

A NEW SPECIES OF *ANOMIOPSYLLUS* BAKER, 1904 (INSECTA: SIPHONAPTERA), AND NOTEWORTHY RECORDS OF FLEAS FROM NELSON'S WOODRAT, *NEOTOMA NELSONI* (RODENTIA: CRICETIDAE), IN THE ORIENTAL BASIN, MEXICO

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ABSTRACT: We report the first record of ectoparasites from Nelson's woodrat, *Neotoma nelsoni*, a rare, endemic mammal of east-central Mexico. We also describe a new flea species of *Anomiopsyllus* (*A. perontesis* n. sp.), which presents a complete row of bristles on sternum IX and 3 blunt spines on movable process; provide a new country record for the flea *Stenistomera alpina* (Baker, 1985); and report a new host record for the flea *Echidnophaga gallinacea* (Westwood, 1875). A taxonomic key for the new species is included.

Nelson's woodrat, *Neotoma nelsoni* Goldman, 1905, is endemic to the Oriental Basin of east-central México (eastern Puebla and west-central Veracruz) (Hall and Dalquest, 1963; Hall, 1981; González-Christen et al., 2002; González-Ruiz et al., 2006). This rare species is listed as endangered by the Mexican government and international agencies and, until the present study, it was known from only 3 localities (Baillie, 1996; Luiselli-Fernández, 2002). *Neotoma* Say and Ord, 1825 contains 22 recognized species of woodrats, with more than 100 records of fleas found on them (Tipton et al. 1979; Musser and Carleton, 2005). Species of the North American subfamily Anomiopsyllinae (*Anomiopsyllus* and *Stenistomera*) are the most common fleas parasitizing woodrats (Barnes et al. 1977; Tipton et al. 1979).

The Anomiopsyllinae is comprised of 6 genera: *Anomiopsyllus*, *Callistopsyllus* Jordan and Rothschild, 1915, *Conorhinopsylla* Stewart, 1930, *Jordanopsylla* Traub and Tipton, 1951, *Megarhroglossus* Jordan and Rothschild, 1915, and *Stenistomera* Rothschild, 1915. Species in the subfamily have a high affinity for the host nest and, relative to other fleas, show degenerate morphology including loss of eyes, reduced jumping ability, and considerable reduction in chaetotaxy (Méndez, 1955). *Anomiopsyllus* has 15 species (Adams and Lewis, 1995), 8 of which are distributed in Mexico (*A. durangoensis* Holland, 1965, *A. martini* Holland, 1965, *A. nidiophilus* Tipton and Mendez, 1968, *A. novomexicanensis* Williams and Hoff, 1951, *A. nudatus* (Baker, 1898), *A. oaxacae* Barnes, 1965, *A. sinuatus* Holland, 1965, and *A. traubi* Barrera, 1951 (Barnes et al., 1977; Morales and Llorente, 1986; Ayala-Barajas et al., 1988; Salceda and Hastriter, 2006). *Stenistomera* contains 3 species: *S. alpina* (Baker, 1895), *S. hubbardi* Egoscue, 1968, and *S. macrodactyla* Good, 1942, distributed from Alberta, Canada to the southern United States (New Mexico).

Echidnophaga gallinacea (Westwood, 1875) of the Pulicidae has been recorded from several vertebrate hosts worldwide (Hopkins and Rothschild, 1953); this species has not been previously recorded from species of *Neotoma*.

MATERIALS AND METHODS

Rodents were trapped in the wild using standard methods approved by the American Society of Mammalogists (Gannon et al., 2007). Fleas were collected from 1 specimen of Nelson's woodrat, *N. nelsoni*, on 22 June 2007 from near El Frijol Colorado, Municipality of Perote, Veracruz (19°34'20.4"N, 97°23'00.7"W, 2,435 m). Parasites were preserved in 70% ethanol and mounted following the method of Smit (1957). Slide-mounted specimens were examined with an Olympus vanox-T microscope (Olympus Corporation, Tokyo, Japan). Species-level identifications were made using taxonomic keys by Hopkins and Rothschild (1956), Barnes et al. (1977), Tipton et al. (1979), and Acosta and Morone (2003). Digital photographs were taken with a Canon camera (Canon, Inc., Tokyo, Japan), and digitized images were prepared with Adobe Photoshop 4.0 (Adobe Systems Inc., San Jose, California).

RESULTS

Three species of fleas were collected from *N. nelsoni*. One represents a species new to science, another is a new host record, and the third represents a new locality record. The host specimen (obtained under Mexican collecting permit FAUT-0002 issued to Fernando Cervantes Reza) is deposited as mammal specimen no. 36663 in the Museum of Natural Science, Louisiana State University (LSUMZ), Baton Rouge, Louisiana. Eight specimens of fleas, representing the 3 species, are deposited in the Museo de Zoología "Alfonso L. Herrera," Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC), México City, D.F.

DESCRIPTION

Anomiopsyllus perontesis n. sp. (Figs. 1–8)

General diagnosis: Males easily distinguished from females by presence of 3 blunt, pigmented spiniforms, ranging in size from large to small on movable process of clasper, and a row of bristles along dorsal margin of st IX; female not readily distinguishable.

Male: General features as in Figures 1 and 2. Conspicuous frontal tubercle. Ocular row of 2 or 3 slender setae. Postantennal region with 2 or 3 very small setae on posterior margin and 1 larger seta ventrally. Eyes absent, as in other species of this genus. Genal lobe rounded. Antenna long, with club concealing much of proepisternum. Maxillary palpus as long as labial palpus. Labial palpus of 4 segments in addition to palpiger, reaching distal end of fore trochanter.

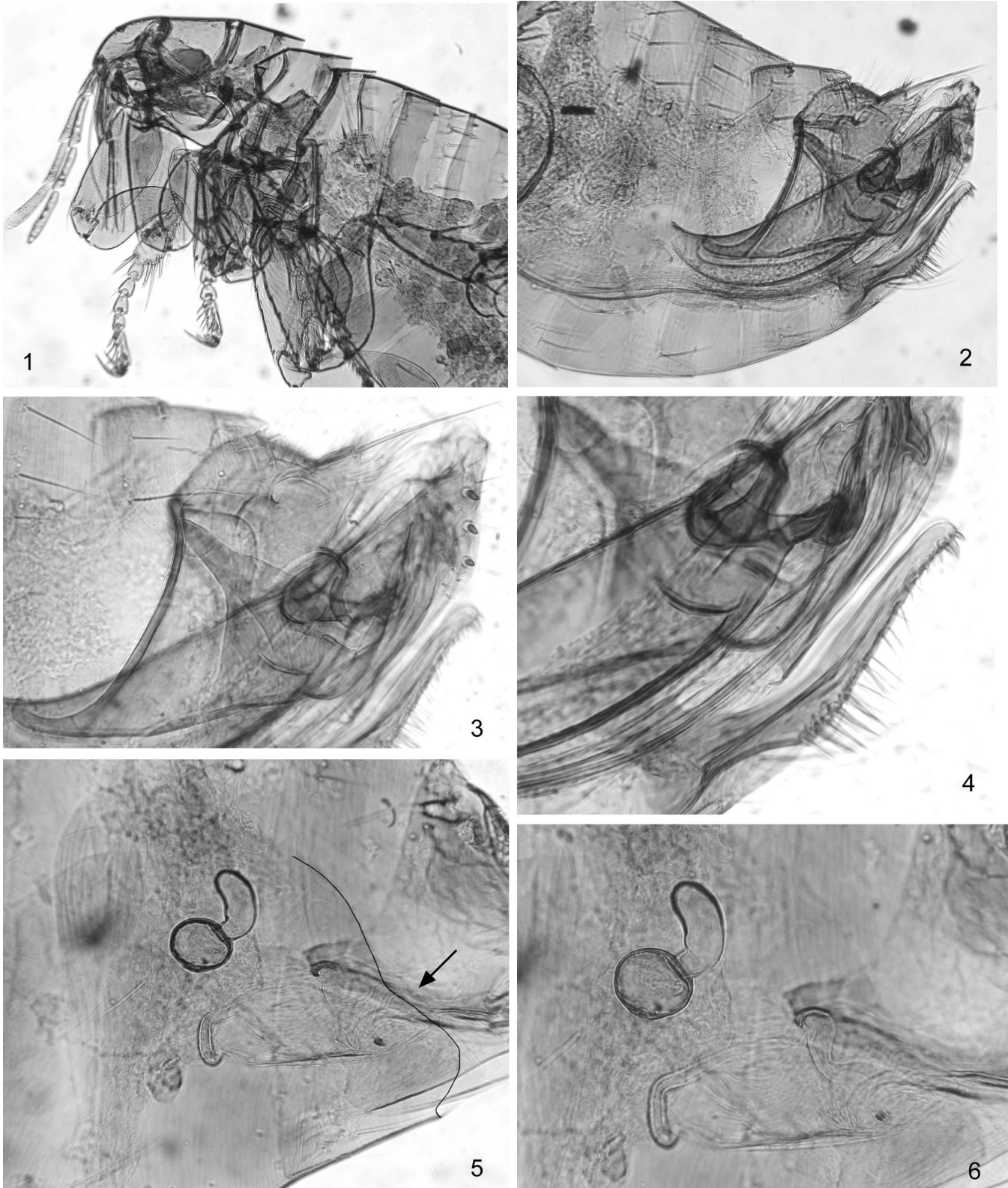
Thoracic segments each with single row of approximately 4 setae with small intercalary bristles and few scattered lucodiscs. Mesepisternum with single seta near pleural rod and 2 or 3 small ones near the anterior margin. Metepimeron with seta below spiracle and another at dorso-posterior angle. One pair of long apical setae on second tarsal segment, extending almost to base of claws on fifth segment.

Abdominal tergum I with 2 apical spinelets and a single row of setae; very small intercalary setae and a lucodisc associated with lowest seta

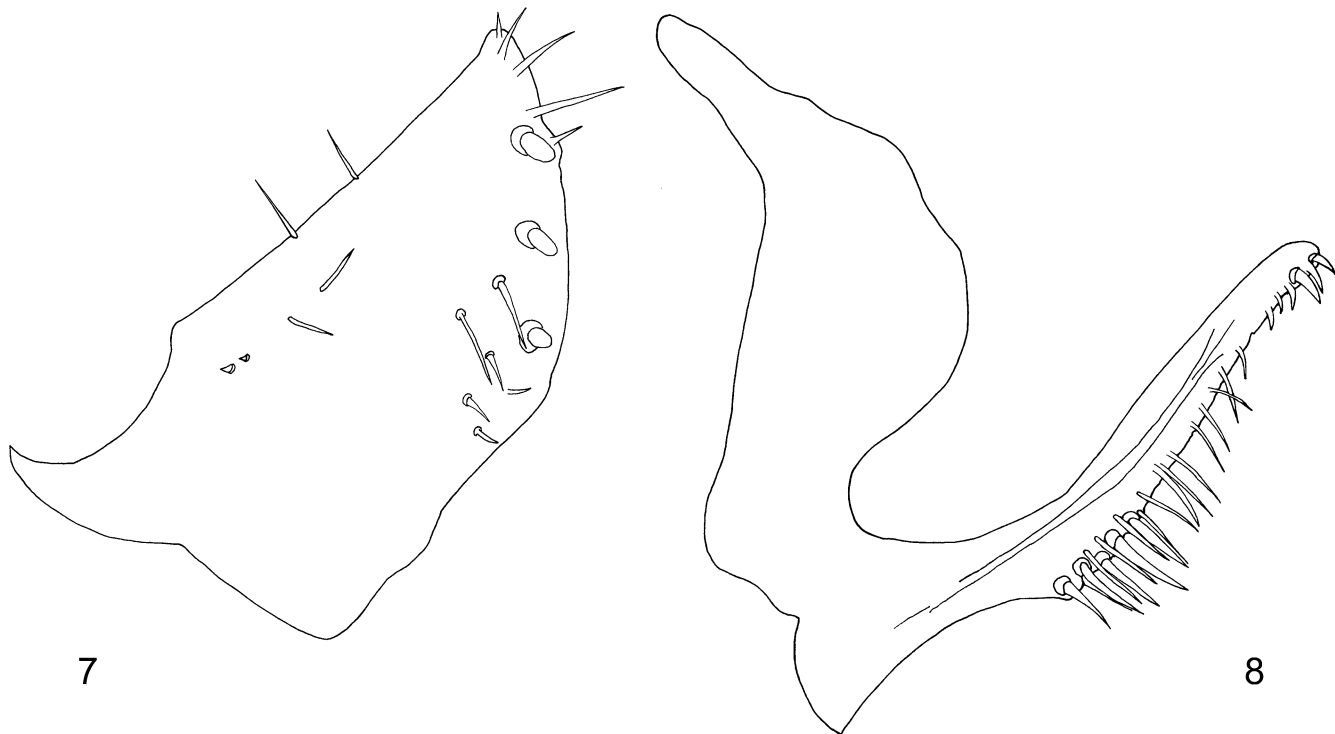
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FIGURES 1–6. *Anomiopsyllus perotensis* n. sp. (1) Head, male; (2) terminal abdominal segments, male; (3) movable and immovable process, male; (4) sternum IX, male; (5) sternum VII, female; (6) spermatheca.



FIGURES 7–8. *Anomipsyllus perotensis* n. sp. (7) movable process, male; (8) sternum IX, male.

in row. Tergum II with single apical spinelet; other terga normally lack spinelets. Terga II–VI each with single row of setae containing about 5, 5, 4, 4, and 4 setae, respectively; some tiny intercalary setae and lucodisc close to base of lowest, or next-lowest, seta of each row. Small, round, and enlarged spiracles. Abdominal sterna each with 2 setae ventrally and few lucodiscs in areas overlapped by terga. Tergum VII with 1 antepygidial seta and 2 tiny lateral bristles.

Genital clasper (Figs. 3, 7) with ventral margin nearly flat rather than convex. Fixed process strongly developed, with long apical seta and scattered smaller ones nearby. Movable process broad, anterior margin straight, apex roundly angulated, dorsal margin slightly curved, with 3 well-developed rows of blunt, pigmented spiniforms ranging in size from large to small. Spiniforms grouped on apical part of process, followed by bristles somewhat smaller than spiniforms; similar distance between first and third spiniforms. Several fairly strong setae on mesal surface between third and fourth spiniforms and several others on apical margin. Slender acetabular seta present. Proximal arm of sternum IX broader than distal arm (Figs. 4, 8), with dorsal margin somewhat straight, ending in a curve; distal arm longer than proximal arm, slender with straight margins; apex rounded with 2 short spiniforms and, below these, a row of 10 or 11 long, narrow bristles. A shallow depression near the base of sternum IX, with a row of 5 stout and longer bristles. Shape of phallosome simple, with some of its features illustrated in Figure 2; apodeme of aedeagus wide with apex acuminate. Apex of manubrium rounded and narrow and posterior margin somewhat sinuous. Sternum VIII with 1 long bristle.

Female: Details of chaetotaxy similar to those of male. Longest seta of second segment of hind tarsus extends only to about middle of fifth. Apical margin of sternum VII with broad, shallow sinus above a rounded lobe (Fig. 5). Tergum VIII with a projecting lobe, usually bearing 2 apical setae. One long antepygidial bristle. Spermatheca (Fig. 6) much like that of *A. hiemalis*; tail angulated 90°; body rounded as in other species.

Taxonomic summary

Type host: *Neotoma nelsoni* Goldman, 1905, Nelson’s woodrat.
Types: Male holotype (06920-MZFC-S) and 4 paratypes (1 male, 3 females 06921, 06922, 06923, and 06924-MZFC-S, respectively).
Type locality: Mexico: Veracruz, Municipio Perote, 3 km S El Frijol

Colorado, 19°34’20.4’’N, 97°23’00.7’’W, 2,435 m. Coll. Jesús A. Fernández.

Etymology: The species is named after the place where the specimens were collected in the municipality of Perote, Veracruz.

Remarks

Species of *Neotoma* live in a wide variety of habitats including deserts, brushlands, and pine–oak forests. The majority of flea species in *Anomipsyllus* are associated with *Neotoma* spp., including several endemic forms (Medvedev, 2000). This is the first species of the genus apparently associated exclusively with *N. nelsoni*.

Both *Neotoma* and *Anomipsyllus* are solely North American taxa; Barnes et al. (1977) mentioned the possibility that these hosts and parasites have co-evolved during what is assumed to be a long history of association. However, further studies on the association between fleas and woodrats will be necessary to elucidate their evolutionary history and association.

To accommodate the new species, the last section of the key by Barnes et al. (1977) is modified as follows:

- 14 (13). Apex of finger distinctly acuminate; posterior margin of st IX with 1 thin, submarginal bristle *A. traubi*
- Apex of finger rounded; posterior margin with >1 evenly spaced bristles extending from heavy apical bristle, about 3/4 down the distal arm of st IX 15
- 15 (14). Internal face of the distal arm sinuous; apex of finger with a tuft of bristles below the spiniform bristles on the distal arm of st IX; Oaxaca state *A. oaxacae*
- Internal face of the distal arm straight; apex of finger with a few short bristles below the spiniform bristles on the distal arm of st IX; Veracruz state *A. perotensis* sp. nov.

DISCUSSION

Prior to the present study, *Stenistomera alpina* (Baker) was known only from Canada and the United States. This is the first record of *S. alpina* from Mexico and is also a new record for the host *N. nelsoni*. Tipton et al. (1979) mentioned that fleas of

the *Stenistomera* spp. are associated with 4 species of woodrats; however, 90% of the specimens collected have come from *N. lepida*, which is primarily a desert-dwelling species. Fleas of this genus are found mainly in the host nest, where they are protected from extreme fluctuations in temperature and humidity. This is important because their hosts live in a wide array of habitats, potentially exposing the fleas to environmental fluctuations that could be detrimental (Barnes, 1977). Finally, *E. gallinacea* (Westwood, 1875), previously known from many hosts of several mammalian orders (mostly rodents) and birds (Hopkins and Rothschild, 1953), is now known from *N. nelsoni*. Material examined: 1 male (06926-MZFC), 1 female (06927-MZFC), ex *N. nelsoni* (LSUMZ 36663).

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