

## ***Lobohalacarus weberi* (Acari, Halacaridae) from Shallow Ground Waters in South Korea**

Jong Hak Shin<sup>1</sup>, Jimin Lee<sup>2</sup>, Cheon Young Chang<sup>1,\*</sup>

<sup>1</sup>Department of Biological Science, Daegu University, Gyeongsan 38453, Korea

<sup>2</sup>Marine Ecosystem Research Center, Korea Institute of Ocean Science & Technology, Busan 49111, Korea

### ABSTRACT

*Lobohalacarus weberi* (Romijn and Viets, 1924) is added to the halacarid fauna of Korea as the third member of freshwater halacarid species. Both the genus and species are newly recorded from Korea. Halacarid mites were collected from two hillside wells and a streamside hyporheic zone in the southeastern region of South Korea. *Lobohalacarus weberi* is characterized by a well-developed frontal spine-like process, seven dorsal setae, the fourth segment of palp with a short distal and three long proximal setae, and tibiae of legs II to IV with two, one, two pectinate setae, respectively. A few minor individual variabilities were observed in the number of perigenital seta and genital acetabula, the setal armature on genua of legs, and the shape of spinule row on lateral claws.

**Keywords:** description, freshwater, halacarid mite, hyporheic zone, new record, wells

### INTRODUCTION

As shown in the taxon name of “Halacarida” (meaning ‘acarids from salt waters’), halacarids are basically marine. Only 67 species or subspecies of 17 genera (about 6% of the total number of species currently recorded in the family Halacaridae Murray, 1877) are freshwater or brackish-water (Bartsch, 2018; FADA, 2021). Recently, we have collected four halacarid mites at two hillside wells and a streamside hyporheic zone in the southeastern region of South Korea (Fig. 1). They are identified as the *Lobohalacarus weberi* (Romijn and Viets, 1924), notwithstanding a few minor morphological variations were observed among the specimens examined. Herein we redescribe it as a new record from South Korea. Following the two former records, *Soldanellonyx chappuisi* Walter, 1917 by Imamura (1968) and *S. monardi* Walter, 1919 by Shin and Chang (2021), this is the third report on the freshwater halacarid mites from Korea.

Methods for field and laboratory works, such as collection, preparation for microscope examination, drawings and measurements, are the same as in our previous studies (Lee and Chang, 2017; Shin and Chang, 2019, 2021).

Voucher specimens are kept in the specimen room of the Department of Biological Science, Daegu University (DB), Gyeongsan, Korea.

Terminology and abbreviations in the text and figure captions follow Bartsch (2006): AD, anterior dorsal plate; AE, anterior epimeral plate; ds, dorsal setae on idiosoma (ds-2, second dorsal setae on idiosoma); GA, genitoanal plate; gac, genital acetabula; glp, gland pore(s), numbered glp-1 to glp-5 from anterior to posterior; GO, genital opening; OC, ocular plate(s); P, palp (P-2, second palpal segment); pas, parambulacral setae; PD, posterior dorsal plate; PE, posterior epimeral plate; pgs, perigenital setae; sgs, subgenital setae.

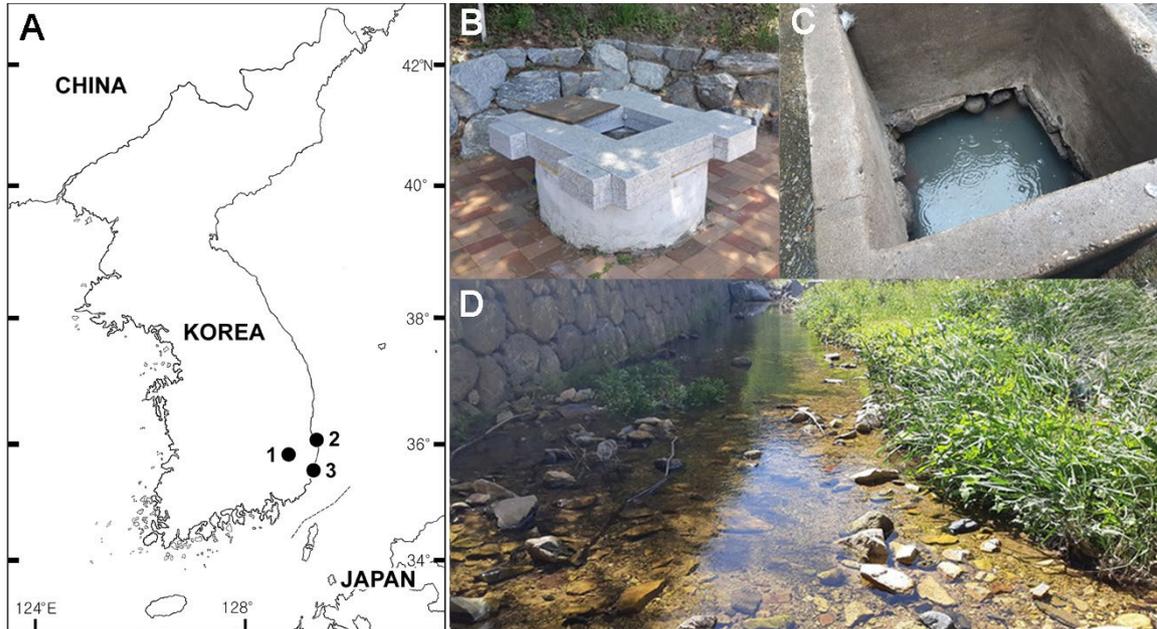
### SYSTEMATIC ACCOUNTS

Subclass Acari Leach, 1817  
Order Trombidiformes Reuter, 1909  
Suborder Prostigmata Kramer, 1877  
Superfamily Halacaroidae Murray, 1877  
Family Halacaridae Murray, 1877  
<sup>1</sup>\*Genus *Lobohalacarus* Viets, 1939

Korean name: <sup>1</sup>\*거북등판물응애속 (신청)

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

**\*To whom correspondence should be addressed**  
Tel: 82-53-850-6454, Fax: 82-53-850-6459  
E-mail: cychang@daegu.ac.kr



**Fig. 1.** Localities. A, A map showing three collection sites in South Korea: 1, Gyeongsan; 2, Pohang; 3, Ulsan; B, A well in Gyeongsan; C, A well in Pohang; D, Jujeon valley, Ulsan.

<sup>1</sup>\**Lobohalacarus weberi* (Romijn and Viets, 1924)  
(Figs. 2, 3)

*Walterella weberi* Romijn and Viets, 1924: 217, figs. 3–6;  
Walter and Bader, 1952: 224, fig. 58.

*Lobohalacarus weberi*: Viets, 1939: 506; Green and MacQuitty, 1987: 162, fig. 68A–D; Bartsch, 2006: 128, fig. 5–8a–f; 2011: 493, fig. 3A–C; 2018: 85, fig. 4A–E.

*Walterella weberi quadripora* Walter, 1947: 236, fig. 35 (cited from Bartsch, 2018).

*Lobohalacarus weberi quadriporus*: Bartsch, 1975: 35, figs. 38–53.

**Material examined.** Korea: 1♀ (DB50040), Gyeongsangbuk-do: Gyeongsan-si, Sajeong-dong, a well (near Gyeongsan railway station), 33°43'16"N, 128°43'39"E, 31 Mar 2020, Chang CY; 1♀ (DB50041), Pohang-si, Donghae-myeon, Heunghwan-ri, a well (in a seaside village), 36°01'43"N, 129°30'14"E, 23 Jul 2020, Chang CY and Shin JH; 1♀ (DB50042), same locality as previous, 9 Oct 2020, Shin JH; 1♀ (DB50043), Ulsan-si, Jujeon-dong, Jujeon stream (near Jujeon-campsite), 35°33'08"N, 129°27'06"E, 18 Apr 2021, Shin JH. All the specimens mounted on H-S slides.

**Description.** Female (DB50043): Idiosoma (Fig. 2A) 271 µm long, 151 µm wide, with single sharp frontal process, 22 µm long, protruding forward on anterior edge of body. AD, PD and OC separated and ornamented with numerous fove-

ae irregularly. AD 94 µm long, 68 µm wide (length to width ratio about 1.38); anterior part blunt triangular-shaped, posterior margin nearly straight or slightly concave, and the widest at level of 3/4 of AD. OC elongated and narrowing posteriorly, 62 µm long, 23 µm wide (length to width ratio about 2.70); corneae and glp absent. PD large, 1.91 times longer than wide, 157 µm long, 82 µm wide; anterior margin wider than posterior one and both margin nearly straight or slightly arched. Seven pairs of dorsal setae (ds) short: ds-1 located between frontal process and anterior AD; ds-2 situated near anterior margin of 1/3 AD; ds-3 and ds-4 located on OC, ds-3 at anterolateral corner of OC and ds-4 at half of OC; remaining 3 dorsal setae (ds-5–7) evenly spaced 1/3 of PD, from anterior third PD to posterior margin of PD.

All ventral plates (AE, PE, and GA) fused (Fig. 2B) and ornamented with numerous foveae. The region corresponding AE with 3 pairs of ventral setae, and pair of epimeral pores present near trochanter of leg II. PE region with 1 short dorsal, 1 long lateral and 1 ventral seta. GO (Fig. 2B, E) 52 µm long, 31 µm wide (length to width ratio about 1.68); posterior portion protrudes slightly backward, with 3 gac on each outside of genital sclerites, lacking sgs. Four pairs of pgs (Fig. 2B) present around GO; foremost pgs located far from ahead of GO; succeeding 3 pgs situated at near anterolateral margin, middle, and posterolateral margin of GO, respectively.

Korean name: <sup>1</sup>\*거북등잔물응애 (신칭)

Gnathosoma (Fig. 2C) 84  $\mu\text{m}$  long, 49  $\mu\text{m}$  wide (length to width ratio about 1.71). Rostrum 42  $\mu\text{m}$  long, similar length to gnathosomal base; tip of rostrum extending to anterior edge of P-2, in ventral view. Gnathosoma with 4 pairs of rostral setae: proto- and deuterostral setae situated along distal and sub-distal edge, respectively; tritrostral setae long, naked and located at level of posterior 70% rostrum ventrally; basirostral setae the longest, 1.45 times longer than tritrostrals one, naked, and situated at base of rostrum. Palp consisting of 4 segments; lengths of P-1 to P-4 10, 33, 11, 30  $\mu\text{m}$  long, respectively; P-1 the shortest, without setae; P-2 the longest, about 3 times longer than P-1 or P-3, with 1 long dorsal seta anteriorly; P-3 subequal to length of P-1, armed with 1 short spiniform seta on its inner-distal corner, 5  $\mu\text{m}$  long; P-4 with 3 long setae subproximally, 1 short seta inner-distally, and bifurcated distal end. Chelicera (Fig. 2D) 83  $\mu\text{m}$  long; movable digit formed a spine 14  $\mu\text{m}$  long, with several minute denticles on inner surface.

Chaetotaxy of legs (tarsi excluded) (Fig. 3A–D): trochanters 1-1-1-0; basifemora 3-3-2-2; telofemora 5-4-3-2; genua 6-6-3-3; tibiae 8-7-5-6. Genu I with 4 filiform setae dorsally, 1 stout fang-like and 1 sharp spiniform setae ventrally. Tibia I with 4 filiform setae dorsally, 2 sharp spiniform and 2 stout fang-like setae ventrally. Tibiae II–IV with 2, 1, 2 pectinate setae (Fig. 3B–D) on ventral surface, respectively. Tarsus I (Fig. 3A, E) with 3 filiform setae dorsally, 1 solenidion, 2 filiform setae ventrally, 2 doublets pas on both laterally, and 1 stout fang-like seta ventrolaterally; lateral membrane of claw fossa swollen. Tarsus II (Fig. 3B, F) with 3 filiform setae dorsally, 1 solenidion, 1 filiform seta ventrally, a pair of pas. Tarsus III (Fig. 3C) with 4 dorsal and 1 ventral filiform setae, and a pair of pointed pas. Tarsus IV (Fig. 3D) with 3 dorsal and 1 ventral filiform setae, and a pair of pointed pas. Solenidion on tarsi I and II approximately 2/3 and 1/2 as long as adjacent dorsal seta, respectively (Fig. 3E, F). Lateral claws on tarsus I slightly smaller than those on succeeding tarsi, smooth ventrally, with 2–3 tiny accessory processes dorsally. Lateral claws on tarsi II–IV with 2–3 accessory processes dorsally and a row of about 4–7 spinules along ventral edges. Median claws on tarsi I–IV present and armed with 1 tooth dorsally.

Male: Not collected.

**Measurements and variability.** Four adult female specimens were examined and measured: idiosomal lengths ranged from 261 to 328  $\mu\text{m}$  (mean 291  $\mu\text{m}$ , standard deviation 30.76), idiosomal widths ranged from 166 to 203  $\mu\text{m}$  (mean 178  $\mu\text{m}$ , standard deviation 23.57), and mean ratio of length to width 1.64. The number of pgs around GO was slightly variable: four pairs of pgs in two specimens, five pairs in one specimen, while three and four pgs in each side in the specimen from Gyeongsan (DB50040). The number

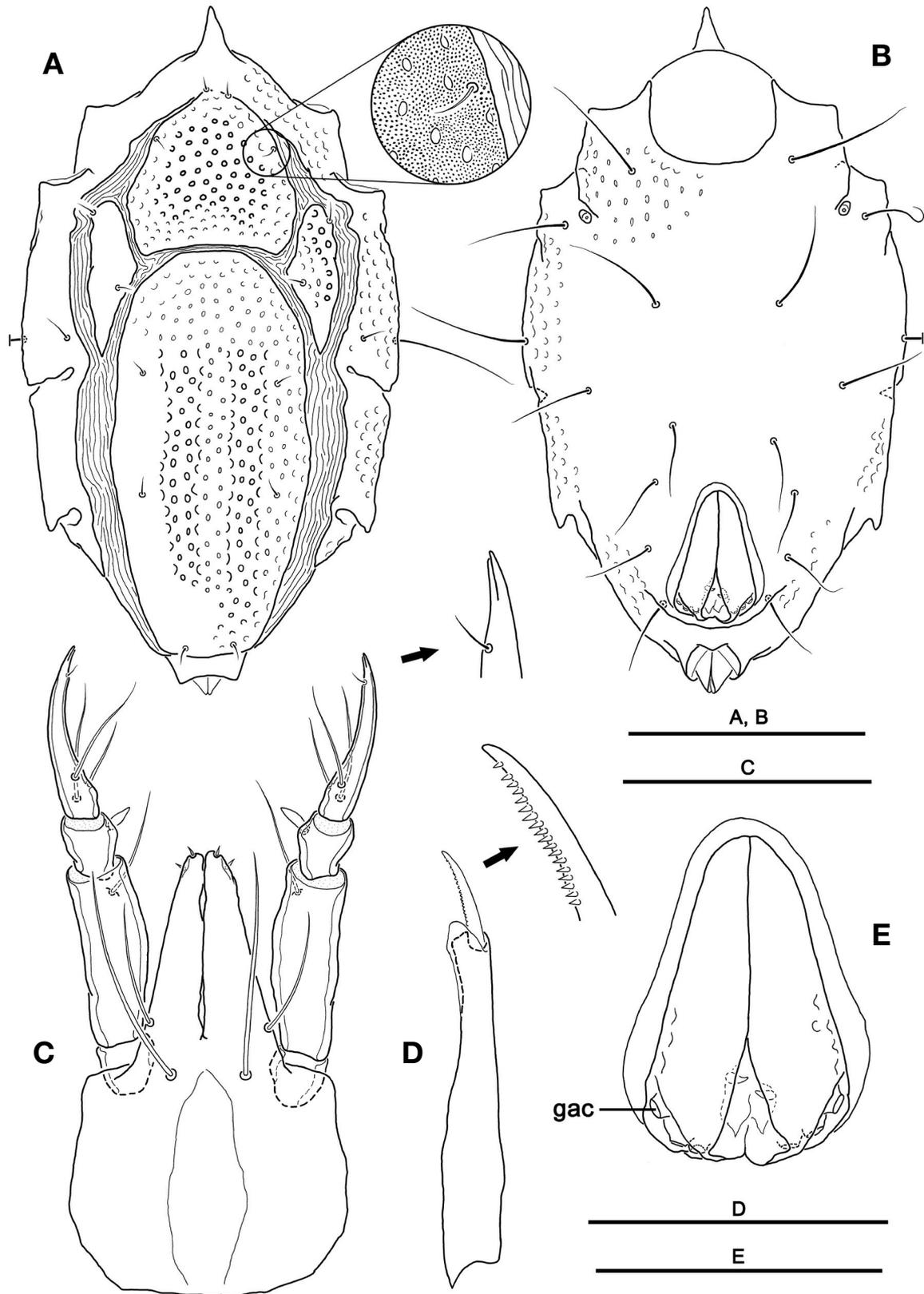
of gac on posterior genital sclerites was also variable: two pairs of gac in two specimens, three pairs in one specimen, while two and three gac in each side in a specimen from Pohang (DB50042). Genu I showed armature of a stout fang-like and a sharp spiniform setae ventrally in three females, while two stout fang-like setae ventrally in the female from Pohang (DB50041) (Fig. 3H). The female from Gyeongsan (DB50040) has a comb row of 10–15 teeth along the inner surface of lateral claws, while the three specimens from the other two localities showed a row of 4–7 setules near the middle of ventral edges of lateral claws. One female specimen from Pohang (DB50041) showed only three pectinate setae without a ventral spiniform seta on the tibia of the left leg II (Fig. 3I).

**Distribution.** Europe (Romijn and Viets, 1924; Green and MacQuitty, 1987; Bartsch, 2008), Africa (Walter and Bader, 1952; Bartsch, 2008, 2013, 2018), Iran (Pestic et al., 2006), Vietnam (Bartsch, 2014), Russia (Stolbov et al., 2018), Canada (Bartsch, 2011), Hawaiian Islands (Imamura, 1981), U.S.A. (Bartsch, 2011), Korea.

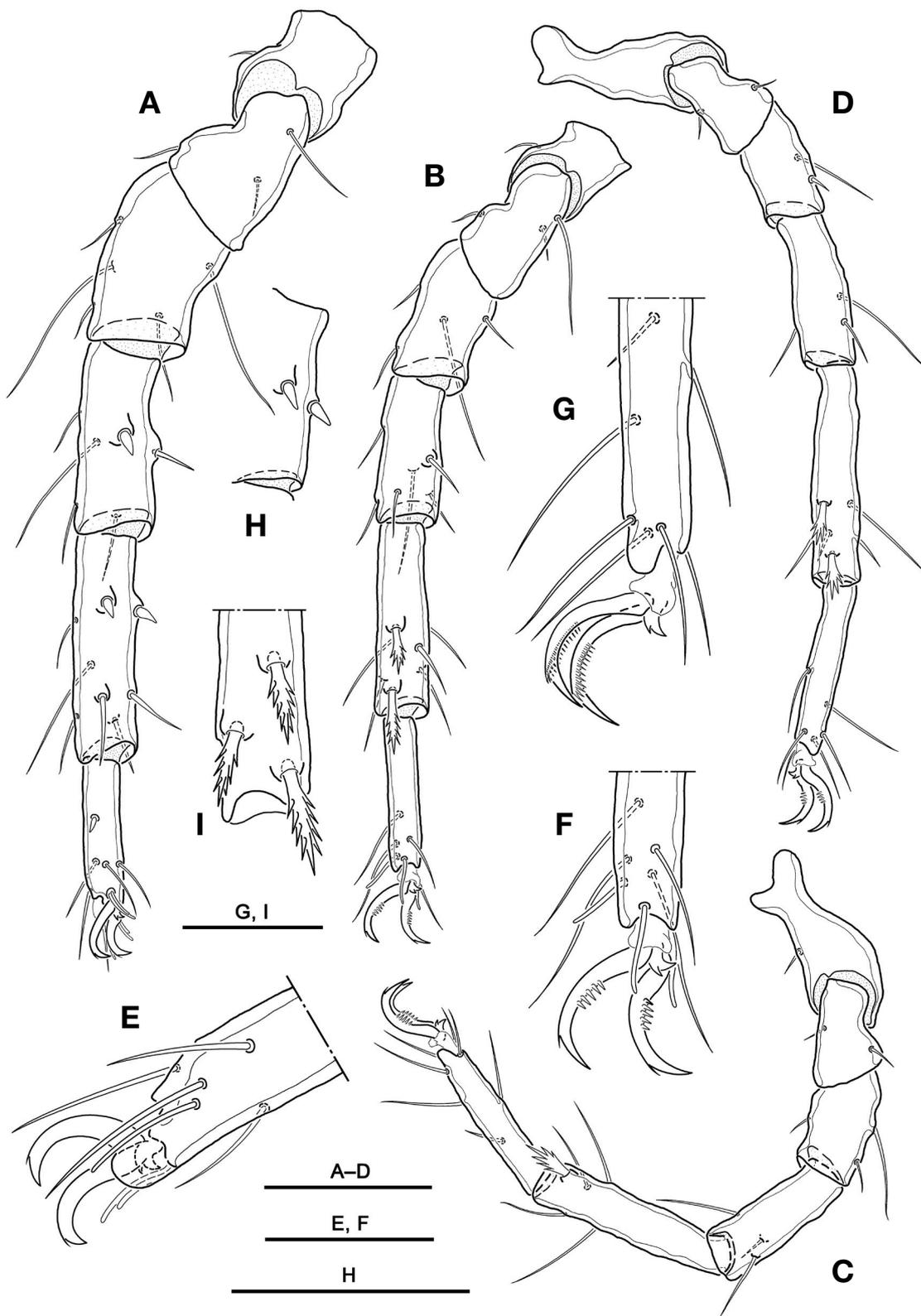
**Remarks.** In the genus *Lobohalacarus* Viets, 1939, eight species or subspecies are currently recorded (FADA, 2021). Among them, *L. processifer* (Walter, 1919) from Peru and *L. bucharensis* Jankovskaja, 1967 from Kizylkum Desert, Uzbekistan should be regarded as *species inquirenda*, because they were obviously based on protonymphs and/or deutonymphs (Bartsch, 2008).

*Lobohalacarus hummelincki* Viets, 1940 from Venezuela and *L. bunurong* Harvey, 1988 from Australia are similar to *L. weberi* (Bartsch, 2008, 2018) in sharing 2, 1, 2 pectinate setae on the ventral surface of tibiae II to IV, respectively. However, *L. hummelincki* differs from *L. weberi* by two pairs of pgs, one to two gac each side of GO, and tarsus IV without ventral seta (Viets, 1940), and *L. bunurong* is discriminated from *L. weberi* by a pair of pgs and P-4 with two basal setae (Harvey, 1988). *Lobohalacarus subterraneus* Bartsch, 1995 from New Zealand is clearly distinguished from *L. weberi* by three pairs of sgs, two ventral spiniform setae (lacking a stout fang-like seta ventrally) in genu I, only a pectinate seta on tibia III throughout all legs, and no ventral setae in tarsi III and IV (Bartsch, 1995b).

Two subspecies of *L. weberi* are recognized as valid: *L. weberi gotoensis* Imamura, 1970 and *L. weberi tristanensis* Bartsch, 1995. *Lobohalacarus weberi gotoensis* Imamura, 1970 from Japan differs from *L. weberi weberi* by five pairs of ds, including single pair of ds each on AD and OC (while seven pairs containing two on AD and OC, respectively, in *L. weberi weberi*) and by a single plumose seta on tibia III only (while 2, 1, 2 pectinate setae on tibiae II–IV in *L. weberi weberi*) (Imamura, 1970). The other subspecies, *L. weberi tristanensis* Bartsch, 1995 from Tristan da Cunha Islands in



**Fig. 2.** *Lobohalacarus weberi*, female (DB50043). A, Idiosoma, dorsal; B, Idiosoma, ventral; C, Gnathosoma, ventral; D, Chelicera, dorsal; E, Genital opening, ventral. Scale bars: A, B= 100 µm, C-E= 50 µm.



**Fig. 3.** *Loboalacarus weberi*, female. A-F (DB50043): A-D, Legs I-IV, ventromedial; E, Tarsus I, lateral; F, Tarsus II, medial. G (DB50040), Tarsus IV, medial. H, I (DB50041): H, Variation of genu I with two stout fang-like setae, ventral; I, Variation of tibia II with three pectinate setae, ventral. Scale bars: A-D, H=50  $\mu$ m, E-G, I=20  $\mu$ m.

the South Atlantic is distinguished from *L. weberi weberi* by the anterior idiosoma forming arch-like with a small round edge or with a spine-like process (while always with a frontal spine-like process in *L. weberi weberi*) and no ventral setae on the telofemur III and tarsus IV (while one ventral seta each on those regions in *L. weberi weberi*) (Bartsch, 1995a).

Korean specimens are well accorded with the typical armature of *L. weberi*, that is, a frontal spine-like process, the arrangement of both dorsal and ventral plates and dorsal setae, ornamentation of pgs in GA area and gac in genital sclerites, and the chaetotaxy of legs, including tibiae II to IV with 2, 1, 2 pectinate setae, respectively. However, the Korean specimens show some minor individual variabilities in the number of pgs and gac, the setal armature on genua of legs, and the shape of spinule row on lateral claws, as mentioned above in the "Measurements and variability".

The male of *L. weberi* is extremely rare or could be completely absent (Bartsch, 1981). In Korea, only females were found. Another semi-subterranean halacarid species, *Soldanellonyx monardi* Walter, 1919 co-occurred with this species in a hillside well at Gyeongsan.

## ORCID

Jong Hak Shin: <https://orcid.org/0000-0002-1889-4212>

Jimin Lee: <https://orcid.org/0000-0001-9004-8275>

Cheon Young Chang: <http://orcid.org/0000-0001-5557-7120>

## CONFLICTS OF INTEREST

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

## ACKNOWLEDGMENTS

We are grateful to two anonymous reviewers for their critical comments that greatly improved the manuscript. This work was supported in part by the research grant of Daegu University, Korea in 2020 to Cheon Young Chang.

## REFERENCES

Bartsch I, 1975. Zur Kenntnis der Halacaridenfauna (Acari) der Quellenregion, I. Ein Beitrag zur Morphologie und Biologie dreier Arten aus dem Sphagnetum. *Gewässer und Abwässer*, 57/58:27-42.  
Bartsch I, 1981. Meeresmilben der Umgebung von Hamburg

(Arach. Acari: Halacaridae). *Verhandlungen des Naturwissenschaftlichen Vereins in Hamburg*, 24:5-18.  
Bartsch I, 1995a. A new subspecies of the freshwater halacarid mite *Lobohalacarus weberi* (Romijn and Viets) (Halacaridae, Acari) from a southern Atlantic Ocean Island. *Annals of the Cape Provincial Museums, Natural History*, 19:171-180.  
Bartsch I, 1995b. *Lobohalacarus subterraneus* n. sp., a freshwater halacarid (Acari: Halacaridae) from New Zealand. *New Zealand Journal of Zoology*, 22:209-212. <https://doi.org/10.1080/03014223.1995.9518035>  
Bartsch I, 2006. 5. Acari: Halacaroida. In: *Süßwasserfauna von Mitteleuropa 7/2-1, Chelicerata: Araneae, Acari I* (Ed., Gerecke R). Elsevier, Spektrum, Heidelberg, pp. 113-157.  
Bartsch I, 2008. Freshwater halacarid mites (Halacaridae: Prostigmata: Acari) from Tunisia, three new records and notes on geographical distribution of these species. *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg*, 15:15-27.  
Bartsch I, 2011. North American freshwater Halacaridae (Acari): literature survey and new records. *International Journal of Acarology*, 37:490-510. <https://doi.org/10.1080/1647954.2010.525528>  
Bartsch I, 2013. Freshwater halacarid mites (Acari: Halacaridae) from Madagascar. New records and the description of a new species. *Acarologia*, 53:77-87. <https://doi.org/10.1051/acarologia/20132080>  
Bartsch I, 2014. New records of freshwater Halacaridae (Acari) from the oriental region and a supplementary description of *Soldanellonyx visurgis*. *International Journal of Acarology*, 40:165-173. <https://doi.org/10.1080/01647954.2014.897369>  
Bartsch I, 2018. Freshwater halacarid (Acari: Halacaridae) from Madagascar: new records, keys and notes on distribution and biology. *Bonn Zoological Bulletin*, 67:79-99.  
FADA, 2021. *Lobohalacarus* Viets, 1939 [Internet]. Accessed 4 Jun 2021, <[http://fada.biodiversity.be/species/search\\_in\\_group?root\\_id=1](http://fada.biodiversity.be/species/search_in_group?root_id=1)>.  
Green J, MacQuitty M, 1987. Halacarid mites. *Synopses of the British Fauna, New Series*, 36:1-178.  
Harvey MS, 1988. A new species of *Lobohalacarus* from Australia (Chelicerata: Acarina: Halacaridae). *Memoirs of the Museum of Victoria*, 49:363-365. <https://doi.org/10.24199/j.mmv.1988.49.15>  
Imamura T, 1968. Results of the speleological survey in South Korea 1966. IX. Halacaridae (Acari) found in a limestone cave of South Korea. *Bulletin of the National Science Museum, Tokyo*, 11:281-284.  
Imamura T, 1970. The fauna of the insular lava caves in West Japan. II. Porohalacaridae (Acari). *Bulletin of the National Science Museum, Tokyo*, 13:455-458.  
Imamura T, 1981. Fresh-water halacarid mites from Oahu Island, Hawaii. *Annotationes Zoologicae Japonenses*, 54:287-292.  
Lee J, Chang CY, 2017. *Scaptognathus teuriensis*, a new record

- of halacarid mite (Acari, Halacaridae) from Dokdo Island of Korea. *Animal Systematics, Evolution and Diversity*, 33:45-50. <https://doi.org/10.5635/ASED.2017.33.1.055>
- Pesic V, Saboori A, Asadi M, Vafaei R, 2006. New records of water mites (Acari: Hydrachnidia, Halacaroidea) from interstitial waters of Iran, with the description of one new species. *Systematic and Applied Acarology*, 11:211-217.
- Romijn G, Viets K, 1924. Neue Milben. *Archiv für Naturgeschichte*, 90:215-225.
- Shin JH, Chang CY, 2019. A new species of the genus *Agauopsis* (Acari: Halacaridae) from Jeju Island, Korea. *Animal Systematics, Evolution and Diversity*, 35:49-56. <https://doi.org/10.5635/ASED.2019.35.2.008>
- Shin JH, Chang CY, 2021. *Soldanellonyx monardi* (Acari: Halacaridae), a freshwater halacarid species newly recorded from Korea. *Animal Systematics, Evolution and Diversity*, 37:19-25. <https://doi.org/10.5635/ASED.2021.37.1.062>
- Stolbov VA, Popova VV, Sheikin SD, Tupitsyn SS, 2018. Water mites (Acariformes: Hydrachnidia, Halacaroidea) of bogs of Western Siberia (Russia). *Ecologica Montenegrina*, 18:102-109.
- Viets K, 1939. Über die Milbengruppe der Porohalacaridae (Acari). *Zugleich ein Beitrag zur Kenntnis der Milbenfauna der Bremer Umgegend und des Plöner Sees*. *Abhandlungen Naturwissenschaftlicher Verein zu Bremen*, 31:502-514.
- Viets K, 1940. Zwei neue Porohalacaridae (Acari) aus Südamerika. *Zoologischer Anzeiger*, 130:191-201.
- Walter C, Bader C, 1952. Mission Scientifique de l'Omo. Hydracarina. *Mémoires du Muséum Nationale d'Histoire Naturelle, Série A, Zoologie*, 4:87-236.

Received June 17, 2021

Revised July 9, 2021

Accepted July 9, 2021