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Contributions to the knowledge of North American tenebrionids of the subtribe Cylindrinotina (Coleoptera: Tenebrionidae: Helopini)

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Abstract

Three North American species of *Helops* are reassigned to the genus *Nalassus*: *N. aereus* (Germar, 1824), comb. n., *N. californicus* (Mannerheim, 1843), comb. n., *N. convexulus* (LeConte, 1861), comb. n. Current distributions as well as paleo distributions are discussed. A lectotype is designated for *Helops californicus*.

Key words: *Nalassus*, new combinations, North American Fauna

Introduction

North America includes species in three genera of the tribe Helopini Latreille, 1802: *Helops* Fabricius, 1775, *Tarpela* Bates, 1870, and *Nautes* Pascoe, 1876. All these genera belong to the subtribe Helopina. *Helops* is a polyphyletic group with species distributed in the Western Palaearctic, the Nearctic, and the Neotropic regions. Palaearctic species of the genus differ from those of the New World by the presence of a strong process on the mentum, the structure of the male genitalia (middle piece of aedeagus with narrowly acute apex), and the one-way valve between spermathecal and gland ducts (this character is also shared with the Western Palaearctic genus *Nesotes* Allard, 1876). Palaearctic *Helops* s. str. is a small group with 6 species and several subspecies that inhabit coniferous forests with *Pinus* spp., *Cedrus libani*, *Juniperus excelsa, Abies nordmanniana* (*H. insignis* Lucas, 1846, *H. glabriventris* Reitter, 1885, *H. thoracicus* Grimm, 1991, *H. cyanipes* Allard, 1877) or broadleaf forests dominated by *Quercus* spp. (*H. caeruleus* Linnaeus, 1758 and *H. rossii* Germar, 1817).

In contrast to the small number of Palearctic *Helops* s. str. species, *Helops* is a species rich and morphologically diverse genus in the New World. Allard (1876, 1877) made the first classification of American Helopini and included some species that are now in different genera. Seidlitz (1896) included all New World Helopini species in *Helops* sensu lato. Since that time, the need for a revision of the American Helopini has been discussed by many authors. Gebien (1943) wrote that "only Palearctic species belong to *Helops* s. str. The North American species must be partly included in the following genera, partly in new genera". Blackwelder (1944–1957) listed 5 subgenera of the genus *Helops* (*Coscinopter* Allard, 1876, *Catomus* Allard, 1876, *Coscinoptilix* Allard, 1877, *Diastixus* Allard, 1876 and *Stenomax* Allard, 1876) without assigning subgeneric positions for 26 Central American species. Marcuzzi (2001) also pointed out the need for a generic revision of Helopini in the Western Hemisphere.

Cifuentes-Ruiz *et al*. (2014) included *Helops californicus* in the subtribe Cylindrinotina. Antoine (1949) divided the tribe Helopini into two groups according to the structure of male genitalia (especially structure of apical piece, penis and alae as extensions of apical piece). Español (1956), based on this division, described the tribe Cylindrinotini (now the subtribe Cylindrinotina) and reviewed in detail the classification of the two tribes.

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Cifuentes-Ruiz *et al*. (2014) for some reason completely omitted Español's paper. The phylogeny presented by Cifuentes-Ruiz *et al*. (2014) shows heterogeneity in the Cylindrinotina, which has been known since the 19th century (Seidlitz 1896). *Helops californicus* Mannerheim, 1843 was interpreted in this work (Cifuentes-Ruiz *et al*. 2014) as a member of the genus *Odocnemis* Allard, 1876 (without providing reasons). This species really should be included in the subtribe Cylindrinotina based on the lower aspect of eye having a posterior ventral groove (figs. 1, 6), and male and female genital tubes, but clearly does not belong to the genus *Odocnemis*. Species of *Odocnemis* are widespread in the Western Palaearctic from Western Europe to Iran and Western Kazakhstan (Nabozhenko & Löbl 2008; Nabozhenko & Keskin 2013). Species of this genus have teeth or granules on the inner side of the male tibiae and 'cylindrinotoid' male genitalia (Nabozhenko 2001, 2005, 2006) with a dorsoventrally flattened and strongly sclerotized apical piece, while *Helops californicus* has a typical 'nalassoid' weakly sclerotized apical aedeagal piece with a laterally flattened keel on the apex. According to Cifuentes-Ruiz *et al*. (2014; p. 213) this keel "could be an artefact of the observation tools, as small keels can be detected when using a scanning electron microscope (SEM) (results not shown)". These conclusions are at least premature, because the authors did not use typical 'cylindrinotoid' genera (*Cylindrinotus* Faldermann, 1837, *Odocnemis*, *Reitterohelops* Skopin, 1960 etc.) in their analysis. Laterally flattened keel on apex of apical piece is not an artefact of the "observation tools" even after preparation using potassium hydroxide, SEM etc. (fig. 5) and it is typical structure that characterizes the genera *Nalassus* Mulsant, 1854, *Xanthomus* Mulsant, 1854, *Zophohelops* Reitter, 1902, *Turkmenohelops* G. S. Medvedev, 1987, *Stygohelops* Leo et Liberto, 2002, *Eustenomacidius* s. str. Nabozhenko, 2006, *Xanthohelops* Nabozhenko, 2006, *Ectromopsis* Antoine, 1949, *Pseudoprobaticus* Nabozhenko, 2001. Representatives of the subtribe Cylindrinotina also have short setae which are directed forward (figs. 5D, E), while species of the subtribe Helopina have thick or thin spines which are directed backward.

Female genital tubes of this species are also 'nalassoid' (Nabozhenko 2005) with short (significantly shorter than body length of imago) unbranched spermatheca with a single duct and the same short spermathecal accessory gland. Additionally, *Nalassus* have ventral posterior grooves beginning at lower the aspect of the eyes, weakly sclerotized male inner sternite VIII, thin rods and not basally produced lobes of the gastral spicula (figs. 2, 3). As a result, this species must be included in the genus *Nalassus*. We also studied other USA species, as *Helops aereus* Germar, 1824 and *Helops convexulus* LeConte, 1862, which also have the same 'nalassoid' characters as *H. californicus* thus also should be transferred to the genus *Nalassus*. For some reason, *Helops aereus* was not interpreted as a member of the subtribe Cylindrinotina according results of their phylogeny (Cifuentes-Ruiz *et al*. 2014; table 1 and fig. 7).

Material and methods

The study is based on the examination of adult beetles from the following institutes, museums and private collections: ZMMU—Zoological Museum of Moscow State University (Moscow, Nikolay Nikitsky); ZIN—Zoological Institute, Russian Academy of Sciences, St. Petersburg (Mark Volkovitsh); CN—private collection of M. Nabozhenko (Rostov-on-Don). Scanning electron microscopy was made by Konstantin Dvadnenko in the analytic laboratory of Institute of Arid Zones of Southern Scientific Centre RAS with the SEM EVO-40 XVP (LEO 143OVP).

Taxonomy

Family Tenebrionidae

Tribe Helopini Latreille, 1802

Subtribe Cylindrinotina Español, 1956

***Nalassus* (s. str.) *californicus* (Mannerheim, 1843), comb. n.**
(Figs. 1–3)

californicus Mannerheim 1843: 287 (*Helops*); Horn 1870: 394 (*Helops*); Allard 1876: 19 (*Omalus*); Allard 1877: 37, 158 (*Omaleis*); Seidlitz 1896: 695 (*Helops*); Cifuentes-Ruiz *et al*. 2014: 194, figs. 5E, 6C, F (*Odocnemis*), fig. 2B (*Helops*).
= *carolina* Manee 1924: (*Helops*). The name was synonymized by Steiner (2009).

Type material. Lectotype (♂), designated here, with labels: "*Nalassus californicus* Californ. Esch.", "type", square with symbol "♂" and green circle. Lectotype is deposited in ZMMU in collection of V. Motshulsky.

Other studied material (prepared for genitalia): 2♂♂ and 2♀♀ with press labels: "California Leconte" (ZIN).

Comments. Victor Motshulsky changed many original labels of other entomologists to his own labels for uniformity in the collection. For example, green label was mark North America. Additionally, sometimes he changed the generic names according to his understanding of beetle classification. Motshulsky always carefully labeled specimens from the type series as "type". So, the name "*Nalassus californicus*" (the genus *Nalassus* was described only in 1854) was pinned later by Motschulsky to the type specimen of M. Mannerheim, who described the species under name "*Helops californicus* Eschscholtz".

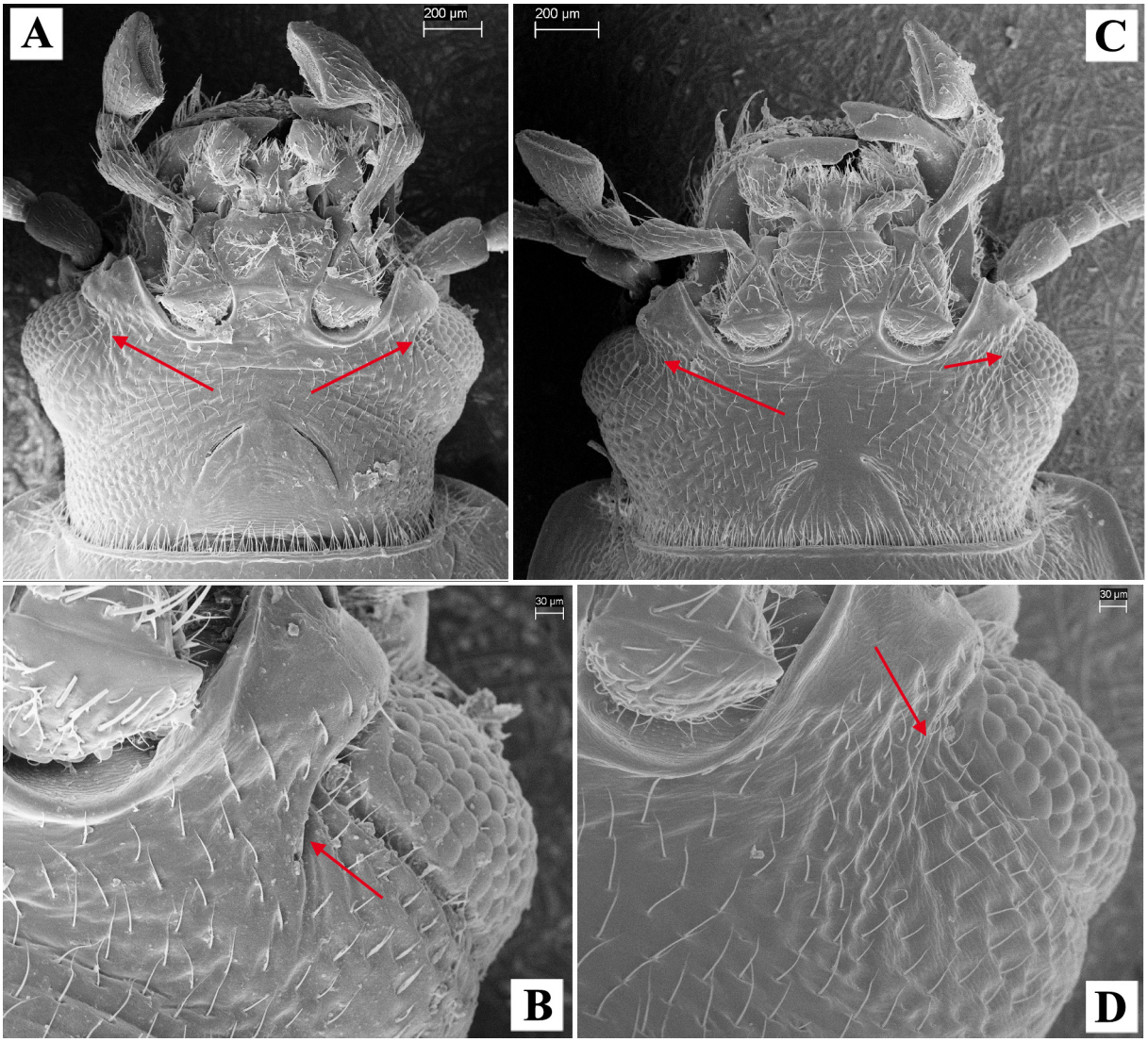

FIGURE 1. *Nalassus californicus*, head, SEM. A—ventral side with well expressed ventral posterior grooves; B—the same, right ventral posterior groove; C—ventral side with poorly expressed ventral posterior grooves; D—the same, right ventral groove. Arrow shows ventral posterior grooves.

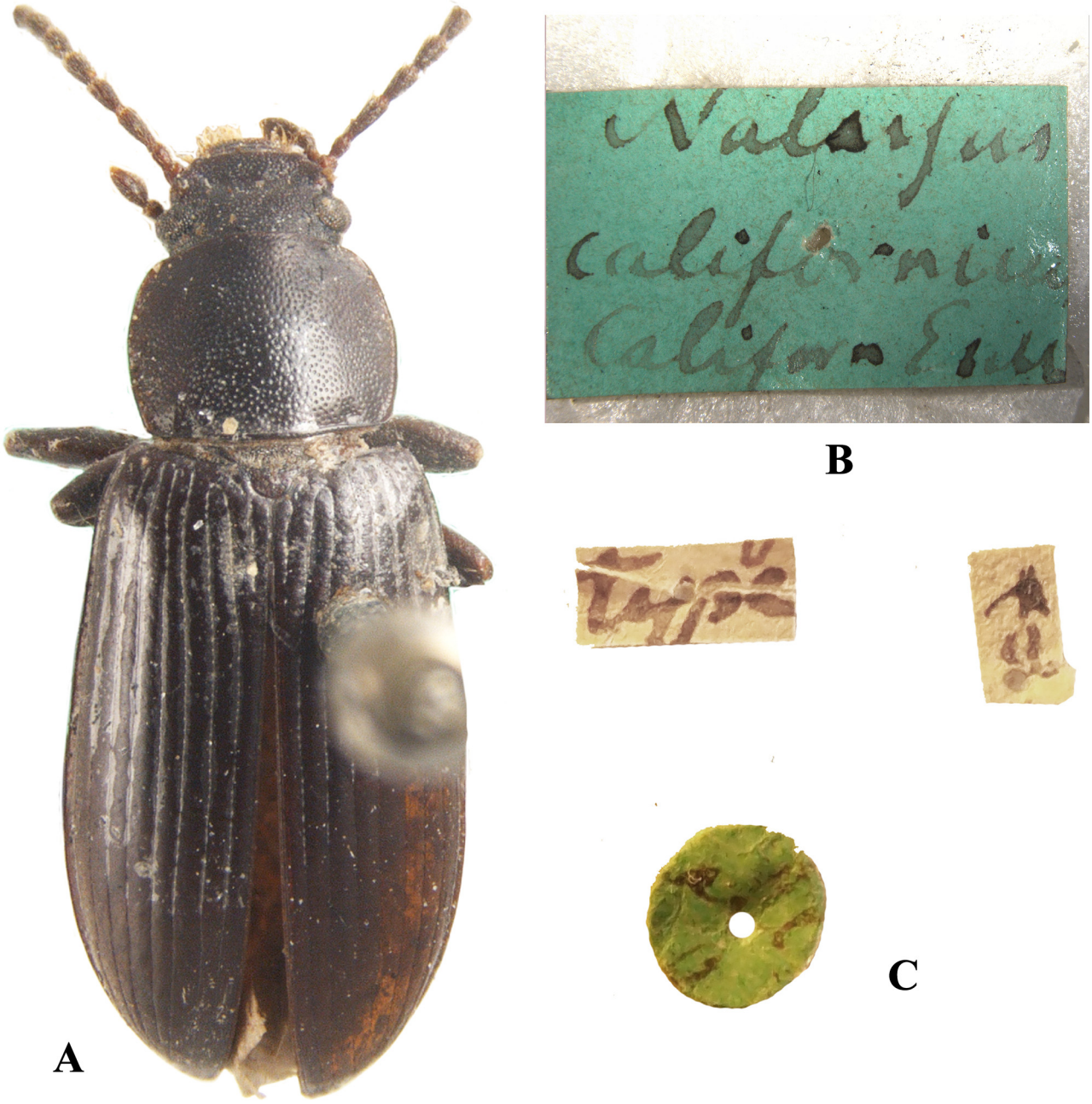

FIGURE 2. *Nalassus californicus*. A—lectotype, male; B—upper label; C—lower labels.

Nalassus californicus is similar to the Palaearctic species *N. genei* (Gené, 1839), *N. plebejus* (Küster, 1850), and *N. pekinensis* (Fairmaire, 1888) of the nominative subgenus, which are also macropterous and lack a brush of setae on the first male abdominal ventrite. Sometimes posterior ventral grooves of head are poorly developed and unclear (figs. 1C, D).

Distribution. USA: California, Oregon, Washington, Nevada; Canada: British Columbia.

Nalassus (?) *aereus* (Germar, 1824), comb. n.

(Figs. 4–6)

aereus Germar 1824: 160 (*Helops*); Horn 1870: 396 (*Helops*); Allard 1876: 19 (*Stenomax*); Allard 1877: 36, 148 (*Stenomax*); Horn 1880: 152 (*Helops*); Seidlitz 1896: 695 (*Helops*); Steiner 2009: 332–333, fig. 1 (*Helops*).

= *aratus* Say 1827: 241 (*Helops*); Allard 1877: 49, 201 (*Catomus*). The name was synonymized by LeConte (1866).

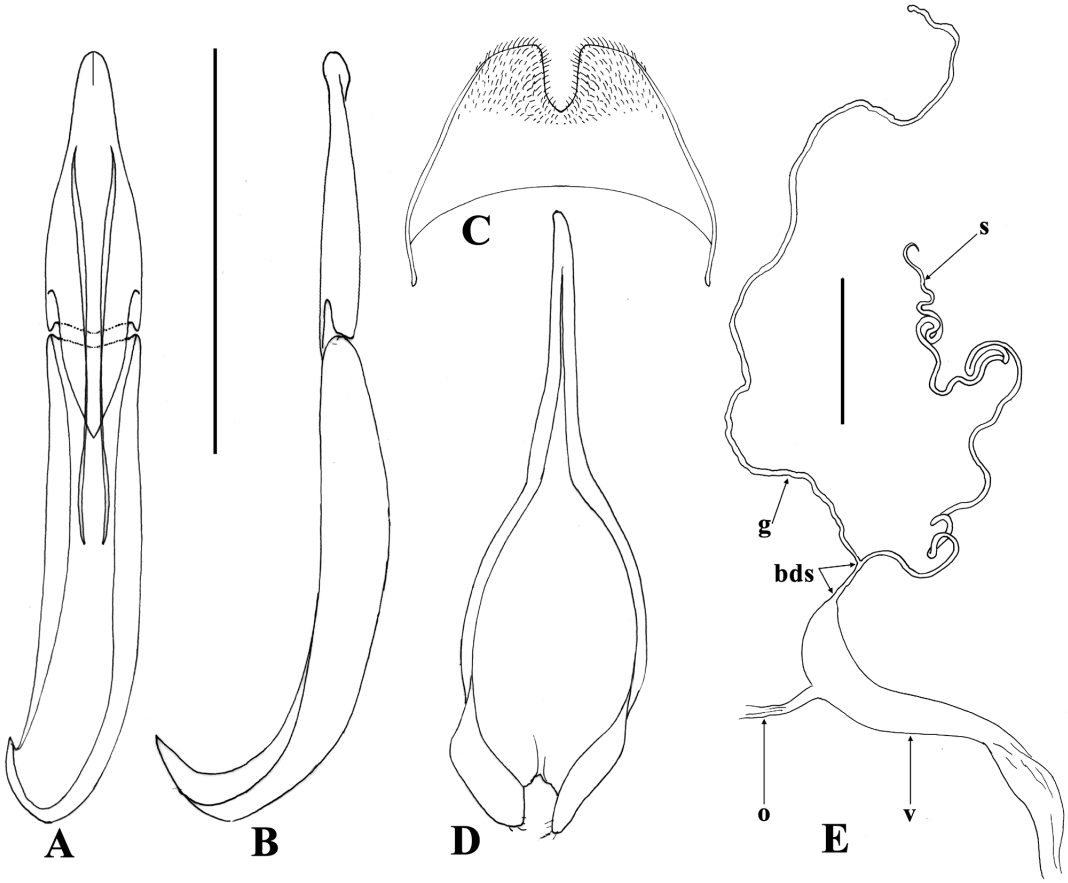

FIGURE 3. *Nalassus californicus*, genital structures. A—aedeagus ventrally; B—aedeagus laterally; C—male inner sternite VIII; D—gastral spicula; E—female genital tubes. g—the spemathecal accessory gland; s—spermatheca; bds—basal duct of spermatheca; o—oviduct; v—vagina. Scale bars 1 mm.

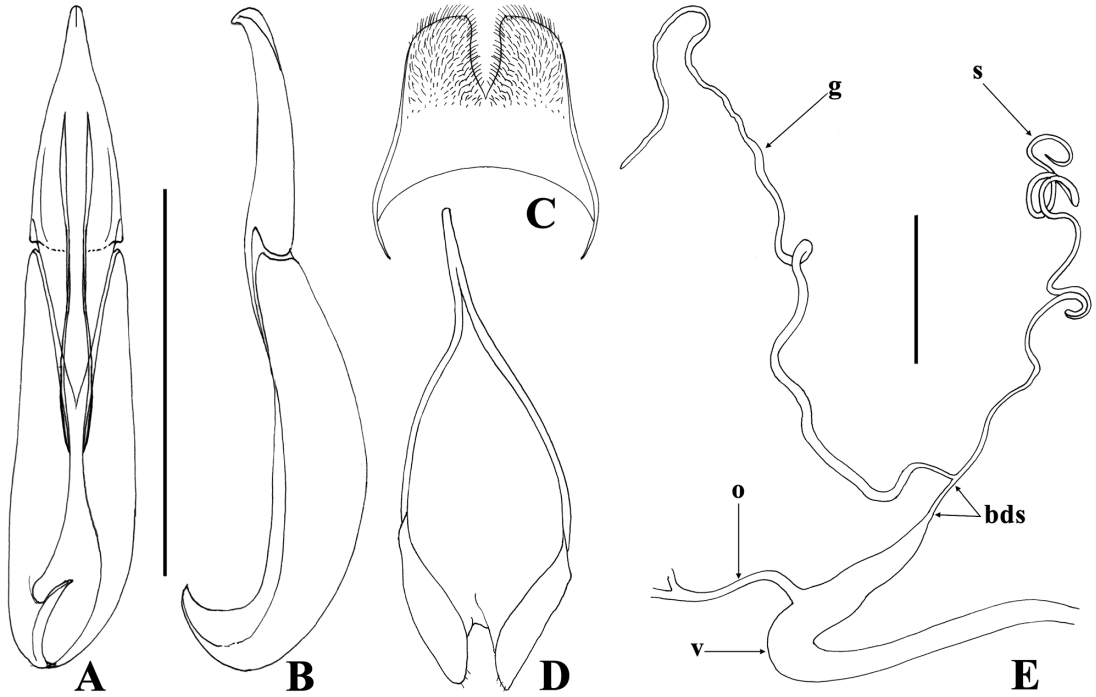

FIGURE 4. *Nalassus aereus*, genital structures. A—aedeagus ventrally; B—aedeagus laterally; C—male inner sternite VIII; D—gastral spicula; E—female genital tubes. g—the spemathecal accessory gland; s—spermatheca; bds—basal duct of spermatheca; o—oviduct; v—vagina. Scale bars 1mm.

Material (prepared for genitalia). 2♂♂, 5♀♀ (CN): USA, Maryland, Anne Arundel County, Russett, near Oxbow Lake, 39°06′52″ N, 76°48′25″W, 17.iii.2013 (leg. W. Steiner).

Comments. Subgeneric position of this species is unclear. The coarse, sparse punctation on the first male abdominal ventrite is similar to males of the subgenus *Caucasonotus* Nabozhenko, 2000. This is in contrast to all other subgenera, in which males have denser and finer punctation on the first abdominal ventrite than on other ventrites. On the other hand, males of *Caucasonotus* have a V-shaped setal brush and V-shaped punctation of very coarse and longitudinal punctures.

Distribution. USA: District of Columbia, Virginia, Alabama, Indiana, Kansas, Maryland, Missouri, New Jersey, New York, North Carolina, Pennsylvania, South Carolina.

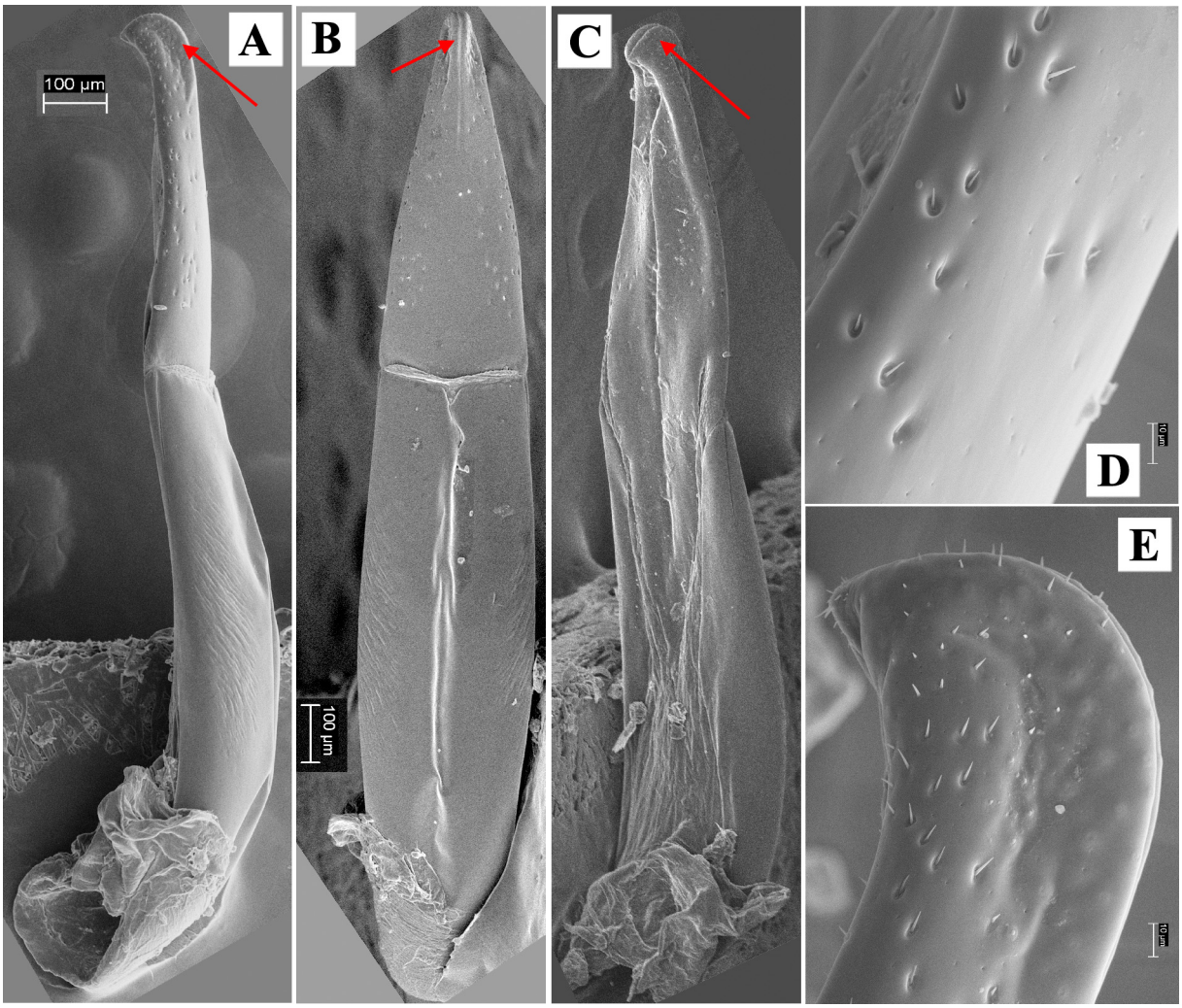

FIGURE 5. *Nalassus aereus*, aedeagus, SEM. A—lateral view; B—dorsal view; C—ventral view; D—setation of apical piece; E—laterally flattened keel. Arrow shows laterally flattened keel of apical piece.

Nalassus (?) *convexulus* (LeConte, 1862), comb. n.

convexulus LeConte, 1862: 353 (*Helops*); Horn 1870: 396 (*Helops*) (*Helops*).
= *montanus* LeConte 1879:518 (*Helops*). The name was synonymized by Bousquet and Campbell (1991: 258).
= *regulus* Blaisdell 1921:227 (*Helops*). Synonymy by Boddy (1965:177).

Type material (*H. regulus*). Holotype (♀),with labels: "*Helops regulus Blais.,*Type ♀", 'Wawawai, Wash., M M Mann V:15:09", "Blaisdell Collection", California Academy of Sciences Type No. 2937" CASC.

Other material examined: Pateros (Washington), April 24, 1964, R. Nagle col. (1); "Vernon, B.C" (British Columbia, Canada), "R Hopping, III 27 28", "J. W. Green Collection", (2); "Cranbrook, B.C. (British Columbia,

Canada), 28 IV 1956, Lot 4, BF&JL Carr" (1); "Durkey, Ore." (Oregon), "VI-17-41, Km&DM Fender" (1); "Salt Lake, Ut." (Utah), "Mar. 31, 1913, Timberlake col." (2).

Comments. The subgeneric position of this species is also unclear. The males have a roughly triangular shaped setal brush on the first abdominal ventrite but the coarse, sparse punctures on all ventrites are similar. The male genitalia is also very similar to *N. aereus* (fig. 5).

Although very similar in shape and size, there seems to be a distinct difference between specimens from the "rocky mountains" area and those from the pacific coast. In specimens (males and females) from the Rocky Mountains, the antennal segments are clearly thicker than those from the Pacific Coast. *Helops convexulus* was described by LeConte from "Bitter Root Valley, Rocky Mountains" in Montana. In the specimens listed above, the thicker antennal segments are found in the specimens from Utah and Montana while in the specimens from Oregon, Washington and British Columbia, the antennal segments are clearly consistently thinner. It is unclear why Blaisdell, while describing *Helops regulus*, compared this new species to *H. pernitens* and *H. aereus* rather than to *H. convexulus*. Perhaps he had no available specimens of this species. Boddy (1965), when synonymizing *H. regulus*, gave no reason why he did so. Finally Doyen in 1985 (unpublished) determined the specimens above from Vernon and Cranbrook (B.C.) to be *Helops regulus*. Perhaps he recognized this difference although it remains unpublished. Examination of additional specimens may allow both of these species to be recognized as valid.

Distribution. USA: California, Oregon, Nevada, Washington, Utah, Colorado, Nebraska, Wyoming; Canada: British Columbia, Alberta.

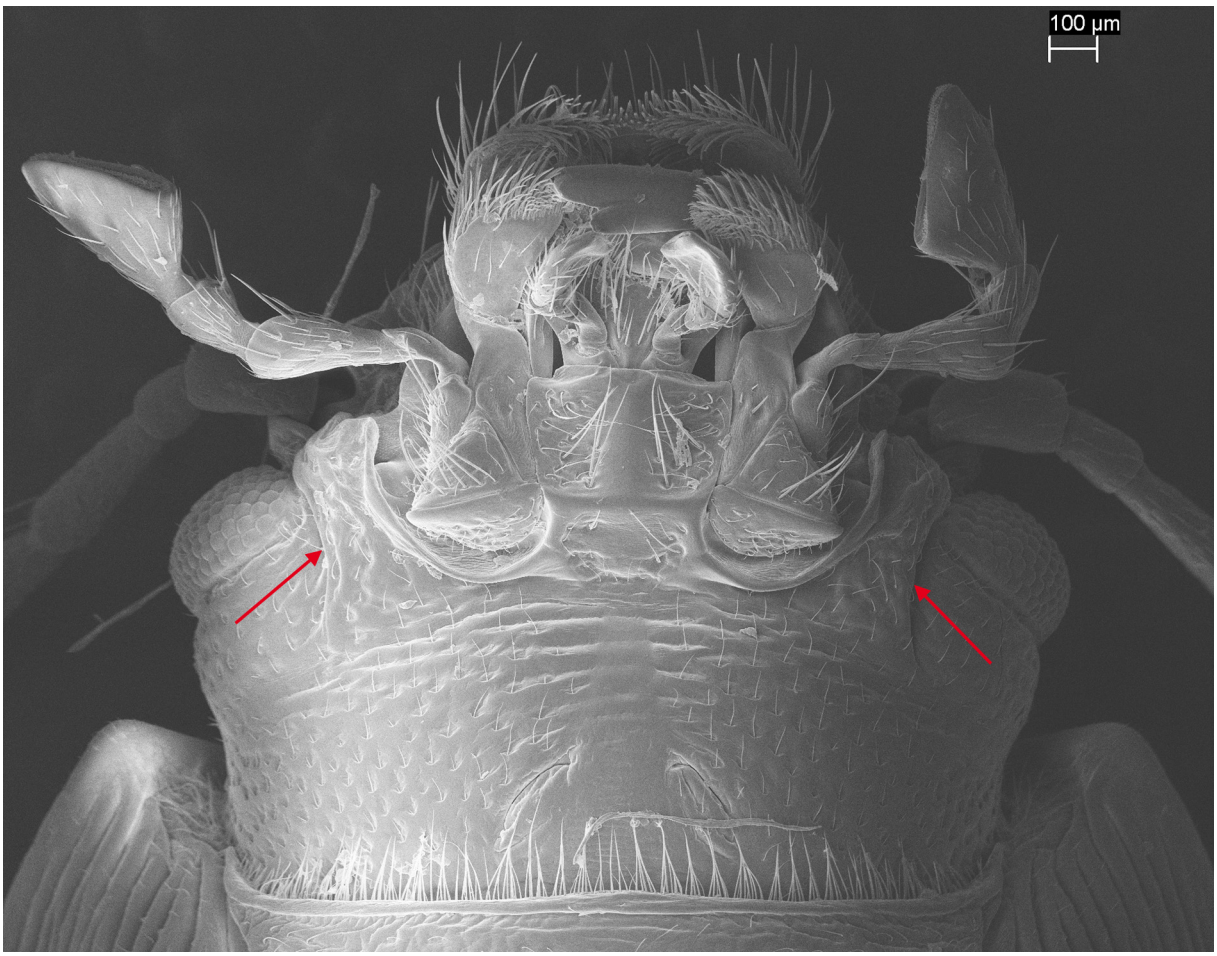

FIGURE 6. *Nalassus aereus*, ventral view of head with ventral posterior grooves (arrow).

Discussion

The genus *Nalassus* is widely distributed in Mediterranean and Europe (including the British Isles), in Anatolia, in

the Caucasus, and in Iran (Nabozhenko 2001; Nabozhenko & Löbl 2008). Isolated generic enclaves are also located in South-Eastern Kazakhstan (Medvedev 1987) and Eastern Asia (Nabozhenko 2012; Nabozhenko & Ivanov 2015). This study extends the range of *Nalassus* to include North America, Western Palaearctic, South-Eastern Kazakhstan, Western (Xinjiang) and Eastern China and North America (Nabozhenko 2013).

The current disjunct distribution of *Nalassus* species provides evidence of a considerably wider distribution of the genus in the Paleogene (Nabozhenko 2012). The habitat preferences of species of *Nalassus* to forested landscapes or other mesophytic landscapes (but not very wet) gives reason to suppose that the group reached its highest peak during the Middle–Late Oligocene, when the warm subtropical savannah changed to more humid and cool climate (Krishtofovich 1957; Zhilin 2001; Kotthoff *et al.* 2014 etc.). The Turgayan flora with the domination of *Qercus*, *Ulmus*, *Fagus*, *Pinophita*, etc. was most widely distributed throughout the Northern Hemisphere in that period. Drevlyanian ("Poltavian flora" sensu Krishtofovich) Eocene flora had secondary importance. Wide distribution of the genus *Nalassus* in the Oligocene (from Atlantic to Pacific Ocean within the boundaries of the current Holarctic) was probably associated with distribution of Turgayan flora (Nabozhenko 2012). Further studies of additional North American *Helops* species may also result in more reassignments to *Nalassus* or other genera within the Helopini.

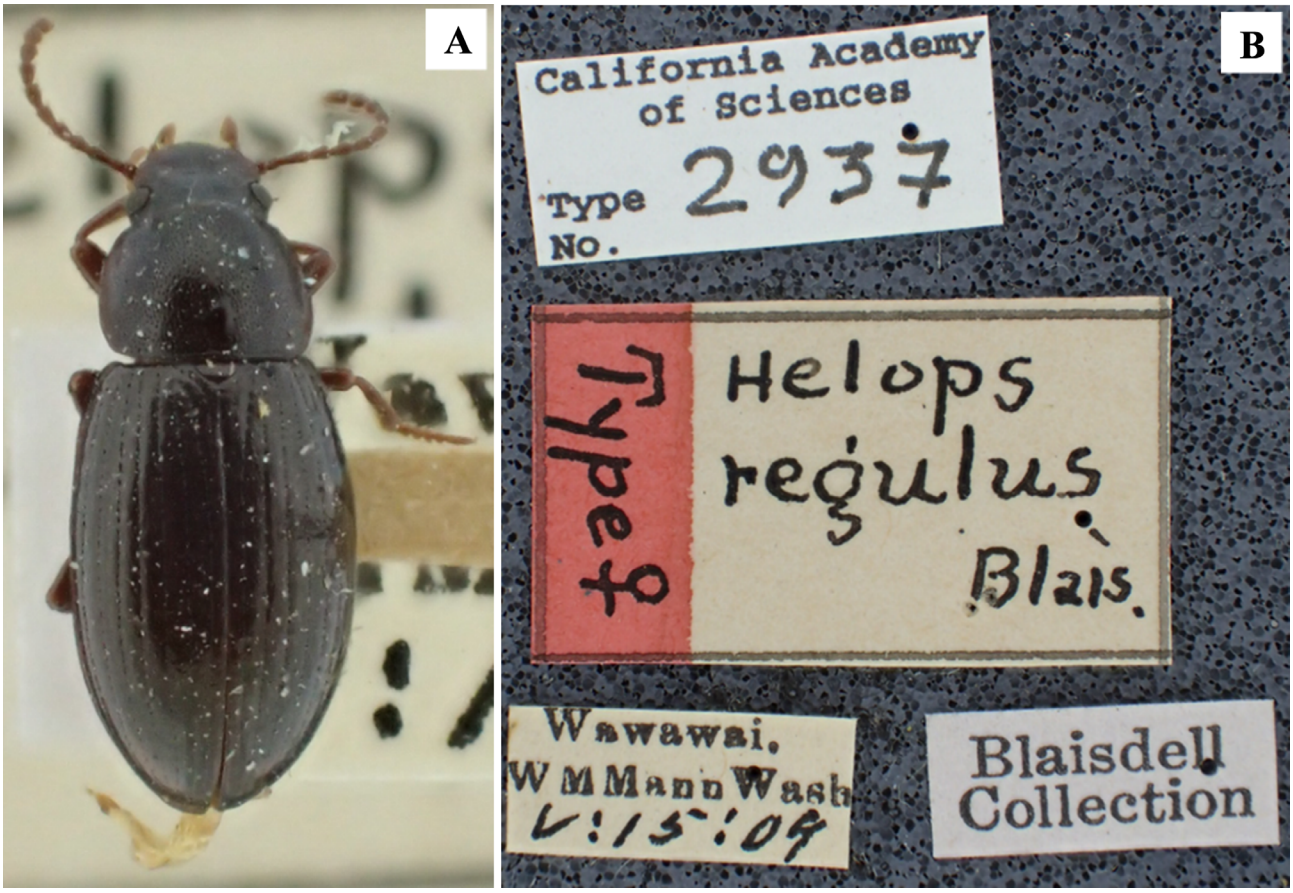

FIGURE 7. *Helops regulus*. A—holotype, female; B—labels of holotype.

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