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RESEARCH ARTICLE

Complementary description of *Neoseiulus neoparaki* (Ehara) (Parasitiformes: Phytoseiidae), a new record for Sakhalin Island, Russia

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ABSTRACT: *Neoseiulus neoparaki* (Ehara) (Parasitiformes: Phytoseiidae) was described about 50 years ago and known only based on its original description from Japan. The original description is quite detailed and include most of diagnostic characters, but still not complete since it lacks the chelicera dentition and some important morphological features regarding leg chaetotaxy. Therefore, this species is redescribed and illustrated based on the material collected from Kuril bamboo, *S. kurilensis* in Sakhalin Island, Russia. This is the first discovery of *N. neoparaki* after its original description, and therefore the first report for Russia.

Keywords: Acari, first record, redescription, predatory mites, leg chaetotaxy
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INTRODUCTION

Phytoseiidae are among the most studied families within Parasitiformes mites due to their potential as biological control agents (McMurtry et al., 2013). The genus *Neoseiulus* Hughes is one of the largest in the family Phytoseiidae, with about 400 described species including synonyms (Demite et al., 2014). The genus includes some important Type II selective predators of tetranychid mites such as *N. californicus* (McGregor), *N. fallacis* (Garman), and *N. longispinosus* (Evans) but also Type III generalist predators found in soil/litter habitats, such as *N. barkeri* Hughes and *N. cucumeris* (Oudemans) (McMurtry et al., 2013). Therefore, *Neoseiulus* species has great potential to be used for the biological control of plant-feeding mites and some small soft-bodied insects that include thrips and whiteflies.

Neoseiulus neoparaki (Ehara, 1972) (Phytoseiidae) was known only from its original description which was based on the holotype female and the paratype male collected from Kuril bamboo, *Sasa kurilensis* (Rupr.) Makino & Shibata (Poaceae) in Shiga Heights, Nagano Prefecture, Honshu, Japan. Although the original description is quite detailed, it does not include several important morphological characters regarding the chelicera dentition and leg chaetotaxy. These two features are frequently used to delimitate *Neoseiulus* species (Zannou et al., 2006; Ferragut and Navia, 2017; Doker et al., 2023). Therefore, in this study, *N. neoparaki* is redescribed and illustrated based on adult females.

MATERIALS AND METHODS

Female specimens were collected from Kuril bamboo, *Sasa kurilensis* (Rupr.) Makino & Shibata (Poaceae) plants in 2021 in Sakhalin Island, Russia. The beating method was used to collect the specimens. For this aim, a thick and a black paper sheet (40 X 50 cm in size) were placed next to the plant's vegetative organs, and the plant was beaten 15-20 times by using a 50 cm wood stick. The phytoseiids on the plants were fallen on the black sheet and were easily recognized due to their fast movement and color. The phytoseiids were then transferred and preserved in plastic tubes which contained 96% ethyl alcohol. Specimens were cleared in lactic acid and mounted in Hoyer's medium. The taxonomic system proposed by Chant and McMurtry (2007) for the Phytoseiidae family is followed. Setal nomenclature for the dorsal idiosoma follows that of Lindquist and Evans (1965) as adapted by Rowell et al. (1978), and Chant and Yoshida-Shaul (1991). For the designation of dorsal solenostomes, the system of Athias-Henriot (1975) is used. Measurements are given in micrometers (µm) and presented as mean followed by the range in brackets. Morphological observations, illustrations and measurements were made using a compound microscope Axio Imager A2 (Carl Zeiss, Germany), equipped with a differential interference contrast (DIC) optical system. Photographs were taken with Axiocam 506 color (Carl Zeiss, Germany). Dorsal shield length was measured along the midline. The examined materials are deposited in Tyumen State University Museum of Zoology, Tyumen, Russia. Two females are deposited in the mite collection of the Acarology Laboratory, Çukurova University, Adana, Türkiye.

RESULTS

Neoseiulus neoparaki (Ehara)

Amblyseius (*Amblyseius*) *neoparaki* Ehara, 1972: 153.

Diagnosis

Idiosomal setal pattern 10A:9B/*JV*–3: *ZV* (*r3* and *R1* off shield). Dorsal shield sclerotized, mostly smooth, except lateral reticulations and a few posterior striations; with slight waist at level of *Z1*; with six pairs of solenostomes

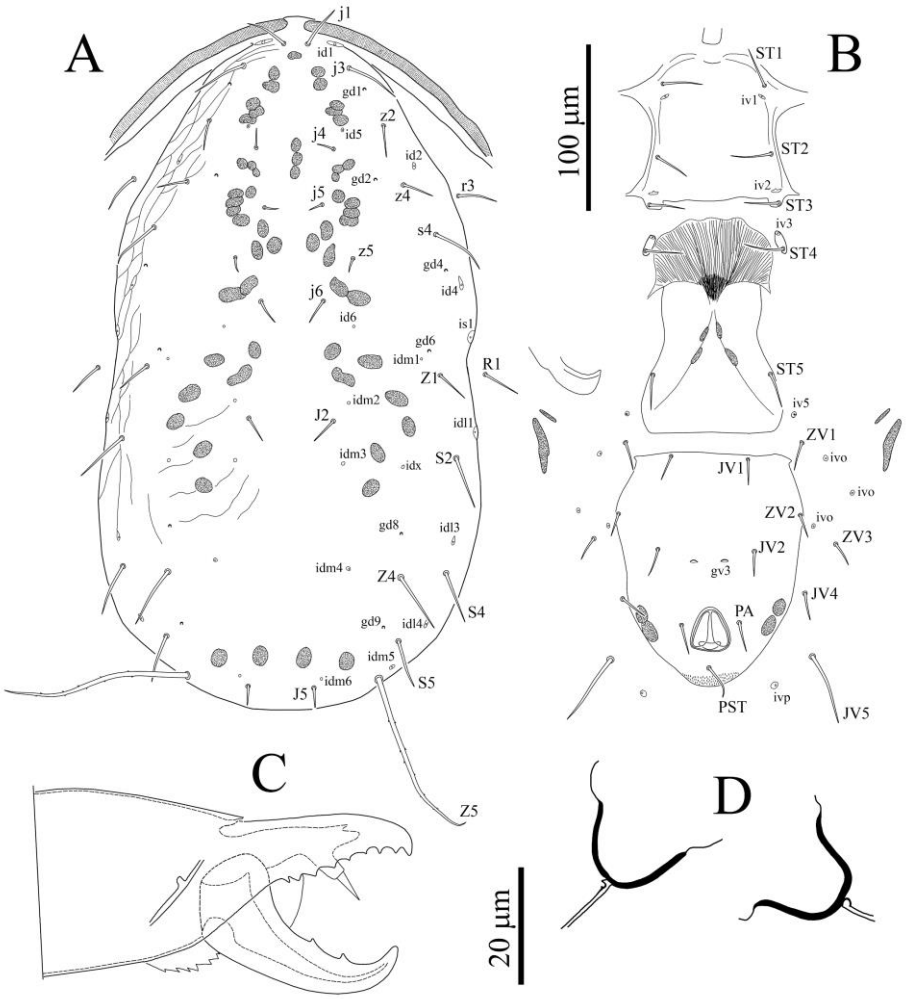

Figure 1. *Neoseiulus neoparaki* (Ehara) (female): **A.** Dorsal idiosoma, **B.** Ventral idiosoma, **C.** Chelicera, **D.** Spermathecae.

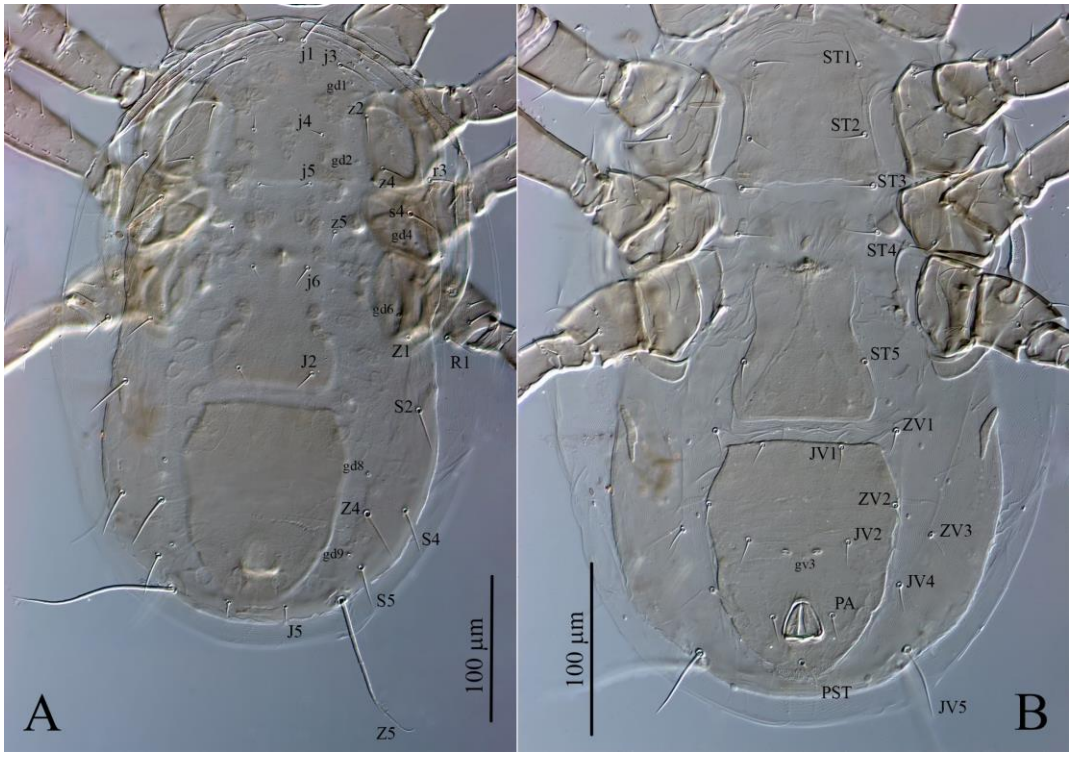

Figure 2. DIC micrographs of *Neoseiulus neoparaki* (Ehara) (female): **A.** Dorsal idiosoma, **B.** Ventral idiosoma.

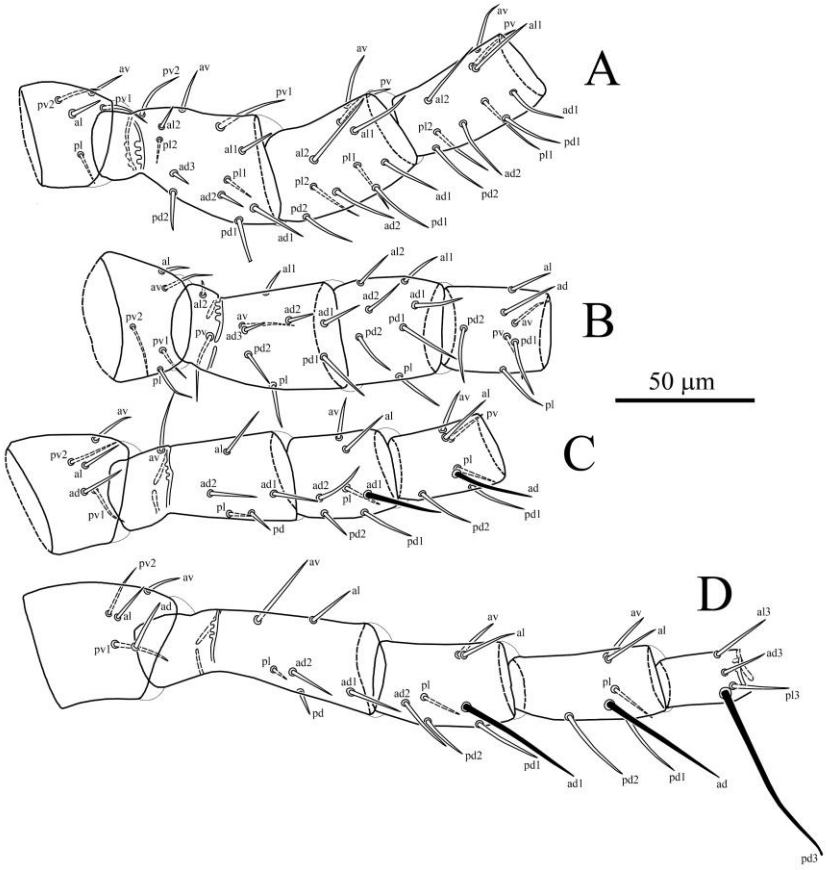

Figure 3. *Neoseiulus neoparaki* (Ehara), right legs of female: **A.** Leg I (coxa and tarsus omitted), **B.** Leg II (coxa and tarsus omitted), **C.** Leg III (coxa and tarsus omitted), **D.** Leg IV (coxa and telotarsus omitted). Macrosetae were drawn in solid black for clarity.

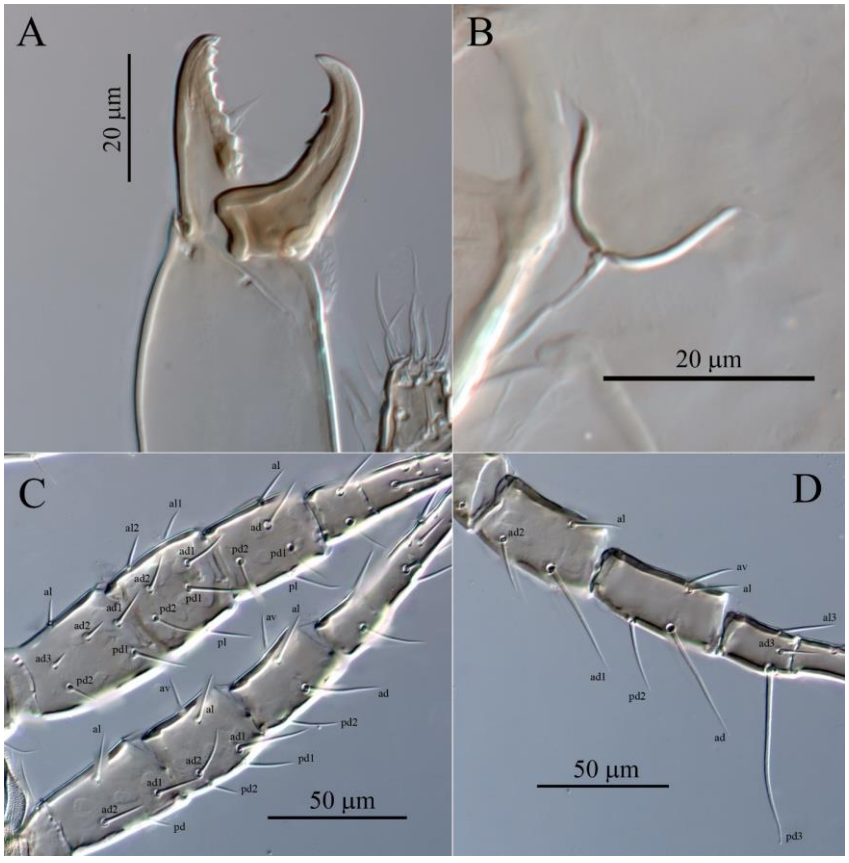

Figure 4. *Neoseiulus neoparaki* (Ehara) (female): **A.** Chelicera, **B.** Spermatheca, **C.** Leg II, dorsal view (femur-basitarsus) and leg III, dorsal view (genu-basitarsus), **D.** Leg IV (genu, tibia and basitarsus).

(*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, and *gd9*); dorsal setae simple, short to medium in length, except *Z5* serrated and more than 2.5 times longer than other setae. Peritremes extending anteriorly to seta *j1*. All ventral shields smooth; sternal shield with three pairs of setae; ventrianal shield pentagonal with three pairs of preanal setae and a pair of crescentic preanal solenostomes located posteromesad setae *JV2*; seta *JV5* smooth and sharp pointed. Spermatheca with short, cup-shaped calyx and small nodular atrium attached to calyx without neck. Fixed digit of chelicera with eight teeth, evenly distributed along digit, and movable digit with two teeth. First two legs without macroseta. Leg III with two and Leg IV with three macrosetae. Macrosetae sharp pointed except *StIV* with very small apical knob. Genu II with seven setae.

Re-description: Female (n=5).

Dorsal idiosoma (Figs 1A, 2A). Dorsal setal pattern 10A: 9B (*r3* and *R1* off shield). Dorsal shield mostly smooth, except lateral reticulations and a few posterior striations, with slight waist at level of seta *Z1*, with six pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd6*, *gd8* and *gd9*), and 16 pairs of poroids (sensillae) (*id1*, *id2*, *id4*, *id5*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl1*, *idl3* and *idl4*). Muscle-marks (sigillae) visible mostly on podosoma, length of dorsal shield 413 (399–422), width (at level of *s4*) 206 (198–218), width (at level of *S2*) 222 (211–230). Dorsal setae smooth except *Z5*, serrated. Measurements of dorsal setae as follows: *j1* 22 (21–24), *j3* 32 (31–35), *j4* 11 (10–13), *j5* 9 (8–10), *j6* 17 (16–17), *J2* 17 (16–19), *J5* 12 (11–13), *z2* 17 (16–18), *z4* 17 (15–18), *z5* 9 (8–10), *Z1* 19 (17–20), *Z4* 36 (35–38), *Z5* 105 (101–110), *s4* 35 (34–36), *S2* 31 (28–32), *S4* 30 (27–32), *S5* 28 (26–29), *r3* 24 (23–25), and *R1* 23 (22–24). Peritremes extend anteriorly to setae *j1*.

Ventral idiosoma (Figs 1B, 2B). Ventral setal pattern 14: *JV–3*: *ZV*. Sternal shield smooth; with three pairs of setae (*ST1–ST3*) and two pair of poroids (*iv1*, *iv2*); distance between bases of setae *ST1–ST3* 73 (72–75), distance between bases of setae *ST2* 67 (66–68); metasternal setae *ST4* and poroids *iv3* on metasternal shields. Genital shield smooth, slightly narrower than ventrianal shield, with one pair of setae *ST5*; width (at level of *ST5*) 71 (70–72); one pair of para-genital poroids *iv5* on soft cuticle. Ventrianal shield pentagonal, smooth; with three pairs of pre-anal setae (*JV1*, *JV2*, and *ZV2*), one pair of para-anal setae *PA*, unpaired post-anal seta *PST*, and a pair of crescentic solenostomes (*gv3*) posteromedian to *JV2*, distance between solenostomes 20 (18–24). Length of ventrianal shield (distance between anterior to posterior margins along midline) 143 (137–146), width (at level of *ZV2*) 111 (105–115). Four pairs of caudoventral setae (*ZV1*, *ZV3*, *JV4*, and *JV5*) and four pairs of poroids (three *ivo*, and *ivp*) on soft cuticle surrounding ventrianal shield. Setae *JV5* smooth, 45 (43–50) in length.

Chelicera (Figs 1C, 4A). Fixed digit 33 (31–37) long, with eight teeth evenly distributed along digit and pilus dentilis; movable digit 35 (34–37) long, with two teeth.

Spermatheca (Figs 1D, 4B). Calyx short, cup-shaped, 12 (11–12) long, atrium nodular connected to calyx without neck, major duct narrow, minor duct not visible.

Legs (Figs 3A-D, 4C-D). Leg I 330 (321–342), II 278 (272–283), III 290 (277–305), IV 373 (361–389) in length. Chaetotaxy of legs as follows: Leg I: coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II: coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 1/1 2/1 1. Leg III: coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV: coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/0 1. First two legs without macroseta. Leg III with two and Leg IV with three macrosetae. Macrosetae sharp pointed except *StIV* with very small apical knob. Measurements of macrosetae as follows: *SgeIII* (*ad1*) 26 (25–28), *StiIII* (*ad*) 27 (25–28), *SgeIV* (*ad1*) 43 (41–46), *StiIV* (*ad*) 46 (44–47), and *StIV* (*pd3*) 63 (59–67).

Male. Not collected in this study.

Material examined. Five females from Kuril bamboo, *Sasa kurilensis* (Rupr.) Makino & Shibata (Poaceae) in Sakhalin Island, Chekhov Mountain, Yuzhno-Sakhalinsk, Russia, 46° 59' 23" N, 142° 50' 07" E, 842 meters above sea level, 13 August 2021, collected by Khaustov V.A., Döker İ., Joharchi O., and Khaustov A.A.

DISCUSSION

Neoseiulus neoparaki was described based on the material collected from Kuril bamboo, *S. kurilensis* in Shiga Heights, Nagano Prefecture, Honshu, Japan. The original description is quite detailed and includes most of the diagnostic characters. However, the chelicera dentition and macrosetae on leg III were not mentioned in that original description. This is the first discovery of the species after its original description, and therefore the first report for Russia. Morphological characters and measurements of the newly collected material are almost identical to those given by Ehara (1972).

Authors' contributions

Vladimir A. Khaustov: Material collection, identification of mite species, investigation, visualization, review-editing. **İsmail Döker:** Material collection, identification of mite species, investigation, writing original draft, review-editing. **Omid Joharchi:** Material collection, investigation, review-editing.

Statement of ethics approval

Not applicable.

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Conflict of interest

The authors declared that there is no conflict of interest.

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