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A new record of phytoseiid mite, *Neoseiulus harrowi* Collyer, 1964 (Acari: Mesostigmata) from Republic of Korea

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During a study of acarine biodiversity, a phytoseiid mite was collected from soil samples under the rose of Sharon plants. The specimen was identified as *Neoseiulus harrowi* Collyer, 1964, which was previously only reported in New Zealand and Australia, and is thus a new record for Korean phytoseiid fauna. *Neoseiulus harrowi* is morphologically similar to *N. makuwa* (Ehara), but distinctly different in two characters: shorter length of two posterior setae (Z4, Z5) and a forked atrium of spermatheca longer in *N. makuwa* than in *N. harrowi* in females.

Keywords: Bioblitz, biological control, hibiscus, *Neoseiulus harrowi*, Seoul metropolitan

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Introduction

Mites in the family Phytoseiidae are primarily feed on smaller arthropods or plant pollen in broad habitats ranging from the ground and aerial habitats (Walter and Lindquist, 1997; Lindquis *et al*., 2009). The family Phytoseiidae is species rich with approximately 1,800-plus described species, which represents approximately 15% of the known diversity of the Mesostigmata (Kostianinen and Hoy, 1996). Although species that specialize on spider mites (e.g., *Phytoseiulus*, *Galendromus*, and some *Neoseiulus*) are best known, most phytoseiids are polyphagous and feed on a variety of small arthropods, including pestiferous thrips, whiteflies, scale crawlers and eriophyoid mites or plant parts such as pollen, honeydew, plant exudates or leaf cell contents, and to a certain extent, fungi (McMurtry and Croft, 1997; Zemek and Prenerova, 1997). Thus, many phytoseiids are used as biocontrol agents of agricultural pests (Beard, 2001). Phytoseiids also are known to be common inhabitants of leaf domatia (Walter, 1996). A few species are found in soil (e.g., some *Neoseiulus*, *Proprioseiopsis*, and *Amblyseius*) or in animal nests (usually species of *Neoseiulus*).

Korean phytoseiid mites have been described Lee and Ryu (1989), Ryu and Ehara (1993; 1997), Ryu (1995; 1996; 1998; 2003; 2004), Ryu and Lee (1995), Ryu and Kim (1998), Ryu *et al*. (2001) and Jung *et al*. (2006). Currently, 51 species of phytoseiid mites, in 10 genera, have been recorded in Republic of Korea. Within the Phytoseiidae, the genus *Neoseiulus* is represented by six species (NIBR, 2013). Here, we provide a description of one new record of the species *N. harrowi* relative to the original description and we compare the species morphometically to a closely related species, *N. makuwa* (Ehara, 1972).

Materials and Methods

We collected soil from an urban forest in Seoul, Republic of Korea, and analyzed as per the previous study done for soil gamasina mites biodiversity in Korea by Keum and Jung (2014). Soil microarthropods were extracted using a modified Berless-Tullgren funnel (30W, 72h), preserved in 70% ethyl alcohol and mounted on glass slides using polyvinyl alcohol mounting medium (PVA medium) (Downs, 1943). Morphological features of adult female mites and setal measurements were conducted under the compound Olympus JP/BX51 phase contrast microscope equipped with a drawing tube. Species that were a new record for Korea were deposited in the Insect Ecology Lab, Department of Plant Medicine, Andong National University (ANU), Andong, Korea and also in NIBR (ZIIYIV0000004875).

Results and Discussion

Family Phytoseiidae Berlese, 1913
Subfamily Amblyseiinae Muma, 1961
Tribe Neoseiulini Chant and McMurtry, 2003

Genus *Neoseiulus* Hughes, 1948

Neoseiulus Hughes, 1948: 141; Muma and Denmark, 1968: 235; Muma and Denmark, 1970: 100; Beard, 2001: 79; Chant and McMurtry, 2003: 15; Chant and McMurtry, 2007: 22.

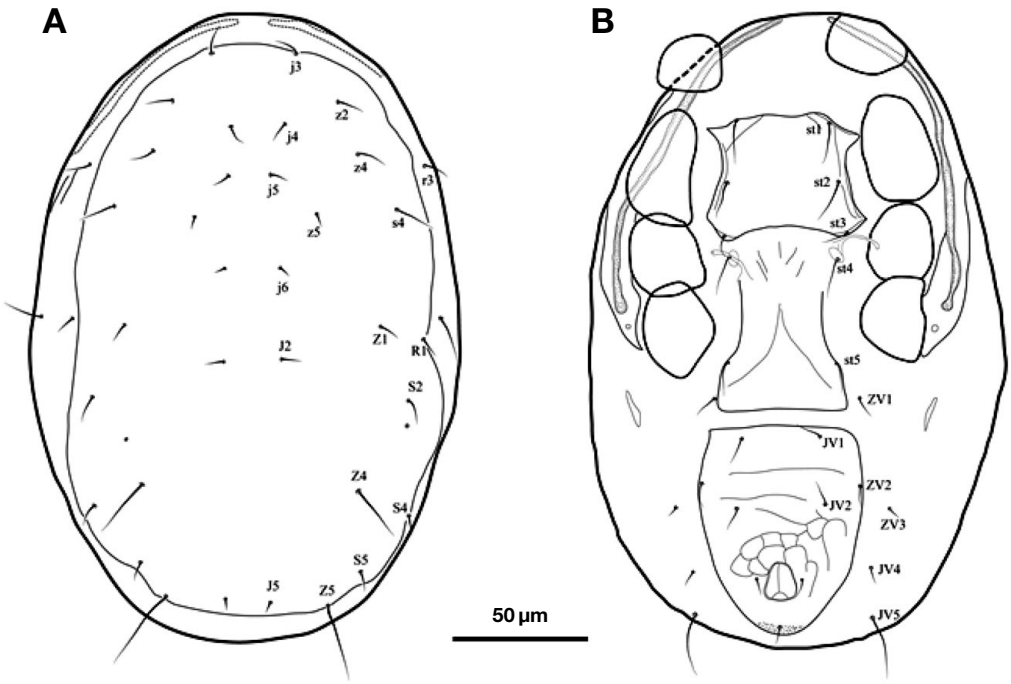

Fig. 1. *Neoseiulus harrowi* Collyer, 1964 female (A) dorsal idiosoma; (B) ventral idiosoma.

Table 1. Setal measurements of *Neoseiulus harrowi* and *N. makuwa*

Coding system of dorsal setae		*N. harrowi* (Collyer)			*N. makuwa* (Ehara)	
		Present study	Schicha (1980)	Amano *et al.* (2011)	Present study	Ehara (1972)
Chant	Garman	mean	rang	mean (range)	mean	
j1	D1	12.50	13-15	14.1 (13.7-15.1)	16.99	18
j3	L1	17.38	12-17	16.8 (15.8-18.5)	20.80	20
j4	D2	17.12	14	14.1 (13.4-15.3)	11.04	11
j5	D3	16.72	14-17	13.8 (12.7-14.8)	11.34	10
j6	D4	18.85	15-16	15.6 (13.0-16.7)	11.46	11
J2	D5	21.50	19-21	18.6 (18.1-18.9)	12.35	11
J5	D6	11.65	11-13	10.2 (9.6-10.8)	10.73	10
s4	L4	22.01	16-18	19.2 (18.2-21.2)	27.87	29
S2	L6	23.02	21-25	19.0 (17.7-21.9)	18.77	15
S4	L7	20.99	19-20	17.5 (16.6-18.9)	14.66	13
S5	L8	20.37	19-20	17.0 (16.0-18.9)	13.11	13
z2	L2	18.53	16-19	16.2 (15.3-17.1)	16.00	15
z4	L3	19.20	18-19	16.9 (15.2-19.2)	15.48	14
z5	M1	16.95	15-17	14.9 (113.6-16.1)	10.56	10
Z1	L5	21.72	19	17.3 (15.8-18.3)	13.37	13
Z4	M2	24.52	22-25	22.1 (20.4-24.9)	35.32	38
Z5	L9	34.68	35	30.5 (26.8-32.2)	52.33	55
r3	S1	18.20		15.5 (12.6-17.8)	16.77	18
R1	S2	18.16		14.1 (12.1-15.7)	14.12	11

All measurements are in µm

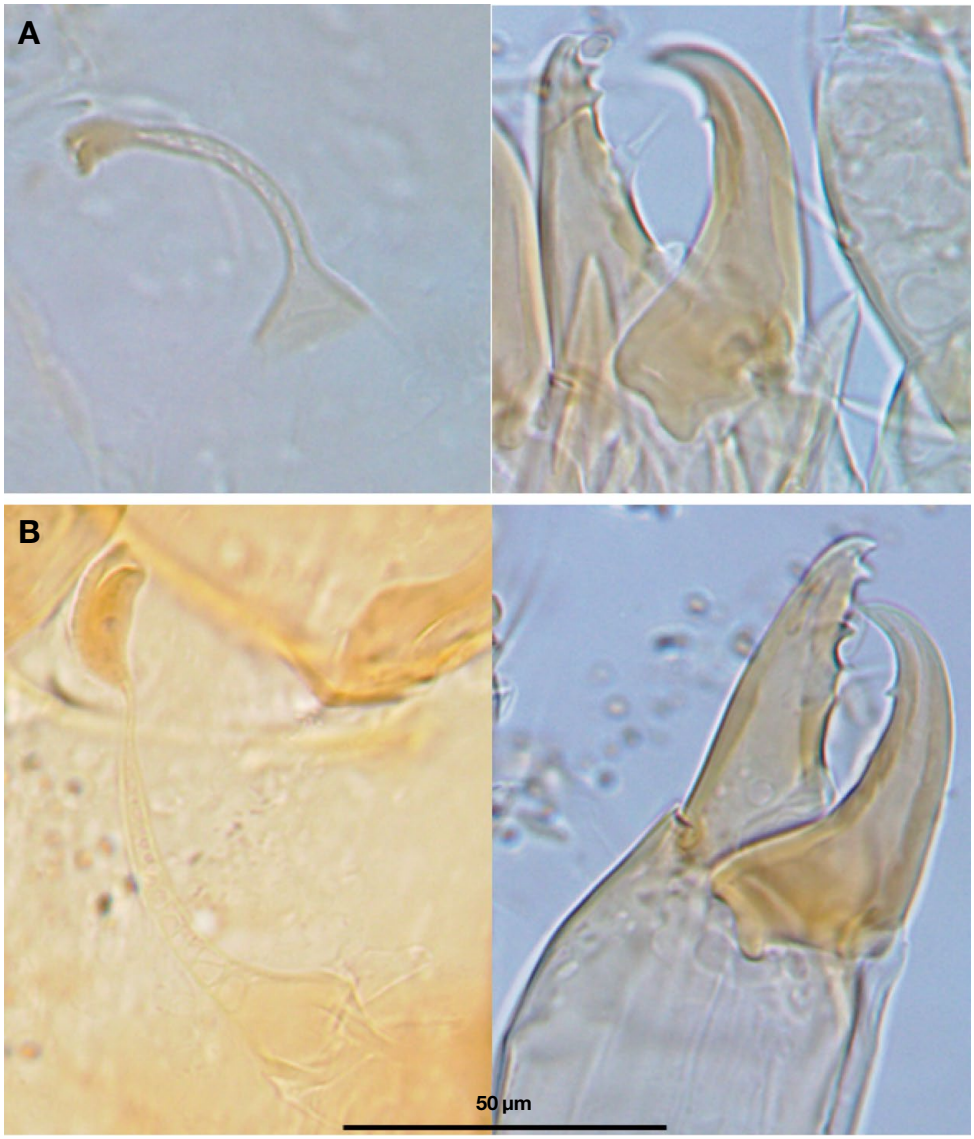

Fig. 2. (A) spermathecal and chelicera of *Neoseiulus harrowi* Collyer 1964 and (B) *N. makuwa* (Ehara, 1972).

TYPE SPECIES: *Neoseiulus barkeri* Hughes, 1948.

Diagnosis. The diagnosis of *Neoseiulus* used here is based on that of Hughes (1948) and following Ryu (2007).

***Neoseiulus harrowi* Collyer, 1964**

Amblyseius harrowi Collyer, 1964: 641. Schicha, 1980: 26; 1983: 116, 1987: 113; Ragusa and Athias-Henriot 1983: 666.

Amblyseius salish Chant & Hansell, 1971: 717. Synonymized by Schicha 1983: 116.

Specimens examined. Thirty four females, Seoul Forest, Seoul, Republic of Korea, 37°32′ N, 127°02′ E. alt. 68 m, 10 Jun 2014, E. Keum coll., from soil of *Hibiscus syriacus*.

Diagnosis. Female. Body length 351-421 and width 208-277 µm. Dorsal shield smooth, with light anterolateral lineation; all dorsal setae short, thin, smooth; Z5 smooth, may have 1-2 small barbs. Sternal shield smooth. Ventrianal shield with pair small round pores, distance between pores 37-38. Fixed digit of chelicera with five or six teeth, two anterior and three or four posterior teeth; movable digit with one strong tooth and a bump, may be a second vestigial tooth. Calyx of spermathecal apparatus long, narrow, tubular, parallel-sided basally and arms diverging strongly distally to form V-shape (trumpet-shaped); atrium large, as broad as junction with major duct; major duct membranous, broad near atrium and

narrowing towards sperm-induction pore. Leg IV with long setaceous macroseta on basitarsus. Dorsal adenotaxy: *gd*2, *gd*5, *gd*8 not visible, *gd*4 present.

Remarks. The first description of this species was based on three adult females collected from weeds in an apple orchard on the North Island of New Zealand by Collyer (1964b). Unfortunately, the original illustration and specimen descriptions lacked fine details and provided no clear understanding of this species. Thus, Schicha (1980) later re-described the species after remounting female lectotypes collected by Collyer. Schicha (1983) and Beard (2001) provided additional morphological and biological data after finding the species in Australia. Beard (2001) described this species on apple trees and orchard groundcover (in Tasmania), and in litter beneath apples (in New South Wales). Schicha (1983) synonymized *Amblyseius salish* Chant and Hansell with *N. harrowi* in a comparative study of neighboring species, although this identity is difficult to confirm because the peritreme of *A. salish* reaches almost to the level of *j*3 (Chant and Hansell, 1971), whereas that the peritremes of *N. harrowi* extends to the base of *j*1 (Amano *et al*., 2011). Ragusa and Athias-Henriot (1983) suggested that *N. harrowi* (Collyer) was synonymous with *N. agrestis* (Karg, 1960), but limited data currently prevent the confirmation of this synonymy.

Comparison of morphological features of *N. makuwa* and *N. harrowi*

Ryu (2007) listed five species in the genus *Neoseiulus* in Korea; *Neoseiulus barkeri*, *N. californicus*, *N. koyamanus*, *N. makuwa*, *N. womersleyi*. NIBR (2013) listed six species in the genus *Neosiulus*: *Neoseiulus barkeri*, *N. californicus*, *N. fallacis*, *N. koyamanus*, *N. makuwa*, *N. womersleyi*. According to the criteria of Chant and McMurtry (2003), *N. makuwa* and *N. harrowi* are members of the *barkeri* species group, but *N. harrowi* belongs to *barkeri-barkeri* subgroup, while *N. makuwa* belongs to *barkeri-womersley* subgroup (Chant and McMurty, 2003).

N. makuwa and *N. harrowi* have a similar tube-like calyx and a thick-walled atrium that is forked at the junction with the major duct. The two species are differentiated, however, by shorter posterior setae (Z4, Z5; Table 1) in *N. harrowi* than in *N. makuwa*. In addition, in females the both spermatheca with the forked atrium is longer in *N. makuwa* than in *N. harrowi* (Fig. 2A, B; Amano *et al*., 2011).

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