

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

Stewart B. Peck
Department of Biology
Carleton University
Ottawa, Ontario, K1S 5B6, Canada

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

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 fesus* 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 *Pogonomyrmex* 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).

Cholevine beetles previously reported from pocket gopher burrows (Peck 1973, 1977) are: *Ptomaphagus schwarzi* 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 cholevine 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 acknowledgments, 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 cholevine 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.

Keys to the genera of United States 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. ALABAMA: **Autauga Co.;** Prattville. **Montgomery Co.;** W. of Pine Level. **GEORGIA: Dodge Co.;** 1.1 mi. NE. of Gresson. **Grady Co.;** Beachton. **Richmond Co.;** McBean. **Thomas Co.;** Metcalf. Collections are from the months of January, February, October; 10 specimens.

Tribe Cholevini

Sciodreporides 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 commonly found on small animal carrion or traps baited with carrion or dung, but it has also been

captured in entrances to fox burrows (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.

Catops simplex Say

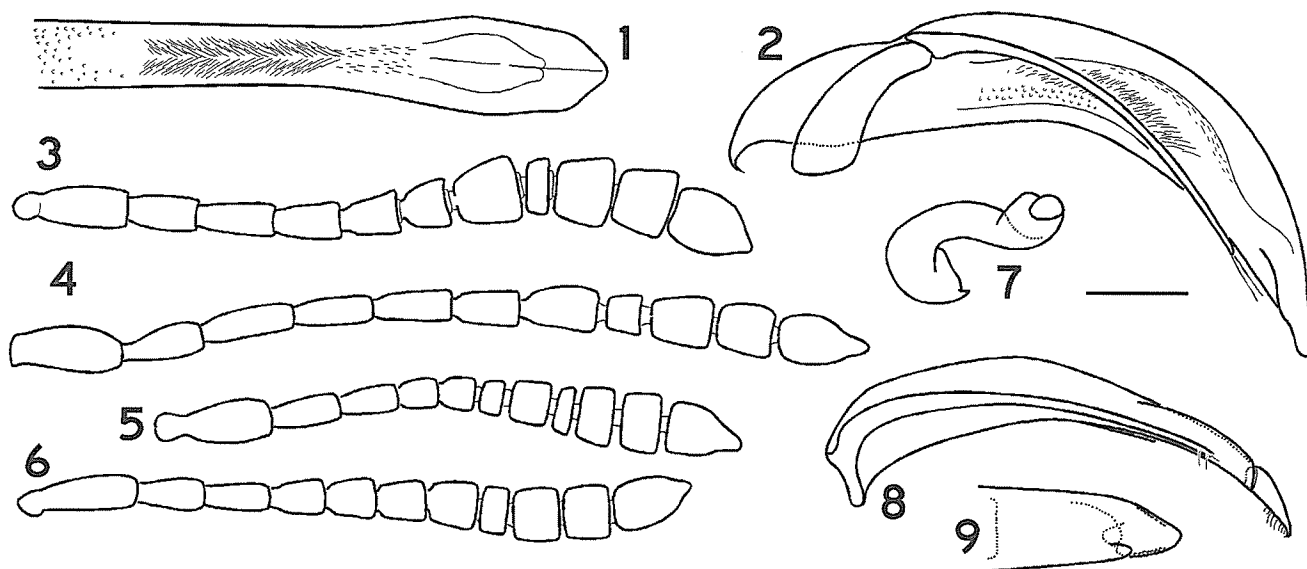
This species is widely distributed throughout eastern and western North America. There are no previous reports of it from pocket gopher burrows. It is most frequently collected with carrion or dung baited pitfall traps, and has been found in mouse nests (Peck unpubl.).

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

Type material. Holotype male (FSCA) label data: **GEORGIA: Dodge Co.;** 1.1 mi. NE. of Gresson, 18.X.1997 to 3.V.1998, P. Kovarik & P. Skelley, *Geomys* burrow pitfall.

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.I.1999, R. Turnbow, malt/swine feces pitfall in *Geomys* burrow (1). **FLORIDA. Alachua Co.:** Gainesville, Doyle Connor Bldg., 2-6-II-1987, P. Skelley, malaise trap (1); Austin Cary Forest, 2-9.XII.1985, 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). **Flagler Co.:** 0.5 mi. S of St. Johns Co. line on US-1, 2.XII.1997 to 20.III.1998, Skelley and Jarrett, *Geomys* burrow pitfall (1). **Gilchrist Co.:** 7.5 mi. E of Trenton, 15.IV.1993, Lloyd R. Davis, Jr. (3). **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).



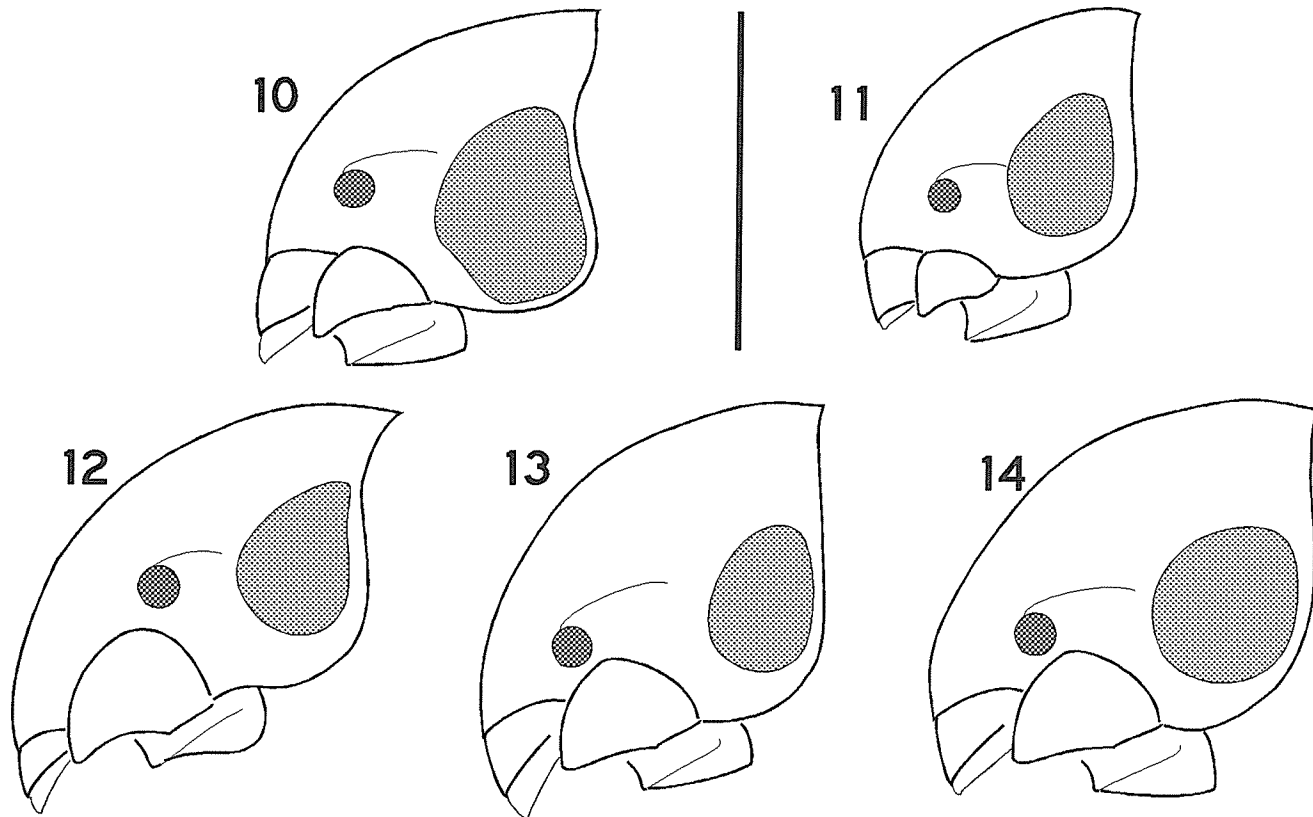
Figures 1-9. Terminalia and antennae. 1-2). Terminalia of *Catops geomysi* Peck and Skelley, 1.) dorsal view of aedeagus, 2.) lateral view of aedeagus. 3-6). Antenna of 3.) *C. geomysi*, 4.) *Ptomaphagus geomysi* Peck and Skelley, 5.) *P. schwarzi* Hatch, 6.) *P. cavernicola* Schwarz. 7-9) Terminalia of *P. geomysi*, 7.) spermatheca, 8.) lateral view of aedeagus, 9.) dorsal view of aedeagus tip. Line = 0.2 mm.

Leon Co.: 5 mi. E of Tallahassee, 6.VII.65, W. Suter (2); Tall Timbers Research Station, 13-20.III.1972, D. Harris, pitfall, Rep 2 (1). **GEORGIA. Richmond Co.:** McBean, 0.1 mi W Bennoch Mill & Horseshoe Rd. 1.II to 2.III.1999, P. J. Harpootlian (1). **Screven Co.:** 15.4 mi. S Hwy 301 on Hwy 24 (W. of Blue Springs), 8.II to 10.III.1999, P. J. Harpootlian, *Geomys* burrow pitfalls (3). **Thomas Co.:** S of Thomasville, 1.8 mi. S Metcalf Rd. on Springhill Rd., 10-17.XI.1996, P. Kovarik & P. Skelley, *Geomys* burrow pitfall (1). **MISSISSIPPI. Oktibbeha Co.:** Dorman Lake, 23.IV.1981, G. L. Snodgrass, hardwood litter (1 female, MUIC). **OKLAHOMA. Latimer Co.:** Near Red Oak, IX.1986 (4); XI.1986 (9); XII.1986 (60); I.1987 (32), all collected by Karl Stephan from pitfall traps in prairie unbaited or baited with dead shrews. **TEXAS. Brazos Co.:** College Station, Lick Creek Park, 31.I-11.XI.1998, M. Yoder *et al.*, malaise trap (2, TAMU); Lick Creek Park, 21.I.1995, R. Garces, malaise trap (1, TAMU); Hwy. 30 at Navasota River, 22.III.1978, R. Anderson, roadside sweeps, (1, TAMU). **Tyler Co.:** 2.8 mi W, 1.9 mi N Spurger, Big Thicket Preserve, Beech Woods, 12.I.1988, R. S. Anderson, beech-magnolia litter (1, SBPC). Most paratypes are deposited in FSCA, others will be deposited in SBPC, CMNC, FMNH, RHTC, MCZC, OSUC and GMNH.

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)



Figures 10-14. Lateral view of heads of *Ptomaphagus* spp. 10.) *P. texanus* Melander. 11.) *P. consobrinus* (Leconte). 12.) *P. cavernicola* Schwarz. 13.) *P. geomysi* Peck and Skelley. 14.) *P. schwarzi* Hatch. Line = 0.5 mm.

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; trogllobites (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. geomysi* 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) ...
..... *P. acutus* Peck & Gnaspini
- 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. cavernicola* Schwarz
- Body light brown; antennomere VI wider than long, can be nearly quadrate (Fig. 5); eye occu-

pying 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.

New *Geomys* burrow records. Florida. Dixie Co.: S. of Jena. December; 1 specimen.

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.

New *Geomys* burrow records. ALABAMA. Houston Co.: Along Route 95. **Macon Co.:** NW of Hurtsboro. **Montgomery Co.:** W. of Pine Level. **Russell Co.:** NW of Seale. **FLORIDA. Alachua Co.:** Gainesville. **Calhoun Co.:** NW corner of county. **Gilchrist Co.:** N of Bell. **Flagler Co.:** Along US-1 nr. I-95. **Jackson Co.:** Dellwood. **Leon Co.:** Near Tallahassee, Miccosukee. **Levy Co.:** SW. of Archer. **Liberty Co.:** S of Gadsden County on Rt-12. **Okaloosa Co.:** Deerland. **Santa Rosa Co.:** Munson. **St. Johns Co.:** Along Route 204 nr. I-95. **Taylor Co.:** Perry. **GEORGIA. Baker Co.:** 8 mi. SW of Newton. **Charlton Co.:** Folkston. **Dodge Co.:** NE of Gressston. **Grady Co.:** Beachton. **Marion Co.:** Pine Knot Creek. **Screven Co.:** Along Highway 24. **Talbot Co.:** N of Mauk. **Thomas Co.:** Metcalf. **LOUISIANA. Natchitoches Parish.** 1 mi NNE Lotus (1, LSAC). **TEXAS. Palo Pinto Co.:** Mineral Wells. Collections are from winter months;

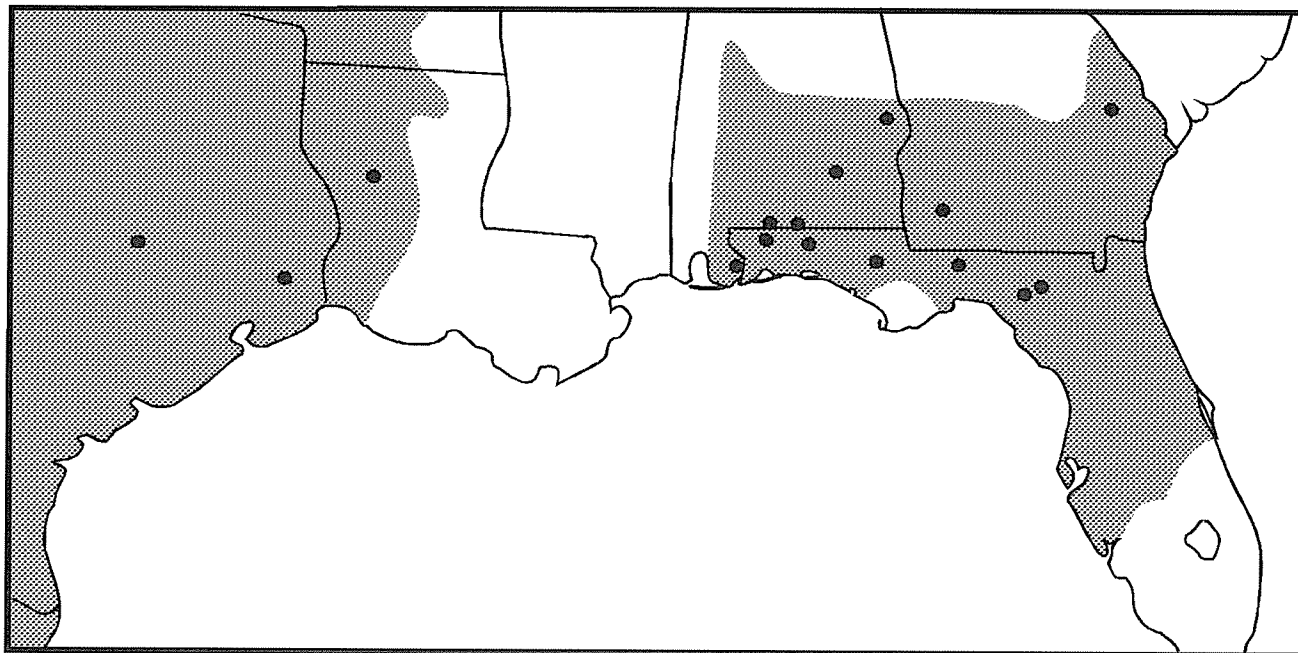


Figure 15. County distribution map for *Ptomaphagus geomysi* Peck and Skelley. Shaded area represents the range of the southeastern pocket gopher, *Geomys pinetus* (Rafinesque), and other species to the west..

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

Ptomaphagus fesus 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).

New *Geomys* burrow records. **NEW MEXICO.** **Chaves Co.:** Mescalero Sands, 4-7.I.1999, Godwin and Yoder, *Geomys* burrow pitfall traps (5, TAMU); White Sands National Monument, 6.I.1999, Godwin and Yoder, *Geomys arenarius* nest (13, TAMU).

Ptomaphagus geomysi new species

Figs. 4, 7-9, 15

Type material. Holotype male (FSCA) label data: **FLORIDA. Santa Rosa Co.,** S of Munson, 4.3 mi. S Jct. Rt-4 & Rt-191 on Sandy Landing Rd.,

1.III to 10.IV.1999, Skelley, Kovarik, & Turnbow, *Geomys* burrow pitfall.

All paratypes (total 211) were collected in *Geomys* burrows by those people listed in the acknowledgement, abbreviated label data as follows (Fig. 15). **ALABAMA. Baldwin Co.:** Seminole, ca. 2 mi. W FL. St. line on US 90, 15.XI-27.XII.1997 (2) and 19.I.-5.IV.1998 (2). **Coffee Co.:** 2.3 mi. E jct. CR-337 on Hwy-189, 20-28.I.1999 (4); 0.7 mi. E jct. CR-337 on Hwy-189, 7-12.I.1999 (9). **Covington Co.:** Wing, 1.5mi.NW, 18-20.I.1998 (1). **Escambia Co.:** 8 mi. ESE of Brewton, 0.5 mi. W CR-19 on Nalty Rd., 20.XII.1998 to 2.I.1999 (1); 8 mi. ESE of Brewton, 1.1 mi. S CR-4 on CR-19, 22.XI-6.XII.1998 (7); 8 mi. ESE of Brewton, 1.5 mi. S CR-4 on CR-19, 3-19.I.1999 (1). **Russell Co.:** 3.5 mi. NW of Seale; 1mi.SW Rt-169 on CR-22 [Sandfort], 30.I-14.II.1999 (2) and 1.III-12.IV.1999 (1). **FLORIDA. Calhoun Co.:** 5.1 mi. W of Clarksville, 8-22.XII.1996 (4); W of Chason; 5.3 mi. W Rt-73 on Rt-274 [7.3 mi. E jct. Rt-167], 3-18.I.1999 (4). **Jackson Co.:** SW of Marianna, 2.8 mi. N of Calhoun Co. line on CR-167, 7-8.XII.1999 (1). **Leon Co.:** vic. Woodville; 0.9mi.E.Rt. 363 on Natural Wells Rd., 10-22.I.1998 (3). **Ocala Co.:** Deerland, 2.8mi.W of Walton Co. line on US 90, 17-31.XII.1991 (14) and 29.XII.1992 (4) and 30.XII.1992 to 5.I.1993 (16) and 5-12.I.1993 (4) and 12-22.I.1993 (2). **Santa Rosa Co.:** 2.2 mi. N of Harold, S boundary of Blackwater R. St. For. WMA,

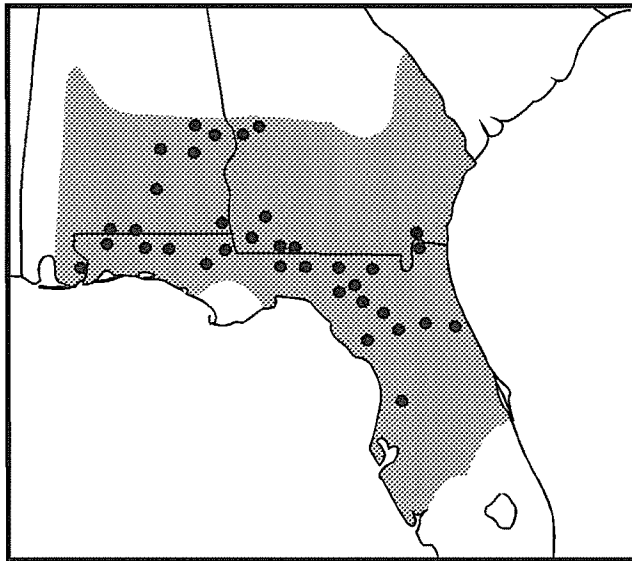


Figure 16. County distribution map for *Ptomaphagus schwarzi* Hatch. Shaded area represents the range of the geomyid rodents.

6-20.XII.1998 (1) and 19.XII.1998 to 3.I.1999 (2) and 1.III-10.IV.1999 (3); 6.9 mi. N of Harold, 0.3 mi. W Bryant Bridge Rd. & Bud Bass Rd., 20.XII.1998 to 2.I.1999 (1); N of Harold; 0.8 mi. N on Deaton Bridge Rd., 5-20.XII.1998 (3); 1.4 mi. NW of Munson on Rt-191, jct. Amos Cabannis Rd., 22.XI-6.XII.1998 (11) and 6-20.XII.1998 (4); 2 mi. NW of Munson, 0.5 mi. N Amos Cabannis Rd., 21.XI-6.XII.1998 (4) and 6-20.XII.1998 (2) and 20.XII.1998 (1); 2.2 mi. N of Munson, 1 mi. E Rt-191 on Green Rd., 20.XII.1998 to 2.I.1999 (6) and 3-19.I.1999 (3) and 19.XII.1998 to 3.I.1999 (3) and 1-III-10-IV-1999 (3); 2.5 mi. NW of Munson, 0.2 mi. S Big Juniper Ck. on Rt-191, 3-19.I.1999 (1); 2.5 mi. NW of Munson, 0.4 mi. S Big Juniper Ck. on Rt-191, 20.XII.1998 to 2.I.1999 (1); 5.2 mi. S of Munson, Bryant Bridge Rd. N of Alligator Creek, 20.XII.1998 (1); S of Munson, 2.8 mi. S jct. Rt-4 & Rt-191 on Sandy Landing Rd., 19.XII.1998 to 3.I.1999 (6) and 3-18.I.1999 (7) and 1.III-10.IV.1999 (6); S of Munson, 4.3 mi. S jct. Rt-4 & Rt-191 on Sandy Landing Rd., 1.III-10.IV.1999 (6); S of Munson, 4.7 mi. S jct. Rt-4 & Rt-191 on Sandy Landing Rd., 19.XII.1998 to 3.I.1999 (9) and 3-18.I.1999 (4); S of Munson, 4.9 mi. S jct. Rt-4 & Rt-191 on Sandy Landing Rd., 20.XII.1998 to 2.I.1999 (1). **Suwannee Co.:** 5.3 mi. W of O'Brien (US-29) on Rt.349 (jct.220th Trail), 15-23.XII.1998 (5). **Taylor Co.:** W of Perry airport, 0.7 mi. W Rt- 362 & Rt-361A, 22.II-4.III.1997 (1) and 4-29.III.1997 (1) and 29.III-6.V.1997 (7). **GEORGIA. Baker Co.:** 8 mi. SW of Newton, Ichauway,

xeric area, 16-17.II.1997 (9) and 17-21.II.1997 (3) and 21-28.II.1997 (4) and 1-7.III.1997 (1) and 7-14.III.1997 (1) and 2-9.IV.1997 (1). **Jenkins Co.:** S of Perkins, 3.25 mi. S Burke Co. line on US-25, 21.X-20.XI.1997 (4) and 19.X.1997 to 14.I.1998 (3). Most paratypes deposited in FSCA, others in SBPC, CMNC, FMNH, RHTC, MCZC, OSUC and GMNH.

The following additional records are not paratypes. **LOUISIANA. Natchitoches Parish:** Red Dirt Wildlife Refuge, Kisaachie Bayou, 27.IX.1992, W Godwin and E. G. Riley, *Geomys breviceps* burrow (7, TAMU); 1 mi NNE Lotus, 20-28.I.2001, A. Cline and A. Tischehkin, *Geomys breviceps* burrows (16, LSAC). **TEXAS. Hardin Co.:** 1 mi. W Silsbee, 16-23.I.1993 and 23.I-7.II.1993, E. G. Riley, deer dung bait in pitfall traps in *Geomys breviceps* burrow (16, TAMU). **Milam Co.:** Gause, 3 mi. N at Sugarloaf Mt., 18.IV.1993 and 8.V-12.VI.1993, W Godwin, from *Geomys attwateri* burrow (4, TAMU).

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 than 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; metatarsomeres 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 be reexamined with new material, especially from Washington and Oregon.

New pocket gopher burrow records. **ARIZONA.** **Cochise Co.:** Chiracahua Mountains, Rustlers Park, July, burrow of *Thomomys umbrinus* (2). **Maricopa Co.:** Bush Hwy at Salt River Bridge, November-December, *Thomomys bottae* burrow (18, WWC); Same data, January (3, WWC); Sunflower, January-February, *Thomomys bottae* burrow (2, WWC). **NEW MEXICO.** **Otero Co.:** White Sands National Monument, January, *Geomys arenarius* nest (12, TAMU). **TEXAS.** **Jeff Davis Co.:** Calamity Creek, 16.8 mi N Alpine, July, in gopher burrow

(2, TAMU). **Kent Co.:** Jayton, February, *Geomys bursarius* burrow (6, TAMU).

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.

New *Geomys* burrow records (Fig. 16). **ALABAMA.** **Baldwin Co.:** near Seminole. **Bullock Co.:** E. of Midway. **Coffee Co.:** Hwy 189 E. of jct. CR-337. **Covington Co.:** NW of Wing. **Escambia Co.:** 8 mi. ESE. of Brewton. **Houston Co.:** Along Rt. 95. **Macon Co.:** near Creek Stand. **Montgomery Co.:** W. of Pine Level. **Russell Co.:** NW of Seale. **FLORIDA.** **Alachua Co.:** SW of Archer, Gainesville. **Calhoun Co.:** W of Chason and on CR 274. **Columbia Co.:** White Springs. **Gilchrist Co.:** W of High Springs, Trenton, N of Bell. **Hernando Co.:** Ridge Manor. **Jackson Co.:** Round Lake. **Jefferson Co.:** Waukeenah, Monticello. **Lafayette Co.:** Mayo, Brandford. **Leon Co.:** Woodville, Miccosukee. **Levy Co.:** Rosewood, SW of Archer. **Madison Co.:** Greenville, I-10 and CR-423. **Nassau Co.:** Boulogne. **Okaloosa Co.:** Deerland. **Putnam Co.:** Florahome, Melrose. **Santa Rosa Co.** Munson, Milton, N of Harold. **St. Johns Co.:** Rt. 204 and I-95. **Suwanee Co.:** O'Brien, Branford. **Taylor Co.:** Perry. **Walton Co.:** DeFuniak Springs, Grayton Beach. **GEORGIA.** **Baker Co.:** Newton. **Charlton Co.:** Folkston. **Decatur Co.:** Bainbridge. **Grady Co.:** Beachton, Thomasville. **Marion Co.:** Jupiter, Ft. Benning. **Talbot Co.:** Mauk. **Thomas Co.:** Metcalf.

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. **Autauga Co.;** Prattville. FLORIDA. **Jackson Co.;** Dellwood. GEORGIA. **Baker Co.;** SW of Newton. **Marion Co.;** Pine Knot Creek. **Richmond Co.;** McBean. **Screven Co.;** Along highway 21, and 24. **Taylor Co.;** Mauk. TEXAS. **Henderson Co.;** 6 mi. N Larue.

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.

Acknowledgements

Scientific collecting permits for pocket gophers were obtained from the Alabama Department of Conservation and Natural Resources; the Florida Game and Fresh Water Fish Commission, Division of Wildlife; and the Georgia Department of Natural Resources. Vouchers of pocket gophers collected during this study are primarily deposited in the Field Museum of Natural History, Chicago, IL. Some specimens were deposited in the following institutions: Eastern Illinois University, University of Central Florida, Georgia Museum of Natural History, and Clemson University. Some travel funding was provided through T. Cohn, University of Michigan, Ann Arbor, MI. Field work of SBP was partially supported by operating grants from the Natural Sciences and Engineering Research Council of Canada.

We thank the following for providing unpublished pocket gopher locality data and assisting in gaining access to sites: R. Franz and C. McCaffery, Florida Museum of Natural History, Gainesville, FL; R. Studeman, Nature Conservancy, Tallahassee, FL; W. Baker, Tall Timbers Research Station, Tallahassee, FL; J. Laerm, Georgia Museum of Natural History, Athens, GA; G. Folkerts, Auburn University, AL; M. Bailey, Conservation Services Southeast, Shorter, AL.

For collecting materials or monitoring traps, we thank: M. Bailey, Conservation Services Southeast, Shorter, AL; E. Cronin, Gainesville, FL; S. Fullerton, University of Central Florida, Orlando, FL; R. Jarrett, Florida Department of Agriculture and Consumer Services, Daytona, FL; M. A. Goodrich, Eastern Illinois University, Charleston, IL; P. Harpootlian, Simpsonville, SC; P. W. Kovarik, Ohio State University, Columbus, OH; R. W. Lundgren, Archer, FL; R. F. Morris, Lakeland, FL; F. Skillman, Sunsites, AZ; C. Smith, Georgia Museum of Natural History, Athens, GA; M. C. Thomas, Gainesville, FL; R. H. Turnbow, Fort Rucker AL; W. F. Michener, D. Fussel, and R. Birkhead, J. W. Jones Ecological Research Center, Newton, GA. Mark Deyrup provided material from Archbold Biological Station. Ed Riley and Will Godwin (both TAMU) provided Texas records. We thank the owners or curators of the many collections we studied for this project. Joyce Cook aided SBP with technical matters and identifications

We thank the following for reviewing the manuscript: Will Godwin, TAMU; Peter Kovarik, OSUC; William Warner, Phoenix, Arizona; and M. C. Thomas and W. N. Dixon, Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL. This is Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Contribution No. 909.

Literature Cited

- Brown, L. N. and G. C. Hickman.** 1973. Tunnel system structure of the southeastern pocket gopher. *Florida Scientist* 36: 97-103.
- Hall, E. R.** 1981. *The mammals of North America.* John Wiley & Sons, New York.
- Hatch, M.** 1933. Studies on the Leptodiridae (Catopidae) with descriptions of new species. *Journal New York Entomological Society* 41: 187-239.
- Hubbard, H. G.** 1894. The insect guests of the Florida land tortoise. *Insect Life* 6: 302-315.

- Hubbard, H. G.** 1896. Additional notes on the insect guests of the Florida land tortoise. Proceedings of the Entomological Society of Washington 3: 299-302.
- Hubbell, T. H.** 1940. A blind cricket-locust (*Typhloceuthophilus floridanus* n. gen et sp.) inhabiting *Geomys* burrows in peninsular Florida. Annals of the Entomological Society of America 33: 10-32.
- Hubbell, T. H. and C. C. Goff.** 1939. Florida pocket-gopher burrows and their arthropod inhabitants. Proceedings of the Florida Academy of Science 4: 127-165.
- Peck, S. B.** 1973. A systematic revision and the evolutionary biology of the *Ptomaphagus* (*Adelops*) beetles of North America (Coleoptera; Leioididae; Catopinae), with emphasis on cave-inhabiting species. Bulletin of the Museum of Comparative Zoology (Harvard) 145: 29-162.
- Peck, S. B.** 1977. The subterranean and epigeal Catopinae of Mexico (Coleoptera: Leioididae). Pp. 185-213. In: J. R. Reddell (ed.). Studies on the caves and cave fauna of the Yucatan Peninsula. Association of Mexican Cave Studies Bulletin 6. (Texas State Museum, Austin, TX.)
- Peck, S. B.** 1982a. Occurrence of *Ptomaphagus cavernicola* in forests in Florida and Georgia (Coleoptera; Leioididae; Cholevinae). Florida Entomologist 65: 378-379.
- Peck, S. B.** 1982b. New records of poorly known *Ptomaphagus* from Texas and the Ozarks (Coleoptera: Leioididae; Cholevinae). Coleopterists Bulletin 36: 109-111.
- Peck, S. B.** 1984. The distribution and evolution of cavernicolous *Ptomaphagus* beetles in the southeastern United States (Coleoptera: Leioididae; Cholevinae) with new species and records. Canadian Journal of Zoology 62: 730-740.
- Peck, S. B.** 1990. Insecta: Coleoptera; Silphidae and the associated families Agryrtidae and Leioididae. Ch 37, pp. 1113-1136. In: D. Dindal (ed). Soil Biology Guide. John Wiley and Sons.
- Peck, S. B.** 1998a. Phylogeny and evolution of subterranean and endogean Cholevinae (=Leioididae, Cholevinae): an introduction. Museo Regionale di Scienze Naturali, Torino (Italy) 1998: 11-40.
- Peck, S. B.** 1998b. Cladistic biogeography of cavernicolous *Ptomaphagus* beetles (Leioididae, Cholevinae: Ptomaphagini) in the United States. Museo Regionale di Scienze Naturali, Torino (Italy) 1998: 235-260.
- Peck, S. B. and P. Gnasparini.** 1997. Review of the myrmecophilous *Ptomaphagus*, subgenus *Echinocoleus* (new status), of North America (Coleoptera: Leioididae; Cholevinae: Ptomaphagini). Canadian Entomologist 129: 93-104.
- Ross, E. S.** 1944. Arthropod collecting in the burrows of a Texas pocket gopher. Entomological News 55: 57-61.
- Skelley, P. E. and R. D. Gordon.** 2001. Scarab beetles from pocket gopher burrows in the southeastern United States (Coleoptera: Scarabaeidae). Insecta Mundi 15(2): 77-93.
- Skelley, P. E. and P. W. Kovarik.** [2001]. Insect surveys in the Southeast: investigating relictual entomofaunas. Symposium on Insect Behavioral Ecology and Systematics. Florida Entomologist [in press].
- Skelley, P. E. and R. E. Woodruff.** 1991. Five new species of *Aphodius* (Coleoptera: Scarabaeidae) from Florida pocket gopher burrows. Florida Entomologist 74: 517-536.
- Young, F. N. and C. C. Goff.** 1939. An annotated list of the arthropods found in the burrows of the Florida gopher tortoise, *Gopherus polyphemus* (Daudin). Florida Entomologist 22: 53-62.