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SUCKING LICE (PHTHIRAPTERA: ANOPLURA) PARASITIZING MONGOLIAN RODENTS WITH THE DESCRIPTION OF A NEW SPECIES OF *HOPLOPLEURA* FROM MOUNTAIN VOLES (*ALTICOLA* SPP.)

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KEY WORDS

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Small mammals
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Asia
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ABSTRACT

The sucking louse fauna associated with Mongolian mammals is inadequately known. We provide a list of 25 species of sucking lice recorded from Mongolian rodents including previously published records, and new records of specimens collected during an expedition to northwestern Mongolia in 2015. *Hoplopleura inagakii* Ono and Hasegawa and *Polyplax cricetulis* Chin are newly recorded from Mongolia and 2 new host associations in Mongolia are recorded for *Hoplopleura acanthopus* (Burmeister). We describe *Hoplopleura altaiensis* n. sp., from the Gobi Altai mountain vole, *Alticola barakshin* Bannikov (type host) with an additional specimen from *Alticola strelzowi* (Kastchenko) (Strelzow's mountain vole). Both sexes of the new species are illustrated with scanning electron micrographs and line drawings. We note small morphological differences in the shape of the female subgenital plate between specimens prepared for scanning electron microscopy versus those prepared for light microscopy following DNA extraction.

The sucking louse (Insecta: Phthiraptera: Anoplura) fauna of wild mammals in Mongolia is inadequately known, with almost all previous records being reported by Kéler (1967), Durden and Musser (1994), Krištofík (1999), and Durden et al. (2019). Despite the publication of these papers (1 is a catalog of world species of Anoplura and provides few details for any countries), sucking lice have not been reported from several species of mammals that occur in Mongolia. Some of these mammals are known to be parasitized by sucking lice in other parts of their ranges. Domestic mammals such as dogs, swine, cattle, horses, goats, and sheep are parasitized by widespread, mostly nonnative species of sucking lice, but even those species are not well documented in Mongolia. The sucking lice that parasitize native mammals in Mongolia are mostly unique to the region, or northern/central Asia, although at least 2 species, *Hoplopleura acanthopus* (Burmeister) and *Linognathoides laeviusculus* (Grube), are widespread across the Holarctic region as ectoparasites of several species of voles and ground squirrels, respectively (Durden and Musser, 1994; Durden et al., 2019). The purpose of this paper is to document the known fauna of sucking lice associated with native rodents in Mongolia by assessing previously published literature and from a recent collaborative parasitological research expedition to northwestern Mongolia. Parasite collections from rodents made during this expedition have produced new records of sucking lice including an undescribed species, which is documented in this paper.

The new species of sucking louse belongs to the family Hoplopleuridae and the genus *Hoplopleura* as designated by Kim and Ludwig (1978) as follows.

Family Hoplopleuridae Ewing, 1929

Small to medium in size (adults ~0.8–1.4 mm long). Head lacking eyes; antennae with 4 or 5 segments. Thorax lacking a notal pit; thoracic sternal plate well developed. Legs progressively larger (from fore, mid, to hind legs), each terminating in an acuminate claw; tibial thumbs well developed. Abdomen usually with well-developed tergal, sternal, and paratergal plates; paratergal plates large, overlapping, and with apices free from body. Abdominal segments 3–8 each with a pair of spiracles. Sternal plate of abdominal segment 2 prolonged laterally on each side to articulate with corresponding paratergal plate. Male genitalia with large basal apodeme, well-developed parameres, and distinct

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pseudopenis. Females with large subgenital plate, large gonopods VIII, and (usually) short gonopods IX.

Genus *Hoplopleura* Enderlein, 1904

With characters of the family. Abdominal segments 2 and 3 each with a narrow, transverse, continuous sternal plate that extends completely across the ventral surface to articulate with the corresponding paratergal plates. Sternal plate on abdominal segment 3 with 2 groups of 2 or 3 enlarged, stout setae (note, this is amended here to "2 groups of 1–3 enlarged, stout setae" to accommodate the new species). Antennae 5-segmented.

Hoplopleura is the most speciose genus of sucking lice and it is distributed globally mainly as species that parasitize rodents, although a few Asian species parasitize lagomorphs (pikas) (Sosnina et al., 1988; Durden and Musser, 1994; Sosnina and Dubinina, 1996). Durden and Musser (1994) listed 136 valid species of *Hoplopleura* worldwide but, with additional new species described since 1994, the current number of valid species in this genus has increased to 164 (Durden et al., 2020).

MATERIALS AND METHODS

As part of a larger project examining the diversity and coevolution of northern latitude mammals and parasites (Cook et al., 2017), rodents were trapped and examined for parasites in Huvsgul, Arhangai, and Bayan Olgii Provinces in northwestern Mongolia during July and August 2015. Parasites were collected from mammals following established field sampling protocols developed to maximize the utility of these holistic collections (Galbreath et al., 2019) and approved by the University of New Mexico under IACUC 19-200-908-MC. Upon sacrifice of each mammal specimen following approved guidelines for animal care and use (Sikes and ACUC (the Animal Care and Use Committee) of the American Society of Mammalogists, 2016), ectoparasites were immediately collected and later prepared and archived at the Museum of Southwestern Biology. Specimens were preserved under a series of 3-yr protocols approved through the Institutional Animal Care and Use Committee (IACUC) at the University of New Mexico. The current protocol (Animal Welfare Assurance No. D16-00565, A4023-01) is enforced under the United States Department of Agriculture Registration No. 85-R-0002. Collected lice were stored in 95% ethanol in the field using fine forceps to allow for later morphological and molecular examination. Examined host specimens are housed at the Museum of Southwestern Biology, University of New Mexico (Appendix I).

DNA was extracted from selected lice, including examples of the new species, as follows. Louse specimens stored in 95% ethanol were transferred to ultrapure water until the louse had completely sunk to the bottom of the vial (plus 5 min) to ensure complete rehydration. A small hole was made in the abdomen of each louse specimen using a new sterile 0.155-mm insect pin and each specimen was transferred to an individual 1.5-ml microcentrifuge tube along with 10 µl of 20 mg/ml proteinase K, 95 µl of ultrapure water and 95 µl of 2× digestion buffer (Zymo Research, Irvine, California), followed by incubation at 58 C overnight. Following incubation, the lysate was transferred to a new 1.5-ml microcentrifuge tube, quickly followed by the addition of 80% ethanol to the original tube with the louse exoskeleton, which was then permanently slide mounted. Two hundred microliters of isopropanol were added to the new tube with the DNA lysate, vortexed, and placed at –20 C for at least 2 hr to precipitate DNA. Precipitated DNA was centrifuged at 17,000 *g* for 15 min, the supernatant removed, washed in 70% ethanol, centrifuged at 17,000 *g* for 5 min (×2), the supernatant removed, dried for 15 min at 58 C, and resuspended in 45 µl of ultrapure water for 2 hr at room temperature. PCR amplification and sequencing of a 610-bp fragment of the nuclear 18S rrnS gene and a 363-bp fragment of the mitochondrial 16S rrnL gene were accomplished using the respective primers NS1–NS2A designed by Black et al. (1997) and 16SF-Lx16SR designed by Dong et al. (2014). Amplified fragments were purified using ExoSAP-it (Affimetrix, Santa Clara, California) and sequenced at Georgia Southern University in both directions using the original PCR primers. Sequence chromatograms were trimmed, assembled, and edited using Geneious version 11.0.4 (Biomatters Ltd., Auckland, New Zealand). DNA sequences were submitted to GenBank (Appendix I).

Selected louse specimens from which DNA had been extracted were slide-mounted from ethanol directly into polyvinyl alcohol (PVA) medium (Bioquip Products, Rancho Dominguez, California). Lice from which DNA had not been extracted, were cleared for ~24 hr in 10% potassium hydroxide, rinsed in distilled water, dehydrated through an ethanol series, further cleared in xylene, and then slide-mounted in Canada balsam. Line drawings were prepared by examining specimens at 100–400× with an Olympus BH-2 phase-contrast high-power microscope (Olympus Corporation of the Americas, Center Valley, Pennsylvania) connected to an Ikegami MTV-3 video camera attachment and monitor (Ikegami Electronics, Neuss, Germany). Measurements were made using a calibrated ocular micrometer. The standardized descriptive format for Anoplura follows Kim and Ludwig (1978) and Durden et al. (2019). Images were stitched together using the "Photomerge" automation application in Adobe Photoshop Creative Cloud 2018 (Adobe Inc., San Jose, California).

Specimens were prepared for scanning electron microscopy (SEM) as follows. Specimens were dehydrated in a graded ethanol series: 70% for 30 min, 80% for 30 min, 90% for 1 hr, 95% overnight, and 100% for 24 hr. Following dehydration, specimens were chemically dried using a graded ethanol/hexamethyldisilazane (HMDS) series; 2(EtOH):1(HMDS) for 2 hr, 1:1 for 2 hr, 1:2 for 3 hr, 1:3 overnight, pure HMDS for 6 hr, followed by replacement of old HMDS with new pure HMDS, and allowed to evaporate overnight. Dried specimens were mounted on an aluminum stub, sputter-coated with gold/palladium, and visualized on a JEOL JSM6610LV SEM (JEOL USA, Peabody, Massachusetts) at 15 kV. Multiple images were captured and stitched together using the photomerge function in Adobe Photoshop CC.

Names of anopluran morphological structures, including setae, follow Kim and Ludwig (1978) and Durden et al. (2019). Host taxonomy, including common names, follows Thorington and Hoffmann (2005) for Sciuridae, with modifications by Helgen et al. (2009) for ground squirrels, Holden and Musser (2005) for Dipodidae, and Musser and Carleton (2005) for Muroidea.

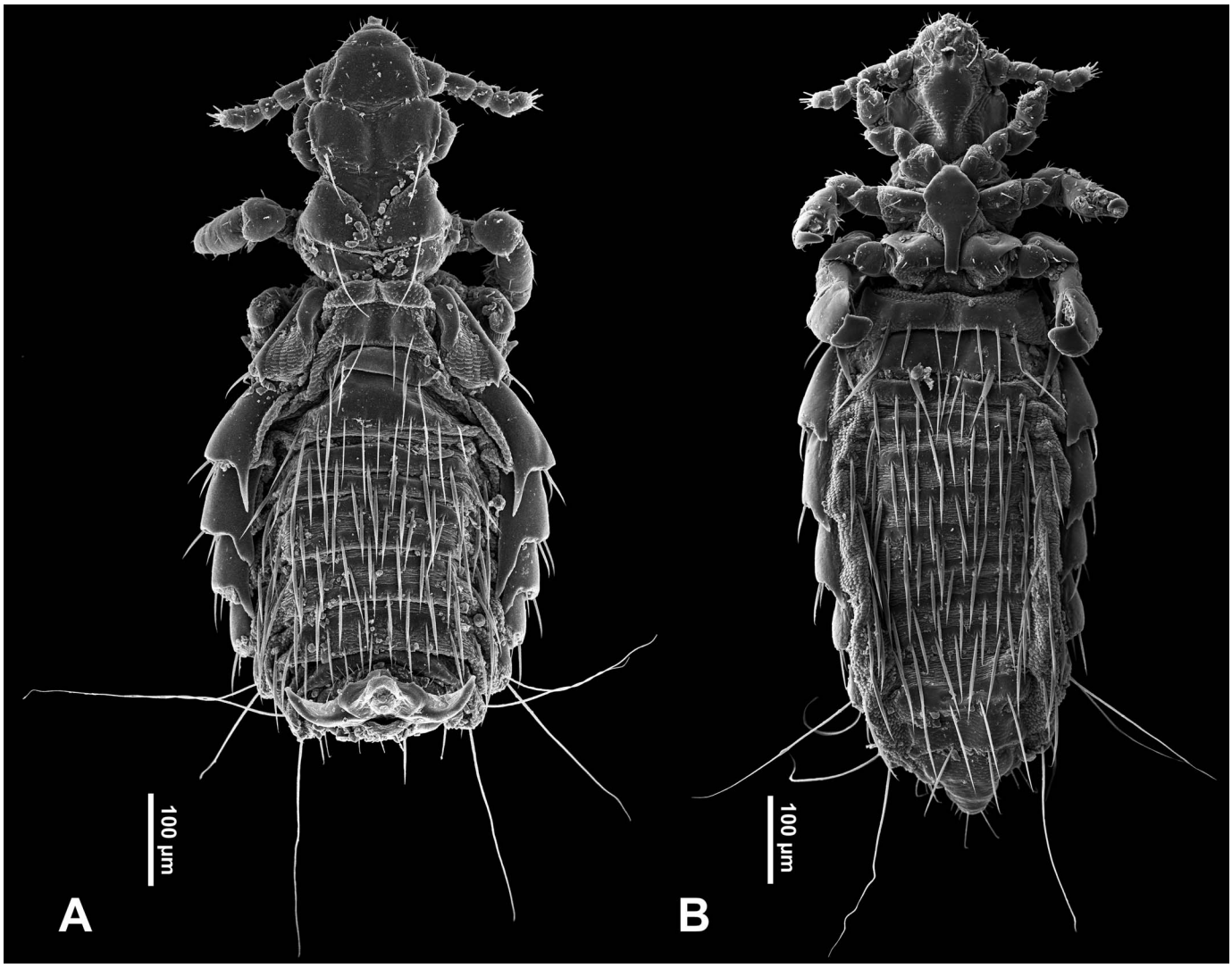

Figure 1. *Hoplopleura altaiensis* n. sp., male. (**A**) Scanning electron micrograph showing dorsal features; (**B**) scanning electron micrograph showing ventral features.

DESCRIPTION

Hoplopleura altaiensis n. sp.

(Figs. 1–3)

Male (Figs. 1A, B, 2A, C) (n = 9): Total body length of holotype, 0.945 mm (mean, 0.916 mm; range, 0.878–1.028 mm). Head, thorax, and abdomen moderately sclerotized.

Head (Fig. 1A, B): Longer than wide with broadly curved lateral margins posterior to antennae and extended anteriorly; distinct dorsal lobe on each side posterior to head suture; maximum head width of holotype, 0.150 mm (mean, 0.151 mm, range, 0.150–0.152 mm). Antennae 5-segmented with fairly broad basal segment and slightly elongated second segment; no antennal segments highly modified. One distinct ventral principal head seta, 2 ventral preantennal setae, 2 sutural head setae, 4 dorsal marginal head setae, 2 dorsal anterior head setae, 1 dorsal anterior central head seta, 1 dorsal posterior central head seta, 1 dorsal principal head seta, 1 small dorsal accessory head seta, 2 supra-antennal head setae, 1 small dorsal preantennal head seta, and 4–6 apical head setae on each side.

Thorax (Fig. 1A, B): Broader than head; maximum thorax width of holotype, 0.205 mm (mean, 0.211 mm; range, 0.205–0.216 mm). Thoracic sternal plate (Fig. 1B) somewhat shield-shaped; long posterior extension with squarish posterior margin, small anterior projection, and small lateral indentation on each side. Thoracic fragma distinct. Mesothoracic spiracle diameter of holotype, 0.016 mm (mean, 0.016 mm; range, 0.015–0.017 mm). Dorsal principal thoracic seta (DPTS) length of holotype, 0.103 mm (mean, 0.104 mm; range, 0.100–0.108 mm). Legs each terminating in tibio-tarsal acuminate claw; claw on hindlegs broader than claws on fore and midlegs; forelegs slightly smaller than midlegs; midlegs slightly smaller than hindlegs; leg coxae variously shaped (Fig. 1B).

Abdomen (Fig. 1A, B): Broader than thorax with 13 tergites and 10 sternites. Tergites 1 and 3 fairly broad; tergite 1 partially separated medially; tergites 2 and 4 very broad each with diverging acuminate posterio-lateral margins; tergites 4–13 wider

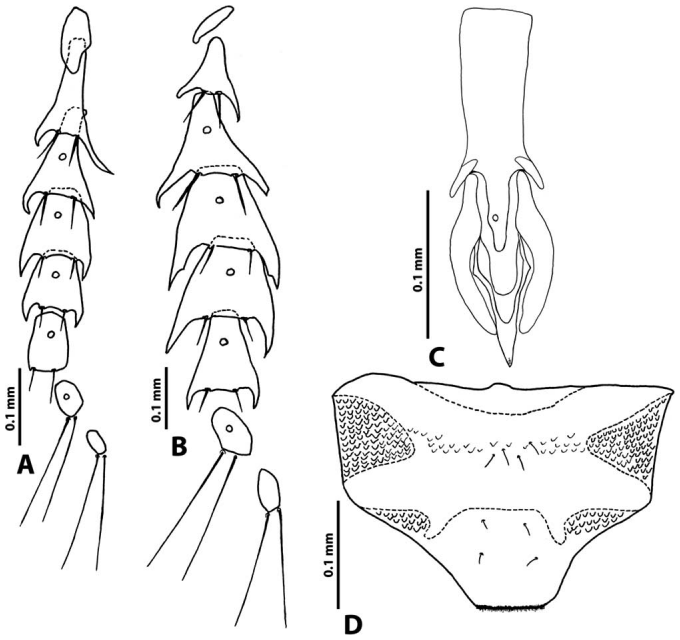

Figure 2. *Hoplopleura altaiensis* n. sp., male and female. (**A**) Paratergal plates of male; (**B**) paratergal plates of female; (**C**) male genitalia; (**D**) female genitalia and posterior, ventral abdomen. The dashed lines show the shape of the subgenital plate for slide-mounted specimens following DNA extraction or clearing in potassium hydroxide.

than previous tergites; tergite 13 distinctly curved. Sternites 1 and 2 broader than other sternites; sternites 2 and 3 each articulating laterally with corresponding paratergal plate (as characteristic of genus); sternites 3–10 each fairly narrow. Tergite 1 lacking tergal abdominal setae (TeAS); tergites 2 and 3 each with 1 long TeAS and 1 very long TeAS on each side; tergites 4–12 each with 7–12 long TeAS; tergite 13 with 4 small setae on each side. One dorsal marginal abdominal seta (DMAS) lateral to tergites 5–12 on each side. Sternites 1 and 2 each with 7 long sternal abdominal setae (StAS); 2 lateral StAS on each side of sternite 2 slightly diverging with medial of each of these pairs of StAS much more robust than lateral StAS. Sternites 3–10 each with 7–8 long StAS. One ventral marginal abdominal seta (VMAS) on each side lateral to each of sternites 5–13.

Paratergal plates (Figs. 1A, B, 2A): Present on abdominal segments 1–8. Plate I small and lacking apical setae. Plates II–V subtriangular; plate VI subrectangular; plates VII and VIII subeliptical. Plates III–VII each with small spiracle. Plates II–VI each with 2 paratergal setae (PrS) of moderate length; plates VII and VIII each with 2 very long PrS; PrS setae on plates II and III slightly thickened.

Genitalia (Fig. 2C): Basal apodeme slightly longer than parameres and with moderately sclerotized, postero-lateral extensions. Parameres fairly straight in anterior section and then broadly curved. Pseudopenis extending posteriorly well beyond posterior apices of parameres and with lateral extensions. Subgenital plate (Fig. 1B) surface distinctly spiculate and extending anteriorly to paratergal plate VI, with slightly concave anterior margin, sinuous lateral margins, tapering posteriorly, and differentially sclerotized as represented by 2 distinct horizontal bands; small central lacuna present anteriorly with 3 very long setae inserted along posterior margin; 2 very long setae inserted along posterior margin of middle sclerotized band.

Female (Figs. 2B, D, 3A, B) (n = 7): Total body length of allotype, 1.275 mm (mean, 1.264 mm; range, 1.198–1.345 mm). Head, thorax, and abdomen as in male unless indicated otherwise.

Head (Fig. 3A, B): Maximum head width of allotype, 0.161 mm (mean, 0.161 mm; range, 0.161–0.162 mm).

Thorax (Fig. 3A, B): Maximum thorax width of allotype, 0.230 mm (mean, 0.227 mm; range, 0.225–0.230 mm). Mesothoracic spiracle diameter of Allotype, 0.017 mm (mean, 0.017; range, 0.016–0.019). DPTS length of allotype, 0.104 mm (mean, 0.105 mm; range, 0.102–0.108 mm). Thoracic sternal plate (Fig. 3B) with more rounded margin on posterior extension than male.

Abdomen (Fig. 3A, B): Broader than thorax with 19 tergites and 15 sternites. Tergites 1–4 as in male; tergites 5–18 narrow, each with 5–8 long TeAS; last tergite distinctly curved and with 1 short and 2 long setae on each side. Sternites 1 and 2 as in male; sternites 2 and 3 each articulating laterally with corresponding paratergal plate (as characteristic of genus); sternites 3–15 each fairly narrow and with 8–12 StAS. One DMAS on each side lateral to each of tergites 6–18. One VMAS on each side lateral to each of sternites 6–15.

Paratergal plates (Figs. 2B, 3A, B): As in male but shape of some individual plates slightly different.

Genitalia (Figs. 2D, 3B): Subgenital plate subtriangular but with small indentation on each side that is more obvious in cleared, slide-mounted specimens (Fig. 2D) and posterior extension that tapers to truncate margin in SEM specimens (Fig. 3B); cleared specimens with 2 distinct posteriorly directed rounded projections; patches of spicules evident especially near anterior and medial lateral margins; 3 rows of small to minute setae in central to posterior region of plate, Row 1 with 4–5 setae, Rows 2 and 3 each with 2 setae. Gonopods VIII slightly elongate and medially situated, each with 3 posterior setae, antero-medial seta slightly shorter than other setae. Gonopods IX less distinct and slightly more lateral than gonopods VIII, each with 3 robust apical setae.

Taxonomic summary

Type host: Alticola barakshin Bannikov, 1947 (Gobi Altai mountain vole) (Museum of Southwestern Biology catalog No. MSB:Mamm:289112—symbiotype).

Other host: Alticola strelzowi (Kastchenko) (Strelzow's mountain vole) (MSB:Mamm:289797).

Specimens deposited: 1 male holotype (MSB:Para:32437), 1 female allotype (MSB:Para:32438), 2 male paratypes (MSB:Para:32441 and 32442), 2 female paratypes MSB:Para:32439 and 32440), 1 additional male (MSB:Para:32447), 1 additional female (MSB:Para:32443) (all sample no. NK270167) ex *A. barakshin* symbiotype; 4 additional males (MSB:Para:32445, 32447, 32448, 32450), 3 additional females (MSB:Para:32444, 32445, 32446) ex 3 *A. barakshin* (sample nos. NK270107, NK270111, NK270120); 1 male ex *A. strelzowi* (MSB:Para:32449) (sample no. NK270545), Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico.

Type locality: (Ex *A. barakshin*) Mongolia: Bayan Olgii Province, Zoolon (49°54′17.496″N, 90°06′55.296″E) (holotype

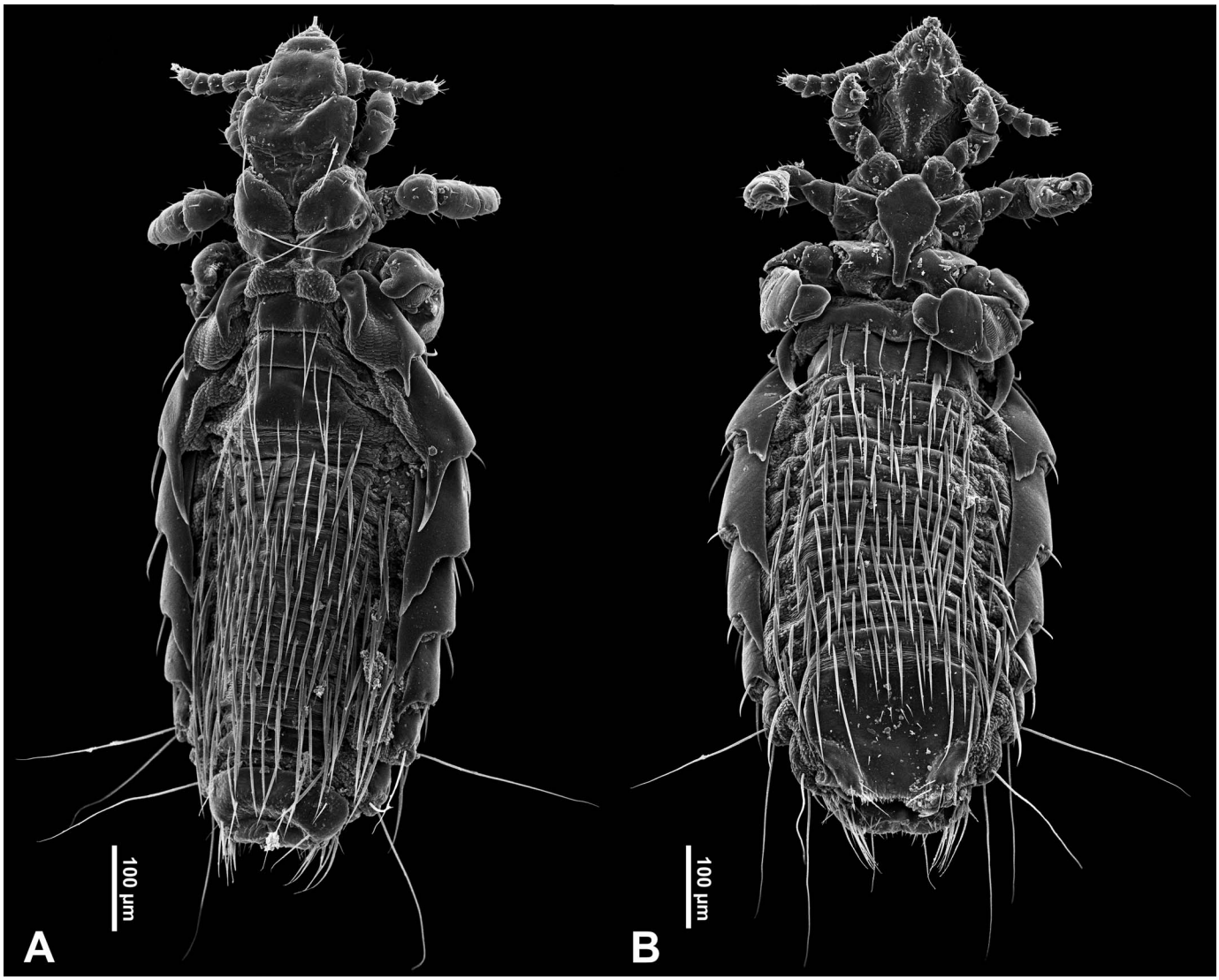

Figure 3. *Hoplopleura altaiensis*, n. sp. Female. (**A**) Scanning electron micrograph showing dorsal features; (**B**) scanning electron micrograph showing ventral features.

male, allotype female, 2 male paratypes, 2 female paratypes, 1 additional male, 1 additional female, 28 July 2015 (sample no. NK270167); collectors: B.-O. Ochirbat, S. E. Greiman, J. A. Cook, B. S. McLean, and N. Batsaikhan.

Other localities: Mongolia: Bayan Olgii Province, Zoolon (48°54′29.448″N, 90°08′50.760″E) ex 3 *Alticola barakshin* (4 males, 3 females), 27 July 2015 (NK270107, NK270111, NK270120); Huljaa river valley (49°24′23.940″N, 89°05′07.908″E) ex *Alticola strelzowi* (1 male), 5 August 2015 (sample no. NK270545); collectors: H. Toman, S. E. Greiman, J. A. Cook, B. S. McLean, and N. Batsaikhan.

Site of infestation: Skin surface and fur.

ZooBank registration: urn:lsid:zoobank.org:act:97DF00C9-EFA1-4305-838B-E4A96987F8BE.

Etymology: The specific epithet is derived from the Altai mountains where the hosts and lice were collected.

DNA sequences: See Appendix I.

REMARKS

With the description of *H. altaiensis* n. sp., there are now 165 valid species of *Hoplopleura* recognized worldwide. Nevertheless, the new species can readily be separated from all other species in this genus. Both sexes of *H. altaiensis* have only 1 long, stout seta on each side of sternite 2, which is unique within the genus *Hoplopleura*. Females of *H. altaiensis* and *Hoplopleura alticola* Mishra and Bhat, from the Himalayan mountains of India (Himachal Pradesh and Uttar Pradesh states) and Pakistan (Hazara district) are the only 2 species of *Hoplopleura* with a subgenital plate that has 2 large lateral processes on each side in addition to 2 large, rounded posterior processes (Fig. 2D) (Mishra and Bhat, 1972; Durden et al., 1990) as seen in cleared specimens. The subgenital plates of these 2 species of lice are very similar, presumably because they both parasitize mountain voles belonging to the genus *Alticola* (*H. alticola* parasitizes *Alticola roylei* Gray [Royle's mountain vole]) and likely evolved from a common ancestor. However, females of these 2 species of lice can be readily

distinguished by the following characters: (1) the distinctly elongated, tapering head anterior to the antennae in *H. altaiensis* n. sp. (not prolonged and with an almost straight anterior margin in *H. alticola*); (2) the shape and the setation of the paratergal plates, in particular plate III, which has 2 long setae in *H. altaiensis* n. sp. (2 short setae in *H. alticola*); (3) the presence of only 1 stout seta on each side on sternite 2 (2 stout setae on each side in *H. alticola*); (4) the presence of 4–5 small setae between gonopods VIII in *H. altaiensis* (2 short setae between gonopods VIII in *H. alticola*).

Males of *H. altaiensis* can be distinguished from males of all other species of *Hoplopleura* by a combination of the following characters: (1) Head prolonged anterior to antennae and tapering to a rounded apex; (2) lacking stout setae on sternite 1; (3) only 1 stout seta present on either side on sternite 2; (4) the shape of the paratergal plates and the lengths of their apical setae; (5) parameres curved, lacking projections, narrowing anteriorly, and almost as long as basal apodeme; (6) pseudopenis long, pointed apically, and extending well beyond apices of the parameres.

As stated above, the single stout seta on each side of sternite 2 in both sexes is unique to *H. altaiensis*. Adults of almost all other species of *Hoplopleura* have 2 stout setae on each side on this sternite, and a few species have 3 on each side (Kim and Ludwig, 1978). Both sexes of *H. alticola* have 2 stout setae on each side on sternite 2 (Mishra and Bhat, 1972).

We do not see any morphological differences between the lice described here as *H. altaiensis* that were collected from *A. barakshin* or *A. strelzowi* but we have designated *A. barakshin* as the type host from which the type series of lice were designated. It is not uncommon for 1 species of sucking louse to parasitize more than 1 species of congeneric hosts, especially if the hosts are sympatric (Durden and Musser, 1994). Nevertheless, most specimens of the new louse were collected from 4 individuals of *A. barakshin* and only 1 adult louse specimen was collected from 1 individual *A. strelzowi*. The records from *A. strelzowi* could reflect a true host–parasite association or a case of straggling.

Nuclear 18S rDNA sequences of the new species from both hosts, *A. barakshin* and *A. strelzowi*, are 100% identical to each other (605 bp). Mitochondrial 16S rrnS sequences of the new species from both hosts are 98% similar to each other, with a total of 6 bp differences across 292 bp, while still being 100% similar when from the same host species. 16S rrnS sequences are also much different from 3 other species of *Hoplopleura* collected from Mongolia in this study, that is, *H. acanthopus*, *H. inagakii*, and *H. edentula*. The new species is closest in sequence similarity to *H. acanthopus* (94–96% similar), while being only 77% identical to *H. inagakii*, and only 73% identical to *H. edentula*.

SUCKING LICE RECORDED FROM MONGOLIAN RODENTS

Note: Host collection numbers (Nr.) provided by Kéler (1967) are included. Neither Kéler (1967) nor Krištofík (1999) provided any other collection or accession numbers for hosts or parasites.

Family Enderleinellidae

Enderleinellus disparilis Blagoveshtchensky, 1965

Ex *Urocitellus undulatus* (Pallas) (long-tailed ground squirrel) (Sciuridae); collection locality: Huvsgul Province, Hanh (Krištofík, 1999).

Notes: Urocitellus undulatus is the only known host of this louse, which has also been reported from this host in the Amur-Zeya plateau in Russia (Blagoveshtchensky, 1965).

Enderleinellus nitzschi Fahrenholz, 1916

Ex *Sciurus vulgaris* Linnaeus (Eurasian red squirrel) (Sciuridae); collection locality: Bulgan Province, Egiyn Gol (Krištofík, 1999).

Notes: This louse parasitizes *S. vulgaris* across Eurasia (Durden and Musser, 1994). The following names are synonyms as documented by Durden and Musser (1994): *Pediculus sphaerocephalus* Nitzsch, 1818; *Haematopinus sphaerocephalus* (Nitzsch, 1818); *Polyplax sphaerocephala* (Nitzsch, 1818); *Enderleinellus sphaerocephalus* (Nitzsch, 1818); *Enderleinellus sphaerocephalus* (Nitzsch, 1818).

Enderleinellus tamiasis Fahrenholz, 1916

Ex *Tamias sibiricus* (Laxmann) (Siberian chipmunk) (Sciuridae); collection locality: Bayan Olgii Province, Tsagaan Nuur (Krištofík, 1999).

New collection: Ex *T. sibiricus*, Huvsgul Province, Heegtsar River Valley, 20 August 2015 (NK272323).

Notes: This louse is known from Mongolia and Korea as an ectoparasite of *T. sibiricus* (Durden and Musser, 1994); presumably it also parasitizes this host in other parts of its range. It has also been reported from introduced *T. sibiricus* in France (Beaucournu et al., 2008).

Family Hoplopleuridae

Hoplopleura acanthopus (Burmeister, 1839)

Ex *Microtus arvalis* (Pallas) (common vole) (Cricetidae); collection locality: Tuv Province, Ulaanbaatar (Kéler, 1967 [Nr. 37, Nr. 88, Nr. 89/90]).

Ex *Microtus* sp. (undetermined vole) (Cricetidae) (Krištofík, 1999); collection localities: Huvsgul Province, Ih-Horoo Gol; Selenge Province, Hyalganat (Krištofík, 1999).

Ex *Clethrionomys* (now *Myodes*) sp. (undetermined vole) (Cricetidae), collection locality: Uvs Province, Harhiraa Uul (Krištofík, 1999).

Ex *Lasiopodomys brandtii* (Radde) (Brandt's vole) (Cricetidae); collection localities: Arhangai Province, Ugii Nuur; Tuv Province: Ulaanbaatar; Zavhan Province, Telmen Nuur (Kéler, 1967 [Nr. 185, Nr. 1243], Krištofík, 1999).

New collections: Ex *Microtus gregalis* (Pallas) (narrow-headed vole) (Cricetidae); Bayan Olgii Province, Songinot Gol, 1 August 2015 (NK270442); Uvs Province, Harhiraa Mountain, Tsunheg, 8 August 2015 (NK270660), Juveriin Gol, 9 August 2015 (NK270687).

Ex *Microtus oeconomus* (Pallas) (tundra vole) (Cricetidae); Bayan Olgii Province, Songinot Gol, 31 July 2015 (NK270348); Huvsgul Province, Heegtsar River Valley, 19 August 2015 (NK272167, NK 272171); Uvs Province, Han Huhii Mountain, Baruun Turuun River Valley, 14 August 2015 (NK270946).

Ex *Microtus* sp. (undetermined vole) (Cricetidae); Bayan Olgii Province, Songinot Gol, 1 August 2015 (NK270431, NK270440).

Notes: Hoplopleura acanthopus parasitizes many species of voles across the Holarctic region (Durden and Musser, 1994). However, we report 2 new host associations for this louse in

Mongolia—from *M. gregalis* and *M. oeconomus*. The collections of this louse from *L. brandtii* reported by Kéler (1967) were listed as "*Hoplopleura acanthopus* ssp." The following names are synonyms or former generic or subspecific assignments for this louse as documented by Durden and Musser (1994): *Pediculus acanthopus* Burmeister, 1839; *Haematopinus acanthopus* (Burmeister, 1839); *Polyplax acanthopus* (Burmeister, 1839); *Hoplopleura acanthopus acanthopus* (Burmeister, 1839); *Polyplax villosa* Galli-Valerio, 1905; *Hoplopleura acanthopus* var. *americanus* Kellogg and Ferris, 1915; *Hoplopleura acanthopus* var. *aequidentis* Fahrenholz, 1916; *Hoplopleura acanthopus* var. *edentulus* Fahrenholz, 1916 (partim); *Hoplopleura fahrenholzi* Eichler, 1952; *Hoplopleura silesica* Eichler, 1952.

Hoplopleura affinis (Burmeister, 1839)

Ex *Cricetulus* sp. (undetermined hamster) (Cricetidae); collection locality: Uvs Province, Zuun Govi Soum (Krištofík, 1999).

Notes: Hoplopleura affinis typically parasitizes various species of *Apodemus* mice (Muridae) across much of Eurasia (Durden and Musser, 1994) so the record from *Cricetulus* in Mongolia would be considered unusual. The following names are former generic and subspecific assignments for this louse as documented by Durden and Musser (1994): *Pediculus affinis* Burmeister, 1839; *Haematopinus affinis* (Burmeister, 1839); *Haematopinus acanthopus* var. *affinis* (Burmeister, 1839); *Polyplax affinis* (Burmeister, 1839); *Hoplopleura affinis affinis* (Burmeister, 1839).

Hoplopleura altaiensis Durden, Robinson, Cook, Bell, Nyamsuren and Greiman, 2022

Ex *Alticola barakshin* (Gobi mountain vole) (Cricetidae); collection locality: Bayan Olgii Province, Zoolon.

Ex *Alticola strelzowi* (Strelzow's mountain vole) (Cricetidae); collection locality: Bayan Olgii Province, Huljaa river valley.

Notes: Hoplopleura altaiensis is described in this paper.

Hoplopleura edentula Fahrenholz, 1916

Ex *Clethrionomys* (now *Myodes*) sp. (undetermined vole) (Cricetidae); collection locality: Huvsgul Province, Hanh (Krištofík, 1999).

New collections: Ex *Myodes rutilus* (Pallas) (northern red-backed vole) (Cricetidae); Arhangai Province, Nariin Gol, north side of Terhiin Tsagaan lake, 22 July 2015 (NK270026), Zurh Mountain, 21 July 2015 (NK270012); Songinot Gol, 31 July 2015 (NK270356); Huvsgul Province; Heegtsar River Valley, 19 August 2015 (NK272186); Uvs Province, Juveriin gol, 9 August 2015 (NK270703), Han Huhii Mountain, Baruun Turuun River Valley, 13 August 2015 (NK270866), Harhiraa Mountain, Tsunheg, 8 August 2015 (NK270667).

Notes: Hoplopleura edentula parasitizes several species of voles in the genus *Myodes* (formerly *Clethrionomys*) in Europe and northern/central Asia (Durden and Musser, 1994). *Hoplopleura acanthopus* var. *edentulus* Fahrenholz, 1916 (partim) is a synonym for this louse.

Hoplopleura inagakii Ono and Hasegawa, 1955

New collections: Ex *Myodes rufocanus* (Sundevall) (gray red-backed vole) (Cricetidae); Bayan Olgii Province, Songinot Gol, 30 July 2015 (NK270283); Huvsgul Province, Heegtsar River Valley, 19 August 2015 (NK272149); Uvs Province, Han Huhii Mountain, Baruun Turuun River Valley, 14 August 2015 (NK270974).

Notes: Hoplopleura inagakii has previously been reported from *M. rufocanus, M. rutilus*, *Myodes andersoni* (Thomas) (Japanese red-backed vole), and *Myodes smithii* (Thomas) (Smith's red-backed vole) in Japan (Kaneko, 1959; Durden and Musser, 1994).

Hoplopleura meridionidis Ferris, 1921

Ex *Meriones unguiculatus* (Milne-Edwards) (Mongolian jird) (Muridae), collection locality: Tuv Province: Ulaanbaatar (Krištofík, 1999).

Ex *Meriones meridianus* (Pallas) (midday jird) (Muridae); collection locality: Zavhan Province, Mongol Els (Krištofík, 1999).

Notes: Hoplopleura meridionidis parasitizes several species of *Meriones* and has been recorded from China, Russia, Iran, and Pakistan, as well as Mongolia (Durden et al., 1990; Durden and Musser, 1994; Krištofík, 1999).

Hoplopleura sp.

Ex *Microtus oeconomus* (Pallas) (root vole) (Cricetidae); collection locality: Hovd Province, Har Us Nuur [Kéler, 1967 (Nr. 537/39)].

Notes: We have not been able to locate these specimens They could have been *H. acanthopus*, which is the only species of *Hoplopleura* recorded to parasitize *M. oeconomus* by Durden and Musser (1994).

Schizophthirus sicistae Blagoveshtchensky, 1965

Ex *Sicista subtilis* (Pallas) (southern birch mouse) (Dipodidae); unspecified collection locality (Sosnina et al., 1984; Durden and Musser, 1994).

Notes: Schizophthirus sicistae is known to parasitize *S. subtilis* and *Sicista betulina* Pallas (northern birch mouse) in parts of Europe and Asia (Blagoveshtchensky, 1965; Sosnina et al., 1984; Durden and Musser, 1994).

Family Polyplacidae

Eulinognathus allactagae Johnson, 1957

Ex *Allactaga sibirica* (Forster) (Mongolian 5-toed jerboa) (Dipodidae); collection localities: Bayanhongor Province, Orog Nuur; Govi Altai Province, Uljastain Gol; Govi Altai Province, Hairhan; Hovd Province, Chono Haraih Gol; Tuv Province, Onjuul Soum (Kéler, 1967 [Nr. 660], Durden and Musser, 1994, Krištofík, 1999).

Ex *Allactaga bullata* Allen (Gobi jerboa) (Dipodidae), collection localities: unspecified and Bayanhongor Province, Orog Nuur (Durden and Musser, 1994; Krištofík, 1999).

Notes: This louse is known to parasitize *Allactaga major* (Kerr) (great jerboa), *A. sibirica,* and *A. bullata* and has been recorded from China, Kyrgyzstan, and Ukraine, in addition to Mongolia (Chin, 1984; Chirov and Ozerova, 1990; Durden and Musser, 1994; Krištofík, 1999).

Eulinognathus biuncatus Ferris, 1932

Ex *Dipus sagitta* (Pallas) (northern 3-toed jerboa) (Dipodidae), collection localities: Bayanhongor Province, Orog Nuur and

Zuun Mod Oasis; Govi Altai Province, Olon Bulag (Shargyn Govi) (Krištofík, 1999).

Ex *Allactaga sibirica,* (Forster) (Mongolian 5-toed jerboa) (Dipodidae), collection locality: Bayanhongor Province: Bayantsagaan Soum (Krištofík, 1999).

Notes: Eulinognathus biuncatus is also known to parasitize *D. sagitta* in northern China (Ferris, 1932; Chin, 1984; Durden and Musser, 1994).

Eulinognathus cruciformis Chin, Bai and Qiu, 1995

Ex *Allactaga bullata* Allen (Gobi jerboa) (Dipodidae), collection locality: Bayanhongor Province, Orog Nuur (Krištofík, 1999).

Ex *Allactaga sibirica,* (Forster) (Mongolian 5-toed jerboa) (Dipodidae), collection localities: Bayanhongor Province, Orog Nuur and Bayan Bulag (Shine Jinst Soum); Govi Altai Province, Bugat Soum (Krištofík, 1999).

Notes: This louse has only been recorded from China and Mongolia from *Allactaga* spp. jerboas (Chin et al., 1995; Krištofík, 1999).

Eulinognathus dipodis Blagoveshchensky, 1965

Ex *Allactaga sibirica,* (Forster) (Mongolian 5-toed jerboa) (Dipodidae), unspecified collection locality (Durden and Musser, 1994).

Notes: This louse has been recorded from Kazakhstan and Mongolia from *A. sibirica* or *Dipus sagitta* (Blagoveshtchensky, 1965, Chirov and Ozerova, 1990; Durden and Musser, 1994).

Eulinognathus euchoreutae Cais, 1977

Ex *Euchoreutes naso* Sclater (long-eared jerboa), collection localities: unspecified, and Bayanhongor Province: Ehiin Gol Oasis and Zuun Mod Oasis (Durden and Musser, 1994; Krištofík, 1999).

Notes: Eulinognathus euchoreutae has only been recorded from China and Mongolia from *E. naso* (Cais, 1977; Chin, 1984; Durden and Musser, 1994; Krištofík, 1999). *Eulinognathus euchoreutei* Chin, 1984 is a synonym (Durden and Musser, 1994).

Linognathoides laeviusculus (Grube, 1851)

Ex *Spermophilus alashanicus* Büchner (Alashan ground squirrel), collection locality: Bayanhongor Province: Bayan Bulag (Shine Jinst Soum) (Krištofík, 1999).

Ex *Spermophilus erythrogenys* Brandt (red-cheeked ground squirrel), collection locality: Govi Altai Province: Esun Bulag (Kéler, 1967 [Nr. 334/35]).

Ex *Urocitellus undulatus* (Pallas) (long-tailed ground squirrel), collection localities: Bulgan Province, Inget Tolgoy (Selenge Soum) and Ulaan Had; Govi Altai Province, Bugat Soum (Mongol Altay); Huvsgul Province, Dood Tsagaan Nuur, Erhel Nuur, Ih Horoo Gol, and Hanh; Uvs Province, Tarialan Soum (Harhiraa Uul) (Krištofík, 1999).

Notes: This louse parasitizes several species of ground squirrels across the Holarctic region (Durden et al., 2019). The following names are synonyms, previous combinations, or subspecies for this taxon as documented by Durden and Musser (1994) and Durden et al. (2019): *Pediculus laeviusculus* Grube, 1851; *Enderleinellus laeviusculus* (Grube, 1851); *Neohaematopinus laeviusculus* (Grube, 1851); *Haematopinus laeviusculus* (Grube, 1851); *Polyplax laeviuscula* (Grube, 1851); *Haematopinus montanus* Osborn, 1896; *Linognathoides montanus* (Osborn, 1896); *Haematopinus columbianus* Osborn, 1900; *Polyplax columbiana* (Osborn, 1900); *Neohaematopinus patiki* Rubin, 1946; *Neohaematopinus laeviusculus bulgaricus* Touleshkov, 1957.

Linognathoides palaearctus (Olsoufjev, 1938)

Ex *Marmota sibirica* (Radde) (Tarbagan marmot) (Sciuridae), collection locality: Tuv Province, Bayan Tsogt Soum (Krištofík, 1999).

Notes: This louse parasitizes marmots (*Marmota* spp.) across much of central Asia (Durden et al., 1990, 2019; Durden and Musser, 1994). *Neohaematopinus palaearctus* Olsoufjev, 1938 is a previous generic assignment and *Neohaematopinus palaearcticus* [sic.] *tarbagani* Dubinina, undetermined date, is a synonym (Durden et al., 2019).

Linognathoides urocitelli Durden, Robinson, Cook, McLean, Nyamsuren and Greiman, 2019

Ex *Urocitellus undulatus* (Pallas) (long-tailed ground squirrel) (Sciuridae).

Collection locations: Arhangai Province, Zurh Mountain; Huvsgul Province, Heegtsar River Valley; Bayan Olgii Province, Huljaa River Valley (Durden et al., 2019).

Notes: This louse is only known from Mongolia, but the host has a wider range in central Asia, encompassing parts of the Russian Federation (Siberia, Transbaikalia), Kazakhstan, Mongolia, China (Heilungjiang and Xinjiang) (Thorington and Hoffmann, 2005), so the louse is likely also more widespread.

Neohaematopinus sciuri Jancke, 1932

Ex *Sciurus vulgaris* Linnaeus (Eurasian red squirrel) (Sciuridae); collection locality: Huvsgul Province, Hanh (Krištofík, 1999).

Notes: This is a widespread Holarctic species that parasitizes *S. vulgaris* in Eurasia and *Sciurus carolinensis* Gmelin (gray squirrel) (Sciuridae) in North America (Durden and Musser, 1994).

Polyplax borealis Ferris, 1933

Ex *Alticola* sp. (undetermined mountain vole), collection locality: Arhangai Province, Terhiin Tsagaan Nuur (Krištofík, 1999).

Ex *Cricetulus* sp. (undetermined hamster), collection locality: Bulgan Province, Inget Tolgoy (Selenge Soum) (Krištofík, 1999).

Notes: Polyplax borealis parasitizes several species of voles mainly in the northern Holarctic region (Durden and Musser, 1994). However, the collection from *Alticola* in Mongolia is a first and the collection from *Cricetulus* in Mongolia represents an atypical host association.

Polyplax chinensis Ferris, 1923

Ex *Meriones meridianus* (Pallas) (midday jird), collection localities: unspecified, and Bayanhongor Province: Orog Nuur (Sosnina, 1979; Chin, 1980; Durden and Musser, 1994; Krištofík, 1999).

New collection: Ex *M. meridianus,* Uvs Province, 6 km northeast of Olgii Soum, 25 July 2015 (NK 270079).

Notes: This louse is known to parasitize *Meriones crassus* Sundevall (Sundevall's jird) and *M. meridianus* and has been recorded from China, Pakistan, Tajikistan, and Turkmenistan, in addition to Mongolia (Sosnina, 1979; Durden et al., 1990; Durden and Musser, 1994; Krištofík, 1999).

Polyplax cricetulis Chin, 1995

New collection: Ex *Cricetulus longicaudatus* (Milne-Edwards) (long-tailed dwarf hamster) (Cricetidae): Uvs Province, 6 km north of Olgii Soum, 25 July 2015 (NK270076).

Notes: Polyplax cricetulis has only been recorded from China (Qinghai Province) (Chin, 1995) and now Mongolia (Uvs Province) as an ectoparasite of *C. longicaudatus*.

Polyplax ellobii (Sosnina, 1955)

Ex *Ellobius tancrei* Blasius (eastern mole vole) (Cricetidae), collection localities: unspecified, Govi Altai Province, Altai; and Hovd Province, Bulgan Gol (Yarantay) (Durden and Musser, 1994; Krištofík, 1999).

New collection: Ex *E. tancrei,* Bayan Olgii Province, Zoolon, Hatuu River valley 27 July 2015 (NK270134).

Notes: This louse has been recorded from *E. tancrei* from China, Kazakhstan, Mongolia, and Tajikistan (Sosnina, 1955; Chin et al., 1993; Durden and Musser, 1994). *Eremophthirus ellobii* Sosnina, 1955 was the original generic assignment for this louse.

Polyplax qiuae Chin, 1993

Ex *Cricetulus barabensis* (Pallas) (striped dwarf hamster) (Cricetidae), collection locality: Tuv Province, Onjuul Soum (Krištofík, 1999).

New collection: Ex *Cricetulus barabensis,* Huvsgul Province, Heegtsar River Valley, 19 August 2015 (NK272202).

Notes: Polyplax qiuae has been recorded from China (Chin, 1993) and Mongolia (Krištofík, 1999). In China, it has been recorded from *Phodopus sungorus* (Pallas) (winter white dwarf hamster) and *Phodopus roborovskii* (Satunin) (Roborovski dwarf hamster) (Chin, 1993), whereas, in Mongolia, it has been recorded from *C. barabensis,* the striped dwarf hamster (Krištofík, 1999).

Polyplax spinulosa (Burmesier, 1839)

Ex *Clethrionomys* (*Myodes*) sp. (undetermined vole); collection locality: Uvs Province, Harhiraa Uul (Krištofík, 1999).

Notes: The spined rat louse, *P. spinulosa*, typically parasitizes peridomestic *Rattus* spp. around the world (Durden and Musser, 1994) but it has also been reported from some other species of rodents. The following names are synonyms as documented by Durden and Musser (1994): *Pediculus spinulosus* Burmeister, 1839; *Haematopinus spinulosus* (Burmeister, 1839); *Haematopinus* (*Polyplax*) *spinulosus* (Burmeister, 1839); *Pediculus denticulatus* Nitzsch, 1864; *Polyplax campylopteri* Zavaleta, 1945.

***Polyplax* sp.** Ex *Ellobius tancrei* Blasius (eastern mole vole) (Cricetidae)—listed as *Ellobius talpinus* (Pallas) (northern mole vole) (Cricetidae) (Kéler, 1967); collection locality: Bayan Olgii Province, Hovd Gol (Kéler, 1967 [Nr. 958/61]).

Notes: This was almost certainly *Polyplax ellobii* (Sosnina), but we have not been able to locate the specimens. Kéler (1967) listed the host as *E. talpinus* which included *E. tancrei* as a synonym at that time. However, *E. tancrei* has since been recognized as a separate species (Durden and Musser, 1994; Musser and Carleton, 2005). The species occurring in Mongolia is *E. tancrei* as discussed by Musser and Carleton (2005).

DISCUSSION

Based on previous records and new records reported here, the sucking louse fauna of Mongolian mammals appears to be quite rich. For rodents, this fauna is notably diverse for the sucking louse genera *Hoplopleura*, *Eulinognathus*, and *Linognathoides,* which reflects the diversity of rodents native to Mongolia (Batsaikhan et al., 2014) including jerboas (hosts for *Eulinognathus* spp. lice in Asia), and ground squirrels and marmots (hosts for *Linognathoides* spp. lice; Durden et al., 2019). Native burrowing rodents (*Ellobius tancrei*) and montane rodents (*Alticola* spp.) in Mongolia are parasitized by unique and morphologically distinctive species of sucking lice belonging to the genera *Hoplopleura* or *Polyplax* including *H. altaiensis* on *A. barakshin* and *A. strelzowi*.

The actual biodiversity of sucking lice parasitizing native rodents in Mongolia is likely to be about twice the figure of 25 species reported here. This estimate is based on the fact that several species of rodents that occur in Mongolia are known to be parasitized by sucking lice in other parts of their ranges (Table I), and because Mongolian rodents have been incompletely sampled for parasitic lice. Mongolian rodents that may be parasitized by undescribed species of sucking lice include *Allactaga balikunica* Hsia and Fang (Balikun jerboa), 2 species of *Salpingotus* (pygmy jerboas), 2 species of *Stylodipus* (3-toed jerboas), *Myospalax psilrus* (Milne-Edwards) (north China zokor), *Allocricetulus curtatus* (Allen) (Mongolian hamster), *Cricetulus migratorius* (Pallas) (gray dwarf hamster), *Cricetulus sokolovi* Orlov and Malygin (Sokolov's dwarf hamster), *Phodopus campbelli* (Thomas) (Campbell's desert hamster), *Alticola macrotis* (Radde) (large-eared vole), *Alticola semicanus* (Allen) (Mongolian silver vole), *Alticola tuvinicus* Ognev (Tuva mountain vole), *Eolagurus luteus* (Eversmann) (yellow steppe lemming), *Eolagurus przewalskii* (Büchner) (Przewalski's steppe lemming), *Lagurus lagurus* (Pallas) (steppe lemming), and *Myopus schisticolor* (Lilljeborg) (wood lemming).

There are surprisingly few records of nonnative widespread species of sucking lice from livestock animals or pets in Mongolia, although Krištofík (1999) reported the cosmopolitan long-nosed sucking louse, *Linognathus vituli* (Linnaeus) from cattle. Sucking lice would be expected to infest dogs, swine, cattle, goats, sheep, horses, and nonnative rabbits in Mongolia, as they do in other parts of the world, and to sometimes cause veterinary problems. There are also scant records of lice from large mammals, notably native, introduced, or domestic ungulates, in Mongolia. Therefore, despite surveys of lice from Mongolian mammals by Kéler (1967), Krištofík (1999), and our group, there are probably additional new species of sucking lice in Mongolia that await discovery. We therefore advocate the additional collecting of lice and other ectoparasites from native and nonnative Mongolian mammals.

Table I. Native Mongolian rodents from which sucking lice have been recorded in other parts of their ranges.

Host species	Sucking louse species	Country/region	Reference
Marmota baibacina Katstschenko (gray marmot)	*Enderleinellus blagoveshtchenskyi* Sosnina and Ozerova	Kyrgyzstan	Sosnina and Ozerova (1987)
	Linognathoides baibacini (Blagoveshtchensky)	Kazakhstan	Blagoveshtchensky (1965)
Spermophilus dauricus Brandt (Daurian ground squirrel)	*Linognathoides laeviusculus* (Grube)	Central Asia	Durden et al. (2019)
Pteromys volans (Linnaeus) (Siberian flying squirrel)	*Enderleinellus replicatus* Redikorzev	Russia: Astrakhan Oblast	Redikorzev (1937)
	Neohaematopinus pteromydis Blagoveshtchensky	Far eastern Russia	Blagoveshtchensky (1965)
Dipus sagitta (Pallas) (northern 3-toed jerboa)	*Eulinognathus dipodis* Blagoveshtchensky	Kazakhstan	Blagoveshtchensky (1965)
Pygeretmus pumilio (Kerr) (dwarf fat-tailed jerboa)	*Eulinognathus alactaguli* Blagoveshtchensky	Kazakhstan Uzbekistan	Blagoveshtchensky (1965)
Cardiocranius paradoxus Satunin (five-toed pygmy jerboa)	*Eulinognathus cardiocranus* Chin	China: Nei Mongol	Chin (1992)
Sicista betulina (Pallas) (northern birch mouse)	*Schizophthirus sicistae* Blagoveshtchensky	Eurasia	Sosnina et al. (1984)
Arvicola amphibius (Linnaeus) (water vole)	*Hoplopleura acanthopus* (Burmeister)	Eurasia	Beaucournu (1968)
	Polyplax borealis Ferris	Eurasia	Durden and Musser (1994)
	Polyplax spinigera (Burmeister)	Eurasia	Beaucournu (1968)
Rhombomys opimus (Lichtensten) (great gerbil)	*Polyplax opimi* Sosnina	Tajikistan	Sosnina (1979)
Micromys minutus (Pallas) (harvest mouse)	*Hoplopleura longula* (Neumann)	Eurasia	Beaucournu (1968)
	Polyplax gracilis Fahrenholz	Eurasia	Durden and Musser (1994)
Dryomys nitedula (Pallas) (forest dormouse)	*Schizophthirus dryomydis,* Blagoveshtchensky	Eurasia	Durden and Musser (1994)
	Schizophthirus jaczewskii Cais	Poland	Cais (1974)
	Schizophthirus pleurophaeus (Burmeister)	Eurasia	Beaucournu (1968)

Lastly, we noted morphological differences in the shape of the female subgenital plate for specimens of *H. altaiensis* n. sp. that had been prepared for SEM compared to those that were slide-mounted following DNA extraction or clearing in potassium hydroxide. Perhaps the latter methods removed some peripheral, weakly sclerotized areas of this plate, giving it the distinctive shape shown by the dashed lines in Figure 2D. Because of the different appearance of the female subgenital plate using these 2 preparation methods, we recommend that louse taxonomists use caution when illustrating and describing this structure using different techniques. We carefully compared other morphological structures for specimens prepared for SEM or slide-mounted following DNA extraction but did not notice any additional differences when using these techniques.

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Appendix I. Rodent specimens examined for sucking lice in Mongolia, 2015. Catalog numbers for lice are MSB:Para and catalog numbers for hosts are MSB:Mammals. Sample (NK) numbers are in parentheses. MSB, Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico.

Louse species	MSB:Para catalog and (sample numbers)	GenBank 18S accession number and 16S accession number	Host species	MSB:Mamm mammal catalog and (sample numbers)	Locality
Enderleinellus tamiasis	(NK272323)	None amplified	*Tamias sibiricus*	289831 (NK272323)	Huvsgul Province, Heegtsar River Valley
Hoplopleura altaiensis n. sp.	32437–32443, 32447, 32450 (NK270167) 32444 (NK270107) 32446, 32448 (NK270111) 32445 (NK270120)	18S: ON055446 16S: ON130975 ON130976 ON130986 ON130987 ON130990 ON130991	*Alticola barakshin*	289112 (NK270167) 289011 (NK270107) 289016 (NK270111) 289977 (NK270120)	Bayan Olgii Province, Zoolon, Hatuu River Valley
	32449 (NK270545)	18S: ON055443 16S: ON130977	*Alticola strelzowi*	289797 (NK270545)	Bayan Olgii Province, Huljaa River Valley
Hoplopleura acanthopus	(NK270348) (NK270442)	16S: ON130993 ON130994 ON130995	*Microtus gregalis*	290099 (NK270348) 289237 (NK270442)	Bayan Olgii Province, Songinot Gol River Valley
	(NK270660)	None amplified	*Microtus gregalis*	289314 (NK270660)	Uvs Province, Harhiraa Mountain, Tsunheg
	(NK270687)	16S: ON130999	*Microtus gregalis*	289413 (NK270687)	Uvs Province, Juveriin Gol River Valley
	(NK272167) (NK272171)	None amplified	*Microtus oeconomus*	289592 (NK272167) 289600 (NK272171)	Huvsgul Province, Heegtsar River Valley
	(NK270946)	None amplified	*Microtus oeconomus*	289383 (NK270946)	Uvs Province, Han Huhii Mountain, Baruun Turuun River Valley
	(NK270431) (NK270440)	16S: ON130996 ON130997 ON130998	*Microtus* sp.	289227 (NK270431) 289236 (NK270440)	Bayan Olgii Province, Songinot Gol River Valley
Hoplopleura inagakii	(NK270283)	16S: ON130992	*Myodes rufocanus*	289914 (NK270283)	Bayan Olgii Province, Songinot Gol River Valley
	(NK272149)	None amplified	*Myodes rufocanus*	289555 (NK272149)	Huvsgul Province, Heegtsar River Valley
	(NK270974)	None amplified	*Myodes rufocanus*	289419 (NK270974)	Uvs Province, Han Huhii Mountain, Baruun Turuun River Valley

Appendix I. Continued.

Louse species	MSB:Para catalog and (sample numbers)	GenBank 18S accession number and 16S accession number	Host species	MSB:Mamm mammal catalog and (sample numbers)	Locality
Hoplopleura edentula	(NK270026)	18S: ON055441 16S: ON130980 ON130981	*Myodes rutilus*	289454 (NK270026)	Arhangai Province, Nariin Gol, north side of Terhiin Tsagaan Lake
	(NK270012)	16S: ON130979	*Myodes rutilus*	289136 (NK270012)	Arhangai Province, Zurh Mountain
	(NK270356)	16S: ON130982	*Myodes rutilus*	289092 (NK270356)	Bayan Olgii Province, Songinot Gol River Valley
	(NK272186)	None amplified	*Myodes rutilus*	289643 (NK272186)	Huvsgul Province; Heegtsar River Valley
	(NK270703)	None amplified	*Myodes rutilus*	289431 (NK270703)	Uvs Province, Juveriin Gol River valley
	(NK270866)	18S: ON055444 16S: ON130984	*Myodes rutilus*	289618 (NK270866)	Uvs Province, Han Huhii Mountain, Baruun Turuun River Valley
	(NK270667)	16S: ON130983	*Myodes rutilus*	289323 (NK270667)	Uvs Province, Harhiraa Mountain, Tsunheg
Polyplax chinensis	(NK270079)	16S: ON130989	*Meriones meridianus*	289572 (NK270079)	Uvs Province, 6 km NE of Olgii Soum
Polyplax cricetulis	(NK270076)	18S: ON055445 16S: ON130985	*Cricetulus longicaudus*	289570 (NK270076)	Uvs Province, 6 km north of Olgii Soum
Polyplax ellobii	(NK270134)	18S: ON055442 16S: ON130978 ON130988	*Ellobius tancrei*	289053 (NK270134)	Bayan Olgii Province, Zoolon, Hatuu River Valley
Polyplax qiuae	(NK272202)	None amplified	*Cricetulus barabensis*	289660 (NK272202)	Huvsgul Province, Heegtsar River Valley