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# Four new *Aphodius* Illiger from pocket gopher burrows in Arizona, Utah, Kansas and Nebraska (Coleoptera: Scarabaeidae: Aphodiinae)

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**Abstract**: We describe four new species of winter-active *Aphodius* (*sensu lato*) from pocket gopher burrows in Arizona, Utah, Kansas, and Nebraska: *A. caccabatus*, *A. paulseni*, *A. skillmani*, and *A. utopensis*. Diagnostic characters of all four species are illustrated.

**Key words**: *Aphodius*, new species, inquiline, pocket gopher.

## Introduction

Winter collecting in southeastern US pocket gopher (*Geomys* spp.) burrows has yielded several new species of inquiline *Aphodius* in the past two decades (Skelley and Woodruff 1991, Skelley and Gordon 1995, 2001). Similar collecting in pocket gopher burrows in Arizona and Utah (*Thomomys* spp.) and Nebraska (*Geomys* sp.) during the winter of 2004-2005 yielded several more. Four of these are here described to make the names available for a Nearctic faunal study currently in preparation (Gordon and Skelley, in prep). Collecting methods for the majority of specimens are described in Warner (1995).

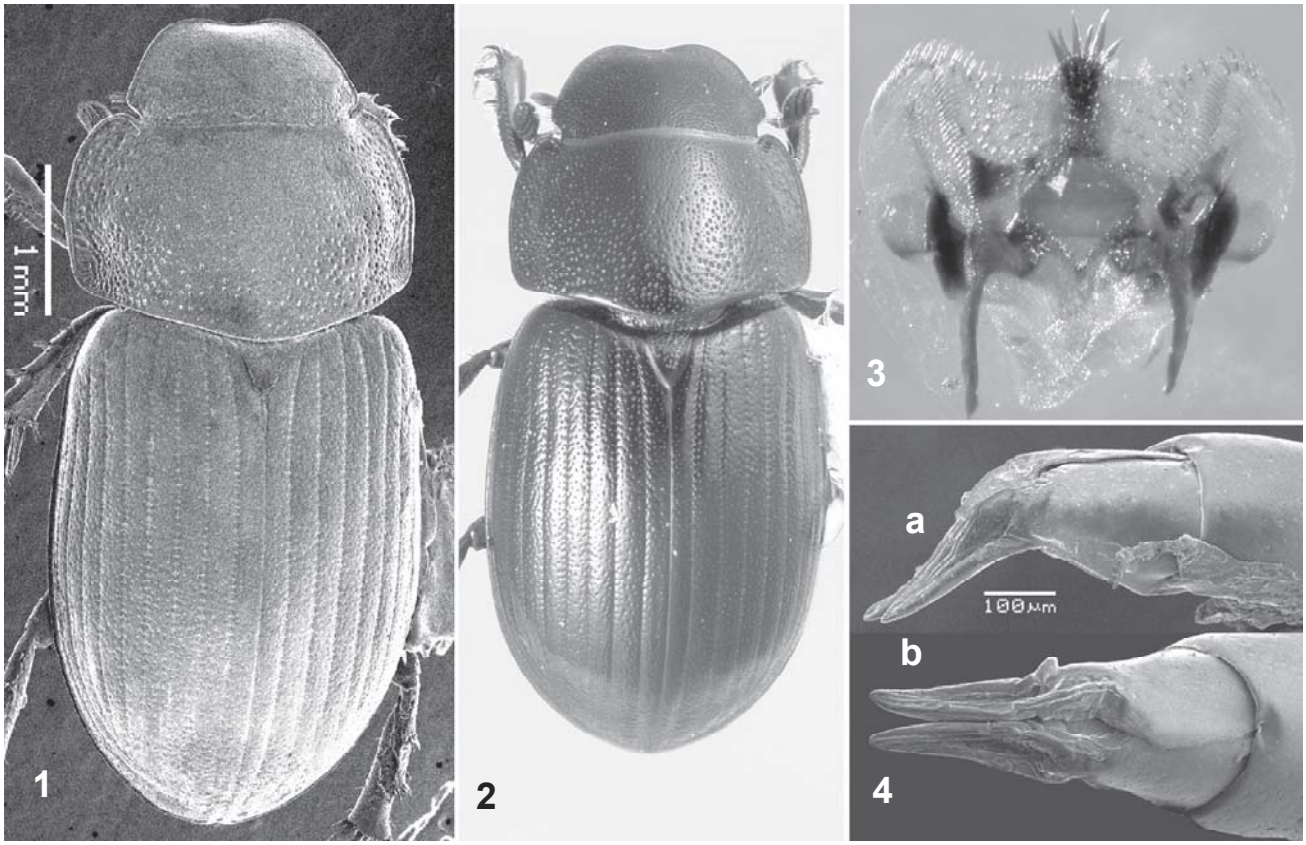
Generic concepts within the Aphodiini are currently in a state of flux, with all former subgenera of *Aphodius* raised in rank to genera by some authors (e.g. Dellacasa, Bordat and Dellacasa 2001). Other authors (pers. comm.) are taking a more conservative approach. Because of the uncertainty of the generic placement of many species, and because many of the cohesive subgroups within Nearctic Aphodiini are yet to be named, the new species described herein are all assigned to *Aphodius*.

Collection abbreviations listed in the text are as follows: BYUC = Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT; FSCA = Florida State Collection of Arthropods, Gainesville, FL; FWSC = Fred W. Skillman, Sunsites, AZ; JSCC = James Saulnier, La Quinta, CA; MJPC = M. J. Paulsen collection, Lincoln, NE; PESC = Paul E. Skelley, Gainesville, FL; RACC = Rich A. Cunningham, Chino, CA; SEMC = Snow Entomological Museum, University of Kansas, Lawrence, KS; UNSM = University of Nebraska State Museum, Lincoln, NE; USNM = United States National Museum of Natural History, Smithsonian Institution, Washington, DC; WBWC = William B. Warner collection, Chandler, AZ.

## *Aphodius caccabatus* Warner and Skelley new species

(Figs. 1 - 4)

**Description**. Holotype male, length 5.1 mm, width 2.2 mm. Form elongate, widest at about middle of elytron; shiny dorsally. Head, pronotum and venter black, elytron dark brown, almost black, legs dark brown. Head and clypeus smooth, finely, densely punctured, with scattered coarser punctures laterally; punctures finer on clypeal disc. Clypeal margin with complete bead, broadly rounded, medially broadly emarginate. Epipharynx (Fig. 3) transverse, side rounded, anterior margin sinuate; epitorma conical; corypha distinctly protruding with apical clump of long spinules; prophobae with scattered large setae intermixed with fine setae that become denser toward corypha; chaetopariae dense. Pronotum broader than elytra at humeri, with lateral margin curved, strongly explanate, with intermixed fine and coarse punctures, coarse punctures sparser on disc, coarser and dense in lateral third, confluent in moderately deep depression on basal third of lateral submar-




**Figures 1 - 4.** *Aphodius caccabatus*. **1)** dorsal habitus, holotype male (SEM); **2)** dorsal habitus, allotype female; **3)** epipharynx; 4) parameres, a - lateral view, b - dorsal view.

gin. Scutellum triangular, disc densely punctate as in elytra. Elytron apically explanate and subacuminate; intervals weakly convex, densely punctured, punctures mostly separated by one diameter or less, denser laterally. Metasternum alutaceous laterally, shiny medially, with fine, deep punctures separated by less than to 3 times their diameters. Protibial spur laterally flattened, moderately stout, in lateral view more or less evenly weakly curved and tapered to acuminate apex. Inferior mesotibial spur with apex very finely and indistinctly hooked. Metatrochanter with single long seta. Metafemur with several short setae on hind margin near metatrochanter and sparsely scattered along posterior margin from base to apex. Metatibia with apical fringe of spinules composed of alternating short and much longer spinules. Genitalia (Fig. 4) with parameres in lateral view angularly bent approximately 110° ventrally at middle, in dorsal view with moderate opening between them for about middle third, constricted just past middle, thereafter parallel and dorsally concave, tips separated and narrowly rounded.

**Female**. Allotype length 5.4 mm, width 2.3 mm. Similar to male except inferior mesotibial spur lacking apical hook, and pronotum not as broadly explanate (Fig. 2).

**Variation**. Length 5.1 to 5.8 mm, width 2.2 to 2.5 mm. Elytra black to dark brown (teneral paratype).

**Type material**. Holotype: "USA: UT: Kane Co., jct. Hwy. 89 and Coral Pink Sand Dunes Rd.; elev. 5880', 37° 11.30'N, 112° 39.48'W, Feb. 26 to Mar. 5, 2005; ex human dung bait pitfall trap in gopher burrow, W. B. Warner, F. W. Skillman" (FSCA). Allotype, same data as holotype except: Nov. 12-18-2004; P. E. Skelley and W. B. Warner (FSCA). Paratype (1 male), same data as holotype (WBWC).

**Remarks**. This species has similar sexual dimorphism in the pronotal shape (male pronotum broader, Figs. 1-2) and form of male genitalia as *A. punctissimus* Brown. They form a complex with additional species found in the same general area in

the American Southwest. *Aphodius caccabatus* is distinguished from these species by the dark color and broader pronotum in the male. All the known specimens were collected in human dung baited pitfall traps in gopher burrows set in pink sand dunes. Other species collected in the same traps were *Aphodius depressiusculus* Schmidt, and *A. umbricollis* Fall.

**Etymology**. The specific name is from the Latin for sooty black, in reference to the dark coloration of the beetle.

### *Aphodius paulseni* Skelley
### new species
(Figs. 5 - 7)

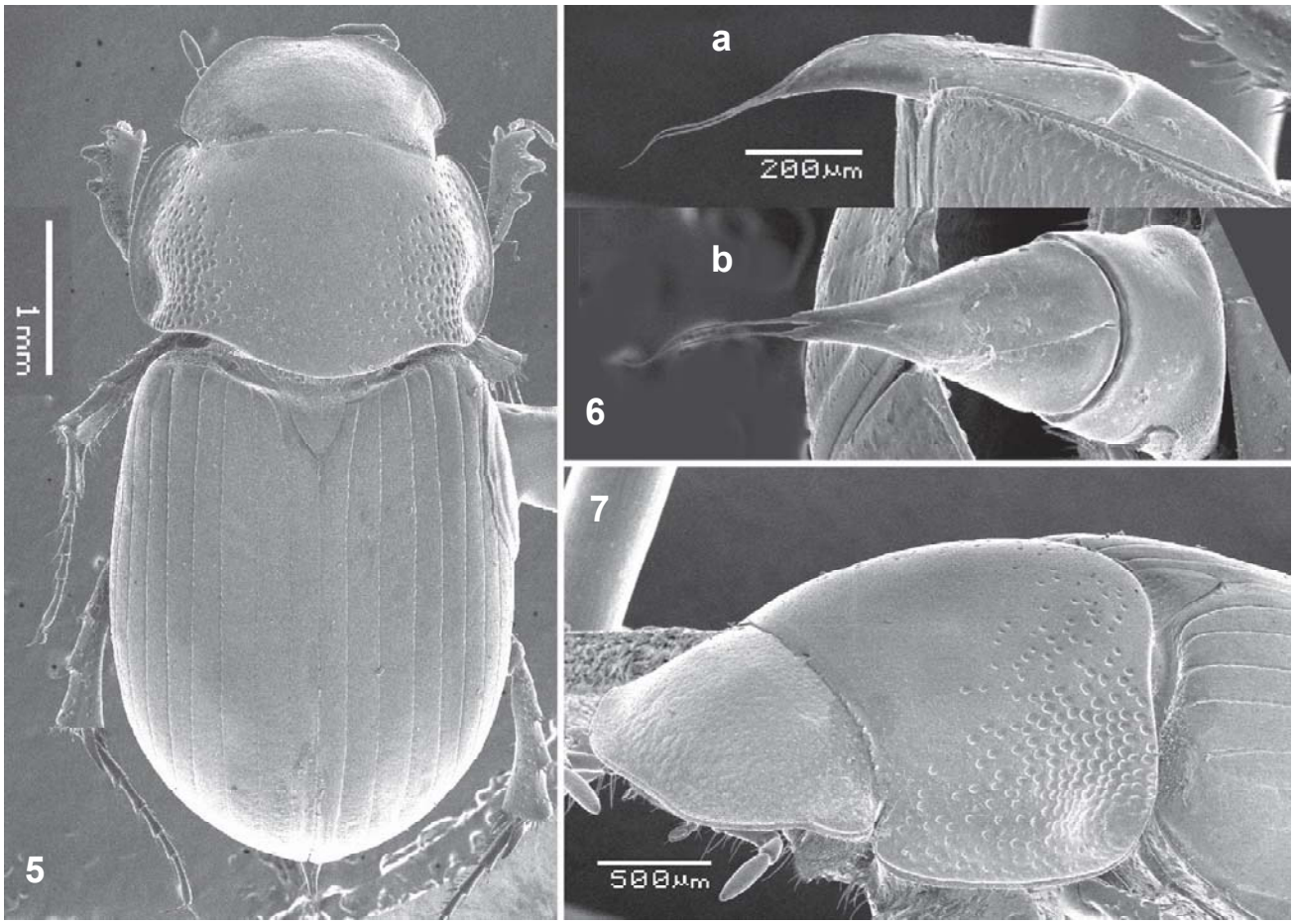
**Description**. Holotype male. Length: 5.9 mm, width: 2.8 mm. Body convex, widest behind middle of elytra. Head, pronotum shiny dark brown except clypeus and explanate margins of pronotum lighter brown; elytra brown, shiny. Head with clypeus broadly rounded either side of shallow, median emargination, not fimbriate, granulate apically (best seen in anterior view, Fig. 7), punctate; punctures moderate in size, separated by 2-3 puncture diameters; frontoclypeal suture obsolete, impunctate, lacking tubercles; frons punctate, punctures moderate but larger than on clypeus, dense, separated by 1 puncture diameter; gena fimbriate. Pronotum broad (Fig. 5), sides laterally rounded and distinctly explanate; base obtusely subangulate behind posterior angle, weakly sinuate, broadly produced medially, base lacking marginal line; pronotum laterally with distinct marginal bead, with deep impression near posterior angle, impression appearing as parenthesis-shaped furrow in dorsal view; discal punctures mixed fine and large, fine punctures separated by 4-5 diameters, large punctures absent from anterior third and along midline, elsewhere increasing in size and density toward posterior angles. Scutellum triangular, small (less than 1/6 length of elytra). Elytra surface shiny, finely, irregularly punctate; striae moderately impressed, feebly punctate. Protibia impunctate, tridentate; protibial spur modified, abruptly bent ventrally at middle. Mesotibial inferior spur modified, length less than half length of superior spur, internal surface with small tooth. Metatrochanter setose; setae long, straight, pale. Metafemur with dense patch of similar setae near metatrochanter, scattered setae continuing from patch to tibial apex; metatibial apex fringed with conspicuously unequal spinules (short spinules alternating with spinules 3 times longer); metatarsus with basal segment longer than superior spur. Male genitalia (Fig. 6) with parameres acuminate, each with long seta-like apical projection.

**Female**. Allotype length 6.4 mm, width 3.1 mm. Externally similar to holotype male except in the following: color everywhere more uniformly dark brown, elytra not lighter than pronotal disc; clypeus and explanate pronotal margin only slightly lighter. Pronotum with lateral margins less strongly explanate, especially anterolaterally. Protibia with spur not abruptly bent, gradually curved ventrally. Inferior mesotibial spur simple, acute, more than half as long as superior spur. Metatrochanter and metafemur with fewer, shorter setae; metafemur lacking dense setal patch.

**Variation**. Length 5.7 to 6.8 mm, width 2.8 to 3.3 mm. Body color varies from brown to dark brown. Some specimens have the clypeal granulation reduced or worn.

**Type material**. Holotype male: "NEBR: Greeley Co., 10 mi N Greeley, jct. HWY 281 and 91, N 41.697º W98.542º, Sandhills, in flight pre-sunset, 17 OCT 2004 MJ Paulsen" (UNSM). Allotype female: "NEBRASKA: Greeley Co., N41.697º - W98.542º, 10mi. N. Greeley, jct. HWYs 281 and 91, 10-X-11-XI-2004, M.J. Paulsen, sandhills ex *Geomys bursarius* burrow" (UNSM).

Paratypes are from two Prairie states. Kansas paratypes were all collected by G. A. Salsbury (not sexed, 6): Kiowa Co., 5 mi. N. Greensburg, 31 Oct. 1997, gopher burrow dung trap (2); same data except 16 Nov. 1997 (1); same data except 17 Dec. 1997, gopher burrow (1); same data except 17 Nov. 1997, in flight (1); same data except 18 Dec. 1997, in flight (1). Nebraska paratypes were all collected by M. J. Paulsen, (13 males, 24 females): Arthur Co., Arapaho Prairie (TNC / Preserve), in flight at dusk, 6 NOV 2004 (1); Dundy Co., 11 mi N of Benkelman, N 40º13'17", W 101º31'27", Sandsage prairie in flight before sunset, 983 m, 16 OCT 2005 (2); Garden Co., 3.4 mi S of Lakeside, N 40º00'25", W 102º23'23", feces pitfall in pocket gopher burrow (*Geomys bursarius*), 14-17 OCT 2005 (1); Greeley Co., 10 mi N of Greeley, W of jct. HWYs 281 and 91, N41.697º W98.542º, 17 APR 2005, feces-baited pitfall trap in burrow of pocket gopher, *Geomys bursarius* (Shaw) (2); same locality except, 3 APR 2005, in pocket gopher, *Geomys bursarius* (Shaw), burrow,



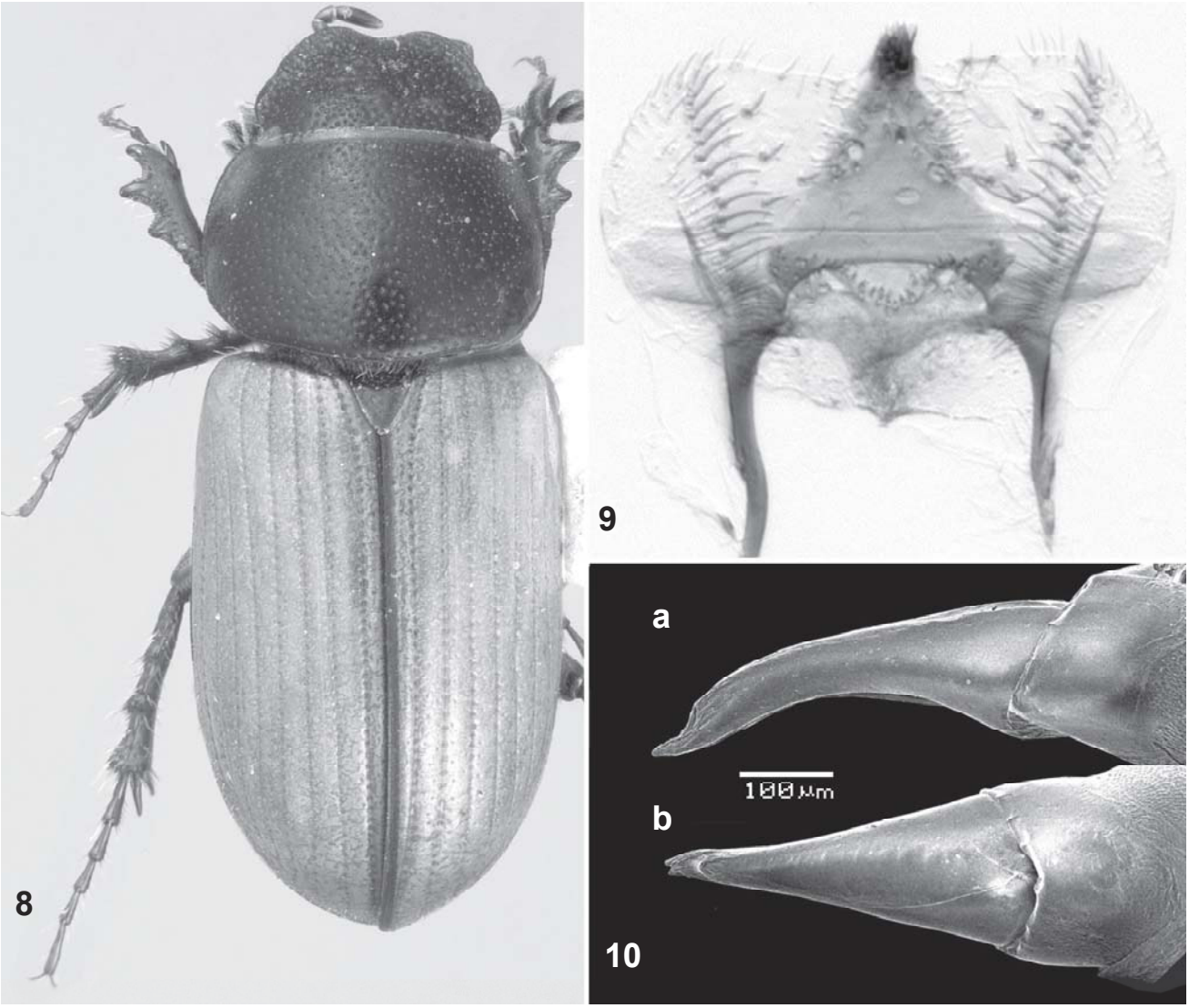

**Figures 5 - 7.** *Aphodius paulseni*. **5)** dorsal habitus; **6)** parameres, a - lateral view, b - dorsal view; **7)** head and pronotum, lateral view.

in fur of dead gopher (2); same data as holotype (2); same data as allotype (3); same data as holotype except, Sandhills, in flight pre-sunset, 8-9 OCT 2004 (3); same locality as holotype except, *Geomys bursarius* burrow, dung pitfall, 10-17 OCT 2004 (1); Greeley Co., 10 mi. N Greeley, in flight before sunset, 3-X-2004 (1); Greeley Co., 10 mi N of Greeley, N 41.697º W 98.542º, feces pitfall in pocket gopher burrow (*Geomys bursarius*), 13-18 OCT 2005 (13); same locality except, Sandhills prairie, in flight before sunset, 13 OCT 2005 (3); Keith Co., 6 mi. S of Paxton, in flight at dusk, N 41.06º, W 101.40º, 15.V.2005 (2). Paratypes are deposited in the MJPC, PESC, SEMC, USNM, WBWC.

**Remarks**. The majority of series was collected from pocket gopher burrows, *Geomys bursarius,* using dung-baited pitfall traps. Some specimens were also taken in flight over short-grass prairies where *G. bursarius* was present. Although certainly a dung feeder, two specimens were found embedded deep in the fur of a dead gopher in one burrow sampled (pers. comm., M. J. Paulsen). No specimens were collected in burrow pitfalls from June to August, 2004, which suggests that adults of this species may not be active during the summer.

*Aphodius paulseni* belongs to a group of pocket gopher specialists with explanate pronota (Fig. 5). In a more narrow sense, *A. paulseni* from Nebraska and *umbricollis* Fall from west Texas form a group of species readily distinguished from all others by the similar male genitalia (Fig. 6) with apical seta-like processes. Each possesses distinct characters: *A. paulseni* has a granulate clypeus, while *A. umbricollis* does not.

**Etymology**. This species is named after M. J. Paulsen, who recently started collecting beetles in pocket gopher burrows, the results of which led to



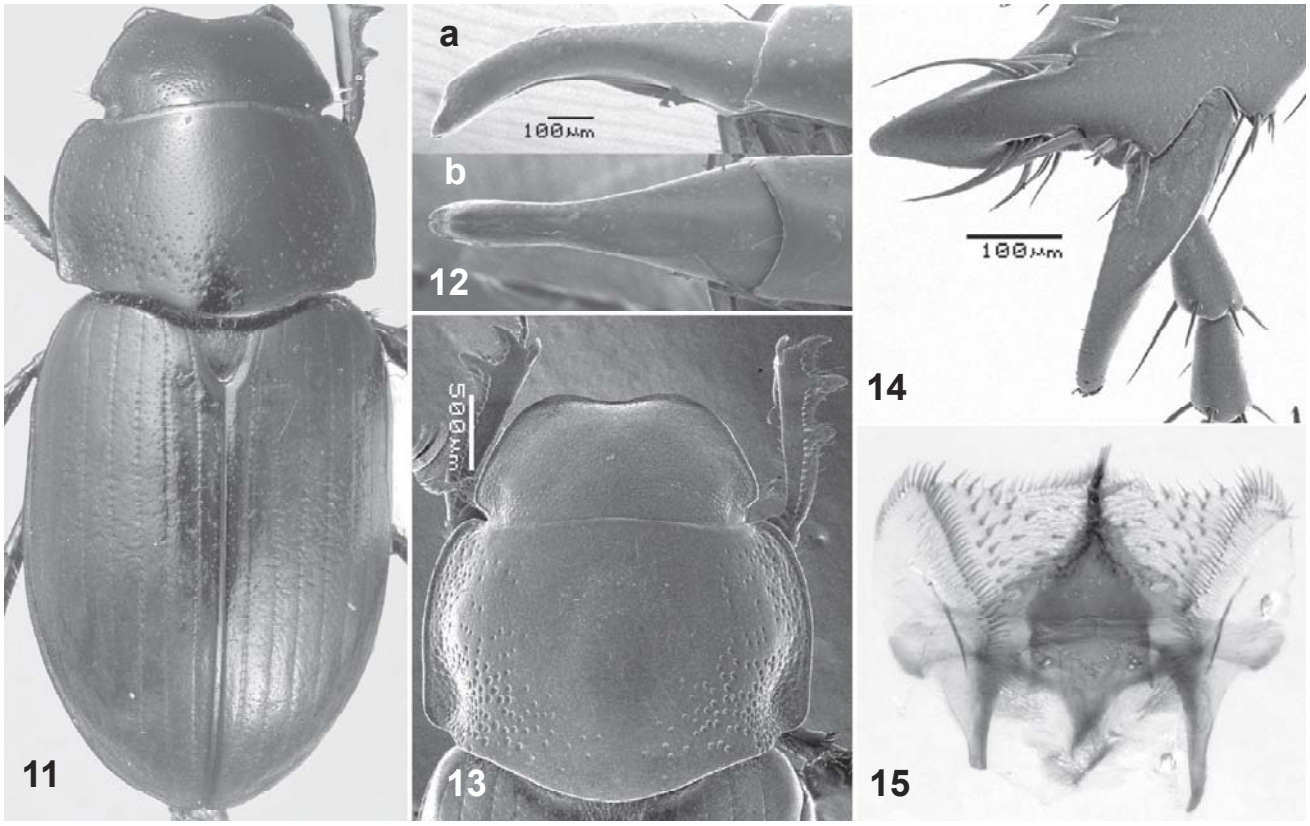

**Figures 8 - 10.** *Aphodius skillmani.* **8)** dorsal habitus, male; **9)** epipharynx; **10)** parameres, a - lateral view, b - dorsal view.

many Nebraska state records (Paulsen 2006) and this new species.

### *Aphodius skillmani* Warner and Skelley new species

(Figs. 8 - 10)

**Description**. Holotype male, length 4.3 mm, width 1.6 mm. Form elongate (Fig. 8), slender, widest behind middle of elytra; pronotum widest at middle. Color dark brown; head paler yellowish brown except vertex dark; pronotum with lateral l/6 paler yellowish brown; elytron yellow except sutural margin narrowly brown. Head not pubescent; clypeus narrowly medially emarginate between rounded sides, disc rugopunctate, with weak transverse ridge at middle; frontoclypeal suture trituberculate, carinate. Epipharynx (Fig. 9) transverse, with rounded side, apical margin sinuate; epitorma broadly triangular; corypha protruding, with apical clump of short spinules; prophobae with 2-4 stout setae in a weak line. Pronotum with punctures more or less uniform in size, unevenly distributed, separated by less than 3 times one diameter. Elytral length slightly less than 2.5 times pronotal length; elytron with short pubescence laterally on apical declivity; intervals with single, irregular row of coarse punctures. Venter with median area of metasternum shiny, coarsely, sparsely punctured. Anterior tibial spur weakly curved, flattened, extending to slightly less than middle of second tarsal segment; inferior mesotibial spur short, subclav-




**Figures 11 - 15.** *Aphodius utopensis*. **11)** dorsal habitus, male; **12)** parameres, a - lateral view, b – dorsal view; **13)** head and pronotum, male (SEM); **14)** anterior tibial spur; **15)** epipharynx.

ate, finely abruptly recurved at apex; apex of metatibia fringed with long setiform spinules alternating with very short dentiform spinules. Metatarsus similar in length to metatibia. Parameres as in Fig. 10.

**Female**. Allotype length 4.9 mm, width 1.9 mm. Similar to male except: pronotum narrower, not as "inflated," and more coarsely punctate; anterior tibial spur slightly shorter, usually extending to about apex of first tarsal segment; inferior mesotibial spur narrowed, about half as long as superior spur, not apically recurved.

**Variation**. Length 3.4 to 4.9 mm, width 1.5 to 2.0 mm. The rugose clypeal ridge is reduced to a rounded, rugose convexity in a few specimens (mostly females), and pronotal punctation varies in intensity, with smaller males having coarser, deeper punctation than similar sized females. Some specimens have a cloudy dark pattern on the elytra consisting of an elongate spot on the third interval just anterior to middle, a short, wavy band behind the humeral umbone extending from the epipleuron to the 7th interval, and the elytral apex behind the apical umbone. A larger number of specimens have the elytral apex darkened, but lack the discal spots. Sex of worn specimens may be difficult to determine because the inferior mesotibial spur of females may be worn to lengths as short as in males, and the recurved apex of that spur on males may be worn off.

**Type material**. Holotype male: "USA: ARIZONA: Cochise Co., 7 mi. W of Sunsites, Feb. 22-29, 2004; ex human dung pitfall trap in *Thomomys bottae* (gopher) burrow; W. B. Warner and F. Skillman" (FSCA). Allotype female: same data as holotype except: Feb. 15-22, 2004 (FSCA).

Paratypes (35 males, 28 females): same data as holotype (1); same as allotype (3); same except, Jan. 30 - Feb. 13, 2005, F. W. Skillman, W. B. Warner (10); Pima Co., N end Sta. Rita Mts., For. Rd. 62, 2.8 mi. W Hwy. 83, grassy prairie, Jan. 29 to Feb. 8, 2005, ex human dung bait pitfall trap in gopher burrow; W. B. Warner (42); same except: Feb. 13-20, 2005 (7). Paratypes are deposited in FWSC, JSCC, MJPC, PESC, RACC, WBWC, USNM.

**Remarks**. This species is similar to *A. peculiosis* Schmidt but is distinguished by the lack of pubescence on the head and the trituberculate frontal suture. It is also very similar to an undescribed species (Gordon and Skelley, in prep.) from north-central Arizona, but differs in pronotal shape, in having shorter elytra (less than 2.5 times vs. about 2.75 times pronotal length), in the male pronotum appearing more weakly punctate and "inflated" to the anterior pronotal angles (vs. slightly depressed-explanate and more heavily punctate), and in having the posterior tarsi about as long as the posterior tibia (rather than distinctly longer). All the known specimens were collected in gopher (*Thomomys*) burrows in pitfall traps baited with human dung. Other *Aphodius* species collected in the same traps included *A. ochreipennis* Horn, *A. rubiginosus* Horn, *A. acuminatus* Cartwright, and *A. luxatus* Horn.

**Etymology**. This species is named for Frederick W. Skillman Jr., expert collector and friend, on whose property the first specimens were collected.

### *Aphodius utopensis* Warner and Skelley new species
(Figs. 11 - 15)

**Description**. Holotype male, length 6.0 mm, width 2.7 mm. Form elongate, widest behind middle of elytra; body margins in dorsal view fimbriate only at gena (Fig. 11). Head, pronotum, venter dark brown except anterior margin of head, broad lateral pronotal margin and apical abdominal sternite reddish brown; legs and elytron reddish brown except sutural margin narrowly dark brown. Head finely, densely punctured, with scattered coarse punctures along lateral clypeal submargin; clypeus broadly rounded, medially emarginate. Epipharynx (Fig. 15) transverse, side weakly flattened; epitorma conical; corypha weakly protruding with apical clump of long spinules; prophobae with scattered large setae intermixed with fine setae that become denser toward corypha; chaetopariae dense. Pronotum (Fig. 13) with lateral margin explanate, very strongly so in basal third, very shallowly sinuate in basal half, then abruptly sinuately constricted in front of elytral humerus; basal margin without bead, very obtusely subangulate; discal surface shiny, not alutaceous, with intermixed fine, coarse punctures, coarse punctures lacking in anteromedial third, subcontiguous laterally, becoming smaller and contiguous within deep posterolateral depression. Scutellum triangular, densely finely punctate. Elytron shiny, not alutaceous, intervals finely punctured, punctures separated by about 3 to 5 times their diameters on discal intervals 1-4, denser and larger on intervals 5-10. Protibial spur (Fig. 14) laterally flattened, sinuate, with flange-like expansion in basal half, flange widest just before middle, then abruptly tapered to acute apex in apical half. Inferior mesotibial spur unmodified. Metatrochanter with one short and one long setae. Metafemur with several moderate setae scattered along posterior submargin from base to apex. Metatibia with apical fringe of spinules composed of more or less alternately short and much longer (subsetaform) spinules; inferior spur unmodified. Genitalia (Fig. 12) with parameres very elongate, in lateral view weakly curved, with apex very obliquely truncate, in dorsal view constricted at apical third.

**Female**. Allotype length 6.9, width 3.3 mm. Similar to male except protibial spur narrower, without flange.

**Variation.** Length 5.4 to 7.1 mm, width 2.4 to 3.1 mm.

**Type material.** Holotype and allotype: "USA: UTAH: Millard Co., 2.5 mi. S jct. US-50 on state rte. 100; Nov. 13-17, 2004; sand dunes; human dung baited pitfall trap buried in Thomomys (gopher) burrow; W.B. Warner, P. E. Skelley" (FSCA).

Paratypes (6 males, 4 females): same data as holotype (6); UT: Juab Co., rte-1812, 1.9 mi. SE Jericho Jct. (= jct. with US-6); xi.13-17.2004; loamy soil; human dung baited pitfall trap buried in *Thomomys* (gopher) burrow; W.B. Warner, P. E. Skelley (4). Paratypes deposited in BYUC, PESC, WBWC, USNM.

**Remarks**. This species is similar to *Aphodius ochreipennis* Horn, but *A. ochreipennis* differs in having the basal pronotal constriction oblique, with the basal pronotal angles much less explanate, the male protibial spurs with the basal "flange" only weakly indicated, the clypeus without scattered coarse punctures laterally, and the overall lighter color.

**Etymology**. The specific epithet is based on the Greek "u-topo-ensis" (meaning "from no place") in reference to the type locality, a spot "in the middle of nowhere." This name was chosen because it is becoming increasingly clear to us that many rare or

undescribed species are to be found at localities lacking any obvious feature that would presumably make them desirable for an entomologist to stop and collect.

## Acknowledgments

Both F. W. Skillman, Jr., and C. W. O'Brien are gratefully acknowledged for their assistance in the field. We thank R. D. Gordon for comparing specimens with his new species (in preparation), and for many helpful suggestions. Shawn Clark (BYUC) and C. Bellamy, California State Collection of Arthropods, Sacramento, CA, kindly lent specimens from their respective institutions. For reviews of the manuscript we thank M. C. Thomas, Florida State Collection of Arthropods, Gainesville, FL; M. J. Paulsen, Nebraska State Museum, Lincoln, NE, and R. Gordon, United States National Museum, Washington, DC. Work by author PES was partially supported by NSF/PEET grant #DEB-0118669 through M. L. Jameson and B. C. Ratcliffe, University of Nebraska State Museum, Lincoln, NE-USA. This is Entomology Contribution No. 1033, Bureau of Entomology, Nematology, and Plant Pathology, Florida Department of Agriculture and Consumer Services.

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