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A new species *Aphodius geomynidomus* n. sp. (Coleoptera: Scarabaeidae: Aphodiinae) from burrows of the pocket gopher, *Geomys arenarius* Merriam 1895 (Mammalia: Rodentia: Geomyidae) in El Paso, Texas

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Abstract
This paper reports a new species of coleopteran of family Scarabaeidae from far western Texas in the vicinity of El Paso, Texas. *Aphodius geomynidomus* n. sp. lives as a commensal symbiotic inquiline in the nest chambers of the pocket gopher, *Geomys arenarius* Merriam 1895 [4]. It is distinguished from the nearest congeneric species by morphological features including sculpture of the head, shape of the male genitalia and adentate condition of the clypeus.

Keywords: *Aphodius geomynidomus* n. sp. Scarabaeidae, inquiline, *Geomys arenarius*, Texas.

1. Introduction
This description is necessary so that the species named herein will be eligible for consideration under the conservation laws and scientific study programs of the United States and the State of Texas. The discovery of this species was a result of investigations into co-evolution between the dung-feeding scarabs of the Aphodiinae and their mammalian hosts, pocket gophers, in the genus *Geomys*. This particular species is noteworthy because the host, *Geomys arenarius*, is the most westerly known species of *Geomys* in North America and a rare endemic of the Rio Grande Valley. Pocket gophers have been known to harbor an obligately associated community of commensal symbionts (inquilines) since pioneering work by E. S. Ross in Texas in the 1940's [5].

2. Materials and Methods
Specimens were collected using unbaited pitfall traps set in the burrows of the host, *Geomys arenarius*. Pocket gopher burrows are rarely open to the surface. Earthen plugs usually seal the burrow. The procedure used is unchanged from that described by Ross (1944) [5]. In this procedure the burrow was located and opened using a shovel. The host animal was removed from the burrow by trapping because a live inhabitant of the burrow would backfill any disturbance and burry an insect pitfall. A small cup of at least 150 ml was placed as a pitfall in the floor of the burrow so that no insect might exit the burrow without falling in. The cup was charged with ethylene glycol to act as a killing and preserving fluid. A wooden board of sufficient dimensions to cover the burrow opening was placed over the burrow entrance and the entire apparatus was re-covered with soil so that no surface insects could enter the trap and to exclude any surface animals from disturbing the trap. After 24 hours the pitfall was un-covered to reveal a sample of any insects that were dispersing through the mammal burrow. Studies were conducted in March 1997. Specimens were dissected to remove male genitalia which were point mounted separately for photography. Mouthparts were dissected out and slide-mounted in Permount. Studies were done using a Leica M125 microscope with Leica Application Suite V3.8 automontage software.

3. Results
3.1. Classification: *Aphodius geomynidomus* is placed in genus *Aphodius* pending thorough phylogenetic analysis of this gigantic taxon. It is most closely related to a monophyletic group of species that are closely associated with pocket gophers. Some members of this group, notably *Aphodius concavus*, have been placed in subgenus *Koshantschikovius* sensu Schmidt (1913) [6]. More recently they have been unofficially referred to as the *concavus* species group. Gordon and Skelley (2007) [1] have recommended elevation of all Nearctic subgenera of *Aphodius* to genus level. Based on their assignment of related species, *A. geomynidomus*

would probably be assigned to their genus *Dellacasiellus*, but this broad upgrade of all subgenera to genus was not based on any analysis, phylogenetic or otherwise and is not recognized here.

Family: Scarabaeidae
Sub-family: Aphodiinae Leach, 1815
Genus: *Aphodius* Illiger, 1798
Host: *Geomys arenarius*, Merriam, 1895
Location: El Paso, Texas, USA
No. of Specimens: 6
Holotype: FSCA

3.2. Description: *Aphodius geomynidomus* n. sp. (Figures 1, 2, 3)

Holotype. Male, length 6.0 mm, greatest width across apical third of elytra 2.8 mm. Color uniformly rufous. Head dorsal surface shining, finely, evenly micropunctate, fewer than 10 coarse pits randomly scattered over surface; surface planar between punctations. Clypeus emarginate apically, apical margin angulate on both sides of emargination; margin lateral to angles evenly arcuate. Genal margin straight anteriorly, curved posteriorly; margin smoothly joins the clypeal margin. Pronotum one third wider than long, evenly convex, not explanate, slightly narrowed anteriorly in the dorsal aspect, lateral declivity steep posteriorly, less so anteriorly, posterior angles sharply curved, lateral margin nearly straight basally, curved anteriorly, posterior margin weakly biconcave, distinctly impressed coarse pits present laterally, disc free of pits; lateral pronotal groove extending from anterior angle to a position opposite the 5th elytral stria, basal pronotal groove extending between points opposite base of third elytral striae. Elytron dorsal surface asetose; striae narrow, about one sixth width of interval, punctate, strial margins entire, not crenate, striae 3-5 widened, eroded at base; intervals randomly punctate; epipleuron rugose, asetose, basally concave. Scutellum sparsely punctate in basal half; lateral margins arcuate. Mesosternum convex, coarsely pitted laterally, disc with small glabrous shining area, two imbricate patches either side of central glabrous area filling space between coarse pits; longitudinal sulci across disc. Metasternum, lateral thirds shining between shallow punctations which bear closely appressed setae; median third shining, finely punctate, slightly concave; midventral line weakly impressed medially, posterior extreme weakly carinate; disc lined posteriorly with a dense patch of setae (here named bruscum) arising from pits, where setae of the bruscum are broken off, pits remain visible marking border of disc. Profemur finely, sparsely punctate ventrally, anterior and posterior surfaces setose. Protibia, proximal teeth present as weak crenations. Protarsal length less than protibial length from base to apical spine; tarsomere 1 half-length of 2, 2-4 subequal, 5 subequal to 4 and 3 combined. Protibial spur broadly lanceolate, not curved laterally, subequal in length to tarsomeres 1 and 2 combined, dorsally convex, ventrally flat. Mesotrochanter bearing clump of setae of length subequal to trochanter width, setae bent in apical tenth. Mesofemur finely punctate, distally bearing a row of 11 short spines. Mesotibia lateral margin facing femur bent laterally in basal fifth, straight apically; mesal and apical intercarinae slightly concave; apical spines unequal. Inferior mesotibial spur approximately half length of superior spur, inner surface convex, polished; outer surface planar, dull, carinate around margin; spur symmetrical, adentate. Mesotarsus slightly longer than mesotibia. Metatrochanter bearing clump of setae of length subequal to trochanter width, some bent laterally in apical quarter. Metafemur finely punctate, shining; distally bearing row of 10 spines. Metatibia lateral margin facing femur bent laterally in basal fifth, straight apically; mesal and apical intercarinae weakly concave, apically flared; inner surface punctate; ventral surface bearing row of setae from base to apex; apical spines unequal in length. Inferior metatibial spur approximately four-fifths length of superior metatibial spur; inner surface of spurs convex, polished; outer surface slightly concave, dull, carinate around entire margin. Abdomen, sternites alutaceous, punctate, setose; setae appressed, length not uniform, longest setae subequal to length of one sternite, shortest setae one sixth length of one sternite. Aedeagus tegmen length approximately twice width; paramere length approximately three-quarters that of tegmen, apical declivity sharp, forming truncate angle approximately 90 degrees, in lateral aspect ventral margin concave, dorsal margin weakly convex from base to apical declivity.

3.3. Sexual dimorphism: Male metatrochanter setae present as described above; several short, straight setae present on female mesotrochanter and metatrochanter. Female inferior mesotibial spurs slender, acuminate, straight, adentate.

3.4. Variation: Length ranges from 6.5 to 7.0 mm. Width ranges from 2.5 to 3.0 mm. the weak carination of the metasternal line is absent in some worn specimens and appears to be abradable.

3.5 Type material: Holotype male: Texas: El Paso Co., El Paso, Rio Grande river plain near downtown, 12/III/1997, *G. arenarius* nest, Wm. Godwin, J. Wappes (FSCA). Allotype; same data as holotype (ETNH). Paratypes: 4, same data as holotype, (TAMU 1) (USNM 1) (Wappes Collection 1).

3.6. Etymology: The specific name refers to the habit of this species being an associate of *Geomys*, living in their nests. The name *geomynidomus* is a concatenation of the host "*Geomys*" and the Latin for nest (nidum) and the Latin for home (domus), thus translated as the *Aphodius* of the *Geomys* nest-home.

3.7. Diagnosis: The smoothly rounded, adentate clypeus of *A. geomynidomus* (Figure 1) serves to distinguish it from dentate species including undescribed species from the burrows of *Cynomys ludovicianus* (prairie dogs) in West Texas, *A. fucosus, A. ruficlarus* and any of the undescribed species known from Nevada or California. The condition of the specimens observed did not give any indication that the anterior margin of the clypeus was worn, such that any dentition would be secondarily lost. The presence of coarse pits on the vertex of the head serves to distinguish *A. geomynidomus* from *A. claudus*, *A. kirni*, *A. laevigatus*, undescribed species from burrows of *Geomys personatus* in South Texas, undescribed species from the burrows of *Geomys tropicalis* in Tamaulipas, Mexico and undescribed species from the burrows of *Geomys knoxjonesi* in West Texas, which all lack pits on the head. *Aphodius geomynidomus* is most similar to *A. concavus* which is also its most proximal geographic neighbor to the north and occurs in the burrows of *Geomys bursarius* which is widely distributed throughout the central plains of the United States from Central Texas to Canada. The male genitalia serve to distinguish the two species. The apical declivity of the aedeagus in *A. geomynidomus* is truncate (nearly 90 degrees) (Figure 2) while that of *A. concavus* is more oblique (approximately 120 degrees).

Fig 1: Habitus photo of holotype. Photo by Steve Korevec.

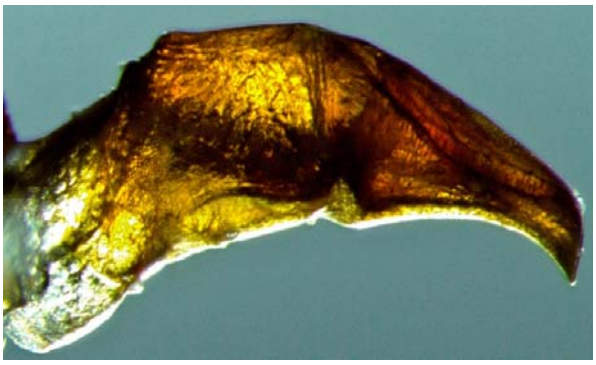

Fig 2: Aedeagus of holotype. Photo by Steve Korevec.

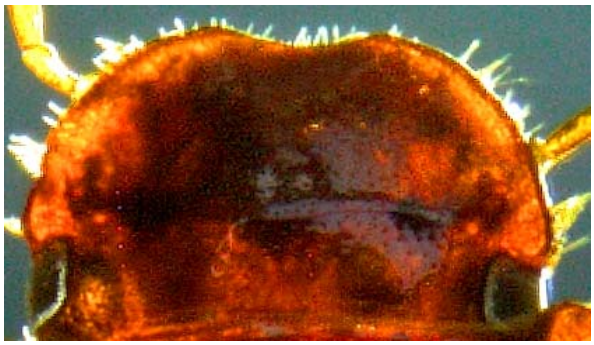

Fig 3: Detail of clypeus and head punctuation in holotype. Photo by Steve Korevec.

4. Discussion

Aphodius geomynidomus appears to be endemic to the burrows of the pocket gopher, *Geomys arenarius*, which is listed as "Near Threatened" by the International Union for Conservation of Nature and Natural Resources (IUCN 2014) [3]. The Texas Parks and Wildlife Department lists the host, *G. arenarius*, as "S2 – imperiled" in its Texas Conservation Action Plan List of Species of Greatest Conservation Need (TPWD 2012) [7]. Given this level of concern for the host species, a similar level of conservation concern should be considered for *A. geomynidomus*. The range of the host, *G. arenarius* is known to extend on both sides of the river through areas of the friable sandy soils of the river floodplain of the Rio Grande River in El Paso County north to Las Cruces, New Mexico (Williams and Baker 1974) [8] (Hafner and Geluso 1983) [2] and into the White Sands National Monument, New Mexico. It is likely that *A. geomynidomus* will be found to occur in Mexico and New Mexico.

5. Acknowledgements

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6. References

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