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Systematic revision of the species of *Geomyphilus* (Coleoptera:
Scarabaeidae: Aphodiinae) of Mexico and neighboring countries
with description of a new Mexican species

Marco Dellacasa
Museo di Storia Naturale, Università di Pisa
Via Roma, 79
I-56011 Calci (Pisa), Italy

Giovanni Dellacasa
Via Talamone 31/19
I-16127 Genova, Italy

Paul E. Skelley
Florida State Collection of Arthropods
Florida Department of Agriculture and Consumer Services
P. O. Box 147100
Gainesville, FL 32614-7100 USA

Robert D. Gordon
Northern Plains Entomology
P. O. Box 65
Willow City, ND 58384 USA

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Marco Dellacasa, Giovanni Dellacasa, Paul E. Skelley, and Robert D. Gordon
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Systematic revision of the species of *Geomyphilus* (Coleoptera: Scarabaeidae: Aphodiinae) of Mexico and neighboring countries with description of a new Mexican species

Marco Dellacasa

Museo di Storia Naturale, Università di Pisa
Via Roma, 79
I-56011 Calci (Pisa), Italy
dellacasa@museo.unipi.it

Giovanni Dellacasa

Via Talamone 31/19
I-16127 Genova, Italy
dellacasag@alice.it

Paul E. Skelley

Florida State Collection of Arthropods
Florida Department of Agriculture and Consumer Services
P. O. Box 147100
Gainesville, FL 32614-7100 USA
Paul.Skelley@FreshFromFlorida.com

Robert D. Gordon

Northern Plains Entomology
P. O. Box 65
Willow City, ND 58384 USA
rdgordon@utma.com

Abstract. A systematic redefinition of the species belonging to the genus *Geomyphilus* Gordon and Skelley, 2007 (Coleoptera: Scarabaeidae: Aphodiinae) of Mexico and neighboring countries is presented. The **new species** *G. tuzincola* of Mexico is described and figured. The **new combination** *Coelotrachelus macgregori* (Islas, 1955) is proposed.

Key Words. *G. tuzincola*, systematics, new species, new combination, *Coelotrachelus macgregori*, Nearctic, Neotropical.

Introduction

This work belongs to a series of papers devoted to the systematic revision of Mexican Aphodiinae. The genus *Geomyphilus* was described by Gordon and Skelley (2007) to include twelve species, systematically arranged in three groups, of Canada and United States. Five of those species, with distribution reaching the southern North American States adjacent to the Mexican border and the four Mexican species herein taken into consideration, make the genus even more polyphyletic. However, subdivisions at genus-group level at this time are not warranted until more materials and additional studies are available. All species with host associations live with rodents.

The main systematic characteristics of the genus are:

- Head with clypeal lateral margin glabrous or, at most, very shortly sparsely bristled; round, angulate or denticulate at sides of median sinuosity;
- Pronotum bordered at basal margin, rarely the border more or less interrupted at middle but therein irregularly crenulated by coarse punctures;
- Scutellum small, triangular;

- Hind tibiae apically fimbriate with irregularly unequal elongate spinules;
- Aedeagus usually with dorsal or apical membranous processes slender, elongate, setiform or lobiform;
- Fore tibiae, in males, never abruptly widened at inner margin.

Materials and Methods

The types of the few critical species were examined. The geographical distribution of the species as well as their natural history are reported based on reliable literary records, mainly those reported in the monograph of Aphodiini of United States and Canada by Gordon and Skelley (2007). Terminology used to describe morpho-anatomical features follows that of Dellacasa et al. (2001, 2010).

Materials studied are in the following collections:

AACX Arriaga Collection, Xalapa, Veracruz, Mexico

DCGI Dellacasa Collection, Genoa, Italy

FSCA Florida State Collection of Arthropods, Gainesville, Florida, U.S.A.

GCWC Gordon collection, Willow City, North Dakota, U.S.A.

Excluded species

Coelotrachelus macgregori (Islas, 1955), new combination

Aphodius macgregori Islas, 1955: 223.

Aphodius (Coelotrachelus) macgregori; Deloya 1991: 204; Deloya and McCarty 1992: 6

Geomyphilus (s.l.) macgregori; Skelley et al. 2007: 4.

Skelley et al. (2007) listed *A. macgregori* Islas in *Geomyphilus (sensu lato)*. Study of external morphological characters (e.g. the shape of lateral pronotal margins towards the hind angles and the epipharyngeal structure) allow us to confirm placement of the species in the genus *Coelotrachelus* Schmidt, 1913, becoming the **new combination** *Coelotrachelus macgregori* (Islas, 1955). Thus, the third couplet of the key to species of *Coelotrachelus* in Dellacasa et al. (2009) has to be modified as follows:

- 3(2). Lateral margins of pronotum regularly arcuate. Chestnut-brown. Length 6.0–7.0 mm. U.S.A. (Arizona, Colorado, New Mexico); Mexico (Chihuahua, Durango) ***C. rudis* (LeConte)**
 — Lateral margins of pronotum almost straight, slightly inwardly sinuate before hind angles **3'**
- 3'(3). Large pronotal punctures lacking on anterior third of disc. Strongly shiny, dark reddish-brown. Length 6.5–7.5 mm. Mexico (Durango, Sinaloa) ***C. symbius* (Gordon and Howden)**
 — Large pronotal punctures densely and subregularly scattered throughout. Moderately shiny, strongly dark reddish-brown, pronotal sides paler. Length 4.0–6.0 mm. Mexico (Distrito Federal, México, Morelos) ***C. macgregori* (Islas)**

Genus *Geomyphilus* Gordon and Skelley, 2007

Geomyphilus Gordon and Skelley, 2007: 393.

Type species. *Aphodius insolitus* Brown, 1928 (original designation).

Diagnosis. Rather small to medium size species (length 4.0–7.5 mm), elongate, moderately convex, shiny or weakly shiny, glabrous or almost glabrous. Piceous; clypeal margin, sides of pronotum and elytral margins reddish. Head with epistome gibbous, almost evenly coarsely punctured; clypeus sinuate at middle, denticulate, angulate or round at sides, lateral margins glabrous or, at most, with extremely

short sparse bristles; genae obtusely round, protruding or not from the eyes; frontal suture almost obsolete or feebly tuberculate. Pronotum transverse, moderately convex, sometimes depressed near hind angles; dually or evenly punctured; hind angles obtuse or widely truncate, base bordered or with border more or less widely interrupted at middle but therein crenulate by coarse punctures. Scutellum small, triangular. Elytra oblong, convex, denticulate or not at shoulder; finely striate, striae feebly crenulate or not; interstriae almost flat, finely sparsely punctured, glabrous or almost imperceptibly pubescent on preapical declivity. Fore tibiae distally tridentate and proximally not serrulate on outer margin; upperside smooth or faintly punctured. Hind tibiae with rather feeble transverse carinae on outer face; apically fimbriate with spinules irregularly unequal. Pygidium subrugosely confusedly punctured, punctures with rather elongate recumbent setae; apical margin with few straight setae. Sexual dimorphism shown in males mostly by fore tibiae spur stout, strong or, at least, digitiform, abruptly downward bent. Aedeagus with elongate, slender paramera abruptly curved and more or less acuminate apically, and with very slender elongate or lobate membranous dorsal or apical processes. Epipharynx round laterally, feebly bisinuate at anterior margin; epitorma drop-shaped; corypha with apical clump of irregularly elongate celtis; pedia densely pubescent mostly toward epitorma, mixed short chaetae almost serially arranged; chaetopariae rather short and dense.

Distribution. Nearctic and Neotropical regions.

Biology. Species rodent burrows associate.

Key to species of *Geomyphilus* of Mexico (and U.S. states bordering Mexico)

1. Genae not protruding from the eyes. Pale reddish brown; head posteriorly and pronotum on disc more or less widely brownish. Length 4.5-6.0 mm. U.S.A. (Arkansas, Illinois, Indiana, Kansas, Louisiana, Oklahoma, Texas, Wisconsin) ***G. insolitus* (Brown)**
- Genae protruding from the eyes **2**
- 2(1). Elytra denticulate at shoulder **3**
- Elytra not denticulate at shoulder **4**
- 3(2). Pronotum irregularly sparsely punctured, basal margin with border widely interrupted at middle but therein crenulate by a belt of coarse punctures. Piceous, clypeal margin, sides of pronotum and elytra reddish brown. Length 5.0-5.5 mm. Mexico (Distrito Federal, México, Puebla, Tlaxcala, Veracruz) ***G. pierai* (Deloya and Lobo)**
- Pronotum almost regularly punctured, basal margin entirely bordered. Reddish brown; clypeal margin and pronotal sides paler. Length 5.0-6.0 mm. Mexico (Distrito Federal, México, Querétaro, Tlaxcala) ***G. barrerai* (Islas)**
- 4(2). Clypeal margin denticulate or angulate at sides of median sinuosity **5**
- Clypeal margin rounded at sides of median sinuosity **8**
- 5(4). Clypeal margin distinctly denticulate at sides of median sinuosity **6**
- Clypeal margin angulate at sides of median sinuosity **7**
- 6(5). Pronotum evenly, finely and regularly punctured. Rufo-piceous; clypeal margin and elytral lateral margins reddish. Length 5.0–5.5 mm. Mexico (México, Morelos) ***G. coronadoi* (Islas)**
- Pronotum dually, irregularly punctured. Piceous; pronotal sides, juxtasutural interstria and apical margin of elytra reddish. Length 4.5–5.0 mm. Mexico (México, Querétaro) ***G. tuzincola* new species**
- 7(5). Clypeal margin obtusely angulate at sides of median sinuosity and moderately sinuate at middle; epistome densely not rugosely punctured. Red to dark brown; epistome and pronotal disc slightly darker. Length 4.0-5.0 mm. U.S.A. (Arizona) ***G. rubiginosus* (Horn)**

- Clypeal margin acutely angulate at sides of median sinuosity and deeply sinuate at middle; epistome rugosely punctured. Yellowish brown; head and pronotum reddish brown. Length 4.5–5.0 mm. U.S.A. (Kansas, Nebraska, Texas) ... ***G. kiowensis* (Gordon and Salsbury)**
- 8(4). Pronotum not depressed on sides near posterior angles; dually irregularly punctured throughout. Light reddish brown; sometimes head and pronotum slightly darker. Length 6.0–7.5 mm. U.S.A. (Arizona, Illinois, Iowa, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota) ***G. russeus* (Brown)**
- Pronotum more or less strongly depressed on sides near posterior angles **9**
- 9(8). Pronotum strongly depressed near posterior angles; punctures of depression foveate, nearly coalescent and notably larger than those on disc. Yellowish brown; head, pronotum and elytral suture reddish brown. Length 4.5–5.0 mm. U.S.A. (Arizona) ***G. geronimo* Gordon and Skelley**
- Pronotum weakly depressed near posterior angles; punctures of depression not foveate, rather sparse, smaller than those on disc **10**
- 10(9). Elytral interstriae finely sparsely punctured. Yellowish brown; clypeal margin and pronotal sides reddish brown; elytra somewhat darker. Length 4.0–4.5 mm. U.S.A. (California) ***G. essigi* (Saylor)**
- Elytral interstriae distinctly and rather densely punctured. Head and pronotum piceous; clypeal margin and pronotal sides shadowy reddish; elytra dirty yellow with a lateral fuscous shade widened from shoulder to beyond the middle. Length 5.0–6.0 mm. U.S.A. (California) ***G. ungulatus* (Fall)**

***Geomyphilus barrerai* (Islas, 1955)**

(Fig. 1–5)

Aphodius (*Platyderides*) *barrerai* Islas, 1955: 493; Dellacasa 1988: 251.

Geomyphilus barrerai; Skelley et al. 2007: 4.

Type locality. “Tlamacas, E.do México” [Mexico].

Type repository. Instituto de Biología, U.N.A.M. Mexico City (type not examined).

Redescription. Length 5.0–6.0 mm; moderately elongate, moderately convex, weakly shiny, nearly glabrous. Reddish-brown; clypeal margin and pronotal sides paler; legs reddish-brown; antennal club dark brown. Head with epistome feebly gibbous on disc, superficially microreticulate, almost densely regularly punctured throughout; clypeus feebly evenly arcuately sinuate at middle, denticulate on each side, denticles more or less acute and more or less strongly upturned, finely bordered, edge shortly and sparsely bristled; genae obtusely round, densely elongately ciliate, feebly protruding from the eyes; frontal suture finely impressed laterally only; front relatively more coarsely punctured. Pronotum transverse, moderately convex, superficially microreticulate, almost regularly and rather densely punctured, punctation somewhat irregular and denser on sides, some more superficial toward hind angles; sides narrowly and feebly flattened; lateral margins thickly bordered, edge almost imperceptibly bristled, subsinuate and broadly inwardly emarginate before subtruncate hind angles; base faintly bisinuate, thickly bordered, border confusedly crenulate by coarse punctures. Scutellum distinctly punctured on basal half. Elytra rather shortly oval, moderately convex, strongly denticulate at shoulder, denticle outwardly directed; striae fine, superficially almost indistinctly punctured, not at all crenulate; interstriae flat, superficially microreticulate, finely sparsely punctured, preapically with extremely short pale hairs. Hind tibiae upper spur nearly as long as first tarsal segment; latter slightly longer than following three segments combined. Male: fore tibiae spur stout, subcylindrical, abruptly downward bent; aedeagus Fig. 4–5. Female: fore tibiae spur slender, regularly conical, not so abruptly bent downward.

Material examined. **MEXICO: México:** Amecameca-Tlamacas, 27.X.1953, leg. A. Barrera, nido de *Cratogeomys merriami* (Th) (2 exx., DCGI); **Querétaro:** Municipio Pinal de Amoles, 3 air miles W Pinal de Amoles, 21°07'21"N, 099°40'17"W, m 2575, 10–13.XII.2013, leg. P. Skelley, P. Kovarik & R. Jones, *Orthogeomys burrow* (2 exx., FSCA); **Tlaxcala:** Malinche, 19°17'02.3"N, 098°02'46.9"W, m 3029, 20.VIII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (4 exx., DCGI).

Distribution. Mexico (Distrito Federal, México, Querétaro, Tlaxcala).

Biology. An autumn active rodent associated species. Specimens examined were collected in the nest of *Cratogeomys merriami* and *Orthogeomys* (label data).

***Geomyphilus coronadoi* (Islas, 1955)**

(Fig. 6–10)

Aphodius (*Platyderides*) *coronadoi* Islas, 1955: 495; Dellacasa 1988: 251.

Geomyphilus coronadoi; Skelley et al. 2007: 4.

Type locality. Zempoala, Edo. Mor[elos]., Mexico.

Type repository. Instituto de Biología, U.N.A.M. Mexico City (type not examined).

Redescription. Length 5.0–5.5 mm; oblong, moderately convex, shiny, glabrous. Rufo-piceous; head distally, elytra margins and legs reddish, antennal club brownish. Head with epistome gibbous on disc and distinctly bent toward apical margin, densely regularly, moderately coarsely punctured; punctation somewhat confused distally; clypeus widely sinuate at middle, with small denticles feebly upturned on sides, faintly bordered, edge glabrous; genae obtusely round, elongately ciliate, distinctly protruding from the eyes; frontal suture not tuberculate, almost obsolete; front with punctation relatively sparser and more irregular than on epistome. Pronotum transverse, moderately convex, subregularly punctured, punctation fine and almost sparse on disc, somewhat irregular, coarser and denser on sides; latter feebly arcuate, thickly bordered, edge glabrous; hind angles obtusely round, base distinctly bordered. Scutellum with curved sides and with few large punctures on basal half. Elytra oblong, moderately convex; striae fine, subcrenulate, very superficially impressed toward apex; interstriae almost flat, distinctly, irregularly punctured. Hind tibiae upper spur shorter than first tarsal segment; latter longer than following two segments combined. Male: fore tibiae spur large, somewhat explanate, abruptly downward bent and curved outwardly; aedeagus Fig. 9–10. Female: fore tibiae spur slender, almost straight and regularly acuminate.

Material examined. **MEXICO: México:** Amecameca, 13.X.1955, leg. G. Halffter (1 ex., DCGI); Tlamacas, 29.X.1953. leg. A. Barrera, nido de *Cratogeomys merriami* (1 ex., DCGI).

Distribution. Mexico (México, Morelos).

Biology. An autumn active rodent associated species. One of the specimens examined was collected in the nest of *Cratogeomys merriami* (label data).

***Geomyphilus essigi* (Saylor, 1935)**

(Fig. 11–15)

Aphodius essigi Saylor, 1935: 134.

Aphodius (*Nobius?*) *essigi*; Dellacasa 1988: 351.

Geomyphilus essigi; Gordon and Skelley 2007: 404.

Type locality. Somma Co., California [U.S.A.].

Type repository. California Academy of Sciences. San Francisco, U.S.A. (type not examined).

Redescription. Length 4.0–4.5 mm; oblong, convex, moderately shiny, glabrous. Head distally, pronotum sides and legs reddish brown; elytra dark yellowish brown; antennal club rufo-piceous. Head with epistome feebly convex on disc, somewhat depressed medially toward clypeal margin, finely, not closely, regularly punctured; clypeus sinuate at middle, round at sides, thinly bordered, edge feebly upturned, glabrous; genae obtusely round, sparsely ciliate, protruding from the eyes; frontal suture slightly tuberculate at least medially; front finely, rather densely, regularly punctured. Pronotum transverse, moderately convex, dually punctured; large punctures, five to six times larger than small, irregularly scattered throughout; small fine punctures, not densely, somewhat regularly sparse all over; lateral margins feebly arcuate, distinctly bordered, edge glabrous; hind angles obtusely round; base slightly bisinuate, distinctly bordered. Scutellum flat, coarsely punctured on basal half. Elytra elongate, almost parallel-sided, rather deeply striate; striae coarsely, not closely punctured, crenulate, interstriae moderately convex, finely irregularly punctured. Hind tibiae upper spur shorter than first tarsal segment; latter as long as following three segments combined. Male: frontal suture with feeble median tubercle; inferior spur of middle tibiae stout, short and apically subtruncate; aedeagus Fig. 14–15. Possibly in female the fore tibiae spur may be slender, almost straight and regularly acuminate.

Material examined. U.S.A.: California: Danville, Contra Costa Co., 07–24.IV.1952, leg. F. X. Williams, ex gopher nests (1 ex., GCWC).

Distribution. U.S.A. (California).

Biology. Apparently a rodent associate species collected from April to December. Some specimens were taken in gopher nests.

***Geomyphilus geronimo* Gordon and Skelley, 2007**

(Fig. 16–20)

Geomyphilus geronimo Gordon and Skelley, 2007: 405.

Type locality. 8 mi. SE of Portal State line Rd. at Portal Rd., 4400 ft., Cochise Co., Arizona [U.S.A.].

Type repository. Florida State Collection of Arthropods. Gainesville, Florida, U.S.A. (holotype examined).

Redescription. Length 4.5–5.0 mm; oval elongate, convex, weakly shiny, almost glabrous. Yellowish brown; head, pronotum and elytral suture reddish brown; legs yellowish; antennal club testaceous. Head with epistome weakly gibbous on disc, moderately depressed medially toward clypeal margin, densely coarsely evenly punctured on disc, punctation confusedly rugose distally; clypeus rather deeply sinuate at middle, round at sides, finely bordered, edge upturned, extremely shortly sparsely bristled; genae obtusely round, sparsely elongately ciliate, protruding from the eyes; frontal suture finely impressed, somewhat gibbous laterally and medially; front coarsely densely almost evenly punctured. Pronotum transverse, convex, slightly alutaceous, somewhat depressed laterally near posterior angles, irregularly densely punctured; punctures larger on sides, contiguous in posterior depression, becoming smaller and more superficial on disc; lateral margins feebly arcuate, rather thickly bordered, edge shortly sparsely ciliate; hind angles obtusely round; basal margin evenly arcuate, distinctly bordered. Scutellum coarsely irregularly punctured on basal half. Elytra almost parallel-sided, strongly convex, slightly alutaceous thus moderately shiny; striae fine, distinctly punctured, feebly crenulate; interstriae weakly convex, densely finely irregularly punctured, sparsely extremely shortly haired on preapical declivity. Hind tibiae upper spur shorter than first tarsal segment; latter shorter than following three segments combined. Male: fore tibiae spur thickened, sinuately elongate, abruptly downward bent; inferior spur of middle tibiae short, strong, apically truncate and with a small inner tooth; aedeagus Fig. 19–20. Female: fore

tibiae spur not thickened and almost straight; inferior spur of middle tibiae regularly elongate, slender and apically acuminate.

Material examined. U.S.A.: Arizona: 8 mi. SE of Portal State Line Road at Portal, Cochise Co., 4400 ft, 12.VIII.1979, leg. J. Saulnier, decomposition duff of banner-tailed kangaroo rat *Dipodomys spectabilis* (holotype male and allotype, FSCA).

Distribution. Known from the type locality only.

Biology. Species collected in decomposing duff of banner-tailed kangaroo rat, *Dipodomys spectabilis*.

***Geomyphilus insolitus* (Brown, 1928)**

(Fig. 21–25)

Aphodius (Platyderides) insolitus Brown, 1928: 18; Dellacasa 1988: 314.

Geomyphilus insolitus; Gordon and Skelley 2007: 399.

Type locality. Payne Co., Oklahoma [U.S.A.].

Type repository. Canadian National Collection. Ottawa (type not examined).

Redescription. Length 4.5–6.0 mm; elongate-oblong, moderately convex, shiny, glabrous. Pale reddish brown; head posteriorly and pronotal disc more or less widely brownish; legs and antennal club pale reddish brown. Head with epistome moderately convex on disc, toward clypeal margin sparsely minutely granulate; finely, rather closely and somewhat irregularly punctured postero-medially; clypeus feebly sinuate at middle, obtusely round at sides, lateral margins arcuate, thinly bordered, edge reflexed and glabrous; genae broadly round, ciliate, not protruding from the eyes; front rather finely, irregularly punctured. Pronotum moderately convex, shallowly depressed near posterior angles, dually punctured; large coarse punctures, ten times or more larger than small, irregularly scattered throughout, denser near hind angles, closer on sides, sparser on disc; small, very fine punctures not closely, evenly sparse throughout; anterior angles broadly round; lateral margins rather subparallel toward base and slightly inwardly sinuate before hind angles, thinly bordered, edge glabrous; hind angles obtusely round, base regularly arcuate, finely bordered. Scutellum distinctly punctured on basal half. Elytra slightly broader posteriorly; striae fine, rather closely punctured, subcrenulate; interstriae almost flat, very finely and sparsely punctured. Hind tibiae upper spur somewhat shorter than first tarsal segment; latter as long as following three segments combined. Male: pronotum relatively less convex, more transverse, more sparsely punctured; fore tibiae spur stout; inferior spur of middle tibiae shortened and obliquely truncate apically; aedeagus Fig. 24–25. Female: pronotum relatively more convex, less transverse, more densely punctured; fore tibiae spur slender; middle tibiae inferior spur acuminate.

Material examined. U.S.A.: Illinois: 4 mi. NW of Hopkins Pk., Kankakee Co., 29.IV.1948, leg H. F. Dybas & R. F. Inger, ex a fecal chamber of *Geomys bursarius illinoensis* (1 ex., DCGI); Hopkins Park, Kankakee Co., reared from larvae collected ex fecal chamber of *Geomys bursarius illinoensis*, adults emerged on 25.V.1951; leg. H. F. Dybas & R. F. Inger (2 exx., DCGI); **Indiana:** 3 mi. S. jct. Hwy 10 & Sr. 55, on Sr. 55, Newton Co., 29.IX–08.XII.1991, leg. P. Kovarik, *Geomys* burrow pitfall (1 ex., DCGI); **Oklahoma:** vcty. Wilburton, Latimer Co., 19–21.XII.1991, leg. K. Stephan & P. Skelley (206 exx., DCGI).

Distribution. U.S.A. (Arkansas, Illinois, Indiana, Kansas, Louisiana, Oklahoma, Texas, Wisconsin).

Biology. A species found in late autumn, winter and early spring associated with rodents; probably exclusive inhabitant in burrows of pocket gopher (*Geomys bursarius*).

***Geomyphilus kiowensis* (Gordon and Salsbury, 1999)**

(Fig. 26–30)

Aphodius kiowensis Gordon and Salsbury, 1999: 65.

Geomyphilus kiowensis; Gordon and Skelley 2007: 406.

Type locality. 4 mi. NW Coldwater, Comanche Co., Kansas (U.S.A.).

Type repository. United States National Museum. Washington (type not examined).

Redescription. Length 4.5–5.0 mm; elongate convex, moderately shiny, almost glabrous. Yellowish brown, head and pronotum reddish brown, slightly darker, legs yellowish brown; antennal club dark brown. Head with epistome feebly gibbous on disc, anteriorly with trace of transverse carina, densely rugose distally, somewhat more slightly rugose and with irregularly immixed few coarse punctures on disc; clypeus deeply sinuate at middle with large, broad and blunt tooth at each side, thinly bordered, edge glabrous and feebly raised; genae obtusely round, sparsely shortly ciliate, protruding from the eyes; frontal suture barely distinct, faintly tuberculate; front densely coarsely evenly punctured. Pronotum transverse, moderately convex, slightly concave before hind angles, superficially alutaceous thus weakly shiny, dually densely punctured; large punctures, two to three times larger than small, denser on sides; small punctures almost evenly scattered throughout; lateral margins arcuate, rather thinly bordered, edge glabrous; hind angles obtusely round; base completely thinly bordered. Scutellum almost flat, distinctly punctured on basal half. Elytra moderately convex, feebly broadened posteriorly, shiny; striae deep, rather finely punctured, subcrenulate; interstriae almost flat, with row of dense, fine punctures on each side near striae, each puncture with fine, short, nearly invisible seta. Hind tibiae upper spur shorter than first tarsal segment; latter longer than following two segments combined. Male: fore tibiae spur relatively longer and abruptly curved downward; inferior spur of middle tibiae slightly bent inward before apex and in lateral view abruptly angled; pronotum relatively more transverse, less convex and less densely punctured; aedeagus Fig. 29–30. Female: fore tibiae spur nearly straight; inferior spur of middle tibiae regularly acuminate; pronotum relatively narrower, more convex and more coarsely punctured.

Material examined. U.S.A.: Nebraska: S. of Lodgepole, 41°06'21"N, 102°36'36"W, 4020 ft., Cheyenne Co., 06.IX.2009, leg. M. Paulsen & P. Skelley, flying in warm calm afternoon over pasture W/gopher/p-dogs (2 exx., DCGI).

Distribution. U.S.A. (Kansas, Nebraska, Texas).

Biology. Poorly known. Most specimens were collected in winter or in early spring in flight over rodent communities.

***Geomyphilus pierai* (Deloya and Lobo, 1996)**

(Fig. 31–35)

Aphodius (*Platyderus* [sic!]) *pierai* Deloya and Lobo, 1996: 44.

Geomyphilus pierai; Skelley et al. 2007: 4.

Type locality. Los Pescados, Cofre de Perote, Estado de Veracruz, Mexico.

Type repository. Instituto de Ecología, Xalapa, Veracruz, Mexico (type not examined).

Redescription. Length 5.0–5.5 mm; oval-elongate, moderately convex, shiny, glabrous. Piceous, clypeal margin, sides of pronotum and elytra reddish-brown; legs brownish; antennal club blackish. Head with epistome moderately convex, finely and somewhat irregularly punctured, punctation more superficial and confused distally; clypeus faintly sinuate at middle, distinctly denticulate at sides, denticles upturned, lateral margins feebly arcuate, not bordered, glabrous; genae obtuse, rather shortly ciliate, distinctly protruding from the eyes; lateral vestiges of frontal suture only; front somewhat more coarsely and irregularly punctured than epistome. Pronotum moderately transverse, moderately convex, narrowly flattened on sides; dually irregularly punctured, large punctures, three to four times larger than small, denser on sides and toward base, almost lacking anteriorly; small rather fine punctures regularly scattered throughout; lateral margins distinctly bordered, feebly inwardly sinuate before hind angles; latter broadly truncate, edge glabrous; basal margin with border widely interrupted at middle but therein crenulate by a contiguous belt of coarse punctures. Scutellum regularly triangular, sparsely punctured on basal half. Elytra elongate, slightly widened posteriorly, distinctly denticulate at shoulder, finely striate; striae rather deep, distinctly punctured; interstriae flat, very finely and sparsely punctured. Hind tibiae upper spur faintly longer than first tarsal segment; latter as long as following three segments combined. Male: head and pronotum relatively less densely punctured; fore tibiae spur short, stout and abruptly downward bent; aedeagus Fig. 34–35. Female: head and pronotum relatively more densely punctured; fore tibiae apical spur slender and regularly curved.

Material examined. MEXICO: Distrito Federal: 15 km S. Parros, m 2910, II.1971, leg. J. Podilla (1 ex., DCGI); **México:** San Martín Chaco, 14.VI.2002, bosque de *Abies*, leg. Y. Mora (1 ex., DCGI); **Veracruz:** Los Pescados, Cofre de Perote, m 3200, 11.VIII.1993, leg. J. Lobo, en nido de Tuza (*Pappogeomys merriami* [nunc *Cratogeomys merriami*]) (1 ex., DCGI); Cofre de Perote, 19°32'40.5"N, 097°07'43.1"W, m 3135, 12.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (8 exx., AACX, DCGI); *idem*, 19°27'29.2"N, 097°10'55.1"W, m 3243, 13.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (64 exx., AACX, DCGI); *idem*, 19°27'26.6"N, 097°10'56.1"W, m 3233, 13.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (37 exx., AACX, DCGI); *idem*, 19°30'04.3"N, 097°07'12.3"W, m 3239, 14.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (10 exx., AACX, DCGI); *idem*, 19°27'29.1"N, 097°10'56.0"W, m 3236, 15.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (40 exx., AACX, DCGI); *idem*, 19°03'14.3"N, 097°24'03.9"W, m 2789, 20.VII.2012, leg. A. Arriaga, nido de Tuza (*Cratogeomys merriami*) (10 exx., AACX, DCGI).

Distribution. Mexico (Distrito Federal, México, Puebla, Tlaxcala, Veracruz).

Biology. Possibly a rodent associate species. Most specimens examined were collected in nests of *Cratogeomys merriami*.

***Geomyphilus rubiginosus* (Horn, 1870)**

(Fig. 36–40)

Aphodius rubiginosus Horn, 1870: 127; 1887: 39.

Aphodius (*Koshantschikovius*) *rubiginosus*; Schmidt 1913: 150; Dellacasa 1988: 191.

Geomyphilus rubiginosus; Gordon and Skelley 2007: 400.

Type locality. Camp Grant, San Pedro River, Arizona [U.S.A.].

Type repository. Museum of Comparative Zoology, Harvard University, Cambridge, MA (U.S.A.) (type not examined).

Redescription. Length 4.0–5.0 mm; moderately elongate; moderately convex, feebly shiny, glabrous. Red to dark brown; epistome and pronotal disc slightly darker; antennal club rufo-testaceous. Head with epistome slightly convex on disc, antero-medially depressed toward clypeal margin, densely almost evenly punctured, punctures somewhat coarser distally; clypeus broadly sinuate at middle, subangulate

at sides, lateral margins regularly arcuate, thinly bordered, edge slightly raised, glabrous; genae obtusely round, shortly sparsely ciliate, protruding from the eyes; frontal suture barely distinct and faintly tuberculate; front evenly coarsely rather densely punctured. Pronotum transverse, moderately convex, not explanate at sides, coarsely and densely dually punctured; large punctures, two times larger than small, not denser on sides and lacking on disc; small punctures almost evenly scattered throughout; lateral margins feebly arcuate, rather thinly bordered, edge glabrous; hind angles obtuse; base regularly arcuate, thinly bordered. Scutellum somewhat convex, finely alutaceous, coarsely irregularly punctured on basal two thirds. Elytra feebly widened posteriorly; striae fine, moderately impressed, closely punctured, crenulate; interstriae almost flat, rather coarsely irregularly punctured. Hind tibiae upper spur shorter than first tarsal segment; latter almost as long as following three segments combined. Male: fore tibiae spur relatively stout, abruptly downward curved; head and pronotum more transverse, less convex and less densely punctured; metasternal plate distinctly excavate; aedeagus Fig. 39–40. Female: fore tibiae spur slender and feebly arcuate; head and pronotum narrower, more convex and more densely punctured; metasternal plate almost flat.

Material examined. U.S.A.: **Arizona:** Wickenburg-Simpson Ranch, Maricopa, 12S 34.0765E 37.59185N UTM, 16–23.I.2008, 2013 ft., leg. P. Kaufman, deer dung baited pitfall in *Thomomys bottae* burrow (6 exx., DCGI).

Distribution. U.S.A. (Arizona).

Biology. Almost certainly a rodent burrows associate species collected from January to April. Trapped from burrows and reared from dung of *Thomomys bottae*.

***Geomyphilus russeus* (Brown, 1928)**

(Fig. 41–45)

Aphodius (*Platyderides*) *russeus* Brown, 1928: 14; Dellacasa 1988: 252.

Aphodius russeus; Ratcliffe 1991: 56.

Geomyphilus russeus; Gordon and Skelley 2007: 408.

Type locality. Payne Co., Oklahoma [U.S.A.].

Type repository. Canadian National Collection. Ottawa (type not examined).

Redescription. Length 6.0–7.5 mm; oblong, moderately convex. shiny, glabrous. Pale reddish brown, head and pronotum slightly darker. Head with epistome gibbous on disc, finely punctured, rather coarsely closely, evenly punctured distally; clypeus broadly sinuate at middle, round at sides, very thinly bordered, edge upturned, glabrous; genae obtusely angulate, sparsely rather shortly ciliate, strongly protruding from the eyes; frontal suture finely impressed, faintly trigibbous; front coarsely densely evenly punctured throughout. Pronotum transverse, moderately convex, narrowly explanate toward anterior angles, dually punctured and with a posteromedian longitudinal areola impunctate; large punctures, three to four times larger than small, irregularly scattered, sparser on disc, denser on sides but absent on anteromedian discal area; small punctures rather irregularly sparse throughout but evenly dense at middle of anterior third; lateral margins almost straight, rather thinly bordered, edge glabrous; hind angles obtuse; base evenly arcuate, very thinly bordered. Scutellum flat, distinctly punctured basally. Elytra oval elongate, feebly broadened posteriorly, alutaceous on preapical declivity, finely striate; striae closely not deeply punctured, faintly crenulate; interstriae flat, finely, barely perceptibly punctate. Hind tibiae upper spur as long as first tarsal segment; latter almost as long as following three segments combined. Male: fore tibiae spur thickened and abruptly bent downward toward apex; inferior spur of middle tibiae very short, apically truncate; aedeagus Fig. 44–45. Female: fore tibiae spur slender and feebly bent downward; inferior spur of middle tibiae moderately elongate but slender and acuminate.

Material examined. U.S.A.: New Mexico: Raven Flats, Bernalillo Co., 7627 ft, UTM 13S 37.98306E 38.74097N, 08.XI.2010, leg. J. M. Rowland, under dead gopher in tunnel (2 exx., DCGI).

Distribution. U.S.A. (Arizona, Illinois, Iowa, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota).

Biology. July to October widespread species rodent burrows associate. Sometimes it has been collected in burrows of *Geomys bursarius*.

***Geomyphilus tuzincola* new species**

(Fig. 46–50)

Type locality. Municipio San Joaquín, Campo Alegre, 20°54'47"N, 099°34'35"W, Estado de Querétaro, Mexico.

Type repository. Florida State Collection of Arthropods, Gainesville, Florida, U.S.A.

Description. Length 4.5–5.0 mm, elongate, moderately convex, shiny, glabrous. Piceous; clypeal margin, pronotal sides, juxtasutural interstriae and apical margins of elytra reddish-brown; legs reddish; antennal club piceous. Head with epistome moderately gibbous, somewhat irregularly, rather densely coarsely punctured; punctation distally confusedly subrugose; clypeus moderately angulately sinuate at middle, denticulate at sides, rather thickly bordered, the edge feebly upturned; genae obtusely round, sparsely elongately ciliate, protruding from the eyes; frontal suture almost obsolete; front coarsely subregularly punctured. Pronotum transverse, moderately convex, dually punctured; large punctures, three to four times larger than small ones, denser and coarser on sides, sparse and almost lacking on disc; small punctures dense and coarse on sides, fine and sparse on disc; lateral margins feebly arcuate, rather thickly bordered; hind angles obtusely round; base not bisinuate, finely bordered. Scutellum with few punctures on basal third. Elytra oblong, convex, not denticulate at shoulder, finely striate; striae superficially punctured, not crenulate; interstriae almost flat, distinctly sparsely punctured. Hind tibiae upper spur as long as first tarsal segment; latter as long as following three segments combined. Male: fore tibiae spur digitiform, as long as first three tarsal segments; aedeagus Fig. 49–50. Female: fore tibiae spur almost regularly acuminate, feebly curved and as long as first two tarsal segments.

Type material. MEXICO: México: 2 km S [San Nicolás] Coatepec, 19°7.5'N, 099°25.5'W; m 2730, 18.II.2001, leg. D. J. Hafner, M. S. Hafner & J. E. Light, sifted from *Cratogeomys merriami* nest material (2 exx., paratypes, DCGI); Querétaro: Municipio San Joaquín, Campo Alegre, 20°54'47"N, 099°34'35"W, m 2480, 08–15.XII.2013, leg. P. Skelley, P. Kovarik & R. Jones, *Orthogeomys* burrow (1 male, **holotype**, 1 female, **allotype**, FSCA); Municipio San Joaquín, Campo Alegre, 20.915645°N, 099.572218°W, m 2456, 11–21-VIII-2015, leg. P. Skelley et al., tuza burrow (1 ex., paratype, FSCA).

Distribution. Mexico (México, Querétaro).

Etymology. The name results from the combination of the Mexican vernacular name “tuza” used for several species of rodents and the Latin suffix “incola” [= inhabitant], and is here considered masculine in gender.

Biology. Specimens were collected sifting materials found in nests of rodents.

***Geomyphilus ungulatus* (Fall, 1901)**

(Fig. 51–55)

Aphodius ungulatus Fall, 1901: 254; Schmidt 1922: 336 (*subgenere incerto*).

Aphodius (Chilothorax) ungulatus; Dellacasa 1988: 212.

Geomyphilus ungulatus; Gordon and Skelley 2007: 411 (lectotype designation).

Type locality. Pasadena, California [U.S.A.].

Type repository. Museum of Comparative Zoology. Harvard University, Cambridge. MA (U.S.A.) (type not examined).

Redescription. Length 5.0–6.0 mm; oblong, moderately convex, moderately shiny, glabrous. Head and pronotum piceous; clypeal margin and pronotal sides shadowy reddish; elytra dirty yellow with a lateral fuscous shade widened from shoulder to beyond the middle; legs pale brown; antennal club fuscous. Head with epistome feebly convex, rather evenly, moderately punctured; punctation distally almost granulo-rugose, finer and sparser on disc; clypeus broadly sinuate at middle, distinctly angulate at sides, thinly bordered, edge slightly reflexed, finely and sparsely fimbriate laterally; genae obtusely round, elongately ciliate, protruding from the eyes; frontal suture obsolete; front moderately evenly punctured. Pronotum transverse, feebly depressed near hind angles, dually punctured; large punctures, three times larger than small ones, close and coarse on sides, lacking on disc; small punctures dense and deeper on sides, sparse and superficial on disc; lateral margins slightly arcuate, thinly bordered, edge sparsely shortly fimbriate; hind angles obtuse; base almost regularly arcuate, thickly bordered toward hind angles, thinly bordered medially. Scutellum flat, coarsely densely punctured on basal half. Elytra oval, scarcely broader posteriorly, finely striate; striae superficially not closely punctured, subcrenulate; interstriae almost flat, strongly alutaceous on preapical declivity, finely irregularly punctured. Hind tibiae upper spur shorter than first tarsal segment; latter as long as following two segments combined. All claws very slender and exceptionally elongate. Male: head and pronotum relatively less convex and less coarsely punctured; aedeagus Fig. 54–55. Female: head and pronotum relatively more convex and more coarsely punctured.

Material examined. U.S.A.: California: Cypress Co., 22.XI.1930, leg. A. C. Davis, hole of *Citellus* (1 ex., DCGI); Rt. 71 16.22 mi. fr. San Bernardino County line, Riverside Co., 03.X.1972, leg. J. Saulnier, refuge chamber of *Thomomys bottae* (8 exx., DCGI).

Distribution. U.S.A. (California).

Biology. Apparently a rodent associate species, collected from November to February.

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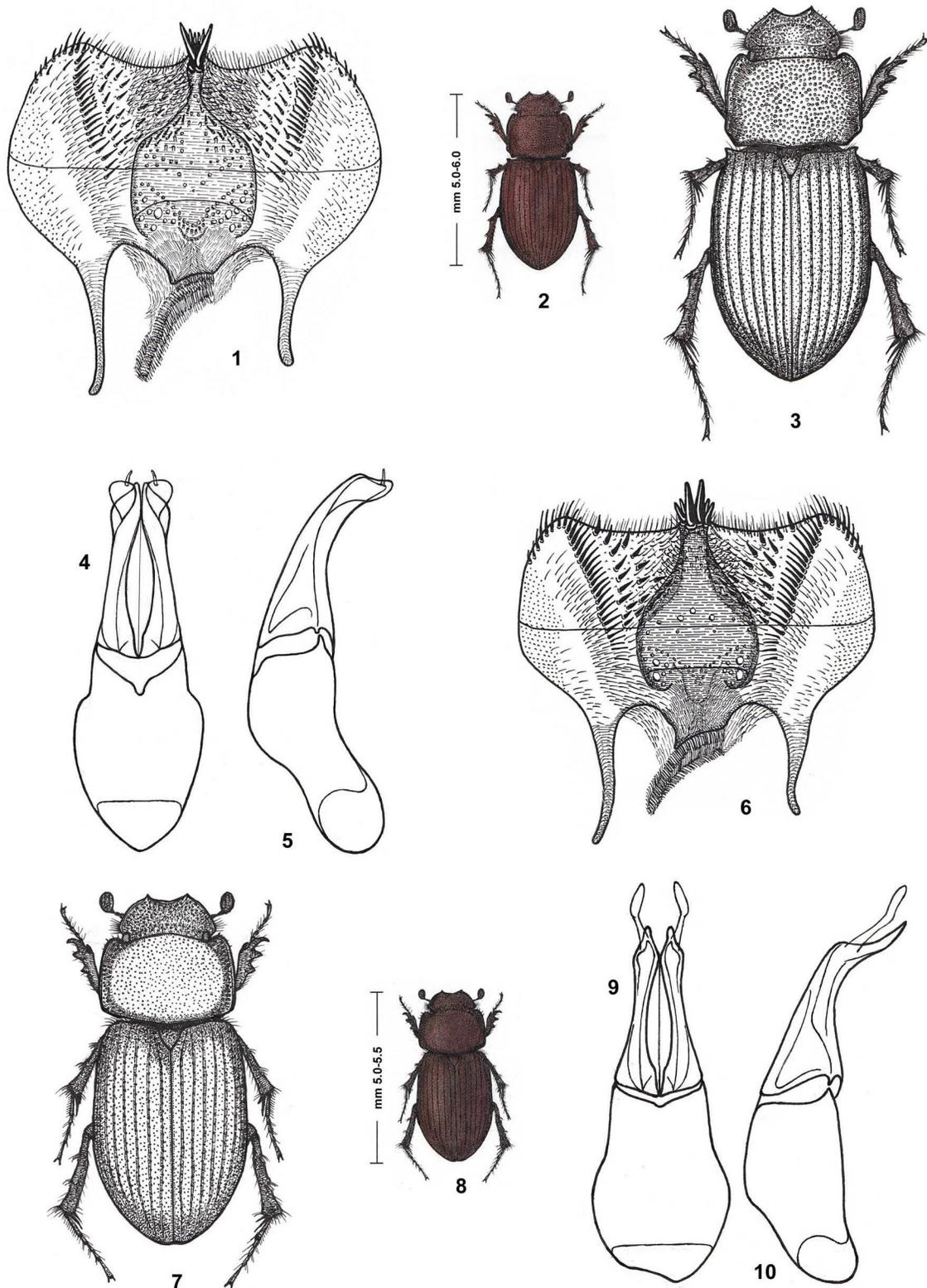
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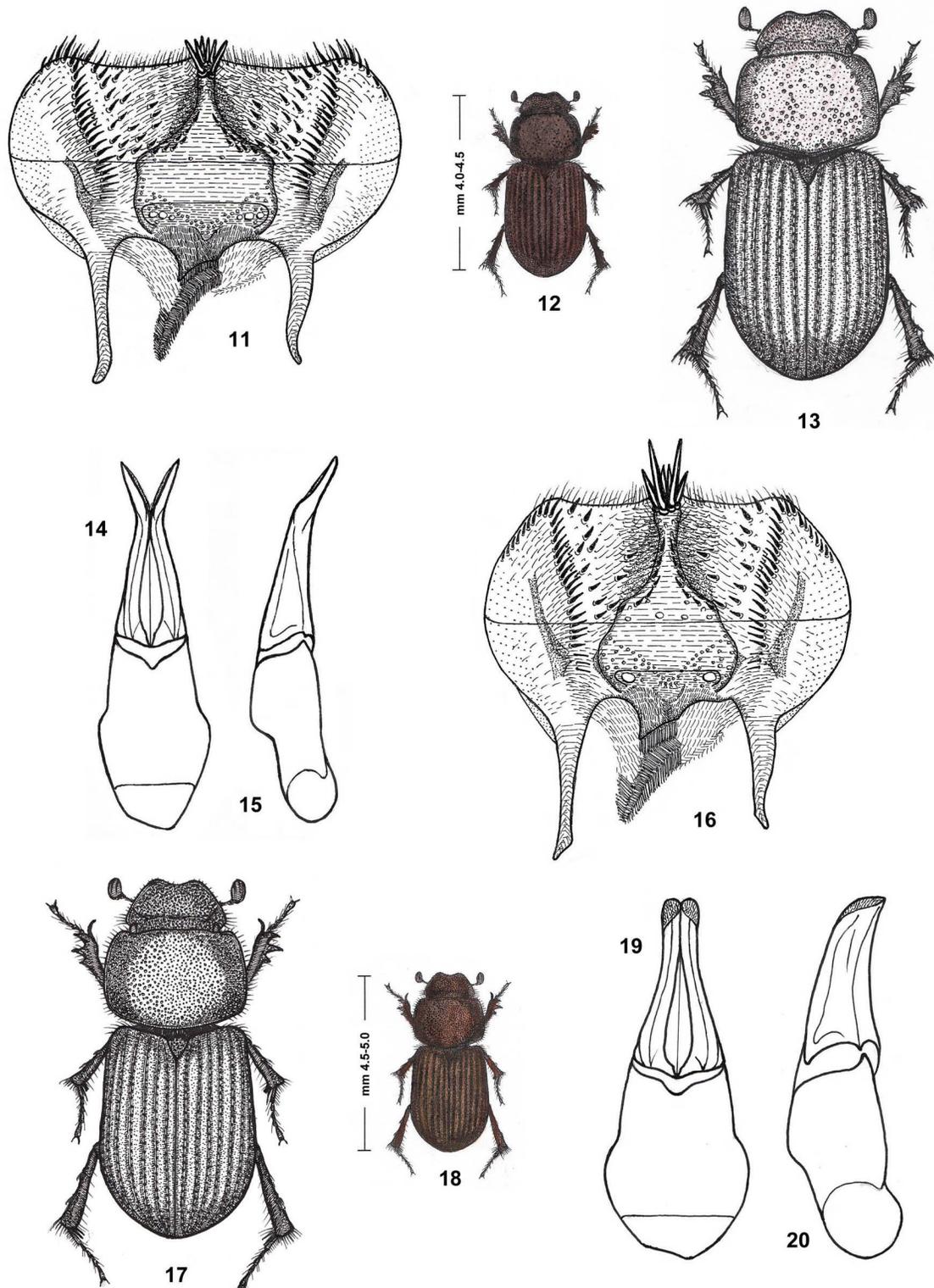
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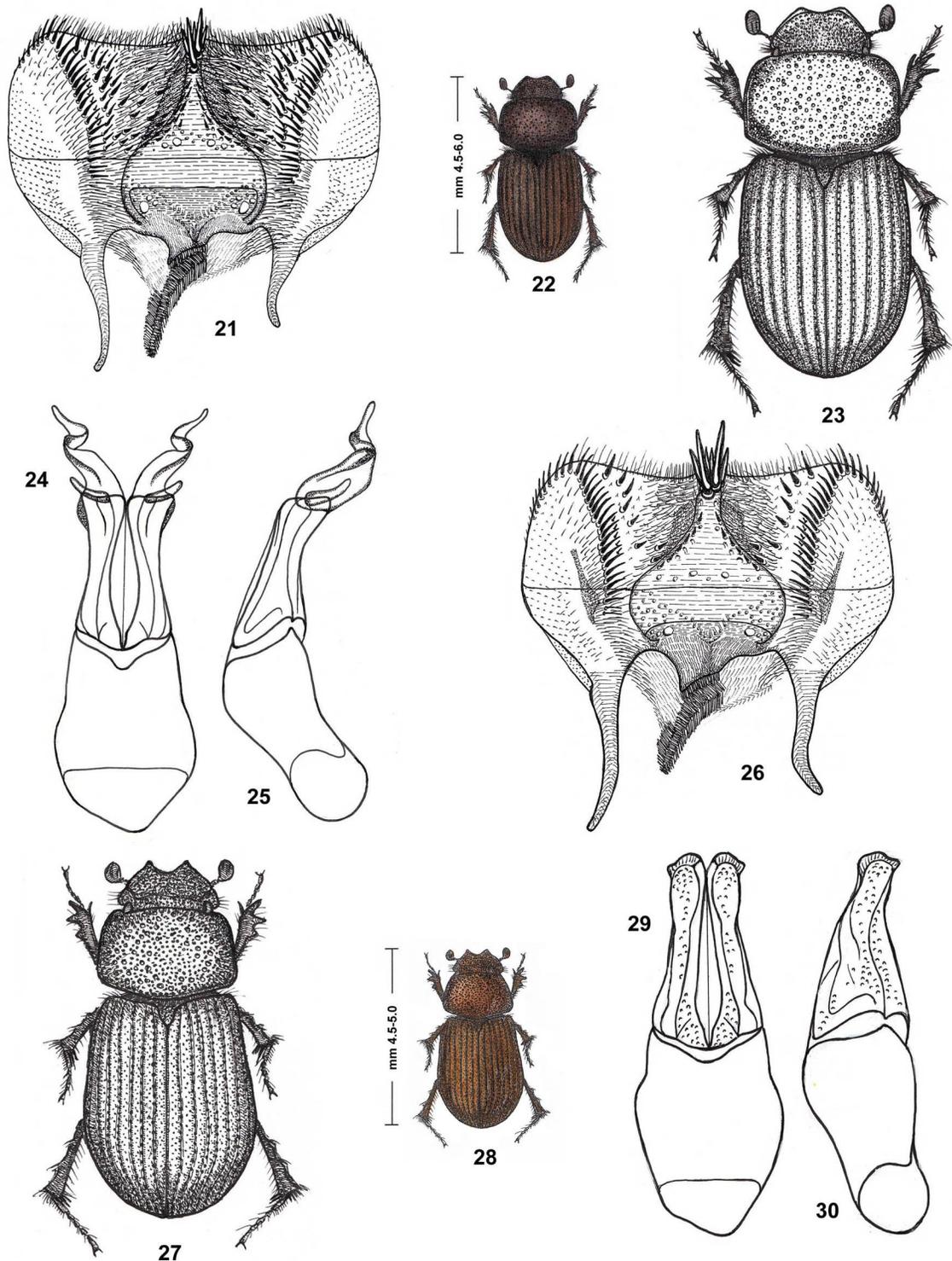
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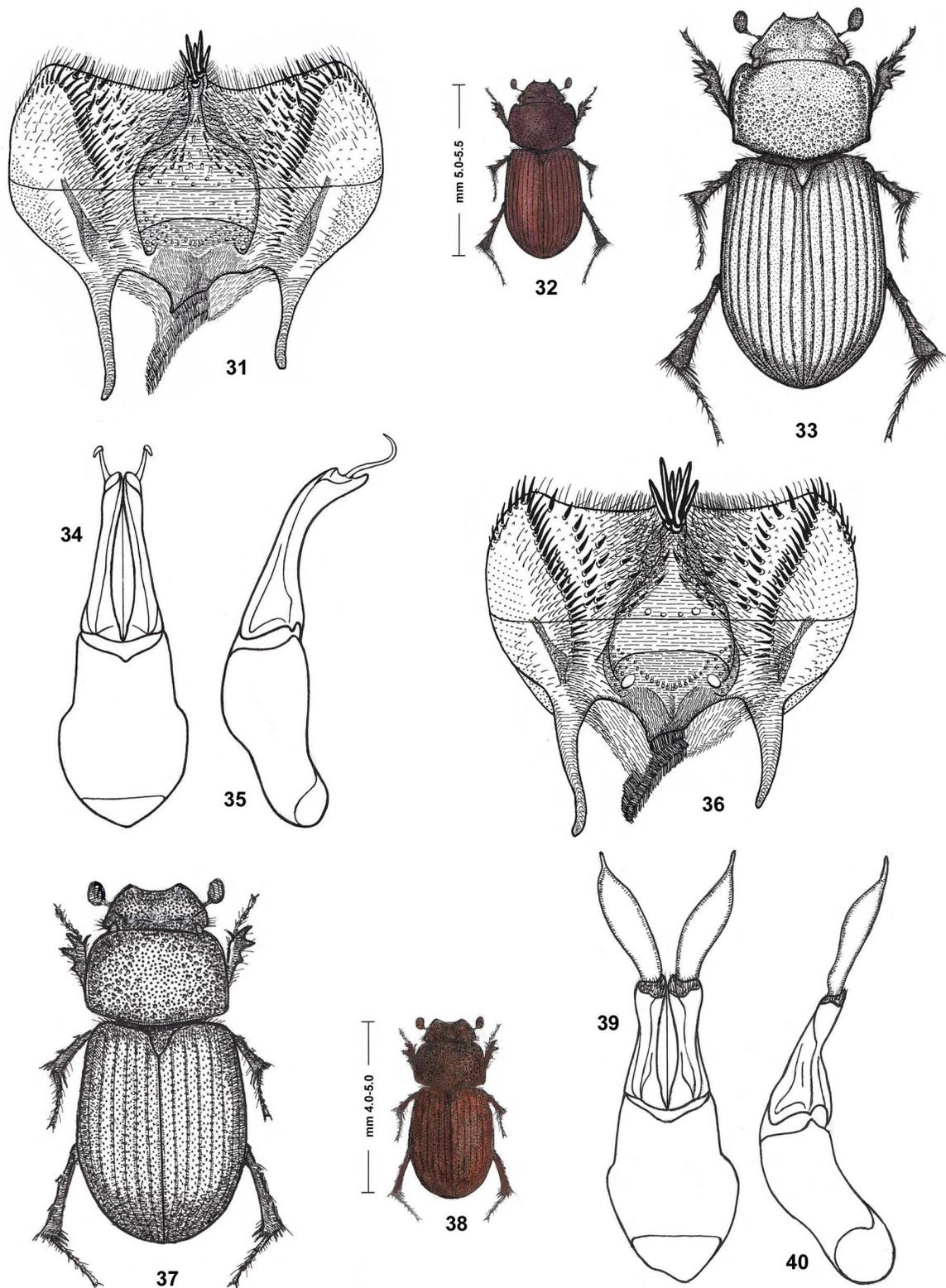
Figures 1–10. Illustrations of species. 1–5) *Geomyphilus barrerai* (Islas, 1955) (Amecameca-Tlamacas, Estado de México, Mexico). 1) Epipharynx. 2–3) Habitus (morphological details and length ideogram). 4–5) Aedeagus (dorsal and lateral view). 6–10) *Geomyphilus coronadoi* (Islas, 1955) (Amecameca, Estado de México, Mexico). 6) Epipharynx. 7–8) Habitus (morphological details and length ideogram). 9–10) Aedeagus (dorsal and lateral view).



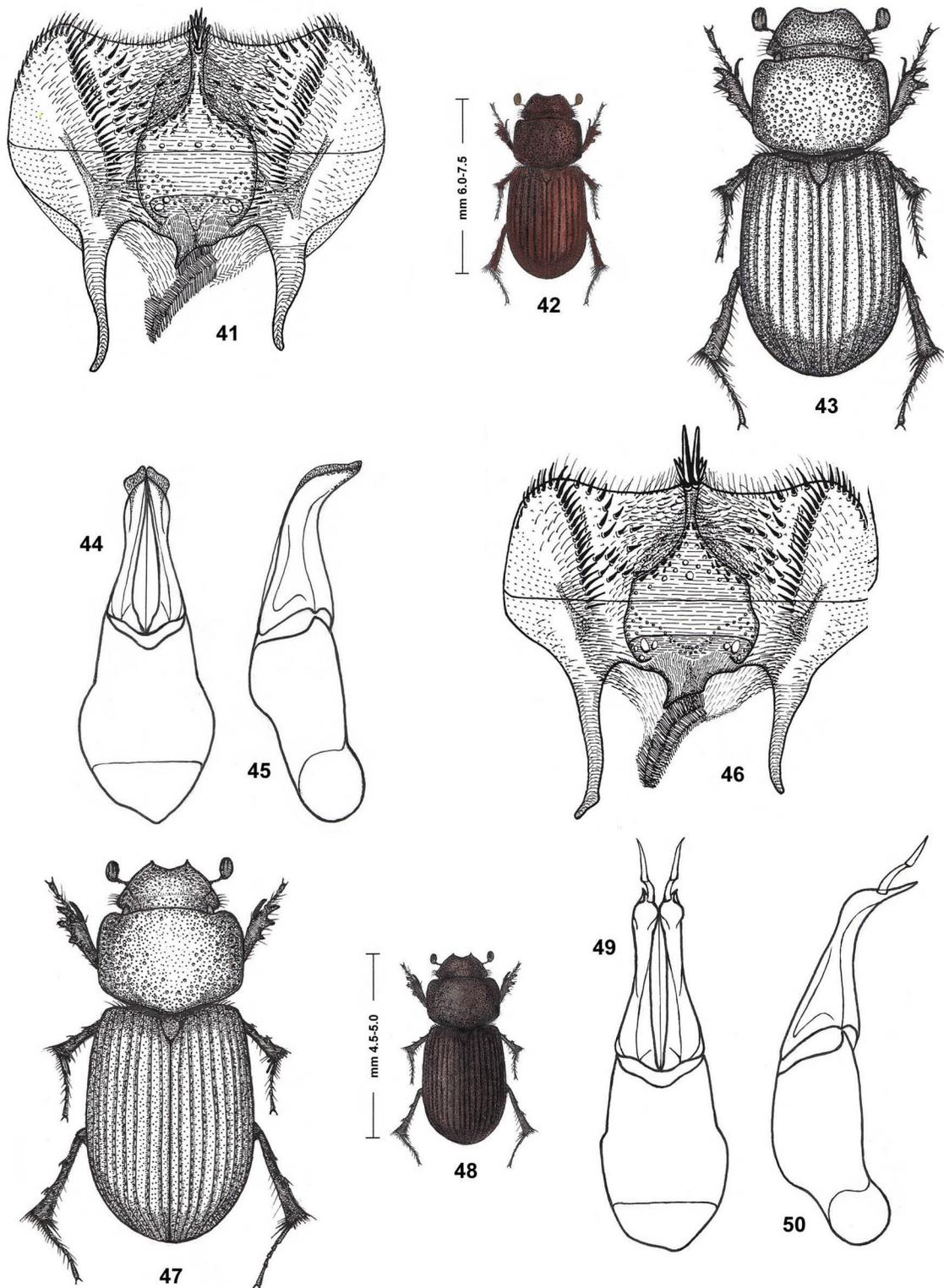
Figures 11–20. Illustrations of species. **11–15)** *Geomyphilus essigi* (Saylor, 1935) (Danville, Contra Costa Co., California, U.S.A.). **11)** Epipharynx. **12–13)** Habitus (morphological details and length ideogram). **14–15)** Aedeagus (dorsal and lateral view). **16–20)** *Geomyphilus geronimo* (Gordon and Skelley, 2007) (8 mi. SE of Portal, State Line Road at Portal, Cochise Co., Arizona, U.S.A.). **16)** Epipharynx. **17–18)** Habitus (morphological details and length ideogram). **19–20)** Aedeagus (dorsal and lateral view).



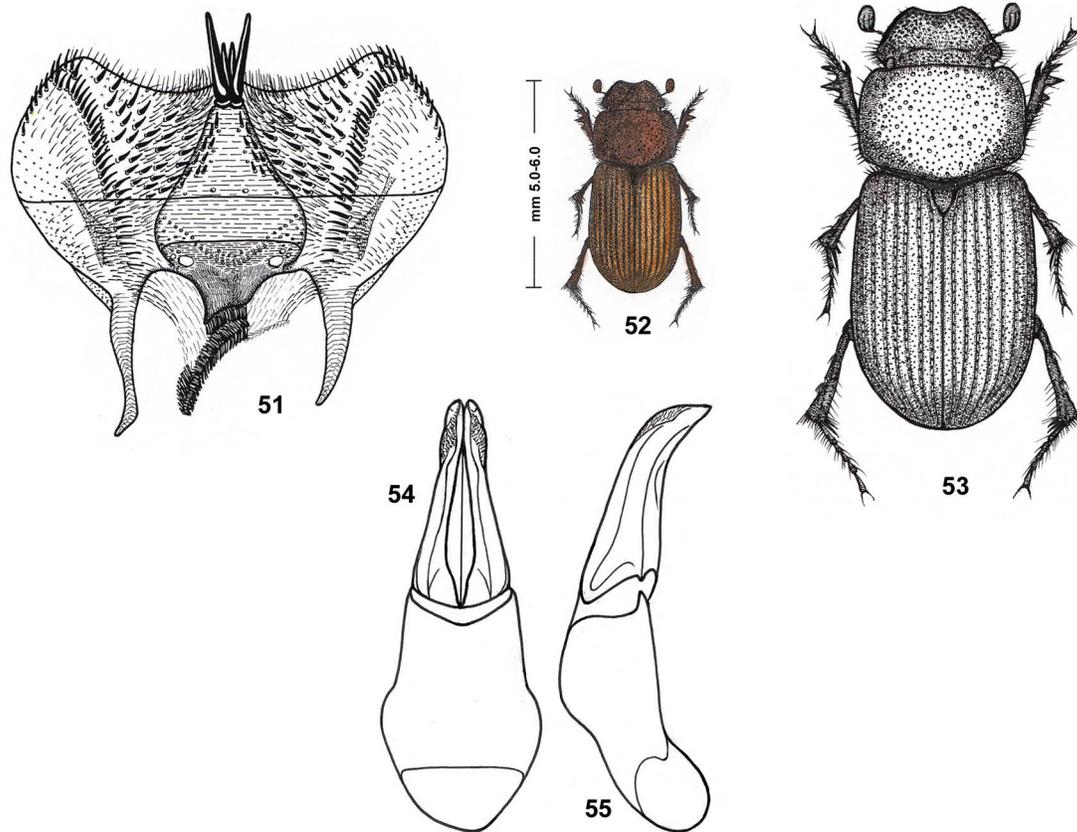
Figures 21–30. Illustrations of species. **21–25**) *Geomyphilus insolitus* (Brown, 1928) (3 mi. S jct. Hwy 10 & Sr 55, on Sr 55, Newton Co., Indiana, U.S.A.). **21**) Epipharynx. **22–23**) Habitus (morphological details and length ideogram). **24–25**) Aedeagus (dorsal and lateral view). **26–30**) *Geomyphilus kiowensis* (Gordon and Salsbury, 1999) (S of Lodgepole, Cheyenne Co, Nebraska, U.S.A.). **26**) Epipharynx. **27–28**) Habitus (morphological details and length ideogram). **29–30**) Aedeagus (dorsal and lateral view).



Figures 31–40. Illustrations of species. **31–35** *Geomyphilus pierai* (Lobo and Deloya 1996) (Los Pescados, Cofre de Perote, Estado de Veracruz, Mexico). **31**) Epipharynx. **32–33**) Habitus (morphological details and length ideogram). **34–35**) Aedeagus (dorsal and lateral view). **36–40** *Geomyphilus rubiginosus* (Horn, 1870) (Wickenburg-Simpson Ranch, Maricopa, Arizona, U.S.A.). **36**) Epipharynx. **37–38**) Habitus (morphological details and length ideogram). **39–40**) Aedeagus (dorsal and lateral view).



Figures 41–50. Illustrations of species. 41–54) *Geomyphilus russeus* (Brown, 1928) (Raven Flats, Bernarillo Co., New Mexico, U.S.A.). 41) Epipharynx. 42–43) Habitus (morphological details and length ideogram). 44–45) Aedeagus (dorsal and lateral view). 46–50) *Geomyphilus tuzincola* new species (2 km S [San Nicolás] Coatepec, Estado de México, Mexico). 46) Epipharynx. 47–48) Habitus (morphological details and length ideogram). 49–50) Aedeagus (dorsal and lateral view).



Figures 51–55. *Geomyphilus ungulatus* (Fall, 1901) (Rt. 71 16.22 mi. fr. San Bernardino County line, Riverside Co., California, U.S.A.). **51)** Epipharynx. **52–53)** Habitus (morphological details and length ideogram). **54–55)** Aedeagus (dorsal and lateral view).

