo-gu, Amnam-dong; collected from Spiny red gurnard, *Chelidonichthys spinosus*, purchased at Songdo beach fish market; collected by YS Kang and DM Lee in August 2020.
Deposition. NIBRIV0000879452, NIBRIV0000879453.
World distribution. Cosmopolitan.
Diagnosis. Body elongate. Oral sucker and pharynx well developed. There is a very short prepharynx. Esophagus short; ceca reaching is to posterior extremity. Acetabulum on short pedicle, in anterior third of body. Testes obliquely tandemly. Cirrus pouch reaching back of acetabulum, containing winding tubular seminal vesicle and long prostatic complex. Ovary pretesticular. No receptaculum seminis. Vitelline follicles in ovariotesticular zone. Uterus filling up all available space of hindbody. Excretory vesicle V-shaped.
Remarks. *Proctoeces maculatus* (Looss, 1901) Odhner, 1911 is the type species of this genus. Currently, 17 spe-



Fig. 5. Adult worm of *Decemtestis takanoha* Yamaguti, 1951 from intestine of *Goniistius zonatus* (Cuvier, 1830). Ventral view. Scale bar = 500 μm.

cies are regarded to valid species including *P. maculatus*. but some dubious species of this genus seem to be redescribed.

Family Opecoelidae Ozaki, 1925 결맹흡충과
Genus *Decemtestis* Yamaguti, 1934 십고흡충속

5. *Decemtestis takanoha* Yamaguti, 1951 (Fig. 5)
아홉도막십고흡충 (신칭)

Material examined. Bukchon-ri, Jejudo, Korea; collected by YS Kang on 3 March 2016; Shinheung-ri, Jejudo; collected by YS Kang on 3 and 8 March 2016.
Deposition. NIBRIV0000835085, NIBRIV0000835086.
World distribution. Pacific Ocean (Japan and Korea).
Diagnosis. Body elliptical. Oral sucker subterminal. Ventral sucker slightly larger than oral sucker, at anterior part of mid-body. Testes ten, in two longitudinal lines, occupied median field in hindbody. Cirrus sac claviform. Genital pore near intestinal bifurcation. Ovary irregularly lobed, wider than length. Vitelline follicles profusely distributed between intestinal bifurcation and posterior extremity. Eggs oval, yellow.
Remarks. The genus *Decemtestis* is characterized by the 9 or 10 testes arranged mostly in two lines in the hindbody and non-filamentous eggs (Cribb, 2005). The present specimens are identified as *D. takanoha* on a basis of preacetabular cirrus sac and smaller ventral sucker than that of *D. megacycle* (Yamaguti, 1938; Yamaguti, 1951).

Phylum Annelida Linnaeus, 1758 환형동물문
Class Clitellata Linnaeus, 1740 환대강
Order Haplotaxida Grube, 1850 지렁이목
Family Naididae Ehrenberg, 1828 물지렁이과
Genus *Dero* Oken, 1815

6. *Dero digitata* (Müller, 1774) (Fig. 6)
손꼴몽똑물지렁이 (신칭)
Nais digitata Müller, 1773: 22.
Dero digitata (Müller) Sperber, 1958: 49.



Fig. 6. *Dero digitata* (Müller, 1774). A. ventral chaeta; B. branchial fossa and posterior gills, dorsal aspect in fixed. Scale bars: A = 40 μm; B = 100 μm.

Material examined. Boeun-gun (36°19′58.49″N, 126°39′35.87″E), Korea; collected by JH Lee on 20 May 2016.
Deposition. NIBRIV0000879697.
World distribution. Cosmopolitan.
Diagnosis. Dorsal bundles onward from VI; mostly one hair chaeta, and one needle chaetae. Ventral chaetae II–V by four to five per bundle, with 1.5 times longer upper tooth (Fig. 6A). Branchial fossa with antero-dorsal margin entire, convex and ciliated and a postero-ventral margin prolonged into a non-ciliated rounded lip. Foliate gills four pairs, one pair dorsal and small, one pair lateral and two pairs ventral (Fig. 6B).
Remarks. The chaeta of our specimen is a bit shorter than previous studies (Timm, 2009). It is too early to predict because there is only one confirmed sample. After more samples are taken, they should be compared.

Genus *Paranais* Czerniavsky, 1880, emend.
Sperber, 1948 장님물지렁이속 (신칭)

7. *Paranais litoralis* (Müller, 1784) (Fig. 7)
연안장님물지렁이 (신칭)
Nais litoralis Müller, 1784: 120, pl. 80, figs. 2–6.

Material examined. Cheonan-si (36°45′18.01″N, 127°17′59.03″E), Korea; collected by JH Lee on 1 December 2014.
Deposition. NIBRIV0000879695.
World distribution. Cosmopolitan.
Diagnosis. Body smooth without papillate. No eyes. Ventral chaetae of II, 5–7 per bundle, with upper tooth 1.5 times longer than lower one (Fig. 7A), teeth length becoming gradually equal. Hair chaetae absent. Dorsal



Fig. 7. *Paranais litoralis* (Müller, 1784). Scale bar = 200 μm.

chaetae beginning from V, with upper teeth longer than lower, slightly thinner than ventral chaetae (Fig. 7B). Coelomocytes present.

Remarks. *Paranais litoralis* has been first recorded from Japan by Kondo (1936) and Yamaguchi (1953). This species is common in brackish water, and freshwater courses receiving saline pollution (Van Haaren and Soors, 2012). The collected site is a spring water pool that is connected to the sea.

Genus *Pristna* Ehrenberg, 1828

8. *Pristina aequiseta* Bourne, 1891 (Fig. 8)
잔털주둥이물지렁이 (신칭)

Pristina aquiseta Bourne, 1891: 352. fig. 7, 14D–G.

Material examined. Seoul-si (37°27′23.32″N, 126°57′25.15″E), Korea; collected by JH Lee on 16 June 2013.
Deposition. NIBRIV0000900837.
World distribution. Cosmopolitan.
Diagnosis. Prostomium bluntly. Hair chaetae finely serrated on convex border per bundle. Needle chaetae bifid, without nodulus, distally curved, with short, very fine teeth. Ventral chaetae 3–10 per bundle in II, longer, thinner than rest, with teeth equally thick, distal twice as long as proximal. In IV on, giant chaetae one to two per bundle, with distal nodulus and very thick distal tooth, strongly hooked and a rudimentary proximal tooth (Fig. 8A, B).
Remarks. *Pristina aequiseta* has giant chaetae in segment V or VI, while *P. forelii* does not. Our specimen has giant chaetae in segment V.

9. *Pristina* (*Pristinella*) *sima* (Marcus, 1944) (Fig. 9)
두갈래주둥이물지렁이 (신칭)

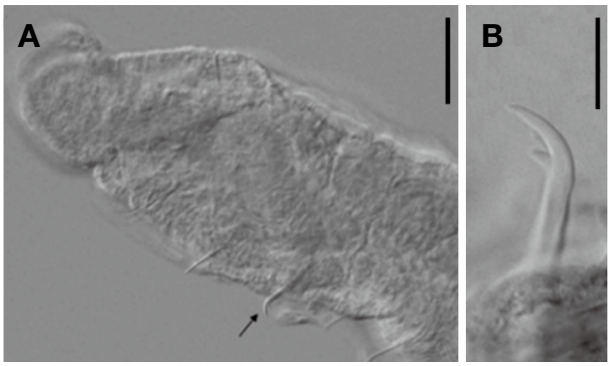


Fig. 8. *Pristina aequiseta* Bourne, 1891. A. anterior part of body (black arrow: giant chaetae); B. giant ventral chaeta of V. Scale bars: A = 50 μm, B = 10 μm.



Fig. 9. *Pristina* (*Pristinella*) *sima* (Marcus, 1944). Living state. Scale bar = 200 μm.

Naidium simum Marcus, 1944: 68, pl. 13, figs. 58, 59.
Pristina sima Sperber, 1948: 223.

Material examined. Paju-si (37°45′59.37″N, 126°46′27.01″E), Korea; collected by JH Lee on 27 August 2013.
Deposition. NIBRIV0000299498.
World distribution. America, Africa, China, Europe and Korea.
Diagnosis. Needle chaetae bayonet-shaped, one to two per bundle, with 1–3 intermediate denticles. Hair chaetae by one, smooth, the longest in midbody. In ventral bundles 3–6 chaetae, upper tooth longer than lower in II, and smaller in posterior bundles.

Genus *Specaria* Sperber, 1939 민눈물지렁이속 (신칭)

10. *Specaria josinae* (Vejdovský, 1884) (Fig. 10)
민눈실지렁이 (신칭)

Nais josinae Vejdovský. Vejdovský, 1884, p. 29, pl. 2, figs. 25–28, pl. 3, figs. 1–4.

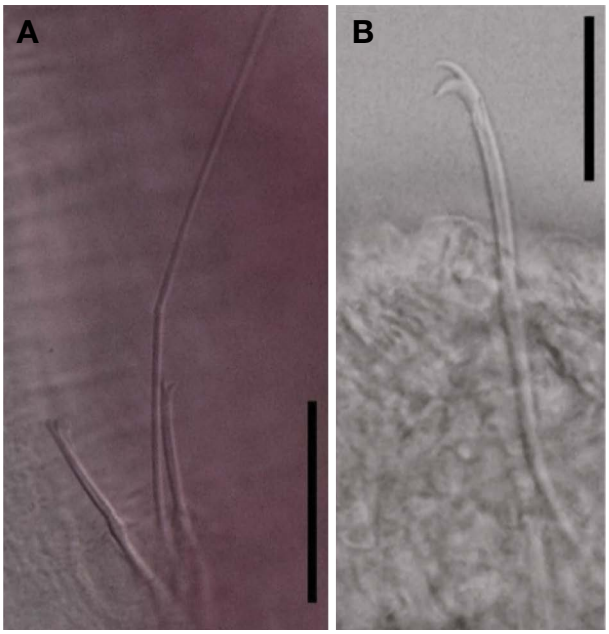


Fig. 10. *Specaria josinae*. A. dorsal chaetae; B. ventral chaeta. Scale bars = 40μm.



Fig. 11. Anterior end of *Dipolydora melanopalpa* Manchenko and Radashevsky, 2002. Scale bar = 0.5 mm.

Specaria josinae (Vejdovský). Sperber, 1948, p. 95, figs. 9, 26d, pl. 4, pl. 5, fig. 1.

Material examined. Incheon-si (37°35′36.08″N, 126°27′20.57″E), Korea; collected by JH Lee on 31 March 2017.
Deposition. NIBRIV0000862922.
World distribution. China, Europe, Japan, North America and Korea.
Diagnosis. No eyes. Prostomium small without proboscis. Dorsal chaetae from VI, 1–2 smooth, bent hairs, with one to two bifid needles chaetae, with precise teeth, equal in length (Fig. 10A). Ventral chaetae bifid, sigmoid from II, 4–5 per bundle with upper tooth longer and thinner than lower, posterior only be-coming equally long (Fig. 10B).
Remarks. *Specaria josinae* has the sigmoid needles that the same shape as the ventral chaetae and are well-developed needle teeth. Previous studies made a mistake in *Nais* species (Michaelsen, 1900; 1909; Piguet, 1906).

Class Polychaeta Grube, 1850 다모강
Order Spionida sensu Rouse and Fauchald, 1997
얼굴갯지렁이목
Family Spionidae Grube, 1850 얼굴갯지렁이과
Genus *Dipolydora* Verrill, 1879 민고리얼굴갯지렁이속

11. *Dipolydora melanopalpa*
Manchenko and Radashevsky, 2002 (Fig. 11)
검은민고리얼굴갯지렁이 (신칭)
Dipolydora melanopalpa Manchenko and Radashevsky, 2002: 193–199, figs. 1, 2.

Material examined. Buan-gun (35°39′54″N, 126°30′37″E), Korea; collected by Korea National Park Service on 14 June 2018.
Deposition. NIBRIV0000900836.
World distribution. Japan and Korea.
Diagnosis. Prostomium anteriorly bifid, extending to almost end of chaetiger 8 as a low caruncle. Palps conspicuously pigmented.

Genus *Laonice* Malmgren, 1867 납작얼굴갯지렁이속

12. *Laonice japonica* (Moore, 1907) (Fig. 12)
일본납작얼굴갯지렁이 (신칭)
Spionides japonicus Moore, 1907: 204, pl. 16, figs. 31–34.

Material examined. Jejudo (33°13′50″N, 126°33′08″E), Korea; collected by SH Kim and JW Kang on 18 July 2018.
Deposition. NIBRIV0000862796.
World distribution. Russia, Japan and Korea.
Diagnosis. Prostomium fused with peristomium at anterolateral corners. Nuchal organ extending to chaetigers 15–16. Genital pouches appearing from chaetiger 4 invariably.

Phylum Rotifera Cuvier, 1817 윤형동물문
Class Eurotatoria De Ridder, 1957 진윤충강
Order Philodinida Melone and Ricci, 1995 선윤충목



Fig. 12. Anterior end of *Laonice japonica* (Moore, 1907). Scale bar = 0.5 mm.



Fig. 13. *Habrotrocha serpens* Donner, 1949. A. creeping, dorsal view; B. creeping habitus, dorsal view. Scale bars = 50 μm.

Family Habrotrochidae Bryce, 1910 협관윤충과
Genus *Habrotrocha* Bryce, 1910 협관윤충속

13. *Habrotrocha serpens* Donner, 1949 (Fig. 13)
뱀협관윤충 (신칭)
Habrotrocha serpens Donner, 1949, p. 130, fig. 10.

Material examined. Jeongseon-gun (37°15′53.6″N, 128°37′0.2″E), Korea; collected by CH Lee and MO Song on 28 August 2021.
Deposition. NIBRIV0000895446.
World distribution. Austria, China, Czech Republic, Rumania, Spain and Korea.
Diagnosis. Rostral lamella big, round, wider than rostrum end, and without median notch. Rostrum long; about 1.5 times as long as rostrum width. Head and neck long. Pharyngeal tube about three times as long as trophi length. Trunk cylindrical and slightly wider than neck width. Foot much narrower than trunk, very short; about 1/15 of total length in creeping. Spurs conical, short and with narrow interspace.

14. *Habrotrocha stenostephana* Schulte, 1954 (Fig. 14)
좁은화관협관윤충 (신칭)
Habrotrocha stenostephana Schulte, 1954, pp. 592, 593, figs. 5a–c.

Material examined. Pyeongchang-gun (37°41′44.7″N, 128°45′49.6″E), Korea; collected by CH Lee and MO Song on 4 October 2021.
Deposition. NIBRIV0000895442.

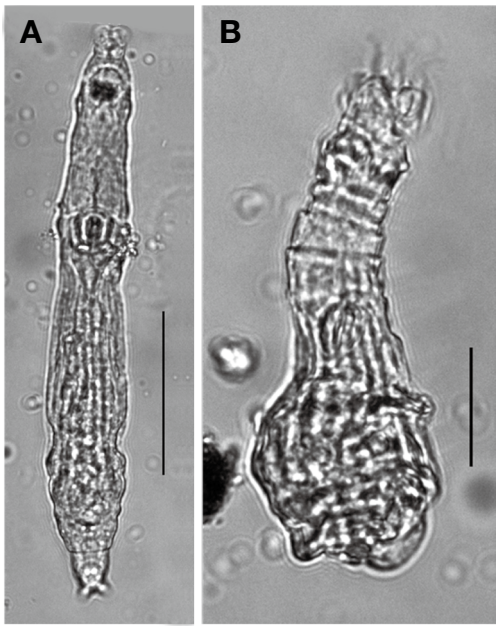


Fig. 14. *Habrotrocha stenostephana* Schulte, 1954. A. creeping, dorsal view; B. feeding, dorsolateral view. Scale bars: A = 50 μm; B = 25 μm.

World distribution. Germany, Portugal and Korea.
Diagnosis. Rostral lamella bilobed, slightly wider than rostrum end; each lobe round. Rostrum short. Pharyngeal tube as long as trophi length. Corona much narrower than cingulum. Upper lip higher than trochal discs, round triangle-shaped, and with wavy lateral margins. Pedicel

high. Foot very short and with four pseudosgements; about 1/12 of total length in creeping. Spurs conical, short and with narrow interspace.
Remarks. The morphology of *H. stenostephana* agrees well with that in the original description except that the rostral lamella is bilobed in the Korean specimens, while that is without median notch in the original description.

Genus *Macrotrachela* Milne, 1886 큰관윤충속

15. *Macrotrachela libera libera* Donner, 1949 (Fig. 15)
자유큰관윤충 (신칭)
Macrotrachela libera Donner, 1949, p. 149, figs. 27a–f.

Material examined. Cheongsong-gun (36°18′57.3″N, 129°13′23.8″E), Korea; collected by CH Lee and MO Song on 18 September 2021.
Deposition. NIBRIV0000895441.

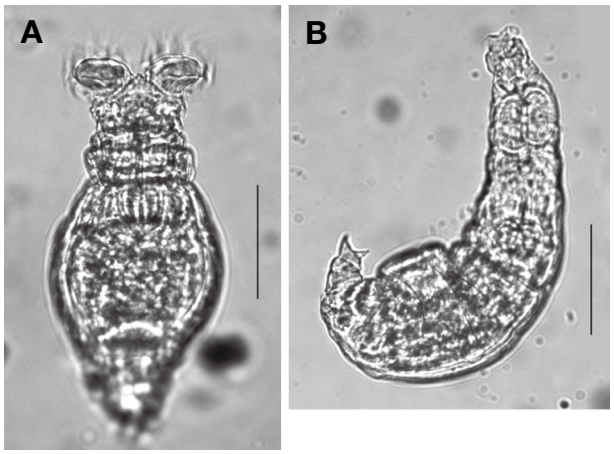


Fig. 15. *Macrotrachela libera libera* Donner, 1949. A. feeding, dorsal view; B. creeping, ventral view. Scale bars = 50 μm.

World distribution. Austria, Germany, Poland and Korea.
Diagnosis. Rostral lamella bilobed and slightly narrower than rostrum end. Corona wider than cingulum. Upper lip lower than trochal discs, rounded triangular, and with a small projection medially. Sulcus much narrower than pedicel width. Pedicel short. Teeth 2/2. First foot pseudosegment plump posterodorsally. Spurs long and conical; outer margin rather straight; inner margin round proximally; with very narrow interspace.
Remarks. The rostral lamella of the Korean specimens is bilobed, while that in the original description was round and without median notch. The corona of the Korean specimens is much wider than cingulum, while that of the original illustration was slightly wider than cingulum.

Order Ploima Hudson and Gosse, 1889 유영목
Family Brachionidae Ehrenberg, 1838 완미윤충과
Genus *Keratella* Bory de St. Vincent, 1822
거북등윤충속

16. *Keratella javana* Hauer, 1937 (Fig. 16)
자바거북등윤충 (신칭)
Keretella cochlearis var. *javana* Hauer, 1937: 382.

Material examined. Jejudo (33°25′13.1″N, 126°50′42.1″E), Korea; collected by SJ Ji on 9 January 2022.
Deposition. NIBRIV0000899201.
World distribution. Pantropical and Korea.
Diagnosis. Lorica stiff. Lorica length twice as long as width. Lateral margin of lorica parallel. Six anterior spines and one caudal spine on dorsal lorica. Reticulated lorica surface. Dorsal lorica plates asymmetry. Frontal median plate rectangular. Left hexagonal, right pentagonal anteromedian plates. Left pentagonal, right hexagonal mesomedian plates. Pentagonal posteromedian plate.

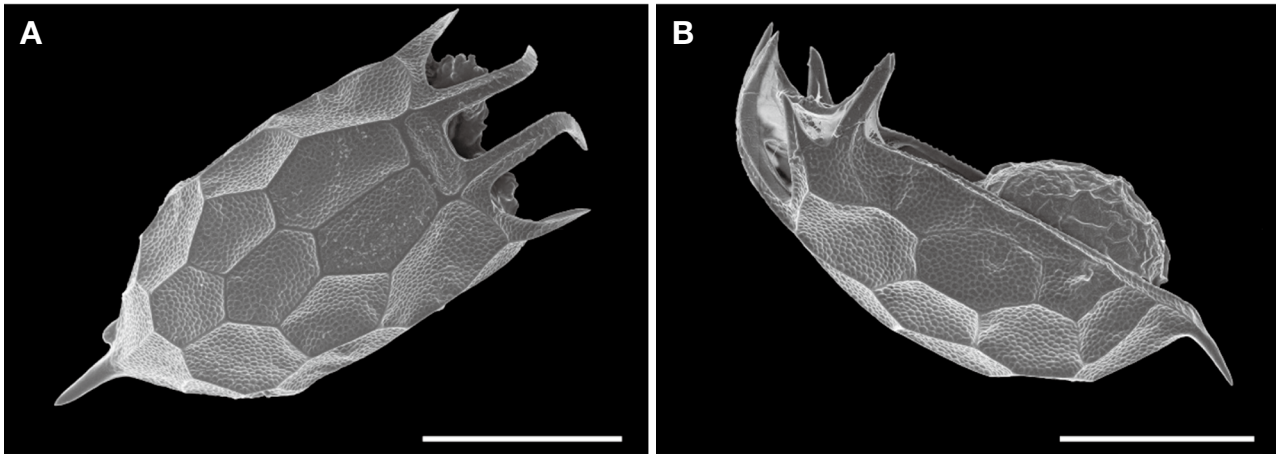


Fig. 16. Photomicrograph of *Keratella javana* Hauer, 1937. A, dorsal view; B, lateral view. Scale bars = 50 μm.

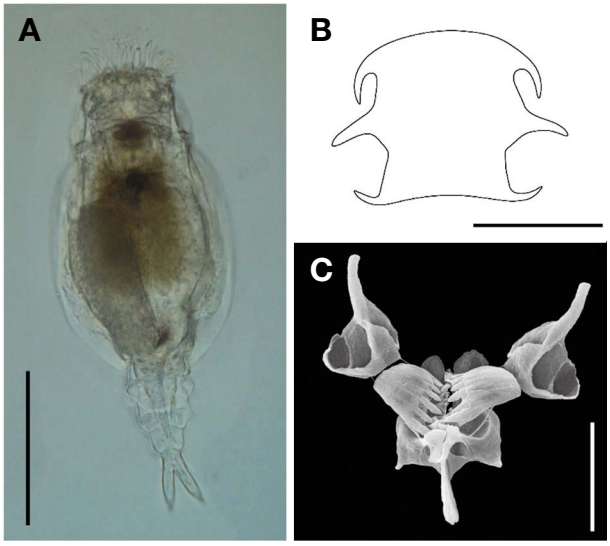


Fig. 17. *Tripleuchlanis plicata* (Levander, 1894). A. dorsal view; B. cross section; C. trophi. Scale bars: A = 100 μm; B = 50 μm; C = 20 μm.

Family Euchlanidae Ehrenberg, 1838 수족윤충과
Genus *Tripleuchlanis* Myers, 1930 이홈윤충속 (신칭)

17. *Tripleuchlanis plicata* (Levander, 1894) (Fig. 17)
주름이홈윤충 (신칭)
Euchlanis plicata Levander, 1894: 48.

Material examined. Incheon-si (37°23′27.1″N, 126°39′51.9″E), Korea; collected by HM Yang on 4 August 2021.
Deposition. NIBRIV0000895437.
World distribution. Cosmopolitan.
Diagnosis. Lorica ovoid. Posterior end of lorica with notch. Dorsal and ventral lorica almost same size, connected by pair of lateral sulci. Transverse view of lorica bellows shape. Foot thick, segmented by three parts. Toes short and sword shape. Trophi malleate type. Unci with six teeth. Rami with alula and denticulated on inner margin.

Family Lecanidae Remane, 1933 술잔윤충과
Genus *Lecane* (Bryce, 1892) 술잔윤충속

18. *Lecane clara* (Bryce, 1892) (Fig. 18)
유리술잔윤충 (신칭)
Distyla clara Bryce, 1892: 271.

Material examined. Jejudo (33°25′13.1″N, 126°50′42.1″E), Korea; collected by SJ Ji on 9 January 2022.
Deposition. NIBRIV0000899202.
World distribution. Cosmopolitan.
Diagnosis. Body soft and flexible. Dorsal and ventral plate hard to distinguish. Anterior margin of lorica flat. Foot pseudosegment not protruding from lorica. Completely separated long toes, about 1/3 of total length. Tip of toe sharp, without claws. Toes lanceolate, and widest in the middle.

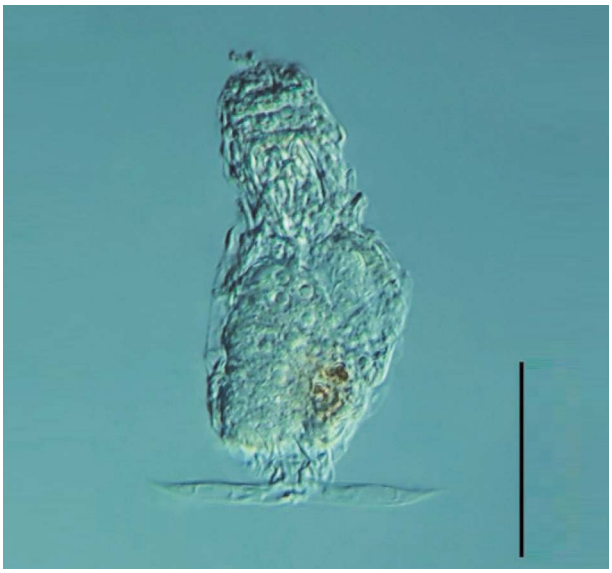


Fig. 18. *Lecane clara* (Bryce, 1892). Scale bar = 50 μm.

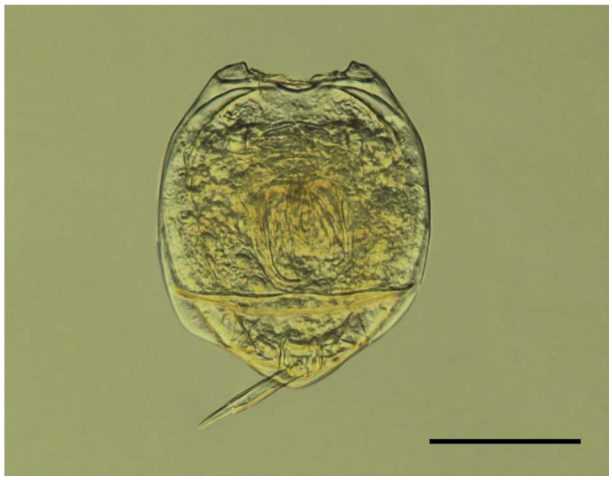


Fig. 19. *Lecane unguitata* (Fadeev, 1925). Scale bar = 50 μm.

19. *Lecane unguitata* (Fadeev, 1925) (Fig. 19)
작은뿔둥근외발술잔윤충 (신칭)
Monostyla unguitata Fadeev, 1925: 21.

Material examined. Shinan-gun (34°50′11.4″N, 126°20′53.6″E), Korea; collected by GH Lee on 3 May 2021.
Deposition. NIBRIV0000900834, NIBRIV0000900835.
World distribution. Cosmopolitan.
Diagnosis. Lorica stiff and circular. Dorsal lorica narrower than ventral lorica. Dorsal lorica apical margin

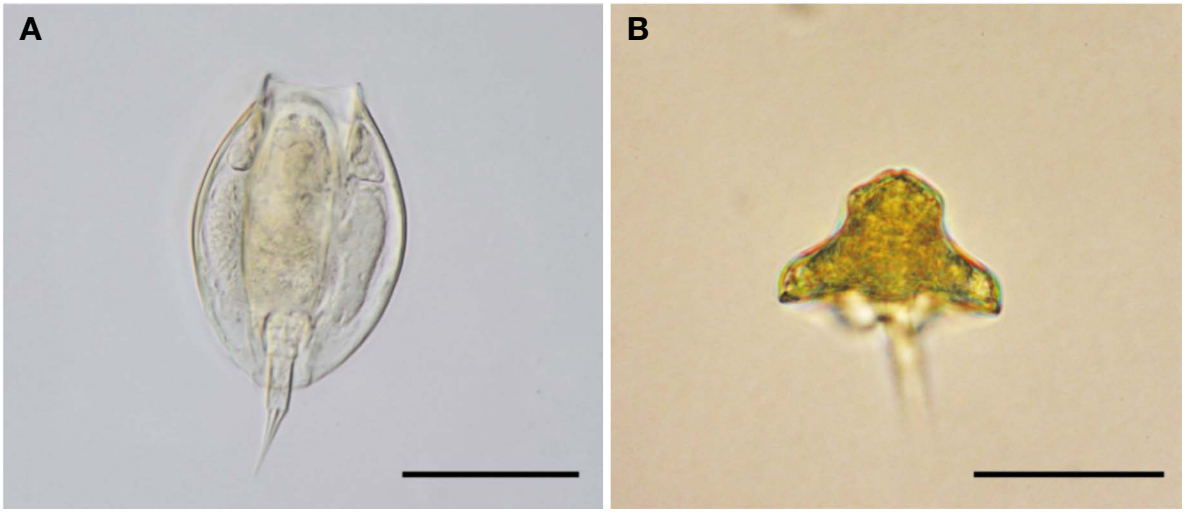


Fig. 20. *Lepadella rhomboides* (Gosse, 1886). A. dorsal view, B. cross section. Scale bars = 50 μm.

straight, ventral with lateral spines. Center of ventral margin concave. Ventral lorica with complete transverse fold. Foot pseudosegment squarcle. Toe single, with two long pseudoclaws. Length of pseudoclaw longer than 1/2 of toe length.

Family Lepadellidae Harring, 1913 안갑윤충과
Genus *Lepadella* Body de St. Vincent, 1826 안갑윤충속

20. *Lepadella rhomboides* (Gosse, 1886) (Fig. 20)
마름모안갑윤충 (신칭)
Metopidia rhomboides Hudson and Gosse, 1886: 108.

Material examined. Jejudo (33°25′16.3″N, 126°51′25.6″E), Korea; collected by HM Yang on 25 June 2021.
Deposition. NIBRIV0000895435.
World distribution. Cosmopolitan.
Diagnosis. Lorica oval. Head aperture broad, U-shaped with collar. Dorsal lorica with high, arched medial keel. Foot opening narrow. Three segmented foot, distal one longest. Two toes straight and pointed.

Phylum Arthropoda von Siebold, 1848 절지동물문
Class Arachnida Lamarck, 1801 거미강
Order Mesostigmata Canestrini, 1891 중기문목
Family Laelapidae Berlese, 1892 가시진드기과
Genus *Gaeolaelaps* Evans & Till, 1966

21. *Gaeolaelaps debilis* (Ma, 1996) (Fig. 21)
다람쥐가시응애 (신칭)
Hypoaspis debilis Ma, 1996.
Hypoaspis debilis Ma, 2004.
Gaeolaelaps debilis Beaulieu, 2009, Yan *et al*., 2018: 261.



Fig. 21. Ventral view of *Gaeolaelaps debilis* (female adult) with extended genital shield. Scale bar = 100 μm.

Material examined. Taehwa River (35°53′83″N, 129°31′13″E), Ulsan-si, Korea; Soil; collected by SY Keum on 3 June 2015.
Deposition. NIBRIV0000835092.
World distribution. China, Iran, Russia far east and Korea.
Diagnosis. Body size much larger (539–575 long, 288–315 wide) and leg I shorter than idiosoma, anal shield longer than wide, post-stigmatic section well developed after stigma. Presternal area sclerotized, with lineate reticulation and bearing st1. Sternal shield with almost smooth, with two pairs of simple and subequal sternal setae, st1

off the shield, genito-ventral shield narrower and longer, its posterior end reaches to the level of JV2, anal shield longer than wide and the peritreme extended to the middle of coxa I.

Remarks. This species is associated with nests of squirrel or ants, and phoretic but not parasitic. This can be free-living predators of smaller arthropods (Kafi *et al*., 2020). *Gaeolaelaps debilis* has the unusual character state of setae st1 off sternal shield. Sternal shield in *Gaeolaelaps* usually bears three pairs of setae, rarely setae st1 off shield in the presternal region. This only occurs in eight species of *Gaeolaelaps* (Beaulieu, 2009; Kazemi *et al*., 2014; Joharchi *et al*., 2019a–c). However, seta st1 being off the sternal shield in the presternal region can be difficult to discern. In particular, in some of the aforementioned species, seta st1 could be borne on paired anterior extensions of the shield, as in *G. jondishapouri*.

Family Pachylaelapidae Berlese, 1913 포수응애과
Genus *Onchodellus* Masan and Halliday, 2014
큰포수응애속

22. *Onchodellus daruma* (Ishikawa, 1977) (Fig. 22)
붉은큰포수응애(신칭)

Pachylaelaps daruma Ishikawa, 1977: 252.
Onchodellus daruma (Ishikawa, 1977), Masan and Halliday, 2014.

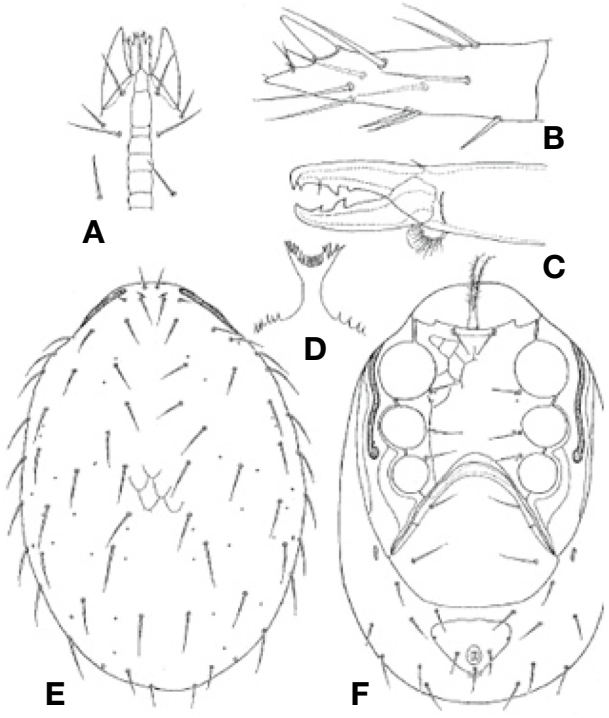


Fig. 22. *Onchodellus daruma* (Ishikawa, 1977). A. venter of gnathosoma; B. tarsus II; C. chelicera; D. epistome; E. dorsum; F. venter.

Material examined. Uiseong-gun (36°27′29″N, 128°23′36″E), Korea; collected by SY Keum on 23 April 2012.
Deposition. N. A.
World distribution. Japan and Korea.
Diagnosis. Dorsum. Dorsal shield entire, weakly reticulated, 30 pairs of simple setae. Setae i4 as long as the distance between bases of setae j4 and z2. Tritosternum well developed. Sternal shield fused with four pair of simple setae and five pair of pores. Genito-ventral shield wider than long. Peritreme extending anteriorly beyond coxae I and base of seta r1. Epistome median denticulate bifurcate process. Corniculi short. Tarsus II with a short stout spur.

Remarks. The species is bigger (length: 0.65 mm) than *Pachylaelaps ishizuchiensis* and was regrouped from the genus *Pachylaelaps* to the genus *Onchodellus* by Masan and Halliday (2014).

23. *Onchodellus ishizuchiensis* (Ishikawa, 1977) (Fig. 23)
포수응애(신칭)

Pachylaelaps ishizuchiensis Ishikawa, 1977: 249.

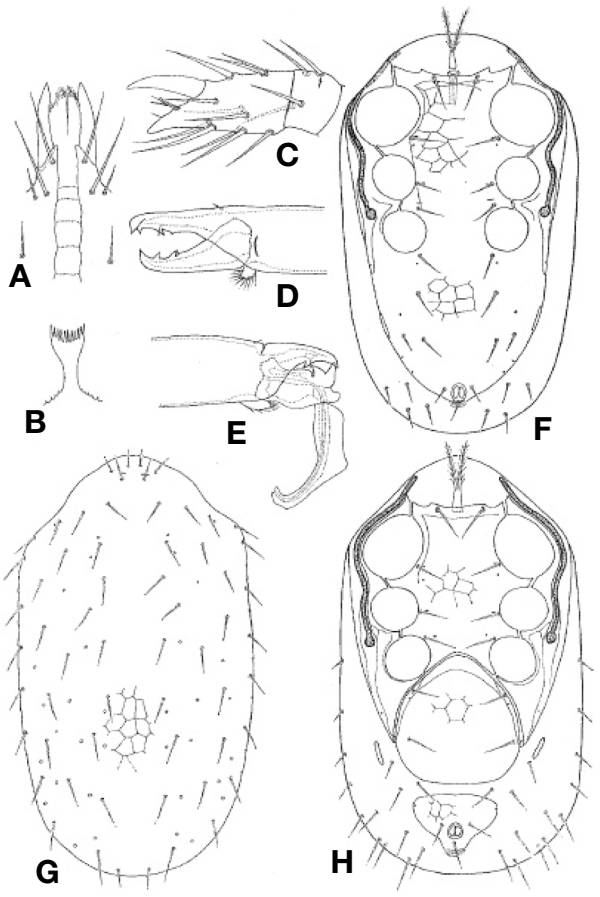


Fig. 23. *Onchodellus ishizuchiensis* (Ishikawa, 1977) (A–D, G, H female; E, F male). A. venter of gnathosoma; B. epistome; C. tarsus II; D, E. chelicera; F. venter; G. dorsum; H. venter.

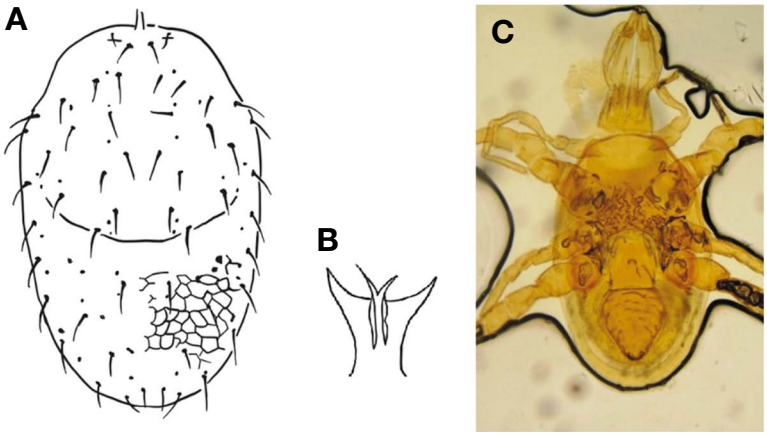


Fig. 24. *Macrocheles similis* Krantz and Fillipponi, 1964, female. A. dorsal shield; B. tectum; C. ventral view.

Onchodellus ishizuchiensis Ishikawa, 1977; Masan and Halliday, 2014.

Material examined. Samcheok-si (37°14′25.76″N, 129° 18′46.62″E), Korea; from soil; collected by SY Keum on 6 June 2011.
Deposition. NIBRIV0000812714.
World distribution. Japan and Korea.
Diagnosis. Idiosome 0.47 mm, dark brown colored. Dorsal shield not separated, but reticulated, and provided with thirty pair of simple setae. Setae j4 shorter than the distance between bases of setae j4 and z2. Tritosternum well developed. Sternal shield with four pairs of simple setae, five pairs of pores. Genito-ventral shield slightly longer than wide. Chelicera with three teeth on fixed digit and a pilus dentilis; movable digit bidentate. Tarsus II bears a long stout spur.
Remarks. Kontschan *et al*. (2014) reported one female individual of this species from Soil Zoology collection of the Hungarian Natural History Museum (Budapest, Hungary) (HNHM). Sample was collected from Yanggang-do, *Larix* forest.

Family Macrocheilia Vitzthum, 1930 파리응애과
Genus *Macrocheles* Latreille, 1829 파리응애속

24. *Macrocheles similis* Krantz and Fillipponi, 1964 (Fig. 24) 순파리응애 (신칭)

Material examined. Sangju-si (36°21′31″N, 128°17′57″ E), Korea; from riparian glass land; collected by SY Keum on 23 May 2009.
Deposition. NIBRIV0000813015.
World distribution. Australia, New Zealand, Japan and Korea.
Diagnosis. Female. Dorsal shield reticular polygonal, line distinct, concave anteriorly; 28 pairs of setae and 22 pairs of pores. Setae j1 distally pilose, bases adjacent; j2, j5, j6, z1, z5, z6, s4, J2, Z3, smooth and pointed; j4, z4, Z4, Z5, S5 with distinct distal pilosity. Sternal shield ornamented. Epigynial shield truncated posteriorly, divided into polygons by a series of punctate lines. Ventri-anal shield, length 245–316 μm, width 244–316 μm; fixed digit of chelicera with a single robust tooth, a terminal hook, and a pilus dentilis, Leg chaetotaxy normal for the genus, six setae on genu IV.
Remarks. *Macrocheles similis* is shown to reproduce by thelytokous parthenogenesis and phoretic, but predatory on *Tyrophagus* mites and possibly nematods (Halliday, 1994; Saito and Takaku, 2013).

Order Sarcoptiformes Reuter, 1909
Family Winterschmiditiidae Oudemans, 1923
Genus *Vidia* Oudemans, 1905

25. *Vidia lineata* Oudemans, 1917 (Fig. 25) 가위벌응애 (신칭)
Vidia lineata Oudemans, 1917: 391.

Material examined. Seoul-si (37°27′20″N, 126°56′ 57″E), Korea; on *Osmia* sp. (Hymenoptera: Megachilidae); with yellow pan trap; collected by KY Lim on 13 May 2020.
Deposition. NIBRIV0000879478.
World distribution. Palaearctic (Klimov *et al*., 2016).
Diagnosis. Body acorn-shaped, yellowish, 221–235 μm long, 160–165 μm wide. Dorsal shield divided into two parts, propodosoma and hysterosoma. Ocelli absent on propodosoma. Leg I–III with pretarsal ambulacrum and simple empodial claws, tarsi I–III with elongated membranous ambulacra, tibia III with three foliate setae, leg IV without foliate setae, tibiotarsus IV with three long setae.
Remarks. Genus *Vidia* is usually associated with Mega-

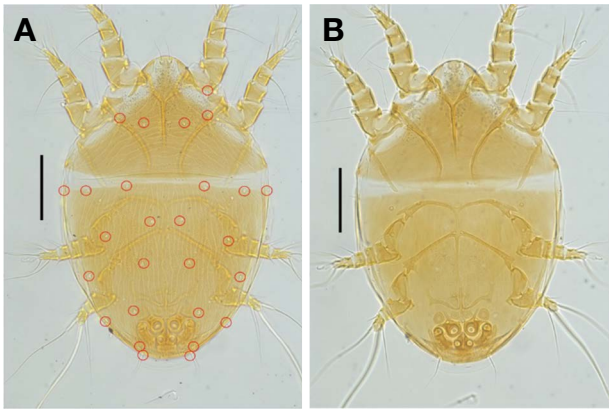


Fig. 25. *Vidia lineata* Oudemans, 1917 (Deutonymph). A. dorsal habitus; B. ventral habitus. Scale bars = 50 μm.

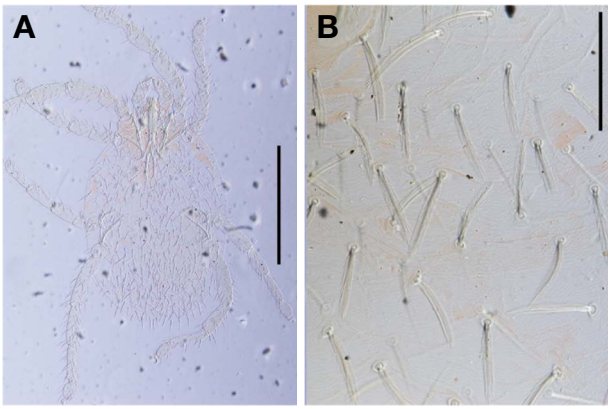


Fig. 26. *Balaustium murorum* Hermann, 1804 (female). A. dorsal habitus; B. shape of setae. Scale bars: A = 500 μm; B = 50 μm.

chilid bee (Klimov and OConnor, 2008). Our samples are also found on *Osmia* sp. Among *Vidia* spp., *V. lineata* is the most common species in the Palaearctic region including the eastern Palaearctic (Klimov *et al*., 2016).

Order Trombidiformes Reuter, 1909
Family Erythraeidae Oudemans, 1902
Genus *Balaustium* von Heyden, 1826

26. *Balaustium murorum* Hermann, 1804 (Fig. 26)
빨간암벽응애 (신칭)
Trombidium murorum Hermann, 1804: 28.

Material examined. Ansan-si (37°13′53″N, 126°34′49″E), Korea; collected by JS Oh on 10 April 2020.
Deposition. NIBRIV0000879477.
World distribution. Cosmopolitan (Halliday, 2001).
Diagnosis. Body oval-shaped, blackish red, 585–796 μm long, 393–552 μm wide. Dorsum covered with densely uniformed penicilate setae. Eyes on lateral side of crista, a pair of urnulae between each eye postero-medially. Chelicera narrow dagger shaped. Pedipalp robust than other species, palp genu as wide as long, palp tibia triangular-shaped.
Remarks. The genus *Balaustium* is a large group, with 41 species worldwide (Mąkol, 2010). This species is usually collected on the rocks and building walls from spring to early summer, whereas *B. medicagoensis* is collected on the ground surface from mid-summer to autumn. *Balaustium medicagoensis* has a much narrow crista than *B. murorum* and has a rough ventral surface with round papillae (Halliday, 2001).

Class Hexanauplia Oakley, Wolfe, Lindgren and Zaharof, 2013
Order Harpacticoida Sars, 1903 갈고리노벌레목
Family Miraciidae Dana, 1846 놀람장수노벌레과
Genus *Paramphiascella* Lang, 1944
나도쌍낭장수노벌레속

27. *Paramphiascella vararensis* (Scott T., 1903) (Fig. 27)
친나도쌍낭장수노벌레 (신칭)
Dactylopus vararensis Scott T., 1903.
Amphiascus vararensis (Scott T., 1903).
Paramphiascoides vararensis (Scott T., 1903).

Material examined. Wando (34°14′34.0″N, 126°50′33.0″E), Korea; collected by DG Jeon on 17 May 2017.
Deposition. NIBRIV0000879019.
World distribution. Scotland, UK and Korea.
Diagnosis. Body semicylindrical, fusiform. Total body length 697 μm, largest width 108 μm. Rostrum not bifid, relatively large, defined at its base, triangular, and with a pair of sensilla. Cephalothorax tapering anteriorly. Caudal rami broader than long. Antennule eight segmented. Antenna with small coxa, elongated allobasis, and three segmented exopod. Swimming legs I–IV, biramous, endopods and exopod three segmented. First endopodite segment of P1 (first thoracopod) reaching to end of exopod at most, third endopodal segment of P1 about 1.5 times as long as second endopod segment. P5 (fifth thoracopod), endopodal lobe with five setae; exopod oval, slightly longer than wide, separated from baseoendopod, and armed with five setae.
Remarks. According to Marcotte (1974) and Wells (2007), the Korean specimen is morphologically most closely related to *Paramphiascella vararensis* (Scott T., 1903) based on the following morphological characteristics: 1) rostrum not bifid, 2) caudal rami broader than long, with two unmodified terminal setae, 3) antenna with three segmented exopod, middle segment of exopod without seta, distal segment of exopod with three setae, and 4) first endopodal segment of P1 extends to just beyond third

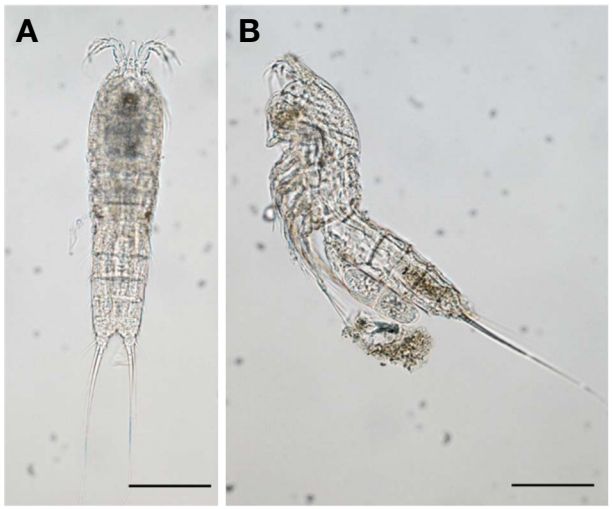


Fig. 27. *Paramphiascella vararensis* (Scott T., 1903), female. A. dorsal view; B, lateral view. Scale bars = 200 μm.

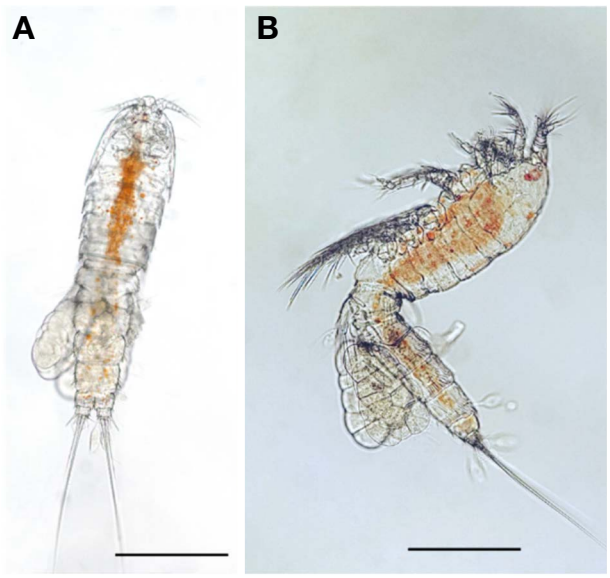


Fig. 28. *Robertsonia propinqua* (Scott T., 1894), female. A. dorsal view; B. lateral view. Scale bars = 300 μm.

exopodal segment at most, third endopodal segment of P1 about 1.5 times as long as second segment of endopod. The Korean population of *P. vararensis* is slightly different from the type species in the shape of P1 endopod first segment.

Genus *Robertsonia* Brady, 1880
로버트슨장수노벌레속 (신칭)

28. *Robertsonia propinqua* (Scott T., 1894) (Fig. 28)
가시로버트슨장수노벌레 (신칭)
Dactylopus propinquus Scott T., 1894.
Amphiascus scotti Sewell, 1924.
Teissierella propinqua (Scott T., 1894).

Material examined. Buan-gun (35°37′24.69″N, 126°28′ 0.82″E), Korea; collected by collected by HW Bang and H Moon on 6 July 2020.
Deposition. NIBRIV0000879020.
World distribution. Mainly subtropical regions such as Africa, India, Argentina, Australia and Korea.
Diagnosis. Body fusiform, slightly depressed, with bent at joint between prosome and urosome. Total body length 857 μm, largest width 229 μm. Rostrum prominent, triangular, with rounded basal corners. Caudal rami short, about 1.4 times wider than long. Antennule five segmented. Antennal exopod three segmented. Swimming legs I–IV biramous, endopods and exopod three segmented. First endopodite segment of P1 (first thoracopod) reaching to end of exopod. P5 (fifth thoracopod) baseoendopod armed with five setae. Exopod nearly as long as wide and armed with six setae.
Remarks. This species is reported from Korean waters for the first time. There are 17 species of genus *Robertsonia* has so far been reported in the world and a key to the species of the genus *Robertsonia* is given by Hamond (1973) and Fiers (1996).

Family Pseudotachidiidae Lang, 1936
가날래장수노벌레과
Genus *Danielssenia* Boeck, 1873
민가날래장수노벌레속 (신칭)

29. *Danielssenia typica* Boeck, 1873 (Fig. 29)
민가날래장수노벌레 (신칭)
Danielssenia fusiformis (Brady, 1880).
Jonesiella spinulosa (Brady, 1880).
Zosime spinulosa Brady and Robertson, 1876.

Material examined. Yeongheungdo (37°11′14.0″N, 126° 26′10.0″E), Korea; collected by RH Jeong and JS Yeom on 4 May 2017.
Deposition. NIBRIV0000879018.
World distribution. UK, Norway and Korea.
Diagnosis. Body fusiform, pedigerous and abdominal somites with denticulated hyaline frills. Total body length 473 μm, largest width 117 μm. Rostrum large, typically deflected, with two pairs of minute sensillae. Caudal rami short, slightly wider than long. Antennule four segmented, antenna is biramus, exopod three segmented. Swimming legs I–IV, biramous, endopods and exopod three segmented, except P1 (first thoracopod) endopod. Proportions and setation as described by Sars (1911), and Gee (1988). P5 (fifth thoracopod) with separate exopod and baseoendo-

pod; baseoendopod armed with three setae; exopod nearly as long as wide and armed with five setae.
Remarks. The genus *Danielssenia* Boeck, 1873 was redefined and revised by Huys and Gee (1993) from the type species *D. typica*, and two other species, *D. quadriseta* Gee, 1988 and *D. reducta* Gee, 1988. *Danielssenia typica* Boeck, 1873 was first described by Boeck (1873), and redescribed by Sars, G. O. (1909), Gee (1988), and Huys and Gee (1993) with new detailed illustrations.

Class Ostracoda Latreille, 1802 패충강
Order Halocyprida Dana, 1853 바다씨벌레목

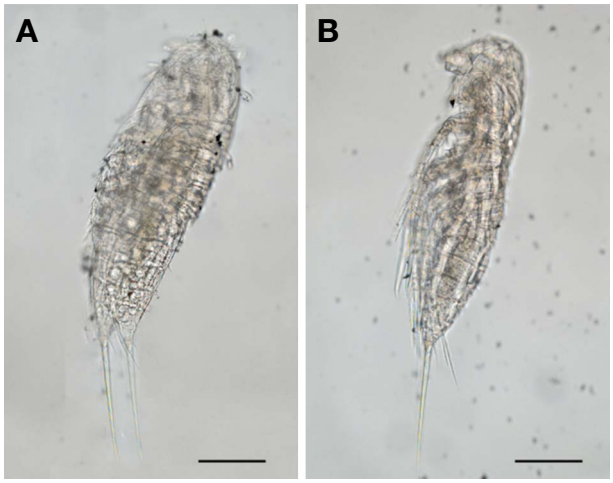


Fig. 29. *Danielssenia typica* Boeck, 1873. A. female, ventral view; B. male, lateral view. Scale bars = 100 μm.

Family Polycopidae Sars, 1865
Genus *Eupolycope* Chavtur, 1981

30. *Eupolycope putjatini* (Chavtur, 1977) (Fig. 30)
작은이빨박피둥근바다씨벌레 (신칭)

Material examined. Goseong-gun (38°18′09.86″N, 128°34′21.87″E), Korea; by scuba diving in depth of 25 m sediment; collected by RH Jeong on 29 June 2016.
Deposition. NIBRIV0000813444.
World distribution. Worldwide.
Diagnosis. Shell rounded in lateral view, right valve with postero-dorsal flange. Both valves with anterior tooth and row of small teeth along the anterior and ventral margins. Bellonci organ consisting of medium long seta. Uropodal lamellae with seven claws each.

Order Podocopida G. O. Sars, 1866
Family Cytheruridae Muller, 1894
Genus *Hemicytherura* Elofson, 1941

31. *Hemicytherura okuboi* Tanaka, Yusaku and Noriyuki, 2011 (Fig. 31)
오쿠보구릉무늬씨벌레 (신칭)

Material examined. Yeosu-si (34°43.165′N, 128°1.421′E), Korea; collected by I Karanovic on 20 August 2013.
Deposition. NIBRIV0000835143.
World distribution. Japan and Korea.
Diagnosis. Central area of four subcircular fossae (1I, 1II, 5II, 2) distinctly separated from surrounding fossae. Fossa

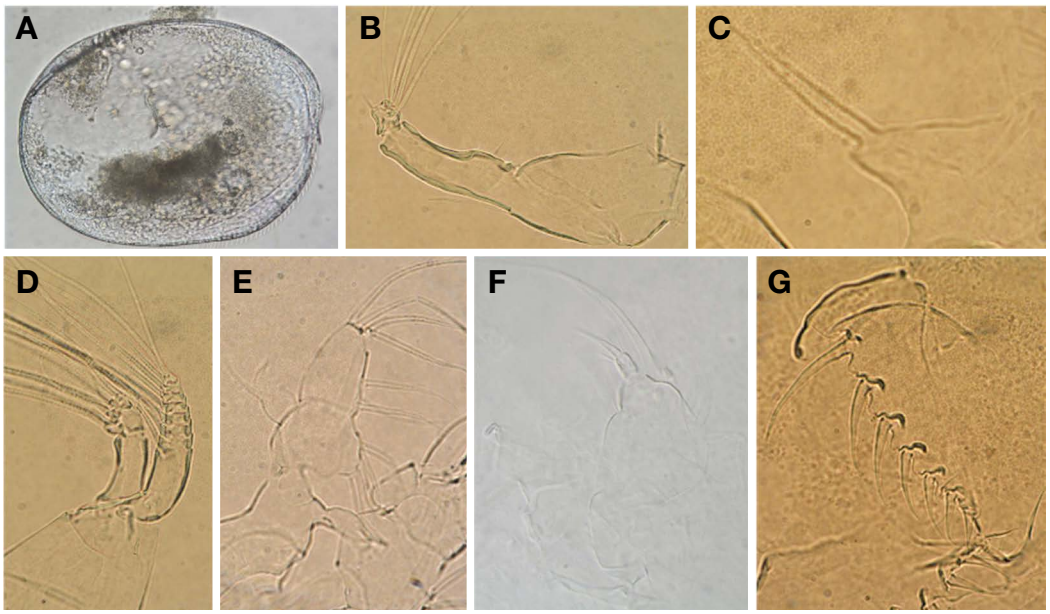


Fig. 30. *Eupolycope putjatini* (Chavtur, 1977). A. right valve; B. A1; C. bellonci organ; D. A2; E. Md; F. fifth leg; G. uropodal lamella.

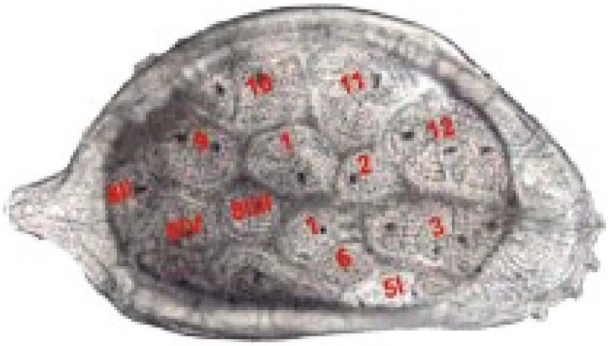


Fig. 31. *Hemicytherura okuboi* Tanaka, Yusaku and Noriyuki, 2011. Right valve with labelled fossae.



Fig. 32. *Robustaurila assimilis* (Kayiyama, 1913). Right valve.

8 divides into 3 fossae (8II, 8III and 8IV); Fossa 9 rarely subdivided by thin murus. Subovate lateral outline. Dorsal margin gently arched; ventral margin almost straight; anterior margin obliquely rounded with four crenulations in lower half; posterior margin with caudal process moderately strong and subtriangular. Surface of fossae covered with remarkable honeycombed pattern.

Remarks. This species is very similar to *H. kajiyamai* Hanai, 1957 already reported from Korea. *Hemicytherura okuboi* differs from *H. kajiyamai* by completely subdivided fossae I and V.

Family Hemicytheridae Puri, 1853
Genus *Robustaurilla* Yajima, 1982

32. *Robustaurilla assimilis* (Kayiyama, 1913) (Fig. 32)
비대칭강낭콩구릉무늬씨벌레 (신칭)

Cythereis assimilis Kajiyama, 1913.
Mutilus assimilis (Kajiyama, 1913) Ishizaki (1968).
Robustaurila assimilis (Kajiyama, 1913) Yajima (1982).

Material examined. Bongam-ri (34°59.629′N, 128° 26.198′E), Gyeongsangnam-do, Korea; collected by I Karanovic on 31 March 2013.
Deposition. NIBRIV0000835142.
World distribution. Japan and Korea.
Diagnosis. Size about 1.2 mm. Surface pitted coarsely and irregularly. The pits, except in the middle area, often disappearing. Anterior marginal ridge strong, parallel to anterior margin. Ventral marginal ridge strong. Radiate ridges also strong.

Valves asymmetrical. Left valve sub-quadrangular in lateral view; greatest height at anterior third. Dorsal margin slightly convex, descending backward, with distinct process postero-dorsally. Anterior margin broadly and distortedly rounded. Posterior margin concave above, convex below, with some denticles, the lowest one of which is most prominent. Ventral margin almost straight. Right valve lower than the left.

Remarks. The genus *Mutilus* differs from the genus *Aurila* only in having strong ornamentation on the surface. No difference in soft parts is found between both genera. Future revisions are necessary and will probably lead to synonymyzation of the two genus names.

Family Leptocytheridae Hanai, 1957
Genus *Callistocythere* Ruggieri, 1953

33. *Callistocythere hosonosuensis* Okubo, 1979 (Fig. 33)
조각파도무늬씨벌레 (신칭)

Material examined. Bongam-ri (34°59.629′N, 128° 26.198′E), Gyeongsangnam-do, Korea; with plankton net; collected by I Karanovic on 31 March 2013.
Deposition. NIBRIV0000835137.
World distribution. Japan and Korea.
Diagnosis. Size about 1 mm. Shell thick (strongly calcified) and laterally compressed. Surface covered with relatively large subdivided (in several) pits. Dorsal margin inclined towards posterior end with greatest height situated frontally. Anterior margin broadly rounded, posterior margin narrower, ventral margin concave around middle length. Radial pore canals poly-furcated anteriorly and posteriorly. Hingement consisting of two anterior terminal teeth on the left valve and two corresponding sockets on the right valve. Hemipenis with anterior process of right-angled triangular lamella with prominent concave hypotenuse; middle process of tongue-like lamella; posterior process of curved bottle-shaped tube with broadened end.

Remarks. This species resembles *C. hayamensis* Hanai, 1957 and *C. angulata* Okubo, 1979 but differs from both in the general outline and shell sculpturing, and most of all in the morphology of hemipenis, especially the bottle-shaped posterior process.

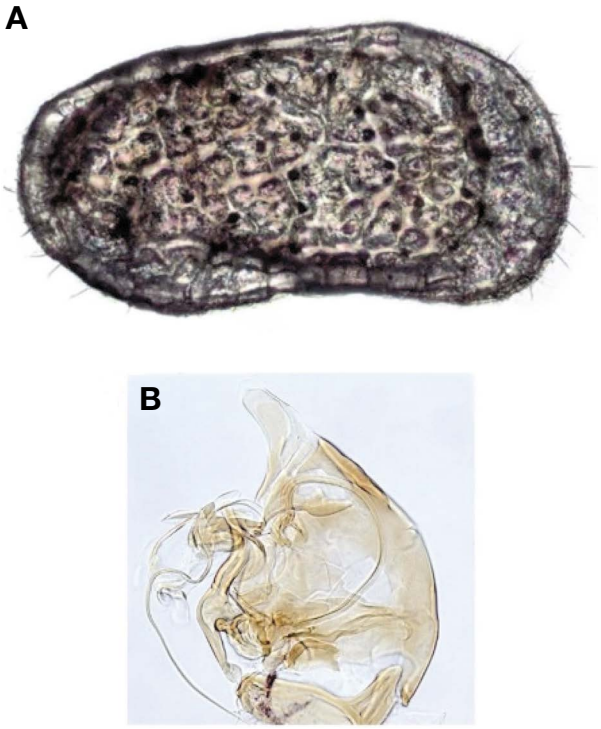


Fig. 33. Hemipenis of *Callistocythere hosonosuensis* Okubo, 1979. A. right valve; B. hemipenis.

34. *Callistocythere laevis* Okubo, 1979 (Fig. 34)
발톱파도무늬씨벌레 (신칭)

Material examined. Boseong-gun (34°40.172′N, 127° 05.424′E), Korea; collected by I Karanovic on 17 August 2013.
Deposition. NIBRIV0000835138.
World distribution. Japan and Korea.
Diagnosis. Size about 1.2 mm. Shell thick (strongly calcified) and laterally compressed. Surface smooth. Dorsal margin slightly arched, anterior margin obliquely rounded, posterior margin narrower than anterior. Ventral margin distinctly sinuated. Radial pore canals poly-furcated anteriorly and posteriorly. Hingement on right valve composed of anterior and posterior teeth and intermediate shelf, which is finely pitted throughout and has one socket anteriorly. On the left valve hingment composed of anterior and posterior sockets and intermediate ridge, crenulated throughout and with one prominent tooth anteriorly. Hemipenis with anterior process of small triangular lamella; middle and posterior processes of flame-shaped lamellae curved backwards. Copulatory tube spiral, coiling several times.
Remarks. This species has an intermediate position between *Callistocythere* and *Leptocythere*. Like the latter genus it is elongated and with a smooth shell, but like the former genus it has poly-furcated radial pore canals.

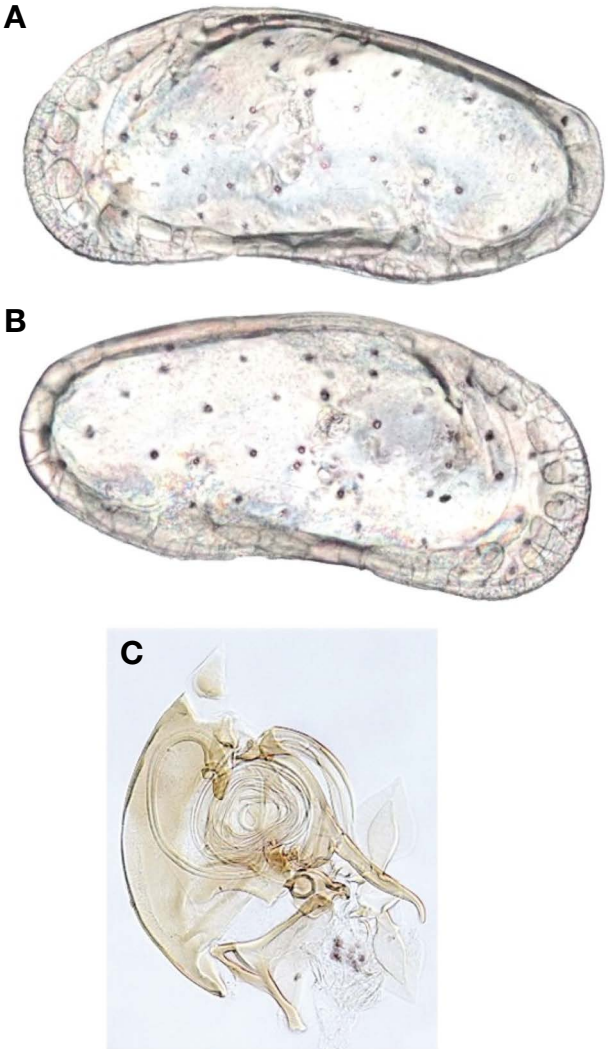


Fig. 34. *Callistocythere laevis* Okubo, 1979. A. left valve; B. right valve; C. hemipenis.

Family Loxoconchidae Sars, 1925
Genus *Loxoconcha* Sars, 1866

35. *Loxoconcha uranouchiensis* Ishizaki, 1968 (Fig. 35)
일본비대칭껍질씨벌레 (신칭)

Material examined. Goheung-gun (34°24′59.6″N, 127° 29′12.7″E), Korea; collected by T Karanovic and I Karanovic on 18 August 2013.
Deposition. NIBRIV0000813450.
World distribution. Worldwide.
Diagnosis. Both valves similar to each other, oblong to elongated, very slightly tapering backward; greatest height at anterior third. Anterior margin broadly rounded, forming faint anterior cardinal angle with dorsal margin, merging into ventral margin. Posterior margin somewhat narrowly rounded. Ventral margin almost straight. Surface

reticulated rather regularly. Two ridges present: one close to the ventral margin (longer) and one close to the postero-dorsal margin (shorter). Hemipenis with triangular distal lobe.

Remarks. The species differs from the original description by having two ridges on the carapace, and by having much longer third segment on A1. Also, hemipenis is somewhat different because in the original description there is a small process on the distal lobe.

Family Paracyprididae Sars, 1923
Genus *Gerdocypris* Mckenzie, 1983



Fig. 35. *Loxoconcha uranouchiensis* Ishizaki, 1968. Left valve.

36. *Gerdocypris nipponica* (Okubo, 1980) (Fig. 36)
일본강낭콩다리씨벌레 (신칭)
Aglaiocypris nipponica Okubo, 1980.
Gerdocypris nipponica (Okubo, 1980) Maddocks (1992).

Material examined. Goseong-gun (38°18′09.86″N, 128° 34′21.87″E), Korea; by scuba diving in depth of 25 m sediment; collected by RH Jeong on 29 June 2016.
Deposition. NIBRIV0000813443.
World distribution. Japan and Korea.
Diagnosis. Carapace reniform in the lateral view, surface smooth and covered only with pores and sensilla, A1 reduced with only five segments. A2 without swimming setae in both sexes. One of the two short setae on the cleaning leg is strong and claw-like. Uropodal ramus with two long posterior setae. Anterior and posterior claw subequal long. Hemipenis with thumb-like lobe a, not projecting laterally.

Family Paradoxostomatidae Brady and Norman, 1889
Genus *Obesostoma* Schornikov, 1993

37. *Obesostoma setosum* (Okubo, 1980) (Fig. 37)
세토잎모양층씨벌레 (신칭)
Paradoxostoma setosum Okubo, 1980.
Obesostoma setosum (Okubo, 1980) Schornikov (1993).

Material examined. Yeosu-si (34°43.165′N, 128°1.421′E),

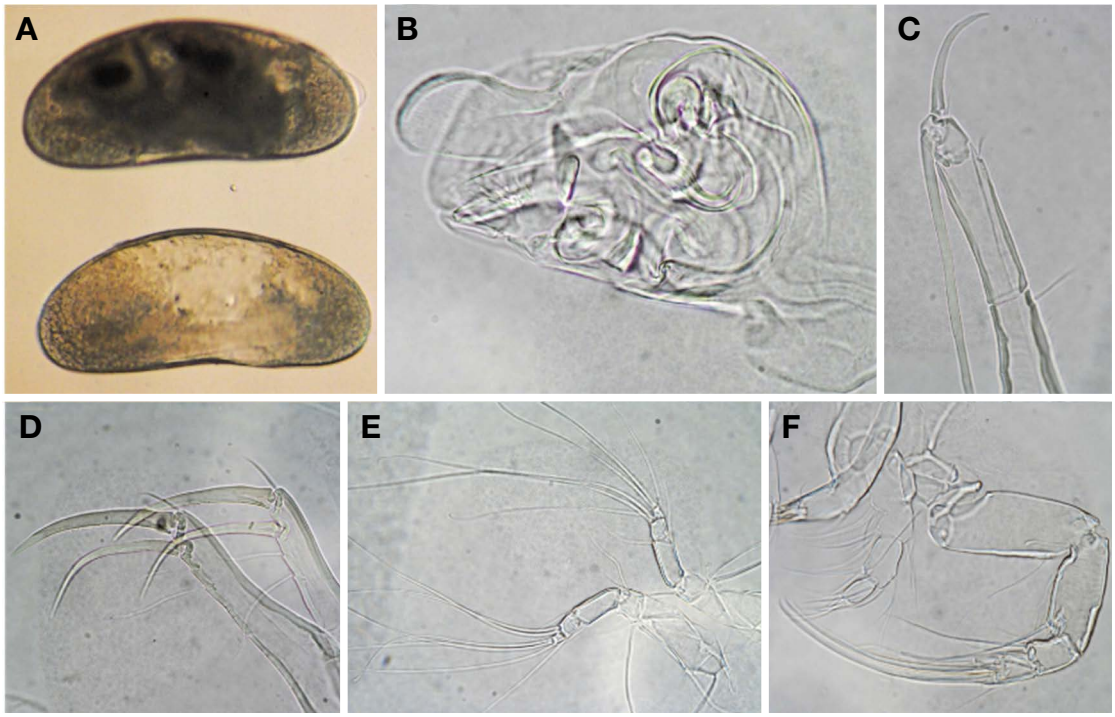


Fig. 36. *Gerdocypris nipponica* (Okubo, 1980). A. whole animal (up) and left valve (bottom) (female); B. hemipenis; C. distal part of L7 (male); D. Uropodal Ramus (male); E. A1 (male); F. A2 and Md.

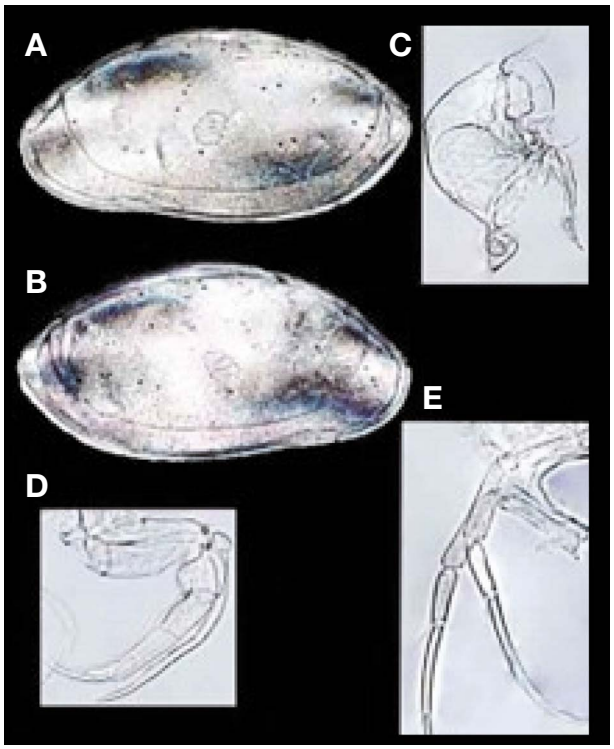


Fig. 37. *Obesostoma setosum* (Okubo, 1980). A. left valve; B. right valve; C. hemipenis; D. A2; E. A1.

Korea; collected by I Karanovic on 20 August 2013.
Deposition. NIBRIV0000835144.
World distribution. Japan and Korea.
Diagnosis. Size about 1 mm. Left valve sub-elliptical; greatest height half of length, just behind the middle. Dorsal margin evenly arched. Anterior and posterior margins narrowly rounded. Ventral margin almost straight along anterior half, ascending toward posterior end. Right valve similar to the left; caudal process more prominent. Selvage well-developed.

Family Trachyleberididae Sylvester Bradley, 1948
Genus *Leguminocythereis* Howe, 1936

38. *Leguminocythereis tomokoae* Ishizaki, 1968 (Fig. 38)
거친그물무늬씨벌레 (신칭)

Material examined. Incheon-si (37°23′07.53″N, 126°24′31.63″E), Korea; collected by I Karanovic on 26 May 2012.
Deposition. NIBRIV0000813448.
World distribution. Worldwide.
Diagnosis. The entire genus is known only after carapace appearance, therefore our identification is only provisional, especially because all other species have strongly ornamented shell surface, in contrast to *L. tomokoae*.

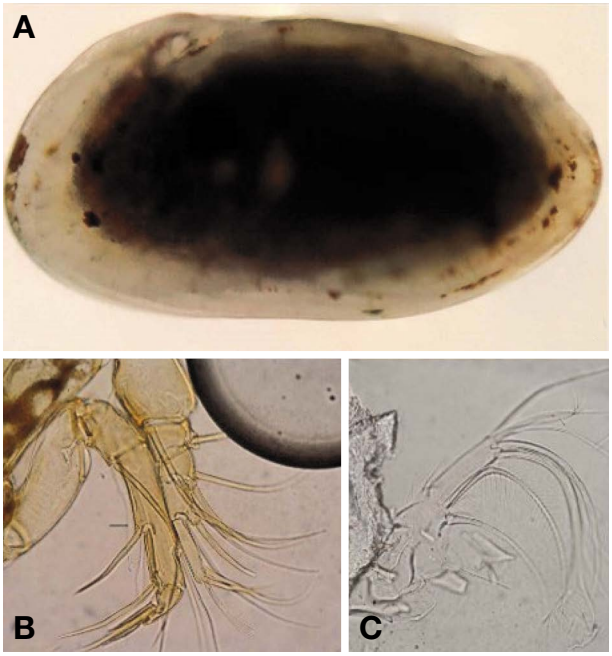


Fig. 38. *Leguminocythereis tomokoae* Ishizaki, 1968. A. left valve; B. A1 and A2; C. Md.

Discussion

In this study, 38 species belonging to four phyla (Platyhelminthes, Annelida, Rotifera, and Arthropoda) were recorded. Among these, 14 genera were reported in Korea for the first time (*Digramma* Cholodkovsky, 1915, *Proctoeces* Odhner, 1911, *Specaria* Sperber, 1939, *Tripleuchlanis* Myers, 1930, *Robertsonia* Brady, 1880, *Danielssenia* Boeck, 1873, *Vidia* Oudemans, 1905, *Balaustium* von Heyden, 1826, *Eupolycope* Chavtur, 1981, *Robustaurilla* Yajima, 1982, *Callistocythere* Ruggieri, 1953, *Gerdocypris* Mckenzie, 1983, *Obesostoma* Schornikov, 1993, and *Leguminocythereis* Howe, 1936).

In general, the publication of new species is a rigorous and careful process. However, unrecorded species can be published as a list with only species names (Sarma *et al*., 2021). This is because the characteristics of most unrecorded species are already well-described in the relevant taxonomic literature, including the original description.

After the publication of the first list-type paper of unrecorded species in 2017 (Song *et al*., 2017), the significance of further taxonomic information, in addition to species names, for subsequent publications was pointed out (unpublished per. com.). Therefore, we have added the following information in the present paper: (1) brief diagnosis and remarks (if necessary), (2) specimen vouchers (deposited at NIBR, the host organization of the project), and (3) photographs or drawings of specimens. This addi-

tional information is expected to be useful for future studies, such as correction of misidentification, reexamination of classification system changes, and comparative studies on related species.

Acknowledgements

This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR201302001, NIBR201501201, NIBR201701201, NIBR201801202, NIBR201902204, NIBR202002204, NIBR202102203, NIBR202203202).

References

Bae, Y.J., K. Cho, G.-S. Min, B.-J. Kim, J.-O. Hyun, J.H. Lee, H.B. Lee, J.-H. Yoon, J.M. Hwang and J.H. Yum. 2021. Review of the Korean Indigenous Species Investigation Project (2006-2020) by the National Institute of Biological Resources under the Ministry of Environment, Republic of Korea. Korean Journal of Environmental Biology 39(1): 119-135.

Boeck, A. 1872. Nye Slaegter og Arter af Saltvands-Copepoder. Forhandlinger i Videnskabs-Selskabet i Kristiana 1872:35-60.

Bourne, A.G. 1891. Notes on the Naidiform Oligochaeta; containing a description of New Species of the Genera, Pristina and Pterostylarides, and remarks upon Cephalization and Gemmation as generic and specific Characters in the Group. Quarterly Journal of Microscopical Science 32:335-356 + Plates XXVI-XXVII.

Brady, G.S. 1880. A monograph of the free and semi-parasitic Copepoda of the British Islands. Ray Society, London. pp. 1-148.

Brady, G.S. and D. Robertson. 1876. Report on dredgings off the coast of Durham and North Yorkshire in 1874. Report of the British Association for the Advancement of Science 45:185-199.

Bryce, D.L. 1892. On some moss-dwelling Cathypnadae; with descriptions of five new species. Science Gossip 28:271-275.

Chavtur, V.G. 1977. Polycopiden der Kurilen-Inseln. In: Fauna der Uferzone der Kurilen-Inseln. 144-171.

Cholodkovsky, N.A. 1914. Cestodes nouveaux ou peu connus. Troisième série. Известия Российской академии наук. Серия математическая 8(5):318.

Cribb, T.H. 2005. Family Opecoelidae Ozaki, 1925. In: Jones, A., R.A. Bray & D.I. Gibson (eds.), Keys to the Trematoda. II. Wallingford: CABI International, London. pp. 533-539.

Donner, J. 1949. Rotatorien der Humusböden. Österreichische Zoologische Zeitschrift, Wien II 1/2:117-151.

Fiers, F. 1996. Robertsonia glomerata new species (Copepoda: Harpacticoida) from a North Carolina estuarine salt marsh. Bulletin of Marine Science 58(1):117-130.

Gee, J.M. 1988. Taxonomic studies on Danielssenia (Crustacea, Copepoda, Harpacticoida) with descriptions of two new species from Norway and Alaska. Zoologica Scripta 17(1):39-53.

Halliday, R.B. 2001. Systematics and biology of the Australian species of Balustium von Heyden (Acari: Erythraeidae). Australian Journal of Entomology 40:326-330.

Hamond, R. 1973. The Australian species of Robertsonia (Crustacea, Harpacticoida), with a revised key to the genus. Australian Museum 28:421-435.

Hauer, J. 1937. Die Rotatorien von Sumatra, Java und Bali nach den Ergebnissen der Deutschen Limnologischen Sunda-Expedition. Erster Teil. Archiv für Hydrobiologie 15:296-384.

Hudson, C.T. and P.H. Gosse. 1886. The Rotifera: or wheel-animalcules. II. Longmans, Greeen, and CO., London. pp. 1-144.

Huys, R. and J.M. Gee. 1993. A revision of Danielssenia Boeck and Psammis Sars with the establishment of two new genera Archisenia and Bathypsammis (Harpacticoida: Paranannopidae). Bulletin of the Natural History Museum, Zoology Series 59(1):45-81.

Ishizaki, K. 1968. Ostracodes from Uranouchi Bay, Kochi Prefecture, Japan. Science Reports of the Tohoku University, Sendai, Second Series (Geology) 40:1-45.

Kajiyama, E. 1913. On the Ostracoda of Misaki (part 3). Zoological Magazine (Dobutugaku-zasshi) 25:1-6.

Klimov, P.B. and B.M. Oconnor. 2008. Morphology, Evolution, and Host Associations of Bee-Associated Mites of the Family Chaetodactylidae (Acari: Astigmata) with a monographic revision of North American taxa. University of Michigan Museum of Zoology Ann Arbor, Michigan. pp. 1-243.

Klimov, P.B., B. Oconnor, R. Ochoa, G.R. Bauchan, A.J. Redford and J. Scher. 2016. Bee Mite ID: Bee-Associated Mite Genera of the World. USDA APHIS Identification Technology Program (ITP), Fort Collins, CO.

Kondo, M. 1936. A List of Naidiform Oligochaeta from the Waterworks Plant of the City of Osaka. Annotationes Zoologicae Japonenses 15:382-393.

Levander, K.M. 1894. Materialien zur Kenntniss der Wasserfauna in der Umgebung von Helsingfors, mit besonderer Berücksichtigung der Meeresfauna, II. Rotatoria. Acta Societatis pro Fauna et Flora Fennica 12:1-72.

Mąkol, J. 2010. A redescription of *Balaustium murorum* (Hermann, 1804) (Acari: Prostigmata: Erythraeidae) with notes on related taxa. Annales Zoologici 60(3):439-454.

Manchenko, G.P. and V.I. Radashevsky. 2002. Genetic differences between two sibling sympatric Dipolydora species (Polychaeta: Spionidae) from the Sea of Japan, and a new species description. Journal of the Marine Biological Assoc-

iation of the United Kingdom 82(2):193-199.
Marcotte, B.M. 1974. Two new harpacticoid copepods from the North Adriatic and a revision of the genus *Paramphiacella*. Zoological Journal of the Linnean Society 55(1):65-82.
Marcus, E. 1944. Sobre Oligochaeta Limnicos do Brasil. Zoologia 43(8):5-135.
Michaelsen, W. 1900. Oligochaeta. R. Friedländer und Sohn, Berlin. pp. 1-575.
Michaelsen, W. 1909. The Oligochaeta of India, Nepal, Ceylon, Burma and the Andaman Islands. pp. 1-158.
Moore, J.P. 1907. Descriptions of new species of spioniform annelids. Proceedings of the Academy of Natural Sciences of Philadelphia 59:195-207.
Müller, O.F. 1774. Vermium terrestrium et fluviatilium, seu animalium infusoriorum, helminthicorum, et testaceorum, non marinorum, succincta historia. Havniæ et Lipsiæ. Pars Altera. pp. 1-72.
Müller, O.F. 1784. Zoologia danica seu animalium Daniae et Norvegiae rariorum ac minus notorum historia descriptiones et historia. Weygand 2:1-124.
National Institute of Biological Resources. 2021. Discovery of Korean Indigenous Species (Invertebrates, excluding insects). NIBR, Korea (in Korean).
Okubo, I. 1977. Fourteen species of the genus *Paradoxostoma* Fischer, 1855 in the Inland Sea, Japan (Ostracoda). Publ. Seto Mar. Biol. Lab. XXIV(1/3):99-131
Okubo, I. 1979. Recent marine Ostracoda in the Inland Sea XII. Five species of Callistocythere (Ostracoda) from the Inland Sea of Seto. Researches of Crustacea 9:13-28.
Ørsted, A.S. 1842. Conspectus generum specierumque Naidum ad faunam Danicam pertinentium. Naturhistorisk Tidsskrift 4:128-140.
Oudemans, A.C. 1917. Acarologische Aanteekeningen, LXIII. Entomologische Berichten 4(96):391-396.
Piguet, E. 1906. Oligochètes De La Suisse Française. Revue suisse de Zoologie, Annales de la Société Zoologique suisse et du Muséum d'Histoire naturelle de Genève 14: 389-403.
Sarma, S.S.S., M.A. Jiménez-Santos and S. Nandini. 2021. Rotifer species diversity in Mexico: an updated checklist. Diversity 13(7):291.
Sars, G.O. 1909. Copepoda Harpacticoida. Parts XXVII & XXVIII. Cletodidae (concluded), Anchorabolidae, Gylindropsyllidae, Tachiidae (part). An Account of the Crustacea of Norway, with short descriptions and figures of all the species. Bergen Museum, Bergen. 5:305-336.
Sars, G.O. 1911. An Account of the Crustacea of Norway: with Short Descriptions and Figures of all the Species, V. Bergen Museum, Bergen. pp. 1-449.
Schornikov, E.I. 1993. Systematic problems of the ostracods of family Paradoxostomatidae and reclassification of *Paradoxostoma s.l.* from Peter the Great Bay (Sea of Japan). In: A.I. Kafanov (ed.), Ecosystems research: Costal communities of Peter the Great Bay. Vladivostok. pp. 153-166 (in Russian).
Schulte, H. 1954. Beiträge zur Ökologie und Systematik der Bodenrotatorien. Zoologische Jahrboücher (Systematik) 82:551-617.
Scott, T. 1894. Report on Entromostraca from the Gulf of Guinea, Collected by John Rattray. Linnean Society of London 6(1):1-161.
Scott, T. 1903. On some new and rare Crustacea collected at various times in connection with the investigations of the Fishery Board for Scotland. Report of the Fishery Board of Scotland 21(3):109-135.
Semenow, W.D. 1927. Vogeltrematoden des weslchen Bereiches der Union S. S. R. Sammlunghelminthologischer Arbeiten, Prof. Dr. K. I. Skrabin, von seinen Schulern gewidmet, Moskau. 252-256.
Sewell, R.B.S. 1924. Crustacea Copepoda. In: Fauna of Chilka Lake. Memoirs of the Indian Museum 5:771-851.
Song, J.-H., Y.-D. Han, W.-K. Lee, I.-H. Kim, S.-G. Paik, J. Lee, H.Y. Soh, W. Lee, J. Jung, S.H. Kim, J.-S. Lee, J.-P. Kim, T. Park, J.-S. Yoo, H.-J. Kil, E. Nam and G.-S. Min. 2017. Unrecorded species of Korean metazoans discovered through the project of "Discovery of Korean Indigenous Species" (2006-2010). Journal of Species Research 6(spc):164-171.
Sperber, C. 1948. A taxonomical study of the Naididae. Zoologiska Bidrag Fran Uppsala 281:1-297.
Sperber, C. 1958. Uber einige Naididae aus Europe, Asien and Madagaskar. Archiv für Zoologie 12(6):45-53.
Tanaka, G., Y. Kaseda and N. Ikeya. 2011. Reclassification of the genus Hemicytherura (Crustacea, Ostracoda) from Japan and the surrounding regions. Bulletin of the Gunma Museum of Natural History 15:19-42.
Timm, T. 2009. A Guide to the Freshwater Oligochaeta and Polychaeta of Northern and Central Europe. Lauterbornia 66:1-235.
Vaillant, L. 1890. Histoire naturelle des Annelés marins et d'eau douce. Lombriciens, Hirudiniens, Bdellomorphes, Térétulariens et Planariens. Tome troisième. Seconde partie. Libraire Encyclopédique de Roret, Paris. 341-768.
Van Haaren, T. and J. Soors. 2012. Aquatic Oligochaeta of the Netherlands and Belgium - Identification Key to the Oligochaetes. KNNV Publishing, Zeist. pp. 1-302.
Vejdovský, F. 1884. Revisio Oligochaetorum Bohemiae. Sitzungsberichte der königlichen Böhmischen Gesellschaft der Wissenschaften in Prag/Zprávy o Zasedání Královské České Společnosti Nauk v Praze 1883:215-231.
Wells, J.B.J. 2007. An annotated checklist and keys to the species of Copepoda Harpacticoida (Crustacea). Zootaxa 1568(1):1-872.
Yajima, M. 1982. Late Pleistocene Ostracoda from the Boso Peninsula, central Japan. Bulletin University Museum University of Tokyo 20:141-227.
Yamaguchi, H. 1953. Studies on the Aquatic Oligochaeta of Japan. Vi. A Systematic Report, with Some Remarks on the Classification and Phylogeny of the Oligochaeta. Journal

of the Faculty of Science 11(2):277-342.
Yamaguti, S. 1938. Studies on the helminth fauna of Japan. Part 21. Trematodes of fishes, IV. Japanese Journal of Medical Science. pp. 1-139.
Yamaguti, S. 1939. Studies on the helminth fauna of Japan. Part 25. Trematodes of birds, IV Japanese Journal of Zoology 8:140-141.
Yamaguti, S. 1951. Studies on the helminth fauna of Japan. Part 44. Trematodes of fishes, IX. Arbeiten aus der Medizinischen Fakultat Okayama 7(4):247-283.

Submitted: September 28, 2022
Revised: October 27, 2022
Accepted: October 28, 2022