Small carrion beetles (Coleoptera: Leiodidae: Cholevinae) from burrows of *Geomys* and *Thomomys* pocket gophers (Rodentia: Geomyidae) in the United States

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Abstract. The cholevine beetles inhabiting burrows of *Geomys* and *Thomomys* pocket gophers (Rodentia: Geomyidae) are reviewed. *Catops geomysi* n. sp. and *Ptomaphagus geomysi* n. sp. are described. Both of these species and *Ptomaphagus schwarzi* Hatch appear to be regular and obligate inhabitants of *Geomys* burrows but are not host specific. *Nemadus hornii* Hatch, *Sciodrepoides watsoni hornianus* (Blanchard), *Catops simplex* Say, *Ptomaphagus cavernicola* Schwarz, *Ptomaphagus consobrinus* (LeConte), *Ptomaphagus fisius* Horn, and *Ptomaphagus texanus* Horn were less frequently collected and are probably facultative inhabitants of *Geomys* burrows, as well as nests or dens of other small mammals. *Ptomaphagus nevadicus* Horn is an inhabitant of burrows of *Thomomys* pocket gophers in western North America. A key to the species of *Ptomaphagus* in the southeastern Gulf Coastal Plain, from non-cave habitats, is provided to aid in their identification.

Introduction

Cholevine leiodids, the small carrion beetles, are frequently found in association with and feeding on moist decaying organic matter. In North America, these beetles are common components of leaf litter and soil habitats in mesophytic forests, and some species have become small-eyed and flightless in deep litter or soil. Nineteen species are blind obligate inhabitants of caves (Peck 1984, 1998a, 1998b). Other distinctive but cave-like habitats which are inhabited by North American cholevines are the subterranean nests of *Vespula* wasps and *Pogonomyrnex* and *Aphaenogaster* harvester ants (Peck and Gnaspini 1997), the burrows of *Gopherus* gopher tortoises and *Speotyto* burrowing owls, the nests of *Neotoma* pack rats, and the nests and burrows of mice, shrews, moles, *Dipodomys* kangaroo rats, *Citellus* ground squirrels, *Marmota* marmots, *Cynomys* prairie dogs, and *Geomys* and *Thomomys* pocket gophers (Peck 1973). The beetles probably feed as scavengers on decomposing nest matter or micro-organisms on feces in the nests and burrows of all these animals.

Pioneering investigations of insects inhabiting *Geomys* burrows were conducted in Florida by Hubbell and Goff (1939). They reported on a diverse and sometimes extraordinary set of insect inhabitants (sometimes eyeless) from the burrows of *Geomys pinetis* (Rafinesque) (Hubbell 1940). Subsequently, Ross (1944) reported on other collections from the burrows of pocket gophers in Texas. Few subsequent studies have explored the insect inhabitants of the burrow systems of these unusual rodents. Intensive sampling in Alachua and Levy Counties, Florida, during 1988-1990 by PES and others revealed that cholevine leiodids and many other arthropods inhabiting *Geomys* pocket gopher burrows were mainly active during the winter months. Some results are in Skelley and Kovarik (2001) and Skelley and Woodruff (1991).

The genus *Geomys* is in the rodent family Geomyidae, which is endemic to North and Central America. There are three genera in this family in the USA: *Geomys*, with seven species in the central and eastern USA; *Thomomys*, with five species in the western USA and Canada; *Papogeomys* (*Cratogeomys*), with one species in the southwestern Great Plains of the USA. There are 13 other species...
in these genera and additional genera in Mexico and Central America (Hall 1981).

Cholevines previously reported from pocket gopher burrows (Peck 1973, 1977) are: Ptomaphagus schwarzii Hatch in Florida; P. nevadicus Horn in California, Texas, Kansas, North Dakota, British Columbia, and Durango, Mexico; P. conejera Peck from Oaxaca, Mexico; and P. tuza Peck from Oaxaca, Mexico. Recent field work by P. Kovarik in Belize and W. Godwin in Panama has yielded undescribed species of Ptomaphagus in the burrows of pocket gophers in those countries. This paper reports on new records and new species of cholevines beetles found in the burrows of Geomys and Thomomys pocket gophers, mostly from the southeastern United States.

Methods and Materials

An extensive sampling program for the arthropods in the burrow systems of the southeastern pocket gopher, Geomys pinetus (Rafinesque), was undertaken by P. W. Kovarik, P. E. Skelley, and R. H. Turnbow. This pocket gopher is found in the southern halves of Georgia and Alabama, and the northern half of Florida (Hall 1981, Fig.15). Literature and museum specimen records for specific localities with pocket gopher populations were compiled into a database. Sightings of pocket gopher mounds by qualified individuals were also included. Locality data based on sightings were added only when there was no doubt that the mound was made by a pocket gopher. All of these data were used to produce a detailed distribution map for the pocket gopher (to be published elsewhere). With this information, a sampling plan was implemented to obtain arthropods from the burrow systems from across the range of the pocket gopher. In some cases this was hindered by apparent local extinctions or uncooperative land owners.

Collecting in the burrow systems of pocket gophers can be quite laborious. If a collector digs along the burrow system, the pocket gophers will often plug the burrow ahead of the collector. Because of this, it is usually necessary to remove the inhabitant from the burrow. There is usually only one animal in a burrow system. The prime goal of excavating the burrow system is to find the nest chamber and the toilet chamber with its dung pellets. Finding these chambers is not easy because the burrow systems may be as long as 165 meters (Brown and Hickman 1973). Such chambers may also be at considerable depth (Hubbell and Goff 1939). In the southeast these chambers have been found up to 3.5 meters deep (personal experience PES), but are usually only 1 to 2 meters deep.

Since total excavation of a burrow is time consuming, exhausting and frequently non-productive, we chose to sample the arthropods by removing the rodent occupant and setting baited or unbaited pitfall traps in the burrows. This method is mentioned in Hubbell and Goff (1939) and Skelley and Woodruff (1991). By using this method, many sites could be sampled with a small amount of effort and with the least amount of habitat destruction. With the help of those listed in the acknowledgements, nearly 200 burrow systems have been sampled across the range of the southeastern pocket gopher using this method.

Early sampling showed that the arthropod fauna of a burrow is primarily active in the winter months. While some members of this fauna are active year round, all species could be collected in the winter. Our sampling focused on the winter season and was primarily from late November through April over several years.

This paper presents an account of the cholevines Leiodidae collected during this survey. Other papers are currently being prepared to cover other components of the arthropod fauna in the burrows (e.g., Skelley and Gordon 2001). To contribute to the completeness of this paper, we report other new data on cholevines collected in association with pocket gophers in other parts of the USA.

Specimens examined are from the collections of: ABSC, Archbold Biological Station, Lake Placid, FL; KSC; Karl Stephan, Red Oak, Oklahoma; FMNH, Field Museum of Natural History, Chicago, IL; LSAC, Louisiana State Arthropod Collection, Baton Rouge, LA; MUIC, Mississippi State University Insect Collection, Mississippi State, MS; RHTC, Robert H. Turnbow Collection, Ft. Rucker, AL; SBPC, Stewart B. Peck collection, Ottawa, ON; TAMU, Texas A & M University Insect Collection, College Station, TX; WWC, William Warner collection, Phoenix, AZ. If no collection acronym is given, specimens are deposited in the FSCA, Florida State Collection of Arthropods, Gainesville, FL. Paratypes or voucher specimens will also be placed in: MCZC, Museum of Comparative Zoology, Harvard University, Cambridge, MA; CMNC, Canadian Museum of Nature, Aylmer, Quebec, Canada; GMNH, Georgia Museum of Natural History, University of Georgia, Athens, GA; and OSUC, The Ohio State University Insect Collection, Columbus, OH.
Insects known as Cholevinae may be found in Peck (1990). All species discussed here, except for the new species, can be keyed using Hatch (1933) or Peck (1973). A revision of the species of North American Cholevini by Peck is in progress. Specimens were studied with binocular dissecting microscopes, and illustrations made by projecting images of cleared microslide preparations of selected structures.

Only abbreviated or summarized label data is given for the previously described species. Full label data is presented for the holotypes of the new species. Paratype label data have been abbreviated for Ptomaphagus geomysi to eliminate excessive duplication of the collectors (all listed in acknowledgements) and habitat information (e.g. “Geomys burrow pitfall trap”). Complete label data for all specimens studied are available from the authors.

Results

Tribe Anemadini

Nemadus hornii Hatch

This species is widely distributed throughout eastern North America. There are no previous records of it occurring in pocket gopher burrows, but it was recorded from a rabbit nest (Hatch 1933), in woodchuck or fox dens, found on Sorex and Blarina shrews, and is frequently found on moist bat guano in southeastern US caves (Peck unpubl.).

New Geomys burrow records. ILLINOIS. Kankakee Co.; Hopkins Park, with “Geomys illinoisensis” (FMNH). McLean Co.; 1 mi E. of Normal. Livingston Co.; 2.8 mi NNE Long Point. NEBRASKA. Lancaster Co.; Nine Mile Prairie. Collections are from the months of May, 2 specimens; and June, 18 specimens.

Tribe Cholevini

Sciodrepoides watsoni hornianus
(Blanchard)

This species is widely distributed throughout eastern North America. There are no previous reports of it from pocket gopher burrows. It is most frequently collected with carrion or dung baited pitfall traps, and has been found in mouse nests (Peck unpubl.).

New Geomys burrow records. ALABAMA. Macon Co.; 6.1 mi. NW. of Hurtsboro. FLORIDA. Lafayette Co.; 1.2 mi. W. of Suwanee River. Collections are from the months of April, November and December; 29 specimens.

Catops simplex Say

This species is widely distributed throughout eastern and western North America. There are no previous reports of it from pocket gopher burrows. It is most frequently collected with carrion or dung baited pitfall traps, and has been found in mouse nests (Peck unpubl.).

New Geomys burrow records. ALABAMA. Macon Co.; 6.1 mi. NW. of Hurtsboro. FLORIDA. Lafayette Co.; 1.2 mi. W. of Suwanee River. Collections are from the months of April, November and December; 29 specimens.

Catops geomysi Peck and Skelley
new species
Figs. 1-3


Paratypes (total 129) label data as follows. Same data as holotype (9). ALABAMA. Coffee Co.; 0.7-1.7 mi. E Co. Rd. 337 on Hwy. 189, 7-12.1.1999, R. Turnbow, malt/swine feces pitfall in Geomys burrow (1). FLAGLER. Flagler Co.; 0.5 mi. S of St. Johns Co. line on US-1, 2-XII.1997 to 20.III.1998, R. Skelley, malaise trap (1); Austin Cary Forest, 2-9.XII.1995, Fairchild & Roberts, insect flight trap (1); 29°34.5' N, 82°29' W [Archer], 7.III.1995, R. W. Lundgren, flight barrier trap in hardwood hammock (2). Gilchrist Co.: 7.5 mi. E of Trenton, 15.IV.1993, Lloyd R. Davis, Jr. (5). Highlands Co.; Archbold Biological Station, 7 mi. S of Lake Placid, 13.II.1984, M. Deyrup, malaise trap, trail 2 (1); Archbold Biological Station, 5.II.1979, H. V. Weems, Jr., Sylvia Halkin, FIT (1).

**Diagnosis.** The species is most readily distinguished by its slightly reduced eyes, elongate and thin antennae (Fig. 3), details of the male aedeagus, its habits of living with pocket gophers (see discussion below), and by being flight active in winter months.

**Description.** Body length 3.5-3.9 mm; width 1.9-2.1 mm. Head, pronotum, elytra and appendages light to dark brown in color. Head, pronotum, and elytral surface appearing granular (caused by setal sockets); densely covered with setae of medium length. Antenna (Fig. 3) elongate; clearly reaching beyond base of pronotum when laid back; antennomere II and III shorter than I; III longer than II; slightly decreasing in length and increasing in width from III to IV; VII much larger, nearly as wide as long; VIII smaller, very transverse; IX and X large, broadest at apex, similar in size and shape; XI rounded, tapering to apex. Eyes pigmented; somewhat reduced, lateral diameter 3 times length of space between anterior margin of eye and edge of socket of antenna. Pronotum widest just before middle, 5/7 as long as wide; apex slightly narrower than base; front angles broadly rounded, hind angles narrowly obtuse. Elytra widest near middle; posterior half with vague longitudinal lines created by linear areas without setae. Legs long, thin. Flight wings fully formed and functional. Male first to third pro- and meso-tarsomeres lightly expanded, first wider than second. Male femora without tooth-like tubercle; mesotibia lightly curved. Male and female abdominal sternites without median dimple, female terminal sternite without median emargination. Aedeagus in lateral view (Fig. 2)

widest before middle; tapering to blunt tip; in dorsal view (Fig. 1) widest before apex; tapering to obtusely angled blunt tip, parameres shorter than median lobe, with two terminal setae; internal sac with abundant tiny sclerotized teeth and central area with massed thin spines.

**Etymology.** This species is named for the habit of living in burrows of *Geomys* pocket gophers.

**Discussion.** It is worth giving additional data provided by Karl Stephan (in litt. 1987) about the collection of a very large Oklahoma series. The habitat was a large treeless grassland. The specimens were caught in a pit trap which was alternately unbaited or contained a dead shrew, and which was at the corner of a building housing a water booster pump. Under the trap was a network of small mammal tunnels (of *Geomys* pocket gophers), in which the beetles were also found. The trap was more effective when covered with a board.

The species was collected either in insect flight traps or at carrion baits or in burrows of at least three species of *Geomys*. Excluding the *Geomys* burrow specimens, the collections are all from fall, winter, or spring months. We think that it is significant that K. Stephan collected none in baited pitfall traps after the third week of January in an extensive trapping program in Oklahoma. We assume that *Geomys* burrows are the usual habitat of the beetle and that adults leave the burrows in late fall, winter, or early spring months and disperse, probably seeking new burrow systems. Possible exceptions are the records from Archbold Biological Station, Highlands County, Florida, and Dorman Lake, Oktibbeha County, Mississippi, which are seemingly beyond the range limits of *Geomys*. This suggests that other habitats, such as rodent burrows in general, may be used by the species. Specimens from Mississippi, Alabama, Florida and Georgia can not be separated from those from Oklahoma and Texas. We suggest that this disjunction in distribution is an artifact of inadequate collecting in intermediate localities, in both open grassland habitats with bait traps or flight intercept traps in the winter and in pocket gopher burrows. But, we also note that the intervening area is mostly one of low topography and with alluvial soils of the Missis-
sippian Embayment, which is an area with few habitats suitable for pocket gophers.

**Tribe Ptomaphagini**

The species of *Ptomaphagus* from non-cave habitats in the southeastern Gulf Coastal Plain can now be separated with the following key.

1. Eye unpigmented, greatly reduced; troglobites (obligate cave inhabitants) .............................................. [see key in Peck, 1973]
   — Eye pigmented, partly reduced or normal sized, may or may not live in caves .................................. 2

2(1). Antennomere VI very elongate (Fig 4), length two times width; living in pocket gopher burrows ................................................. *P. geomytis* n.sp.
   — Antennomere VI length less than two times width, usually nearly quadrate or transverse ........... 3

3(2). Body shortened; pronotum two times wider than long; elytral length almost equal to width; living with harvester ants (*Pogonomyrmex* sp) ...
   — Body elongate; pronotum nearly quadrate; elytral length about 1.5 times width .......................... 4

4(3). Eye smaller (Figs. 11, 12, 14); ventral and posterior margin of head around eye broad throughout, or distinctly wider at front ................. 5
   — Eye larger (Fig 10); ventral and posterior margin of head around eye narrow, nearly same width throughout; living in nests of harvester ants, in burrows of the gopher tortoise and of pocket gophers ......................... *P. texanus* Melander

5(4). Body dark, nearly black; antennomere VI two times wider than long (Figs. 5, 6); head with wide ventral and posterior margin of eye, nearly of same width throughout (Fig. 11); usually a surface litter dweller in forests ......................... *P. consobrinus* (LeConte)
   — Body pale brown to dark red-brown; antennomere VI nearly quadrate or elongate; head with margin posterior to eye narrower than margin ventral to eye (Figs. 12, 14)............................ 6

6(5). Body dark brown; antennomere VI longer than wide (Fig. 6); eye occupying half or more of the distance between the posterior margin of the head and the antennal socket (Fig. 12); usually in caves, but also in other habitats ................................................................. *P. caurernicola* Schwarz
   — Body light brown; antennomere VI wider than long, can be nearly quadrate (Fig. 5); eye occupying less than half of the distance between the posterior margin of the head and the antennal socket (Fig. 14); usually living in pocket gopher burrows ........................................ *P. schwarzi* Hatch

**Ptomaphagus cavernicola** Schwarz

Figs. 6, 12

This species is widely distributed throughout eastern North America from South Carolina and Florida westward to Iowa and Texas, and into northeastern Mexico. Almost all previous records for this species were from caves, but a few have been taken from forest litter, and in flight intercept traps in forests (Peck 1973, 1982a, 1982b). The following is the first record from a rodent burrow.


**Ptomaphagus consobrinus** (Leconte)

Fig. 11

This species is widely distributed across the southeastern Coastal Plain from New Jersey south to Florida, and west to Oklahoma and Texas, with records needing verification from Colorado and west Texas (Peck 1973). It is usually taken in litter or in dung baited pitfall traps and a few records exist for specimens from the entrances to gopher tortoise burrows. There are no previous records from pocket gopher burrows.

92 specimens collected, usually one per burrow, with up to 29 in a single burrow.

**Ptomaphagus fisus** Horn

This species is widely distributed in the southwestern USA, from west Texas, through New Mexico, Arizona, and California to Colorado, Utah, and Idaho. It is taken in carrion baited pitfall traps and at lights. It was previously known from nests and burrows of ground squirrels, prairie dogs, and kangaroo rats (Peck 1973).


**Ptomaphagus geomysi** new species

*Figs. 4, 7-9, 15*


Figure 16. County distribution map for *Ptomaphagus schwartzi* Hatch. Shaded area represents the range of the geomyid rodents.


**Diagnosis.** The exceptionally long and thin antennae and legs (especially the hind tarsi), smaller eye with transverse diameter equal to distance between its anterior margin and antennal socket, shape of the spermatheca, and habitat of *Geomys* burrows (not caves) distinguish this southeastern US species.

**Description.** Length 3.0-3.4 mm; width 1.3-1.4 mm. Color pale to dark yellowish brown. Head, pronotum, elytra finely striolate; covered with fine recumbent yellowish setae; pronotal striae transverse, elytral striae oblique. Eyes pigmented; reduced in size; their lateral diameter equal to distance from their anterior margin to edge of antennal socket. Antennae (Fig. 4) very thin and elongate, reaching well beyond base of pronotum when laid back; antennomere III longer that II and IV, IV and V subequal, VI and VII of equal length but VII wider (some Texas specimens have VI shorter than VII), VIII trapezoidal, IX longer and wider than X, XI conical at apex. Pronotum widest before base, 1.5 times wider at base than long. Elytra 1.6 times longer than wide at base; widest slightly behind base; external apical angles effaced; apex obliquely truncate in both sexes; inner apical angle acute. Flight wings fully formed and apparently functional. Mesosternal keel present, low in profile. Legs elongate, male metafemur without tooth; metatarsomerses conspicuously long and thin. Aedeagus in lateral view (Fig. 8) widest before middle, tapering to downcurved tip; tip in dorsal view (Fig. 9) obliquely truncate and blunt; internal sac with basal bulb, flagellum long, thin, tubular. Spermatheca
(Fig. 7) stout; shaft slightly curved, anterior end with low crest, posterior end with curve and bulge.

**Etymology.** Named for the habit of the species of living in the burrows of at least three species of *Geomys* pocket gophers.

**Discussion.** This species is most closely related to *Ptomaphagus schwarzi* Hatch. The very long antennae might suggest that *P. geomysi* is grouped with the cave-restricted "hirtus" group of species from the southern Appalachian region, but the shape of the spermatheca does not support this. We conclude that the elongate antennae are a convergent character. The shape of the spermatheca clearly groups the species with those in the "consobrinus" species group of southern Canada, the USA, Mexico, and Central America. *Ptomaphagus geomysi* is not clearly different from *P. schwarzi* in either the shape of the aedeagus or spermatheca. These structures, the similarly sized eyes, the pale color, and being a *Geomys* burrow inhabitant initially led us to misidentify specimens as *P. schwarzi*. The very elongate antenna was the first clue that *P. geomysi* was indeed distinct (Fig. 4). The antennae of *P. schwarzi* (Fig. 5) are conspicuously stouter and shorter.

**Ptomaphagus nevadicus** Horn

This species, as presently understood, is widely distributed across much of the western United States and extends into southwestern Canada and western Mexico. Many collecting records of the species are from the burrows of small mammals or birds (Peck 1973). The records are mostly from pocket gopher burrows but also include those of mice, kangaroo rats, marmots, and burrowing owls. Peck (1973) placed three other species names into synonymy with *P. nevadicus*, but the question needs to reexamined with new material, especially from Washington and Oregon.


**Ptomaphagus schwarzi** Hatch

**Fig. 5, 14, 16**

This species was previously known from only 6 specimens from Alachua and Putnam counties, Florida. Five of the specimens were from pocket gopher burrows (Peck 1973). The following records now show it to have a much larger distribution and to be a regular, obligate occupant of *Geomys* burrows.


A total of 845 specimens have been taken in 81 separate collections. This is a mean of 10.4 specimens per collection, with a range of 1-29 per burrow. The records are from winter months.

It is appropriate to note that the species was named for Eugene Schwarz, who was himself a pioneer in collecting beetles in unusual habitats. He and H. G. Hubbard excavated the burrows of *Gopherus* gopher tortoises around Crescent City, Florida (Hubbard 1894, 1896) and probably took the type specimen of *P. schwarzi* there. Young and Goff (1939) provide an extended list of insects from...
burrows of these tortoises in Florida. They seemingly took no additional specimens, but they list the genus _Ptomaphagus_, although the species names are suspect and the location of the specimens is not known. The above collections now show that _P. schwarzi_ is a frequent and obligate inhabitant of pocket gopher burrows.

**_Ptomaphagus texanus_ Melander**

*Fig. 10*

This species was previously known only from some 50 specimens from Florida, Georgia, Alabama, and Texas. Some collections have been made from pit traps, but most are from nests of mice or _Pogonomyrmex_ harvester ants and burrows of _Geomys_, all taken in winter or spring. The following records show the species to be a regular inhabitant of _Geomys_ burrows.

**New _Geomys_ burrow records. ALABAMA.**


  A total of 218 specimens have been captured, with usually less than ten in a burrow system which contains the species, but with up to 164 in one burrow.

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