

## Korean New Records of Five Bdelloids including Four Rare Species

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**Abstract** - The bdelloids collected from various terrestrial habitats such as mosses, lichens, mushrooms on tree trunks, leaf litter and soil at four different locations in Korea were investigated. Five bdelloids new to Korea were identified: *Macrotrachella inermis* Donner, 1965, *Macrotrachela magna* Schulte, 1954, *Macrotrachela oblita* Donner, 1949, *Habrotracha eremita* (Bryce, 1894) and *Habrotracha schultei* Donner, 1965. All these rotifers except *M. inermis* are new to Asia as well. Remarkably, these five Korean new records included four rare species with poorly known distributions. *M. magna* and *H. schultei* are recorded outside their type localities for the first time. *M. oblita* has been reported only from five European countries, and *M. inermis* has been known from three European countries and Eastern Turkey before the present study. The taxonomy and distribution of each rare bdelloid are discussed here.

**Key words:** bdelloids, new records, taxonomy, Korea, distribution

### INTRODUCTION

In the genera *Macrotrachela* Milne, 1886 and *Habrotracha* Bryce, 1910, about 106 and 128 taxa, respectively, have been known to the world (Segers 2007, updated in 2012). In Korea, 17 *Macrotrachela* and 18 *Habrotracha* taxa have been reported until recently (Song 2015; Song and Min 2015). The result of the present study added three *Macrotrachela* and two *Habrotracha* species to the Korean record, which led to 20 taxa in *Macrotrachela* and 20 in *Habrotracha*.

These Korean new records included four rare species with very limited distributions such as *M. magna*, *M. oblita*, *M. inermis* and *H. schultei*. Most remarkably, *M. magna* and *H. schultei* are recorded outside their type localities for the first time after 60 and 49 years after their descriptions, respectively. *M. oblita* has been reported only from five European countries, and *M. inermis* has been known from three

European countries and Eastern Turkey before the present study. While *H. eremita* is a presumably cosmopolitan species because of its wide distribution, it is new to Asian fauna.

Here diagnostic characteristics, illustrations and discussions on the taxonomy and distribution of each Korean new record are provided.

### MATERIALS AND METHODS

For the present taxonomic study on Korean rotifers, specimens collected from various terrestrial habitats such as mosses, lichens, mushrooms on tree trunks, leaf litter and soil were investigated. Samples were collected from four locations in Korea from July 4, 2014 to May 24, 2015. The detailed habitat information and sampling date of each locality are listed in Table 1. The bdelloids were extracted, examined and identified according to a previously described method (Song 2014). The photography and motion records of living specimens were performed using an Infinity 2 digital camera (Lumenera Corporation, ON, Canada). The pho-

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**Table 1.** List of sampling localities

Locality	GPS coordinates	Sampling date	Habitat	Species
1. Gangneung-Wonju National University campus, Gangneung-si, Gangwon-do	37°46'07.9"N, 128°52'11.8"E	June 22, 2014	Mushrooms on a tree trunk	<i>Macrotrachela magna</i>
2. Saryeoni forest, Jocheon-eup, Jeju-si	33°25'20.9"N, 126°37'29.0"E	July 4, 2014	Mushrooms on a tree trunk	<i>Macrotrachela inermis</i> , <i>Habrotracha schultei</i>
3. A mountain in Jeongan-myun, Gongju-si, Chungcheongnam-do	36°36'30.86"N, 127°7'12.42"E	Sep. 20, 2014	Lichens and mosses	<i>Macrotrachela oblita</i>
4. Mongsanpo, Nam-myun, Taean-gun, Chungcheongnam-do	36°40'24.7"N, 126°16'23.0"E	May 24, 2015	Leaf litter, mosses and soil	<i>Habrotracha eremita</i>

tographs and computer-grabbed images of motion records were used for illustrations. Measurements were made by using Photoshop CS3. The specimens were killed with head, foot, and toes extended, by using the boiling water fixation method (Pennak 1978) instead of narcotization. The method of Stemberger (1979) was used for the preparation of permanent mounts.

The classification scheme is based on Melone and Ricci (1995).

## RESULTS AND DISCUSSION

Phylum Rotifera Cuvier, 1817 유행동물문  
Class Eurotatoria De Ridder, 1957 진운충강  
Subclass Bdelloidea Hudson, 1884 질형아강  
Order Philodinida Melone & Ricci, 1995 선운충목  
Family Philodinidae Bryce, 1910 선운충과  
Genus *Macrotrachela* Milne, 1886 큰관윤충속

### 1. *Macrotrachela inermis* Donner, 1965 (Fig. 1)

연약큰관윤충 (신칭)

**Synonyms:** *Macrotrachela inermis* Donner, 1965, pp. 139-140, Fig. 103; Donner, 1970, p. 242, Abb. 21d, g, h.

**Material examined:** 2 specimens, Saryeoni forest, Jocheon-eup, Jeju-si, July 4, 2014.

**Diagnosis:** Upper lip arched and with rounded triangle-shaped median lobe; upper lip slightly lower than trochal discs. Corona much narrower than cingulum pad. Pharyngeal tube slightly longer than trophi length. Teeth 4/4. Spurs conical with pointed ends; interspace narrower than spur base width.

**Measurements:** Total body length (in feeding) 203 ~ 210  $\mu$ m. Total body length (in creeping) 270  $\mu$ m. Greatest trunk

width (in feeding) 58 ~ 59  $\mu$ m. Greatest trunk width (in creeping) 44  $\mu$ m. Corona width 22  $\mu$ m. Cingulum width 23 ~ 25  $\mu$ m. Cingulum pad width 28 ~ 29  $\mu$ m. Trophi length 11 ~ 12  $\mu$ m. Spur length 6  $\mu$ m.

**Remarks:** This species is distinguished from its congeners by wide rostrum, short rostral lamella, 4/4 teeth and corona as wide as or narrower than cingulum pad. The general morphology of the Korean specimens conforms to the original description well except that the upper lips of some Austrian specimens were much lower than trochal discs and with a slight median notch (Fig. 103d-e in Donner 1965).

While the Austrian and Turkish specimens were collected from mosses (Donner 1970; Kaya 2013), the Korean specimens were isolated from mushrooms on a tree trunk. Kaya (2013) reported this species from the eastern part of Turkey (Erzurum), which was the first Asian record of it.

**Habitat:** The specimens were isolated from mushrooms on a tree trunk at Saryeoni forest.

**World Distribution:** Austria, Italy, Turkey, Belarus, Korea.

**Deposition:** NIBR (KOSPGR0000270525, KOSPIV 0000206148, KOSPIV0000206149).

**Identifier:** Min Ok Song.

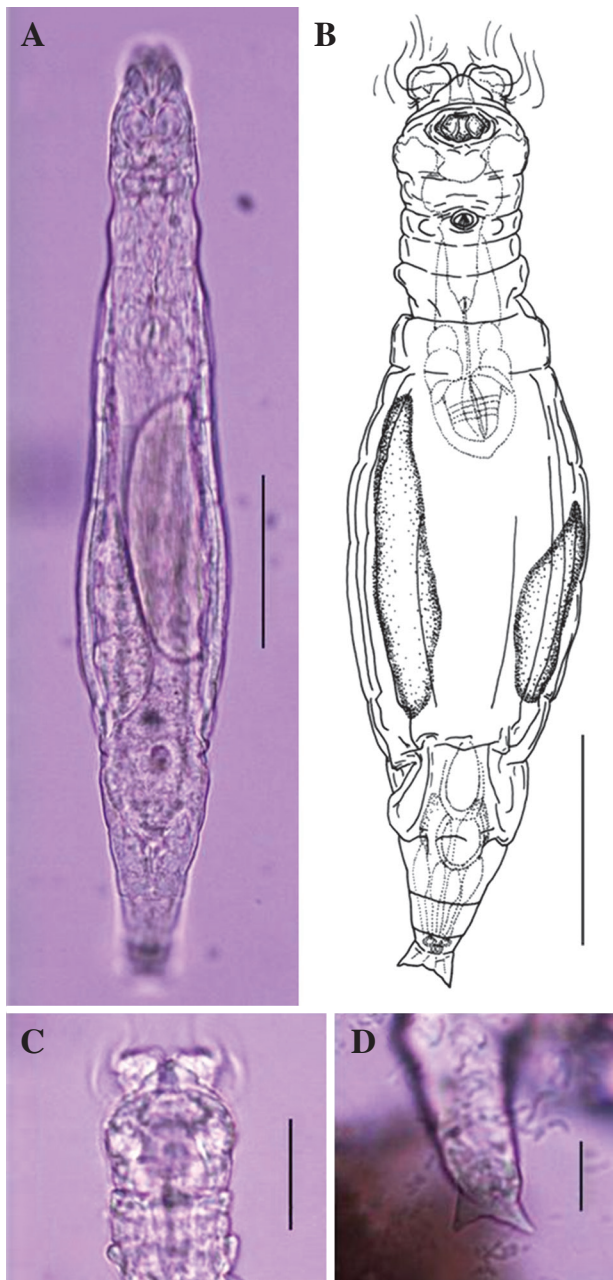
### 2. *Macrotrachela magna* Schulte, 1954 (Fig. 2)

거대큰관윤충 (신칭)

**Synonyms:** *Macrotrachela magna* Schulte, 1954, pp. 603-604, Abb. 29a-d; Donner, 1965, p. 140, Fig. 94j.

**Material examined:** 3 specimens, Gangneung-Wonju National University campus, June 22, 2014.

**Diagnosis:** Upper lip bilobed medially and with slightly bilobed depression between 2 lobes. Corona wider than cingulum. Body reddish and granulated. Spurs conical, pointed, not granulated and with narrow interspace. First foot pseudosegment with one hump dorsally. Teeth 2 + 1/1 + 2.



**Fig. 1.** *Macrotrachela inermis* Donner, 1965: A, creeping, dorsal view; B, feeding, dorsal view; C, head and neck (in feeding), dorsal view; D, foot and spurs (in creeping), ventral view (scale bars: A, B = 50  $\mu$ m; C = 25  $\mu$ m; D = 10  $\mu$ m).

Three toes very short.

**Measurements:** Total body length (in feeding) 380  $\mu$ m. Greatest trunk width (in creeping) 74  $\mu$ m. Greatest trunk width (in feeding) 102 ~ 116  $\mu$ m. Corona width 83  $\mu$ m. Cingulum width 70 ~ 71  $\mu$ m. Cingulum pad width 65 ~ 68  $\mu$ m. Trophi length 29 ~ 30  $\mu$ m. Spur length 14  $\mu$ m.

**Remarks:** This species is rather bigger than other *Macrotrachela* species and its total body length is up to 500  $\mu$ m (Donner 1965). The general morphology of the Korean specimens is in good agreement with the original description. The present study is the first record after the original description of this species from Germany by Schulte (1954).

**Habitat:** The specimens were isolated from mushrooms on a tree trunk at Gangneung-Wonju National University campus.

**World Distribution:** Germany and Korea.

**Deposition:** NIBR (KOSPGR0000270524, KOSPIV 0000206146, KOSPIV0000206147).

**Identifier:** Min Ok Song.

### 3. *Macrotrachela oblita* Donner, 1949 (Fig. 3)

삼엽무늬큰관윤충 (신칭)

**Synonyms:** *Macrotrachela oblita* Donner, 1949, pp. 148-149, Abb. 26a-g; Donner, 1965, pp. 164-166, Figs. 121a-e.

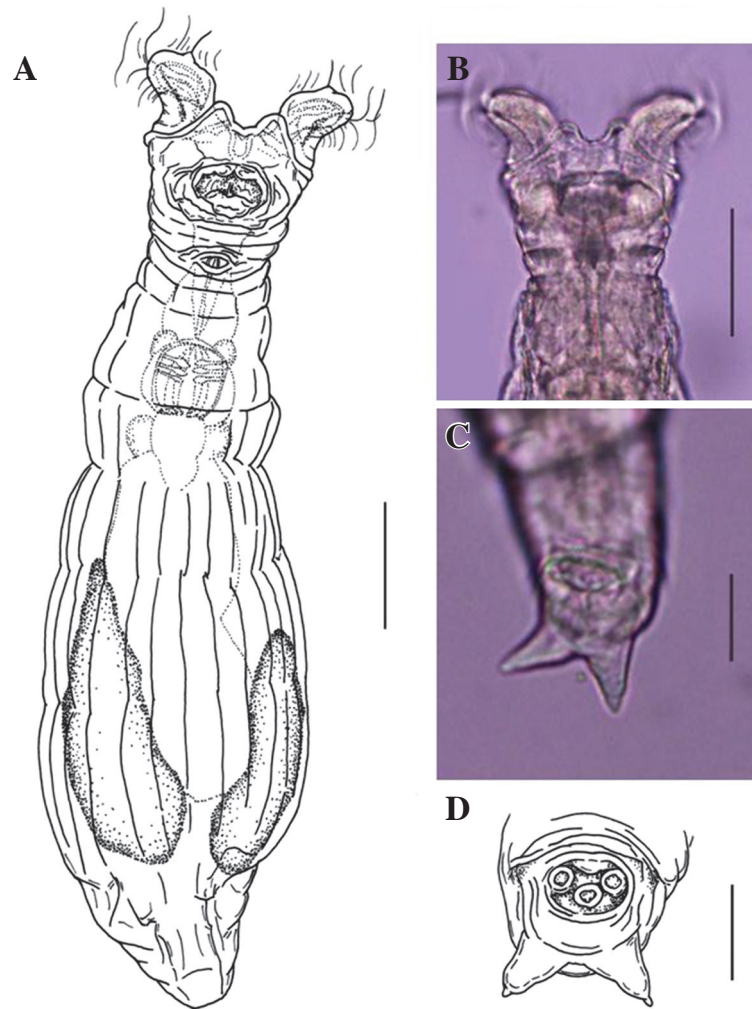
**Material examined:** 5 specimens, Jeongan-myeon, Gongju-si, Chungcheongnam-do, Sep. 20, 2014.

**Diagnosis:** Corona wider than cingulum and higher than upper lip. Upper lip arched and trilobed medially; upper lip with trilobed and crusted area dorsally. Sulcus with 2 small projections medially. Teeth 2/2. Spurs conical, narrow, with straight margins and with pointed ends; interspace wider than spur base width.

**Measurements:** Total body length (in creeping) 385  $\mu$ m. Greatest trunk width (in feeding) 89 ~ 90  $\mu$ m. Greatest trunk width (in creeping) 70  $\mu$ m. Corona width 75  $\mu$ m. Cingulum width 61 ~ 63  $\mu$ m. Cingulum pad width 55  $\mu$ m. Smallest neck width 34  $\mu$ m. Trophi length 22  $\mu$ m. Spur length 10 ~ 13  $\mu$ m.

**Remarks:** This species is characterized by two small processes on sulcus and thick patched area on upper lip, which is granulated and trilobed anteriorly. The morphology of the Korean specimens conforms well with that of the original description except that the spurs are narrower and the interspace is a little bit wider than those of the type specimens. This species has been reported only four European countries after its description from Austria by Donner (1949). The present report is the first one outside Europe.

**Habitat:** The specimens were isolated from lichens and mosses collected from a mountain at Jeongan-myeon, Gong-



**Fig. 2.** *Macrotrachela magna* Schulte, 1954: A, feeding, dorsal view; B, head and neck (in feeding), dorsal view; C, foot and spurs (in creeping), ventral view; D, spurs and toes, ventral view (scale bars: A, B = 50  $\mu$ m; C, D = 20  $\mu$ m).

ju-si.

**World Distribution:** Austria, Belgium, Czech Republic, Hungary, Belarus and Korea.

**Deposition:** NIBR (KOSPGR0000276141, KOSPIV 0000219237, KOSPIV0000219238).

**Identifier:** Min Ok Song.

Family Habrotrichidae Bryce, 1910 협관윤충과

Genus *Habrotracha* Hudson and Gosse, 1886 협관윤충속

#### 4. *Habrotracha eremita* (Bryce, 1894) (Fig. 4)

은둔협관윤충 (신칭)

**Synonyms:** *Callidina eremita* Bryce, 1894, pp. 452-454, pl. 23, fig. 3.

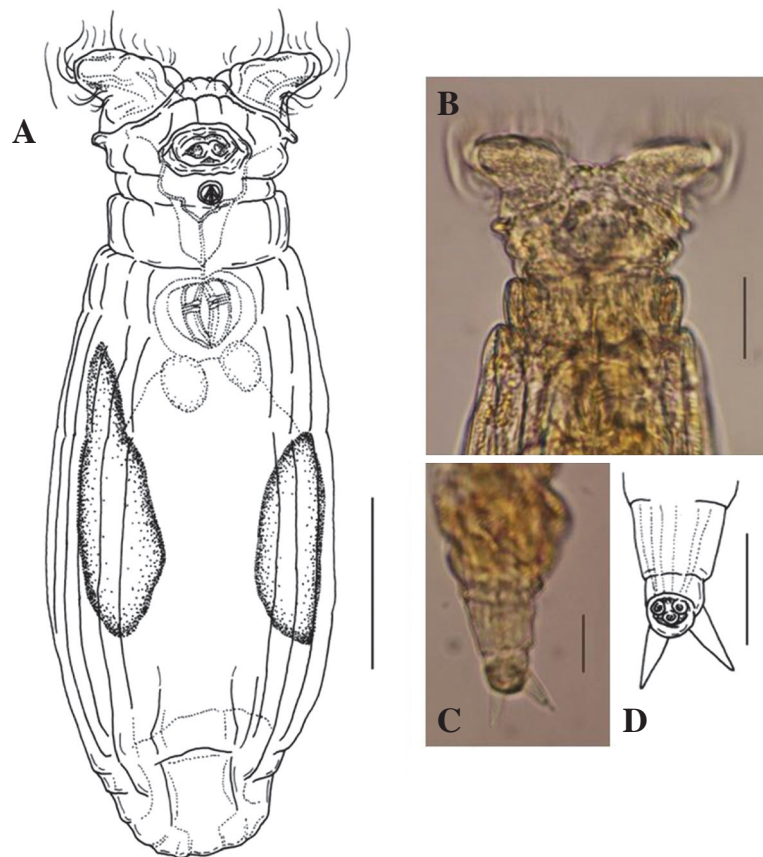
*Habrotracha eremita*: Donner, 1949, p. 140, fig. 17; Donner, 1950, p. 292, fig. 2; Donner, 1962, p. 316, figs. 12b, c.

**Material examined:** 1 specimen, Mongsanpo, Nam-myun, Taean-gun, Chungcheongnam-do, May 24, 2015.

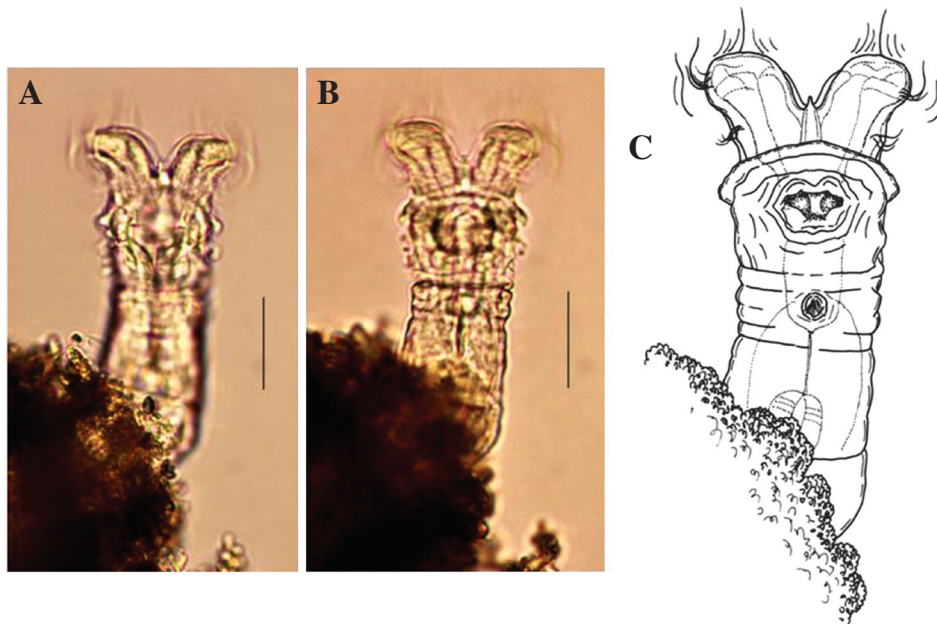
**Diagnosis:** Nest composed of gelatinous material and debris. Corona much wider than cingulum pad. Sulcus V-shaped and slightly narrower than pedicel width; one small and triangular projection in the middle of sulcus. Pedicel long and divergent. Upper lip much lower than sulcus base; arched, rimmed and with auricel-like swollen lateral margin. Head and neck cylindrical. Trunk round.

**Measurements:** Total body length (in creeping) 180  $\mu$ m. Corona width 38  $\mu$ m. Cingulum width 34  $\mu$ m. Cingulum pad

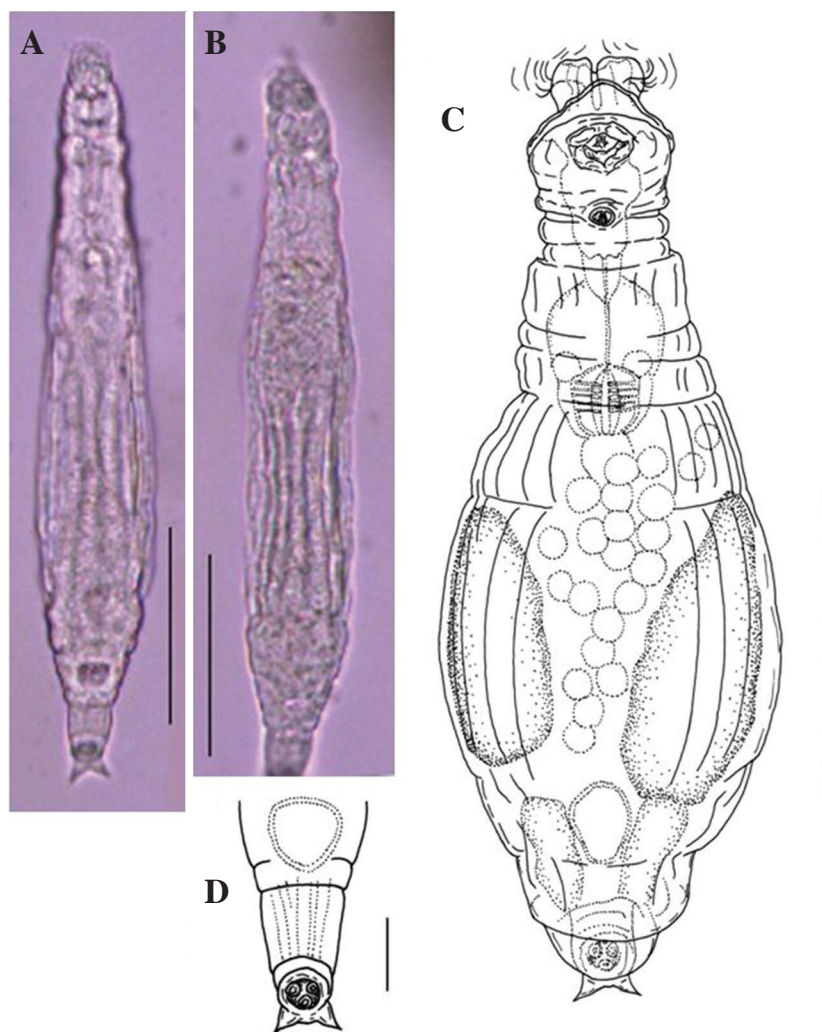




**Fig. 3.** *Macrotrachela oblita* Donner, 1949: A, feeding, dorsal view; B, head and neck (in feeding), dorsal view; C, rump, foot and spurs, ventral view; D, foot, spurs and toes, ventral view (scale bars: A = 50  $\mu$ m; B = 25  $\mu$ m; C = 10  $\mu$ m; D = 20  $\mu$ m).



**Fig. 4.** *Habrotracha eremita* (Bryce, 1894): A, feeding, ventral view; B, C, feeding, dorsal view (scale bars: A-C = 25  $\mu$ m).



**Fig. 5.** *Habrotrocha schultei* Donner, 1965: A, creeping, ventral view; B, creeping, dorsal view; C, feeding, dorsal view; D, foot and spurs, ventral view (scale bars: A-C = 50  $\mu$ m; D = 10  $\mu$ m).

width 28  $\mu$ m. Dorsal antenna length 12  $\mu$ m. Trophi length 20  $\mu$ m. Smallest neck width 25  $\mu$ m.

**Remarks:** This species closely resembles *H. solitaria* Donner, 1949 and *H. visa* Donner, 1954. Donner (1962) placed these three species in a “*solitaria-visa-eremita*” group, and examined the variations in body size, trophi length, feeding head length, dental formula, corona width, cingulum pad width, sulcus width, upper lip morphology, presence or absence of a projection on the sulcus, and egg size. One of the most distinguishable characteristic may be the ratio of the corona width to the cingulum pad width, which is 0.75 ~ 0.93 for *H. solitaria*, 0.92 ~ 1.11 for *H. visa*, and about 1.38 for *H. eremita* (Song and Min 2015). The ratio of the corona width

to the cingulum pad width is 1.36 for the Korean specimen.

Even though this species has a very wide distribution as shown below, the present study is the first Asian record of it.

**Habitat:** The specimen was isolated from leaf litter, mosses and soil collected from Mongsanpo beach area.

**World distribution:** Europe, Africa, North and South America, New Zealand and Korea.

**Deposition:** NIBR (KOSPIV0000228917).

**Identifier:** Min Ok Song.

##### 5. *Habrotrocha schultei* Donner, 1965 (Fig. 5)

숯트협관윤충 (신칭)

**Synonyms:** *Habrotrocha* spec. A, Schulte, 1954, p. 599,

Abb. 17a-d.

*Habrotrocha schultei* Donner, 1965, p. 79, Fig. 58h-k.

**Material examined:** 2 specimens, Saryeoni Forest, Jocheon-eup, Jeju-si (mushrooms on tree trunk), July 4, 2014.

**Diagnosis:** Upper lip wavy and rounded triangle-shaped; upper lip much lower than trochal discs. Corona much narrower than cingulum pad; corona width about 3/5 of cingulum width. Sulcus very narrow. Pharyngeal tube as long as trophi. Teeth 5/5. Spurs conical with pointed ends; interspace much narrower than spur base width.

**Measurements:** Total body length (in feeding) 164 µm. Greatest trunk width (in feeding) 57 ~ 58 µm. Corona width 16 µm. Cingulum width 25 µm. Cingulum pad width 24 µm. Smallest neck width 22 µm. Trophi length 12 µm. Spur length 4 µm.

**Remarks:** This species is easily recognized by its very narrow sulcus, rounded triangle-shaped upper lip, plump trunk during feeding and very narrow corona, which is only about 3/5 of cingulum width.

This is very rare species and the present study is the first report of it after the original description. Schulte (1954) described the present species as *Habrotrocha* spec. A from pinewoods at Erlangen, Germany. Donner (1965) made a new specific epithet "*schultei*" for this species.

**Habitat:** The specimens were isolated from mushrooms on a tree trunk at Saryeoni forest.

**World Distribution:** Germany and Korea.

**Deposition:** NIBR (KOSPGR0000270526, KOSPIV000206151).

**Identifier:** Min Ok Song.

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## REFERENCES

- Bryce D. 1894. Further notes on macrotrachelous Callidinae. J. Quekett Microsc. Club ser. 2:436-455.
- Donner J. 1949. Rotatorien der Humusböden. Österr. Zool. Zeitscr. Wien II:117-151.
- Donner J. 1950. Rotatorien der Humusböden. Hüllen und Gehäuse bei bdelloiden Rädertieren, besonders bei Bodenbewohnern. Österr. Zool. Zeitscr., Wien 2:287-335.
- Donner J. 1962. Neue und wenig bekannte Bdelloidea (Rotatoria) des Bodens. Acta Zool. Academ. Scient. Hungaricae 8: 303-333.
- Donner J. 1965. Ordnung Bdelloidea (Rotatoria, Rädertiere). Bestimmungsbücher zur Bodenfauna Europas. Akademie-Verl., Berlin. 297 pp.
- Donner J. 1970. Die Rädertierbestände submerser Moose der Salzach und anderer Wasser-Biotope des Flußgebietes. Arch. Hydrobiol. Suppl. 36:109-254.
- Kaya M. 2013. Terrestrial bdelloid rotifers from Erzurum (eastern part of Turkey). Turk. J. Zool. 37:413-418.
- Melone G and C Ricci. 1995. Rotatory apparatus in Bdelloids. Hydrobiologia 313/314:91-98.
- Pennak RW. 1978. Freshwater Invertebrates of the United States. 2nd ed. John Wiley and Sons Inc., New York. 803 pp.
- Schulte H. 1954. Beiträge zur Ökologie und Systematik der Bodenrotatorien. Zool. Jahrb. (Syst.) 82:551-617.
- Segers H. 2007. Annotated checklist of the rotifers (Phylum Rotifera), with notes on nomenclature, taxonomy and distribution. Zootaxa 1564:1-104.
- Song MO. 2014. Eight new records of monogonont and bdelloid rotifers from Korea. J. Species Res. 3:53-62.
- Song MO. 2015. New Records of One Monogonont and 5 Bdelloid Rotifers from Korea. Korean J. Environ. Biol. 33: 140-147.
- Song MO and G-S Min. 2015. A new species and ten new records of bdelloid rotifers from Korea. Zootaxa 3964:211-227.
- Stemberger RS. 1979. A Guide to Rotifers of the Laurentian Great Lakes. US Environmental Protection Agency, Cincinnati, Ohio. 185 pp.

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