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A New Record of *Porcellio scaber* (Isopoda: Oniscidea: Porcellionidae) from South Korea, with Notes on Its Variation

Ji-Hun Song*

Animal & Plant Research Team, Nakdonggang National Institute of Biological Resources, Sangju 37242, Korea

ABSTRACT

The common rough woodlouse *Porcellio scaber* Latreille, 1804 is newly reported from South Korea with following diagnostic characteristics: the presence of distinct tubercles on body; the strongly developed lateral lobes of head; the presence of notch on tracheal field of pleopod 1 exopod; and distinctly short exopod of uropod. This species is reported to be cosmopolitan, but there were no taxonomic records of it in South Korea. All voucher specimens were collected from humid shaded areas adjacent to the eastern coast of South Korea. Organismal ecology and scanning electron microscope photographs are provided. In addition, the results of *COI* analysis of individuals representing the different color and morphological variations are provided.

Keywords: *COI*, eastern coast, ecology, p-distance, *scaber-obsoletus*-group, SEM, variation

INTRODUCTION

The genus *Porcellio* Latreille, 1804 belongs to the family Porcellionidae Brandt, 1831 and currently contains 189 valid species (Boyko et al., 2020). To date, only one porcellionid species, *Porcellio laevis* Latreille, 1804, has been reported from Korea (Kim et al., 1990). *Porcellio scaber* Latreille, 1804 is reported to be a cosmopolitan species and has been recorded in neighboring countries such as Russia, Japan, and China, but not in South Korea (Saito et al., 2000; Chen, 2003; Nefediev et al., 2018). This species has been studied in a wide range of fields including anatomy, molecular biology, physiology, behavioral science, and ecology (Schmalzfuss, 2003). Here, I report on *P. scaber* collected in South Korea and provide descriptions of its diagnostic characteristics. I also analyzed the *COI* sequences of Korean materials to examine the taxonomic status in subspecies of *P. scaber*.

Sample collection was performed directly using soft tweezers in moist shaded areas adjacent to the shore in Gangwon-do and Gyeongsangbuk-do Province. All voucher specimens were deposited at the Nakdonggang National Institute of Biological Resources (NNIBR), South Korea. Figures of the whole body and head were obtained using a

stereomicroscope (Model M165C; Leica Biosystems, Nussloch, Germany). Photographs of selected individual's head were obtained using a scanning electron microscope (Model MIRA3; Tescan, Kohoutovice, Czech Republic). As pre-treatment, I used Tween 20 (P9416; Sigma-Aldrich, St. Louis, MO, USA) to remove debris on the specimens. The genetic divergence represented by pairwise distance (p-distance) was calculated by Geneious Prime v.2019.0.4 (Kearse et al., 2012). A maximum likelihood (ML) analysis of 355 *COI* sequences of *P. scaber* (including GenBank data) collected from various countries was performed on the W-IQ-TREE web server (<http://iqtree.cibiv.univie.ac.at/>) (Trifinopoulos et al., 2016). The figure of ML tree was obtained using FigTree v1.3.1 (Rambaut, 2009).

SYSTEMATIC ACCOUNTS

Order Isopoda Latreille, 1817
Suborder Oniscidea Latreille, 1802
Family Porcellionidae Brandt, 1831
Genus *Porcellio* Latreille, 1804

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*To whom correspondence should be addressed
Tel: 82-54-530-0816, Fax: 82-54-530-0829
E-mail: jhsong08@nnibr.re.kr

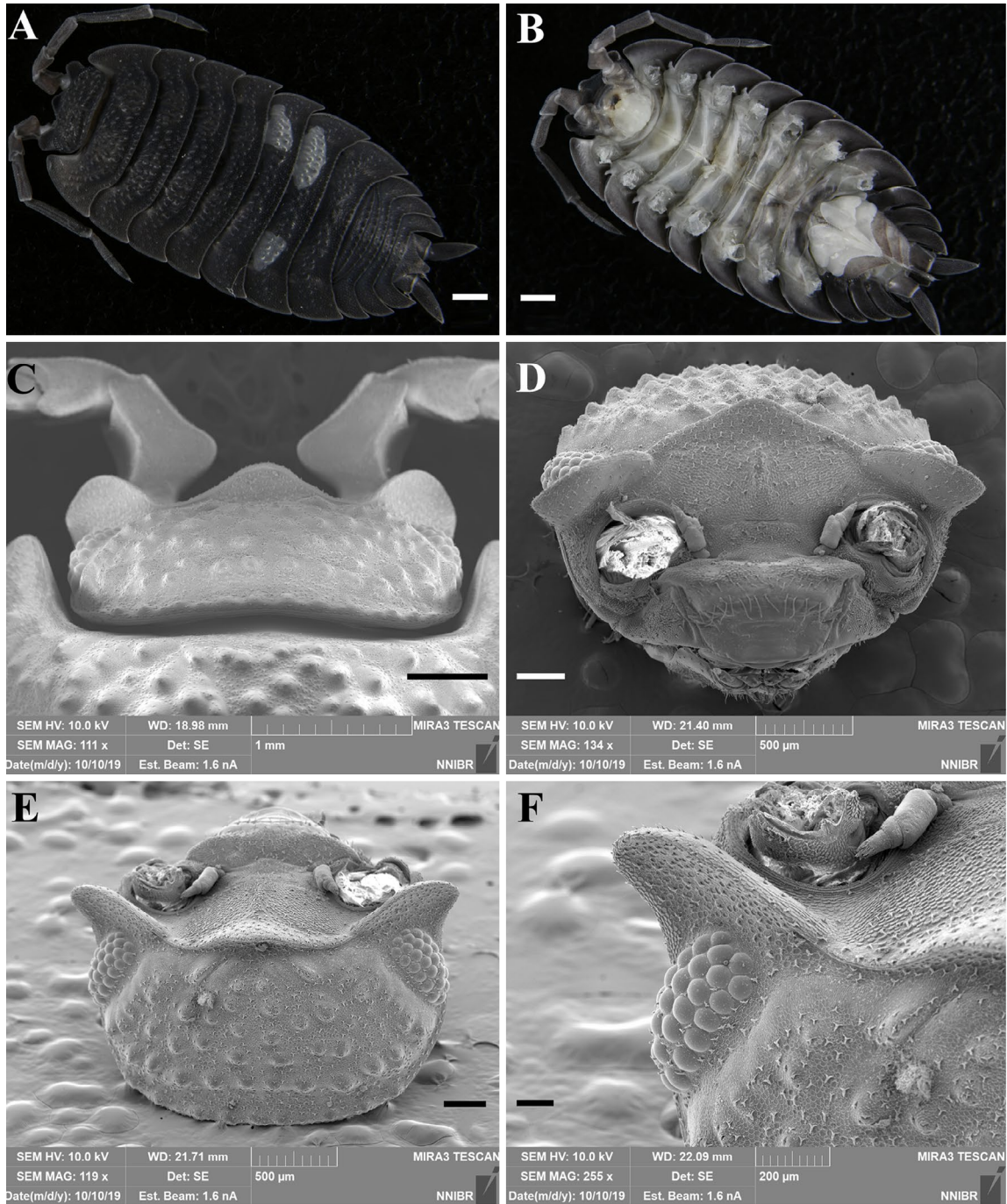


Fig. 1. *Porcellio scaber*. A, B, Male (NNIBRIV37558): A, Body, dorsal; B, Body, ventral; C-F, Male, scanning electron microscope photographs: C, Head, dorsal; D, Head, frontal; E, Head, dorsal; F, Head lateral lobe, dorsal. Scale bars: A, B=1 mm, C=0.5 mm, D, E=250 µm, F=100 µm.

¹*Porcellio scaber* Latreille, 1804 (Figs. 1-3, 5)
Oniscus granulatus Lamarck, 1818: 154.
Philoscia tuberculata Stimpson, 1856: 97.

Porcellio (Porcellio) cayennensis Miers, 1877: 653.
Porcellio asper C. Koch, 1847: 201.
Porcellio brandtii Milne Edwards, 1840: 115.

Korean name: ¹거친양쥐머리 (신칭)

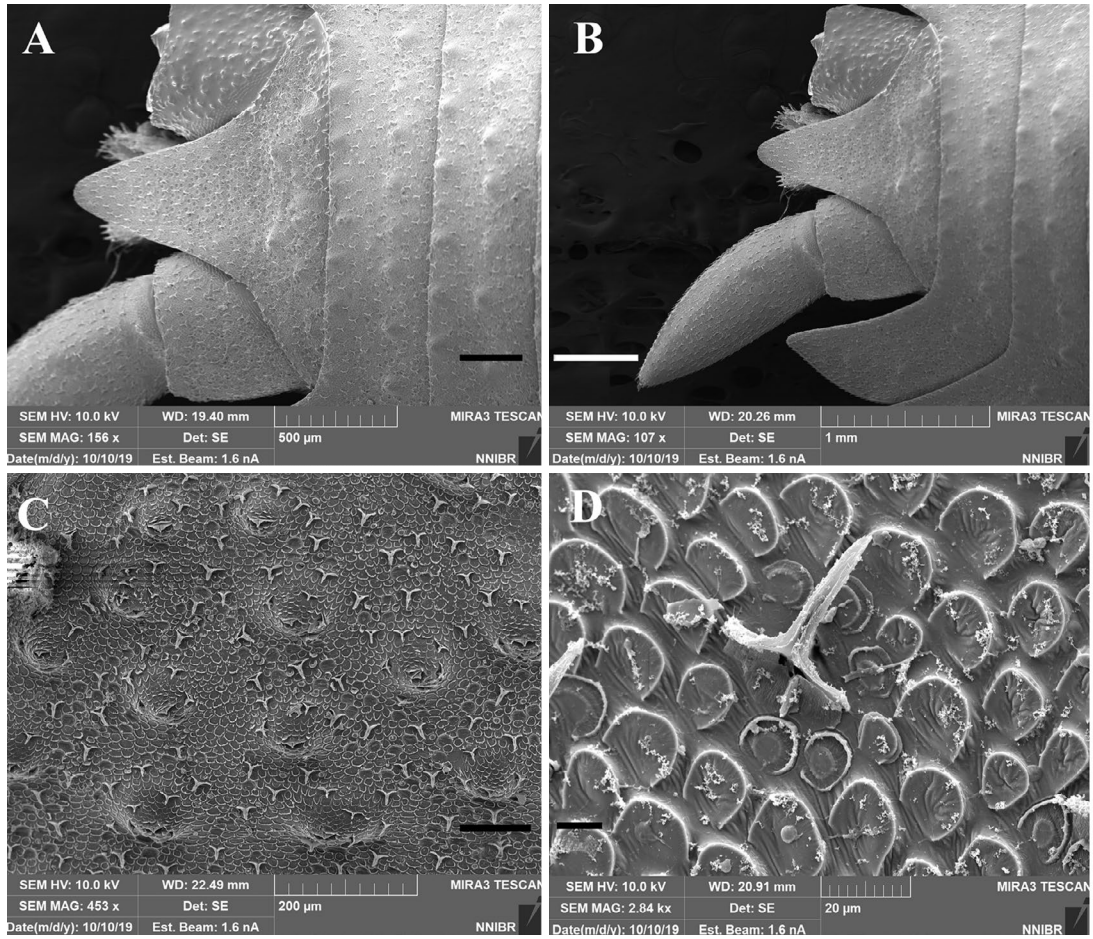


Fig. 2. *Porcellio scaber*. A-D, Male, scanning electron microscope photographs: A, Telson, dorsal; B, Uropod, dorsal; C, Tubercles on body; D, Dorsal scale-seta. Scale bars: A=250 µm, B=0.5 mm, C=100 µm, D=10 µm.

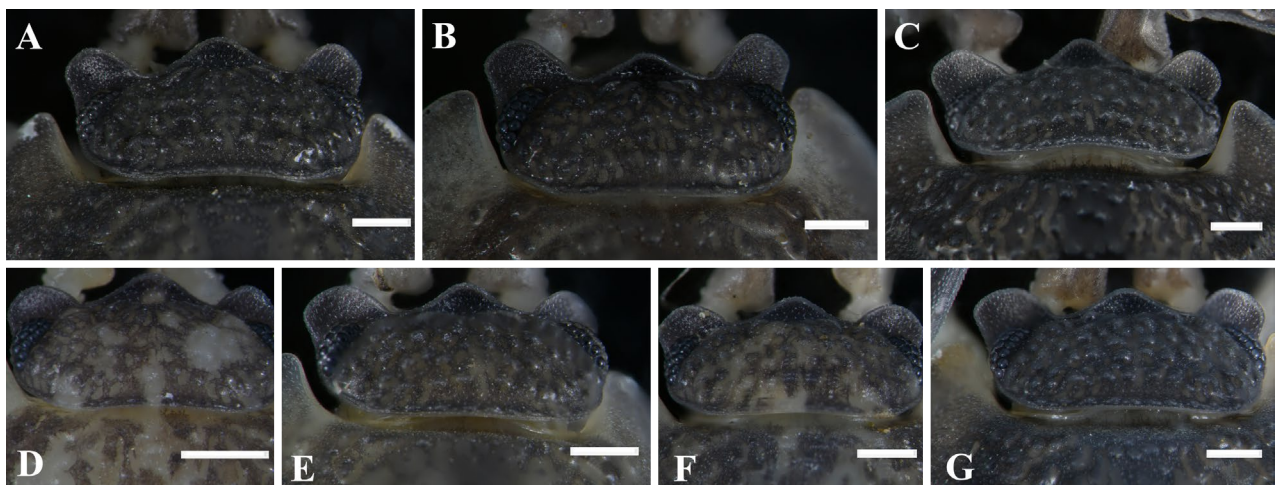


Fig. 3. The variation of head lobe and dorsal tubercle among Korean *Porcellio scaber*. A-G, Male: A, Uljin-1 (NNIBRIV38206); B, Gangneung-1 (NNIBRIV37542); C, Sokcho (NNIBRIV37558); D, Gangneung-3 (NNIBRIV37545); E, Uljin-2 (NNIBRIV38207); F, Goseong (NNIBRIV37651); G, Gangneung-2 (NNIBRIV37544). Scale bars: A-G=0.5 mm.

Table 1. The p-distance (%) among the partial sequences of mt-CO1 gene from seven Korean *Porcellio scaber*

	1	2	3	4	5	6	7
1. Uljin-1		0.0	0.2	2.8	2.4	2.4	2.4
2. Gangneung-1	0.0		0.2	2.8	2.4	2.4	2.4
3. Sokcho	0.2	0.2		2.6	2.2	2.2	2.2
4. Gangneung-3	2.8	2.8	2.6		1.6	1.6	1.6
5. Uljin-2	2.4	2.4	2.2	1.6		0.0	0.0
6. Goseong	2.4	2.4	2.2	1.6	0.0		0.0
7. Gangneung-2	2.4	2.4	2.2	1.6	0.0	0.0	
Figs.	3A, 5B	3B, 5C	3C, 5D	3D, 5E	3E, 5F	3F, 5G	3G, 5H

The GenBank accession numbers/voucher numbers are as follows: 1, Uljin-1 (MT800773/NNIBRIV38206); 2, Gangneung-1 (MT670324/NNIBRIV37542); 3, Sokcho (MT670321/NNIBRIV37558); 4, Gangneung-3 (MT670322/NNIBRIV37545); 5, Uljin-2 (MT800774/NNIBRIV38207); 6, Goseong (MT670320/NNIBRIV37651); 7, Gangneung-2 (MT670323/NNIBRIV37544).

- Porcellio dubius* C. Koch, 1841: 28.
- Porcellio gemmulatus* Dana, 1853: 696.
- Porcellio graniger* Miers, 1876: 218.
- Porcellio granulatus* Milne Edwards, 1840: 115.
- Porcellio marginalis* Mulaik, 1960: 79.
- Porcellio montesumae* Saussure, 1857: 304.
- Porcellio niger* Say, 1818: 57.
- Porcellio nodieri* Dollfus, 1898: 357.
- Porcellio paulensis* Heller, 1865: 280.
- Porcellio sociabilis* L. Koch, 1901: 17.
- Porcellio toyamaensis* Nunomura, 1980: 13.
- Porcellio tristis* Zaddach, 1844: 39.

Material examined. South Korea: 42 males (NNIBRIV 37558–37599) and 2 males coated with platinum for scanning electron microscopy, Gangwon-do: Sokcho-si, Joyang-dong, 1458, Pampas Resort, 28 Sep 2019, Song JH, Lim JW; 3 males (NNIBRIV37651–37653), Goseong-gun, Toseong-myeon, Gyoam-ri, 177-1, Cheonhakjeong, 29 Sep 2019, Song JH, Lim JW; 1 male (NNIBRIV37542), Gangneung-si, Gyeongpo-dong, 3139beon-gil, Yulgok-ro 24, Ojukheon, 6 Sep 2019, Song JH, Kim SK; 11 males (NNIBRIV37544–37554), Gangneung-si, Yonggang-dong, 58-1, Daedohobu Gwana, 6 Sep 2019, Song JH, Kim SK; 2 males (NNIBRIV38206–38207), Gyeongsangbuk-do: Uljin-gun, Jukbyeon-myeon, Deungdae-gil, 52, Jukbyeon Lighthouse Park, 8 Jul 2020, Song JH, Kim JY.

Diagnosis (male). Body approximately 10.6 mm in length, 2.0 times as long as wide, with developed conical or rounded tubercles. Pereonites I–III, posterior margins distinctly sinuous. Pleon with less developed tubercles. Telson with two tubercles, triangular, lateral margins notched; apex surpassing uropod protopod. Head lateral lobes distinct, with rounded margins; median lobe raised upwards, triangular. Pleopod 1 exopod, median lobe not elongated, with a truncated posterior margin; tracheal field with a distinct notch.

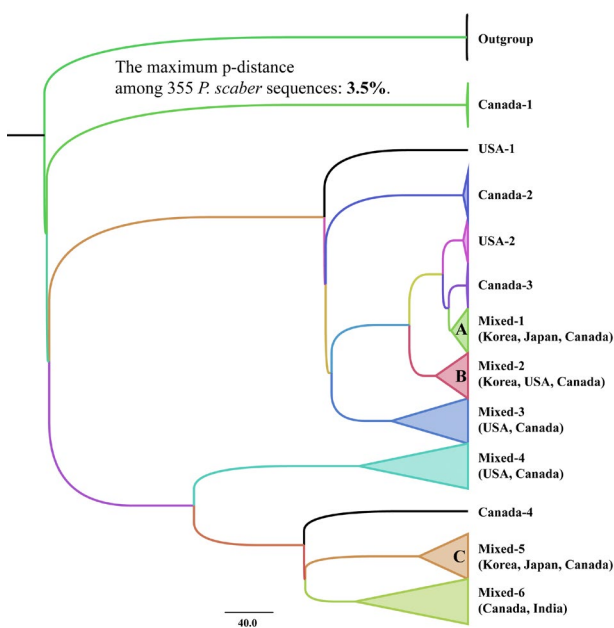


Fig. 4. A collapsed maximum likelihood tree of 355 CO1 sequences of *Porcellio scaber* collected from various countries: A, Uljin-2, Goseong and Gangneung-2 are included; B, Gangneung-3 is included; C, Uljin-1, Sokcho and Gangneung-1 are included.

Uropod leaf-like, exopod distinctly short, approximately 2.5 times as long as wide; endopod much shorter than exopod.

Ecology. The present species was found in humid shaded areas and sometimes co-occurred with clausiliid species (Mollusca: Gastropoda: Stylommatophora). Additionally, they were mostly found in anthropogenic environments such as flower beds and damp buildings. Numbers of *P. scaber* were much higher at night than during the day, and the species only inhabited soil covered with freshwater.

Remarks. The genus *Porcellio* includes the following two groups: the *laevis-hoffmannseggi*-group characterized by

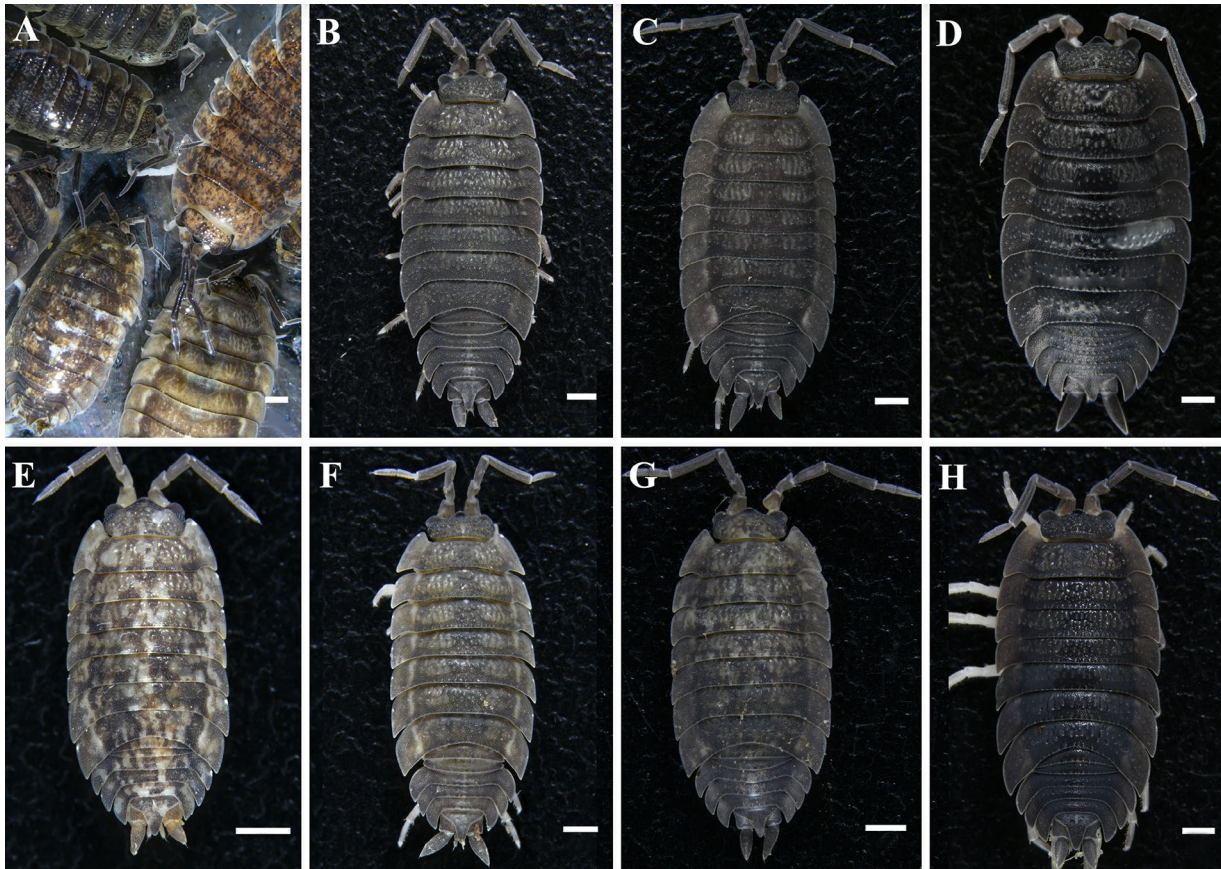


Fig. 5. The variation of body color among Korean *Porcellio scaber*. A–H, Male: A, Uljin population (bulk sample); B, Uljin-1 (NNIBRIV38206); C, Gangneung-1 (NNIBRIV37542); D, Sokcho (NNIBRIV37558); E, Gangneung-3 (NNIBRIV37545); F, Uljin-2 (NNIBRIV38207); G, Goseong (NNIBRIV37651); H, Gangneung-2 (NNIBRIV37544). Scale bars: A–H=1 mm.

an elongated male pleopod exopod and the *scaber-obsoletus*-group characterized by a short male pleopod exopod (Schmalfuss, 1992, 1998). *Porcellio scaber* was first described in Western Europe and belongs to the *scaber-obsoletus*-group. In general, the materials of *P. scaber* collected in South Korea agree well with the original description by Latreille (1804) and the re-description by Vandel (1962).

Porcellio scaber contains the following six subspecies: *Porcellio scaber americanus* Arcangeli, 1932; *Porcellio scaber flavobrunneus* Collinge, 1917; *Porcellio scaber flavomaculata* Collinge, 1918; *Porcellio scaber japonicus* Verhoeff, 1928; *Porcellio scaber lusitanus* Verhoeff, 1907; and *Porcellio scaber scaber* Latreille, 1804. However, the characteristics used to define the various subspecies were those affected by allometric growth, such as the size of the tubercles of the body or the size of the head lobes. In fact, these characteristics were found to be mixed within the same population and included intermediate forms, so they were not used as characteristics to define subspecies of *Porcellio* species (Caruso et al., 2007; Karasawa and Nakata, 2018; Cifuentes, 2019).

Vandel (1962) also mentioned the above in re-describing *P. s. scaber* and *P. s. lusitanus*, and concluded that subspecies would be valid only if genetic differences clearly isolate them. The differences in the characteristics mentioned above were also found among Korean materials, but they included intermediate forms and did not consistent with genetic differences (Table 1, Fig. 3). Furthermore, the maximum p-distance between all *P. scaber* sequences collected from Canada, the United States, Japan, India, and Korea was 3.5%, and each sequence were not unique to the country or region, but were all mixed (Fig. 4).

In terms of body color, *P. scaber* is mostly dark gray, but there are many variations, such as pale yellow with irregular pigmentation, gray with reddish pigmentation, and occasionally no pigmentation (Vandel, 1962). Color variation was also observed in the Korean materials, and there were no significant differences in morphology other than body color. In addition, the maximum p-distance between *COI* sequences obtained from each individual representing a particular color variation was 2.8% (Table 1, Fig. 5). Therefore,

it can be hypothesized that the only nominal species currently valid is *Porcellio scaber*, and that all the other subspecies should be considered synonyms.

ORCID

Ji-Hun Song: <https://orcid.org/0000-0003-3542-0091>

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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