Review of the tribe Melolonthini in the southeastern United States (Coleoptera: Scarabaeidae: Melolonthinae)

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Abstract. This paper reviews the tribe Melolonthini (Scarabaeidae, Melolonthinae) in the southeastern United States, primarily in the states of Mississippi, Alabama, Georgia, and northern Florida. Four new species are described: *Gronocarus inornatus*, *Hypothyce burnei*, *Polyphylla donaldsoni*, and *Polyphylla woodruffi*. One new synonymy is made: *Gronocarus multispinosus* Howden is synonymized under *Gronocarus autumnalis* Schaeffer. Description of the previously unknown female is made for *Polyphylla brownae* Young. New collection records are presented for many species. Comments on natural histories and a key to species (omitting only species of the genus *Phyllophaga* Harris) in this region are presented.

Key Words. Scarabaeidae, Melolonthinae, new species, United States, *Polyphylla*, *Gronocarus*, *Hypothyce*.

Introduction

Within the southeastern United States live many interesting endemic scarabs with relationships to the western fauna. Peninsular Florida is well known for its high percentage of endemics (see Woodruff 1973, 1982, Woodruff and Beck 1989, Woodruff and Deyrup 1994, etc.). In their list of Florida beetles, Peck and Thomas (1998) indicate that 35 of more than 300 scarab species known from Florida are endemic. Their number is somewhat misleading, as many of the scarabs endemic to the panhandle region of Florida, which occur just over the border in neighboring states, were not considered endemic.

The region between the Piedmont and the coastal plain starting in central South Carolina and extending to the southern tip of Mississippi, represents relictual coastal areas with a prehistoric relationship to peninsular Florida. The geologic history of this region is complicated, involving glaciation, changing ocean levels, and erosion during which were several influxes, isolation, and continued evolution of faunas isolated from other areas (Delcourt 2002, Olson et al. 1954, Hubbell 1960, Howden 1963, 1966, Young 1988, and many others). This region is already known for several interesting endemic scarabs: *Gronocarus* spp. (Howden 1961), pocket gopher scarabs (Skelley and Gordon 2001), *Mycotrupes* spp. (Olson et al. 1954), *Phyllophaga ovalis* Cartwright (Woodruff and Beck 1989), etc. Enough evidence is mounting to show that this region is rich in relictual biota, yet it remains poorly collected.

Recent collections in this region have produced several new melolonthine scarabs. The purpose of this paper is to describe new species and document new data to further our knowledge of this interesting area of the United States.

Materials and methods

Complete specimen data are presented for new species only, or where the data significantly add to our present knowledge of the taxon. Thus, several taxa are only briefly mentioned. Unless noted, all label data herein were collected from specimens studied for this work, numbers are for males, unless specifically noted as female. Measurement ranges are based only on available specimens or, when available, literature accounts. Length is from tip of clypeus to tip of elytra. Width is maximum width of elytra.

Studied specimens are deposited in the following institutional and private collections: **CMNC** - Canadian Museum of Nature, Ottawa, Canada; **EGRC** - E. G. Riley , College Station, TX; **HAHC** - H. and A. Howden, Canadian Museum of Nature, Ottawa, Canada; **FSCA** - Florida State Collection of Arthropods, Gainesville, FL; **HDIC** - H. Douglas, Carlton University, Ottawa, Canada; **JCBC** - J. C. Burne, Macon State College, Macon, GA; **JWIC** - J. Wappes, Bulverde, TX; **MEMC** - Mississippi Entomological Museum, Mississippi State, MS; **NMNH** - National Museum of Natural History, Smithsonian Institution, Washington, DC; **PESC** - P. E. Skelley, Gainesville, FL; **PKLC** - P. K. Lago, University of Mississippi, University, MS; **RFMC** - R. F. Morris, II, Lakeland, FL;

RHTC - R. H. Turnbow, Jr., Enterprise, AL; **TAMU** - Texas A&M University, College Station, TX; **UGAC** - University of Georgia, Athens, GA; **UNSM** - University of Nebraska State Museum, Lincoln, NE; **WBWC** - W. B. Warner, Chandler, AZ.

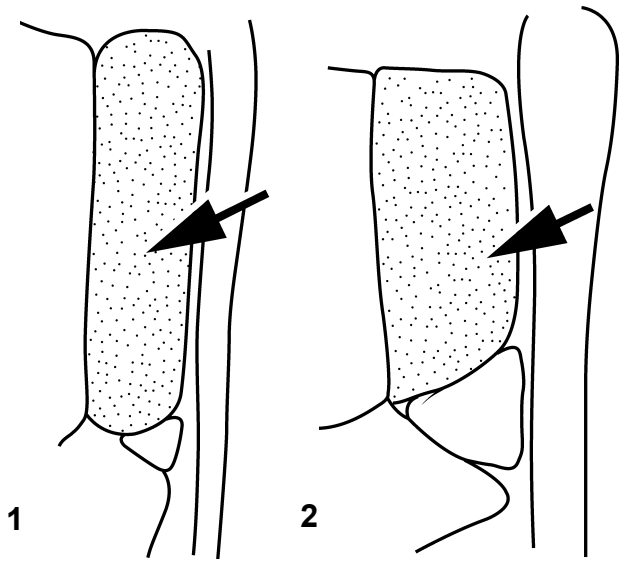
Key to the Tribe Melolonthini in the Southeastern United States

This key is based on Evans (2002, starting at couplet 21 for the Melolonthini) and modified to include species occurring between the Piedmont and the coastal plain in the southeastern United States. *Polyphylla comes* Casey and *Polyphylla variolosa* (Hentz) are found on the northern borders of this region. They are included in the key, but are not mentioned further. The genus *Phyllophaga* Harris is too speciose to be considered fully in this paper, but is briefly mentioned. Other Melolonthinae (not considered to be in the Melolonthini, Evans 2002, 2003) which occur, or possibly occur, in the southeastern United States, are not covered here: *Diplotaxis* Kirby, *Serica* Kirby, *Maldera* MacLeay, *Plectris* Saint-Fargeau, *Dichelonyx* Harris, *Macrodactylus* Latreille, and *Hoplia* Latreille.

1. Metepisternum narrow (Fig. 1); parameres of male genitalia usually short (Figs 50-53, 62-63), usually shorter than basal piece, simple or highly modified 2
— Metepisternum wide (Fig. 2); parameres of male genitalia more elongate (Figs. 64-99), as long or longer than basal piece, gradually tapering to a variably pointed tip 4

2(1). Labrum deeply emarginate in anterior view and wide, more than half width of clypeus (Fig. 3); tarsal claws not simple, variously toothed, cleft or serrate, slightly so in some; abdominal ventrites variably fused at middle in most species; widespread ..... *Phyllophaga* spp. (*sensu lato*)
— Labrum not emarginate in anterior view, less than half width of clypeus (Fig. 4); tarsal claws simple, base may be enlarged; abdominal ventrites not fused; coastal Mississippi, Alabama, and Florida panhandle [*Gronocarus* Schaeffer] 3

3(2). Male with posterior margin of abdominal ventrite V bearing a median tooth (Figs. 54-57); west of Choctawhatchee River in Florida, coastal Alabama and Missisippi .... *G. autumnalis* Schaeffer
— Male with posterior margin of abdominal ventrite V lacking a median tooth (Figs. 60-61); east of Choctawhatchee River in Florida panhandle ... . *G. inornatus* Skelley, n. sp.

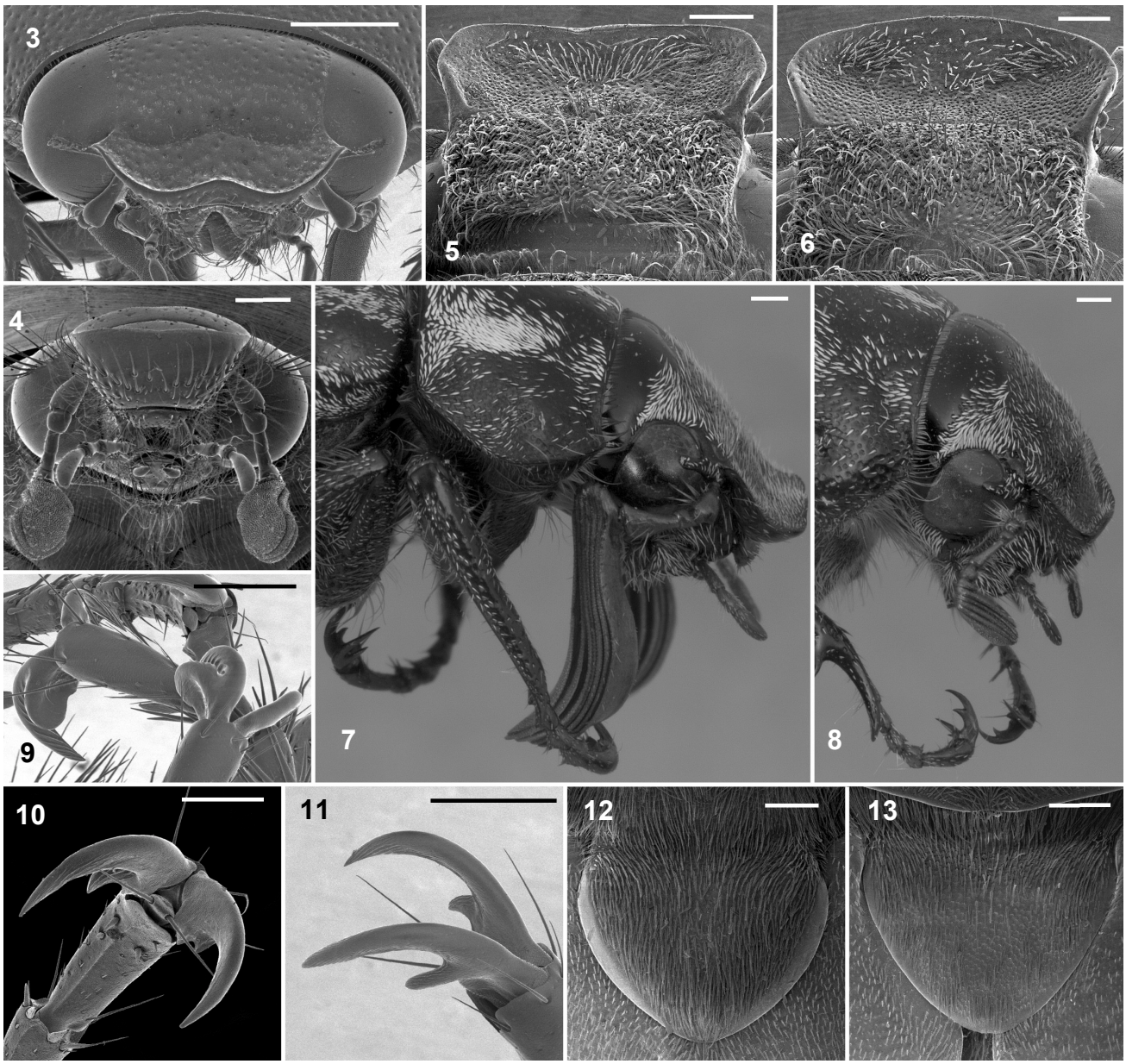


Figures 1-2. Metepisterna (from Evans 2002), 1) Narrow as in *Phyllophaga* spp. and *Gronocarus* spp., 2) Wide as in *Polyphylla* spp., etc.

4(1). Antennal club with 3 segments; accessory teeth on adjoining tarsal claws distinctly different in size (Figs. 9-10); parameres of male genitalia with subapical spine on ventral margin, apex strongly compressed from sides and lobed upwardly (Fig. 91-99) 5
— Antennal club with 5 (female) or 7 (male) segments (Figs. 7-8, 28-29); accessory teeth on adjoining tarsal claws for most species nearly equal in size (Fig. 11), length of teeth not differing more than 50%; parameres of male genitalia lacking subapical spine on ventral margin, apex variably compressed and often hooked downward (Fig. 64-90) [*Polyphylla* Harris] 7

5(4). Adjoining tarsal claws with accessory tooth of anterior claw lobe-like (Fig. 9), posterior claw notably smaller; abdominal sutures between ventrites II-III-IV distinct at midline; peninsular Florida ..... *Hypotrichia spissipes* LeConte
— Accessory tooth on both tarsal claws small and acute (Fig. 10); abdominal sutures between ventrites II-III-IV obliterated medially, indicated only by a line where the dense vestiture stops between ventrites; Georgia [*Hypothyce* Howden] 6

6(5). Clypeal punctures distinctly larger and sparser at middle than near lateral margin, apical margin truncate or slightly convex (Fig. 5); scutellum glabrous along lateral edge, setae distant from



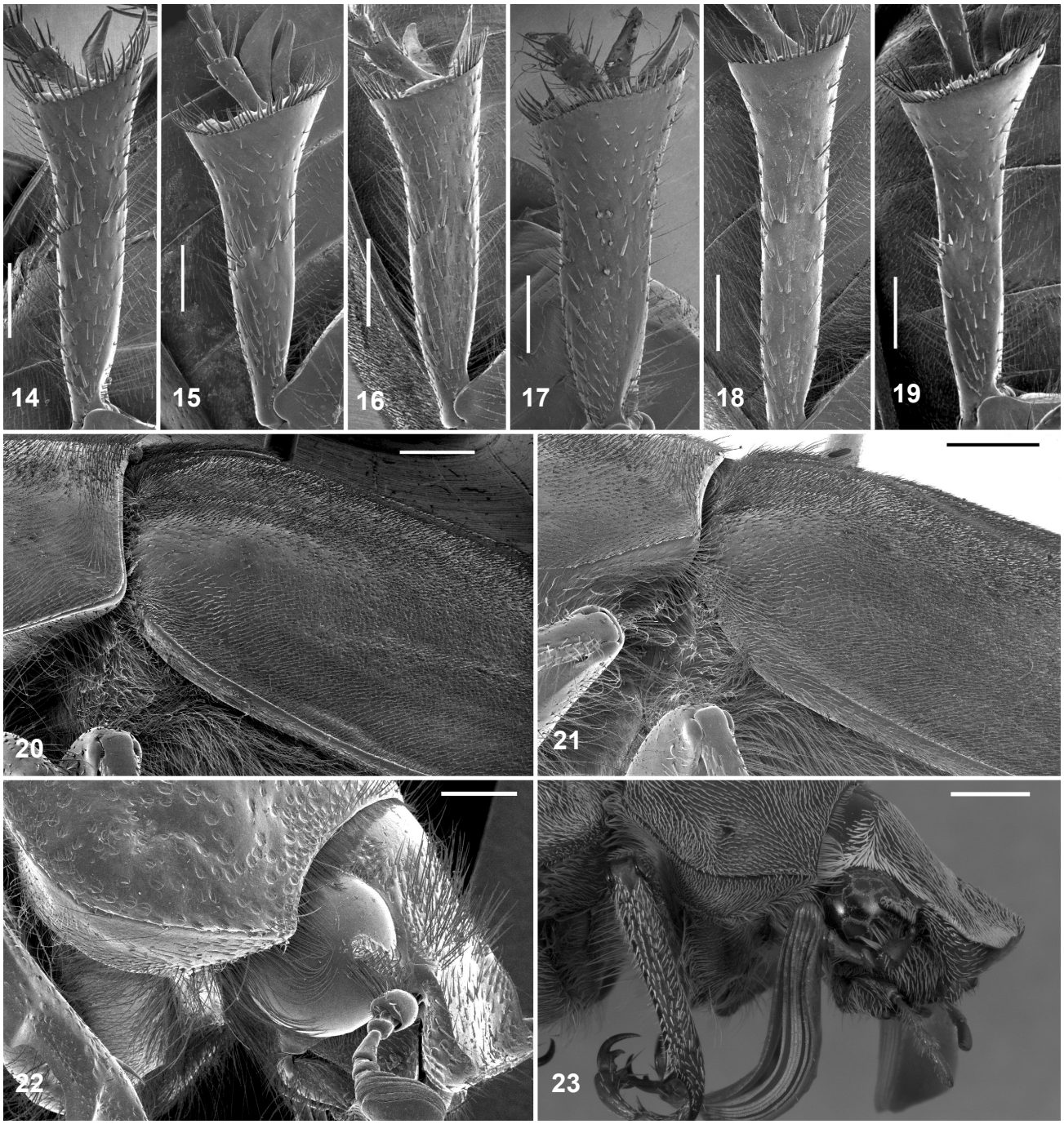
Figures 3-13. Various body parts, scale line = 0.5 mm. 3) *Phyllophaga gracilis* (Burmeister) anterior view of head; 4) *Gronocarus inornatus* anterior view of head; 5) *Hypothyce osburni* dorsal view of head; 6) *Hypothyce burnei* dorsal view of head; 7) *Polyphylla gracilis* male lateral view of head; 8) *Polyphylla gracilis* female lateral view of head; 9) *Hypotrichia spissipes* tarsal claws; 10) *Hypothyce burnei* tarsal claws; 11) *Polyphylla woodruffi* tarsal claws; 12) *Hypothyce osburni* scutellum; 13) *Hypothyce burnei* scutellum.

edge (Fig. 12); Flint River area near Albany, Georgia ..... *Hypothyce osburni* (Cartwright)

— Clypeal punctures same size and density across surface, apical margin distinctly convex (Fig. 6); scutellum sharply edged, setae reaching lateral edge (Fig. 13); Ocmulgee and Oconee River areas near Macon, Georgia .... *Hypothyce burnei* Skelley, n. sp.

7(4). Pronotum lacking median stripe of scale-like setae and coarse punctures (Figs. 42-49), disc with evenly distributed fine punctures bearing short, hair-like setae (a glabrous, glossy median stripe may be present under the setae); setal color pattern lacking [*pubescens* species group] 8

— Pronotum with distinct median stripe of scale-like setae, coarse punctures, or both (Figs. 24-27), disc with unevenly distributed coarse punctures bearing recumbent scale or hair-like setae (even-

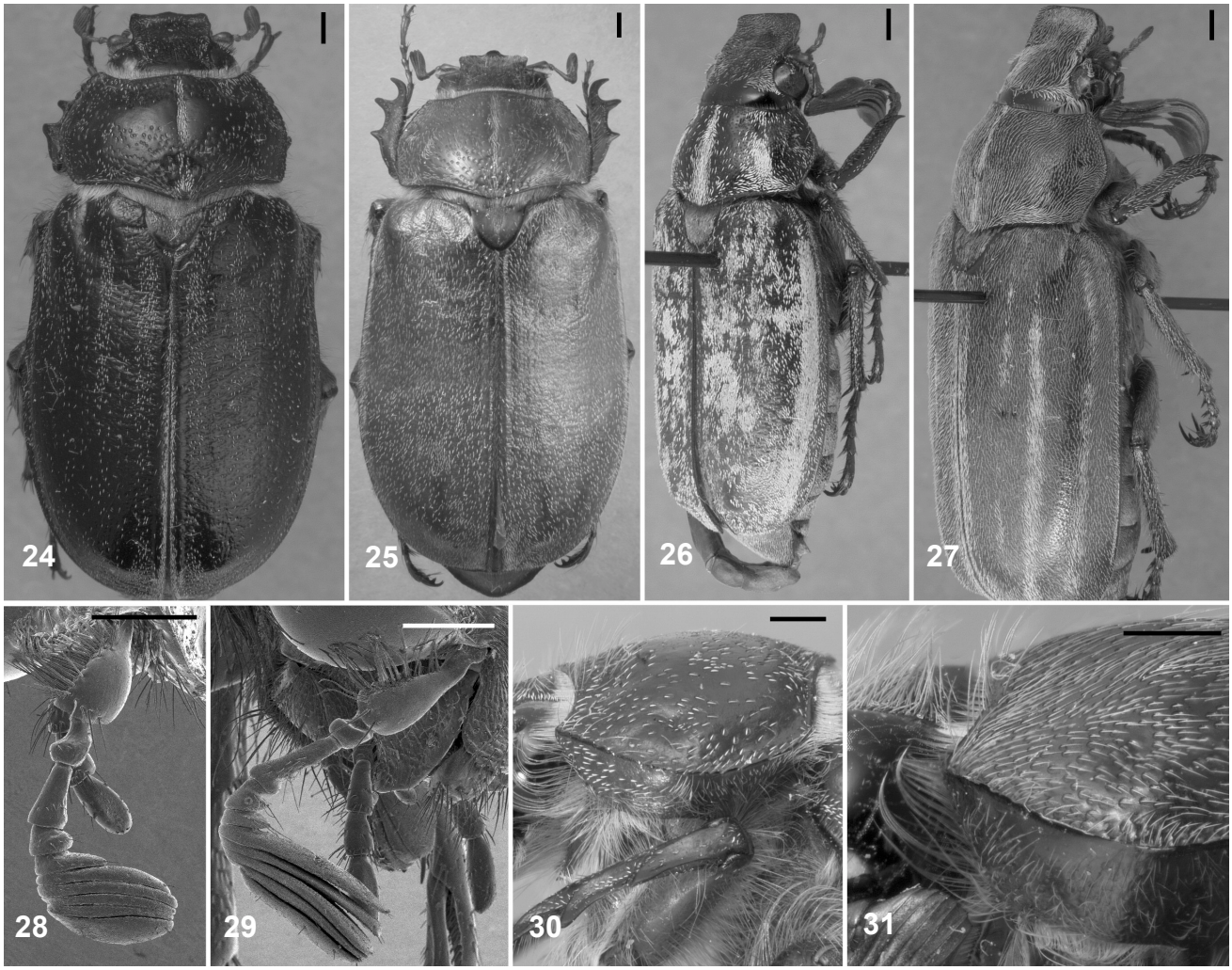


Figures 14-23. *Polyphylla* spp., scale line = 1.0 mm. 14) *P. pubescens* male metatibia; 15) *P. pubescens* female metatibia; 16) *P. woodruffi* male metatibia; 17) *P. woodruffi* female metatibia; 18) *P. donaldsoni* male metatibia; 19) *P. donaldsoni* female metatibia; 20) *P. pubescens* lateral view elytral base; 21) *P. woodruffi* lateral view elytral base; 22) *P. hammondi* lateral view of head; 23) *P. occidentalis* lateral view of head.

ly distributed, coarse punctures in *P. occidentalis*, Fig. 27); pronotum and elytra with setae (scale or hair-like) forming obvious stripes or mottled patterns 10

8(7). Metatibia parallel-sided for most of length (Figs. 18-19); central Georgia .... *P. donaldsoni* Skelley, n. sp.

— Metatibia diverging toward apex for most of length (Fig. 14-17); Florida panhandle 9



Figures 24-31. *Polyphylla* spp., scale line = 1.0 mm. 24) *P. hammondi* female habitus; 25) *P. brownae* female habitus; 26) *P. gracilis* male dorso-lateral habitus; 27) *P. occidentalis* male dorso-lateral habitus; 28) *P. hammondi* female antenna; 29) *P. comes* female antenna; 30) *P. hammondi* female lateral pronotum; 31) *P. brownae* male lateral pronotum.

9(8). Elytral lateral margin reaching base (Fig. 20); metatibia usually black, same color as pronotum; inland Florida panhandle, west of Choctawhatchee River, Eglin Air Force Base area ... . *P. pubescens* Cartwright

— Elytral lateral margin not reaching base (Fig. 21); metatibia usually tan, contrasting in color with pronotum; primarily coastal Florida panhandle east of Choctawhatchee Bay .... *P. woodruffi* Skelley, n. sp.

10(7). Head between eyes with short, recumbent, scale-like setae only, in profile similar to setae of clypeus (Figs. 7-8, 23); protibia of male uni- or bidentate, female bi- or slightly tridentate .. 11

— Head between eye with long, erect, hair-like setae, in profile distinctly different from setae of clypeus (Fig. 22), recumbent scales present or not; protibia of male bi- or tridentate, female strongly tridentate 12

11(10). Elytral disc with setal pattern mottled, lacking sutural stripe, lateral stripe broad (Fig. 26); male protibia unidentate (Figs. 7, 26); female protibia bidentate (slightly tridentate); Florida, southern Alabama, southwestern Georgia .... *P. gracilis* Horn

— Elytra with setal pattern striped, sutural stripe present, lateral stripe narrow (Fig. 27); male (Fig. 23, 27) and female protibia bidentate; southeastern coastal plain, generally below the fall line, Virginia to Mississippi, Florida .... *P. occidentalis* (L.)

12(10). Abdomen and hypomeron of prothorax lacking scales (Fig. 31), body dorsally covered with hair-like setae, lacking pattern (Fig. 25); southwest-

ern Alabama and southeastern Mississippi .... *P. brownae* Young

— Abdomen and hypomeron of prothorax with some recumbent scales (Fig. 30), body dorsally variably patterned (mottled or striped) with mix of hair-like and scale-like setae (Figs. 24, 26-27) 13

13(12). Male protibia bidentate; metafemur narrow, parallel-sided; parameres of male genitalia with groove on each side of apical notch (Figs. 85-90); female antennomere III long, length = 3.5-4.0 times apical width (Fig. 29); elytral color patches distinct, irregularly striped or mottled; widespread in eastern United States 14

— Male protibia tridentate, often slightly; metafemur swollen at middle; parameres of male genitalia lacking groove on each side of apical notch (Figs. 64-69); female antennomere III short, length = 2.0-2.5 times apical width (Fig. 28); elytral color pattern striped, populations in the Southeast with stripes reduced and easily overlooked, but sharply defined (Fig. 24); widespread west of Mississippi River and a few states on its east, including Mississippi .... *P. hammondi* LeConte

14*(13). Distinct broad vittae often formed adjacent to suture; length of male antennal club lamellae 5.15-7.05 mm; primarily around the Great Smoky Mountains, northern parts of the southeastern states to Louisiana, Piedmont and north ....*P. comes* Casey

— Sutural vittae variable, male antenna club lamellae length 3.20-5.00 mm; primarily coastal Virginia, north and west to Quebec and Ontario ... . *P. variolosus* (Hentz)

[*couplet 14 taken from Young 1988]

Taxonomic Accounts

Gronocarus Schaeffer

Gronocarus Schaeffer 1927: 213.

Type species. *Gronocarus autumnalis* Schaeffer 1927, by monotypy.

Diagnosis. *Gronocarus* spp. look like small, stout, brown, ventrally hairy, fat-lipped *Phyllophaga* (Figs. 4, 32-35, 58-59). They differ most notably from all known melolonthines in the southeastern United States in having reduced mouthparts and being active in the winter during rains. They are most similar to *Fossocarus* Howden (1961, 1971), which occurs in eastern Texas.

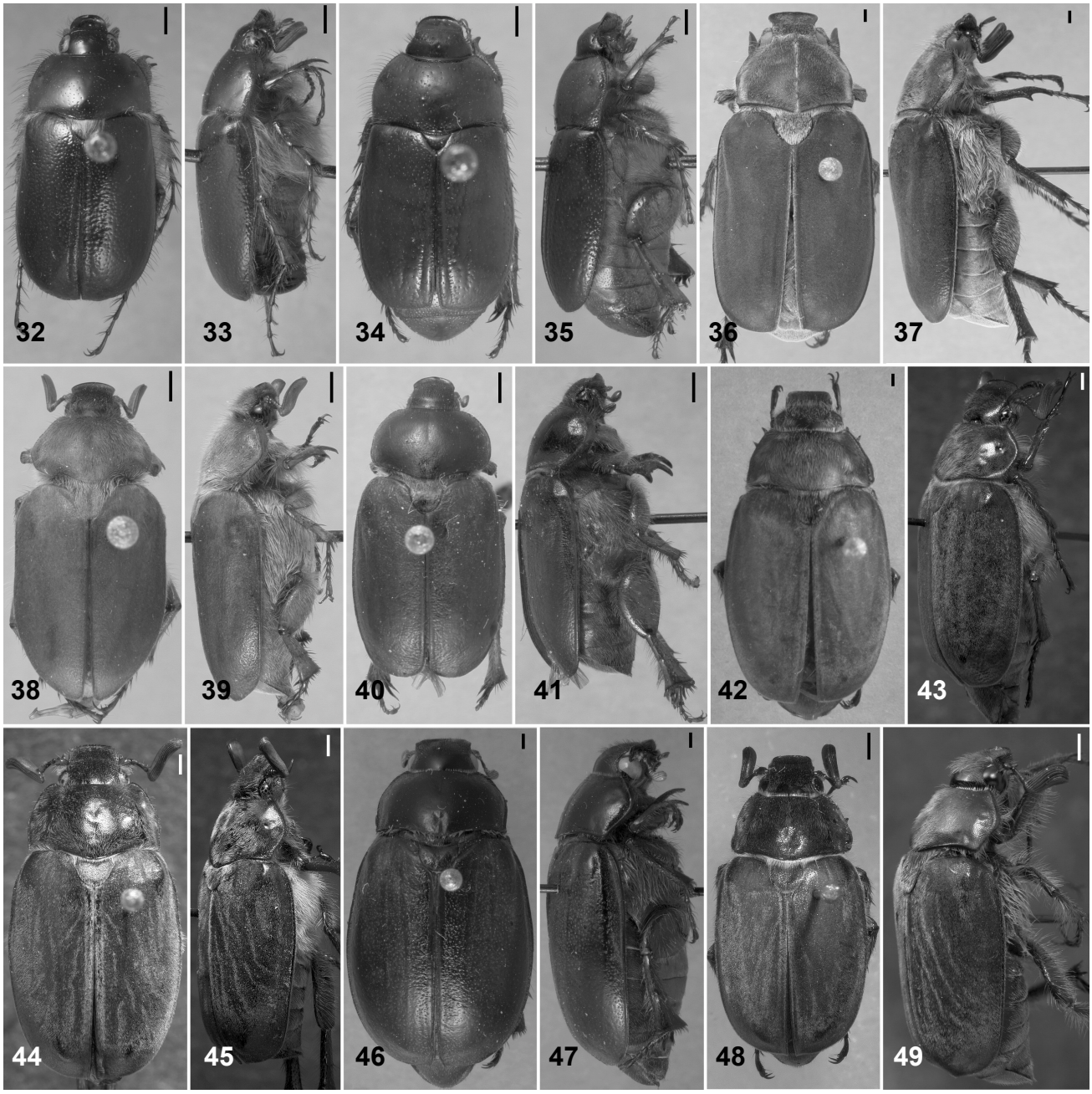
Females are similar to males in the reduced mouthparts and general characteristics just mentioned. They differ from males in a number of characters: reduced eyes and antennal club (compare Figs. 32-33,58 to 34-35, 59), lack of flight wings, greatly swollen metafemur, and shortened tarsi. The lack of hind wings and reduced eyes distinguish *Gronocarus* females from other melolonthines in the southeastern United States.

Description. Descriptions of *Gronocarus* species by Schaeffer (1927) and Howden (1961) are fully adequate for the entire genus as presently understood. The description that follows, with modification, is a merging of their work.

Length 8.0-16.0 mm, width 4.3-7.2 mm (with numerous exceptions, females average smaller than males). Body above glabrous, shining, variably brown in color, lacking color pattern, with base of head and clypeus darker; shape moderately elongate.

Head with frons and vertex convex; punctation variable, with sparse, irregular, coarse punctures or nearly impunctate, female usually with fewer punctures than male; frons separated from clypeus by a moderately impressed straight, sinuate or arcuate suture. Clypeus with surface basally flattened and apical margin concave, punctures as on head; outline semicircular from above, almost two-thirds as long as wide; anterior margin strongly reflexed in front in male, less strongly reflexed in female; margin usually not emarginate, though can be slightly concave; clypeal portion anterior to margin (above labrum) glabrous at middle near margin, with coarse punctures bearing long setae on sides and at middle next to labrum, distance from margin to labrum much greater than length of labrum. Eyes of male large and prominent, ball-like, distinctly faceted; with finger-like canthus projecting well into anterior portion, dorsally bounded by distinct groove; in female greatly reduce to vague elongate areas (exact shape variable) with slight faceting, not at all prominent, not encroached upon by canthus, not readily separable from head dorsally. Antennae 9 segmented, last 3 forming a moderately large lamellate club, lamellae longer than funicle and opaque in male; as long as funicle and shining in female.

Pronotum about twice as wide at base as long, sides from base gradually narrowing to about middle then strongly narrowing to apex; basal angles broadly rounded, anterior angles obtuse; lateral margin feebly, finely crenate; anterior margin distinct, no mem-



Figures 32-49. Habitus images in pairs, dorsal and lateral views, scale line = 1.0 mm. 32-33) *Gronocarus inornatus* male; 34-35) *Gronocarus inornatus* female; 36-37) *Hypothyce burnei* male; 38-39) *Hypotrichia spissipes* male; 40-41) *Hypotrichia spissipes* female; 42-43) *Polyphylla donaldsoni* male; 44-45) *Polyphylla pubescens* male; 46-47) *Polyphylla pubescens* female; 48-49) *Polyphylla woodruffi* male.

brane anteriorly; base not margined nor impressed; surface sparsely punctate, lacking setae except at extreme margins and hind angle; lateral and basal margins with long, yellowish hairs.

Elytra at base not wider than pronotum, sides nearly parallel; sutural costa scarcely visible, discal costae absent; surface coarsely punctate, coarser that on pronotum; lateral margins with single row of hair-like setae. Metathoracic wings (flight wings) present in male, absent in female.

Body of male ventrally clothed with moderately long, yellowish hairs sparsely placed on hypomeron of prothorax, abdomen, and femora, dense on meso- and metasternum; female not as densely pubesent as male

ventrally. Metepisternum narrow, length 3-4 times width.

Protibia strongly bidentate in both sexes, often with a small third tooth. Protarsus of male longer than tibia, in female tarsi shorter than tibia. Metafemur notably stouter in female than male. Metatibia moderately stout, more so in female; dilated toward apex, with 2 free spurs. Metatarsus slender and longer than tibia in male; in female shorter than tibia. All tarsal claws simple, equal, slender, and not toothed or cleft.

Abdomen with 6 visible ventrites not connate, freely movable; ventrites finely punctate; penultimate and ultimate segments more coarsely punctate at middle, sparser at sides. Pygidium sparsely punctate at middle, becoming denser at base, margin fine laterally becoming thick at apex; surface convex, some males strongly so.

Male parameres simple (Figs. 50-53, 62-63), dorso-ventrally flattened and slightly arched; length 2.0-3.5 times width; sides vary from wider at base to parallel-sided, most wider at base, very few wider at apex; apex usually truncate, with few rounded or slightly concave; opening in parameres for internal sac variable from elongate to nearly circular, but usually half length of parameres.

Variation. Except for characters used to distinguish the species below, all variations occurred in every studied population. Very few of these variations appeared to be clinal or regional variants.

Comments. Until recently, specimens of *Gronocarus* have been rare in collections. Howden (1961) mentioned finding dead specimens lying under lights or in spider webs. The Panama City specimens mentioned by Howden (1961) were found on the ground near the post office (pers. comm., R. E. Woodruff), several of which had been stepped on.

Howden (1961) equated their rarity with a winter activity period. While this is true, it was not until there was some insight into their biology and development of a search procedure that they were found to be locally abundant. While checking pitfall traps west of DeFuniak Springs in December 1990, M. C. Thomas was caught in a rain storm. During this shower, he noticed what he thought was a swarm of bees. Upon capturing one, realized what he had found: *Gronocarus* males are winter active and fly in the rain.

Living nearby and being interested in unusual beetles, R. H. Turnbow, Jr., began making frequent trips to the area trying to get caught in winter rain events. Instead of collecting in the cold rain, which often ended before arriving at the site, he found it was much more productive (and comfortable) looking for them after a rain along sandy roads. He discovered that as males burrow in after a rain, they would leave a small, 10-15 mm diameter disturbance in the sand. Rain would smooth and wet the surface, so these disturbances were the first evidence of activity in the sand, and males were no more than 3-4 cm away from the point where they burrowed. Once the sand dried on the surface, these disturbances disappeared. Searching for these disturbances after rains allowed us to successfully survey for these beetles, finding many new localities, and collecting series of specimens.

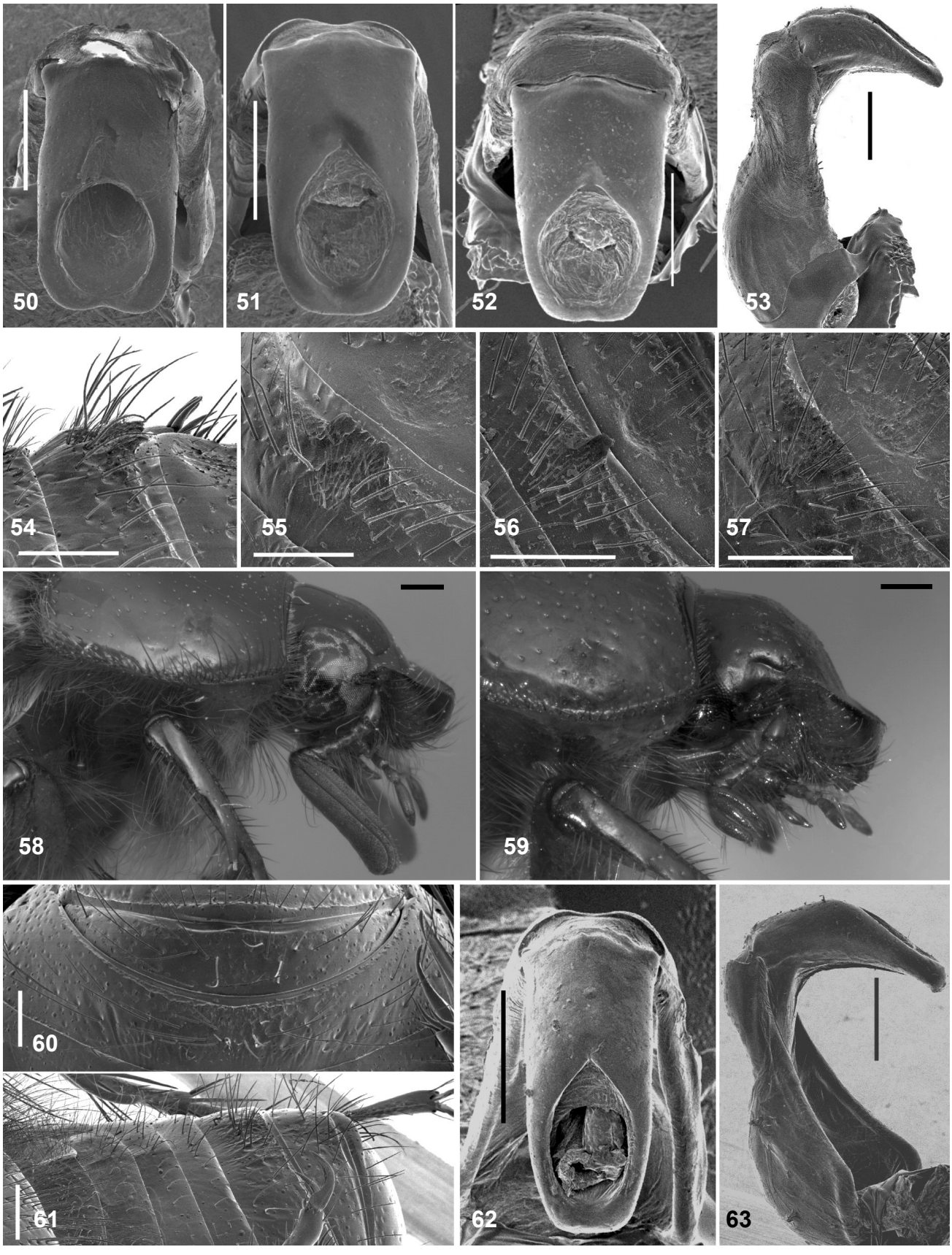
Females usually made different types of disturbances, often being found under pencil-sized holes in the sand, but about 10 cm deep. Apparently females only stick their abdomen out of the sand to mate, then return beneath the surface (pers. comm., R. H. Turnbow). Even with our new searching abilities, females were less frequently found.

Attempts were made to rear larvae of *Gronocarus* collected west of DeFuniak Springs. Males and females were placed in small (ca. 1 liter) containers with sand from their collection site in hopes they would mate and lay eggs. However, no activity was noticed until a vacuum cleaner was run near them, then males started flying in the container. Every time the vacuum was on, males would fly until it was turned off. It is postulated that vibrations of the machine were similar to rain pounding the earth. This vibration (noise) is suspected to be the stimulus triggering flight of the males (Skelley 1998).

Females and males kept in these small containers showed interesting longevity. Males died after about a month, but females survived several months apparently without food. One female survived 6 months in a container with nothing but the original sand. Males and females do not appear to feed as adults. However, the longevity of females would indicate they either fed, or survived on fat reserves from the larval stage.

Surprisingly, females laid many eggs, some more than 20. The vast majority of these eggs hatched. Some first instars were preserved, others were set up to attempt rearing third instars for description. After

Figures 50-63. *Gronocarus* spp., scale line = 0.5 mm. 50-53) *G. autumnalis*, male parameres; 50-51) Variants from DeFuniak Springs; 52-53) Typical paramere from Alabama, dorsal and lateral views; 54-57) *G. autumnalis* apex male abdominal ventrite V; 54-55) Typical form, lateral and ventral view; 56-57) Extreme variations from DeFuniak Springs; 58-59) *G. inornatus*, lateral view of head, male and female; 60-61) *G. inornatus*, apex male abdominal ventrite V, ventral and lateral views; 62-63) *G. inornatus*, genitalia of holotype, dorsal and lateral view.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a full year the few remaining grubs finally molted to the second instar. A second instar grub was also preserved. None of the remaining grubs survived to the third instar. This would indicate a possible 2-3 year larval development.

First instar larvae appeared to feed on organic matter in the sand. Several different food sources were mixed in the sand with the larvae, including well-aged horse manure (found dried in a field) ground to coarse power, button mushrooms (from the grocery store), fresh grass clippings, and living grass roots. The longest lived grubs fed on the old horse manure. However, the failed rearing indicates they were not provided with a food source, or variety, suitable for long term survival.

Early instars of *Gronocarus* were compared with third instar grubs collected in the areas where adults were found. The only third instar grub that matched the reared grubs was found about a meter under the surface in relatively root-free sand. The food source is unknown, but it is suspected that *Gronocarus* grubs burrow deeper in the sand than other melolonthine scarabs.

Observations of burrowing activity explains the function of some larval structures. The abdomen of *Gronocarus* bears a dense patch of short, posteriorly pointing setae at the end of abdominal segment X. Abdominal segments I-VII have well developed dorsal patches of microspicules. Also, each set of legs is different: protarsus with a single large claw, mesotarsus with a smaller claw, and hind leg longer with a swollen metatarsus lacking any hint of a claw, but bearing many stout setae.

The grubs arched the abdomen, wedging it vertically in the burrow between the dorsal patches of microspicules and the abdominal apex. Then using the hind legs, it wedged itself horizontally. This allows it to have a full range of motion for the head and fore legs. The grub used its front legs and mandibles to dig through the sand, forming a sand ball between the mandibles and middle legs as it went. The mouthparts (at least in the first instar) and front pairs of legs were quite active. It seemed to be picking through the sand, eating bits of organic materials. Once a sizable ball was formed, the grub did a somersault to pull the body in front of the ball. Then it pushed the ball to the back of the burrow with its head, do another somersault, wedged itself in place, and start digging again.

Adult *Fossocarus* (in Texas) have similar habits as *Gronocarus*, and I have collected specimens in the same manner described above. First instar larvae for *Fossocarus* were also obtained, and as with *Gronocarus*, failed to complete development. Detailed morphological description of these first instar grubs, *Gronocarus* and *Fossocarus*, will be provided in another paper. Preserved larval specimens mentioned above are deposited in PESC.

Taxonomy. The uniqueness of *Gronocarus* was first recognized by Schaeffer (1927) who stated it "... does not fit well in any of the tribes occurring in North America ..." Until recently, *Gronocarus* was placed in the Pachydemini; currently it is in the Melolonthini (Evans 2002, 2003).

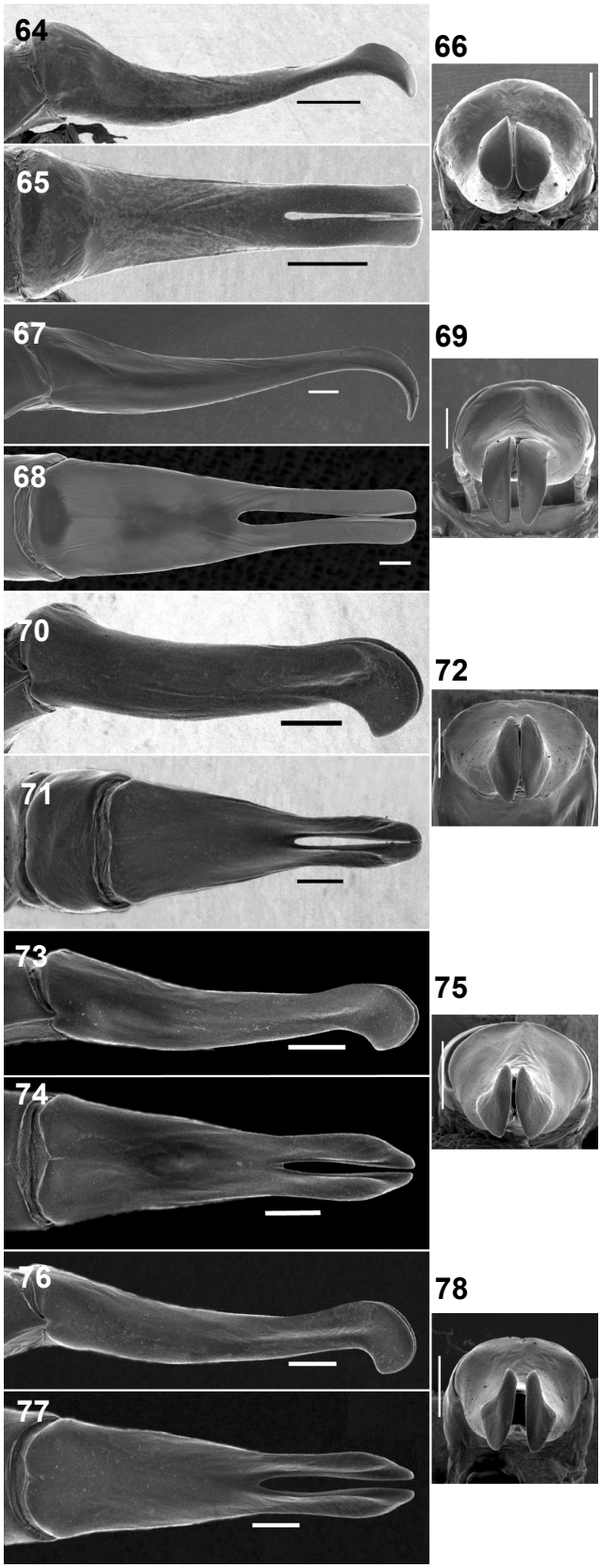
At the species level, matters were also difficult. Howden (1961) discussed variations of characters among *G. autumnalis*, *G. multispinosus*, and a third population from Panama City, FL. While not formally recognizing this third population, he discussed how it seemed to be intermediate in characters used to distinguish the described populations.

With the discovery of a collecting method and acquisition of series from many localities, we discovered that characters used to recognize these 3 populations (numbers of spines on hind tibia, development of clypeus and clypeal punctures, general body punctation and size, male genitalia, etc.) varied widely within a population and in all cases broadly overlapped those of any other population (analyses of M. C. Thomas and R. H. Turnbow, Jr., and pers. obs.).

For example the number of metatibial spinules was counted and analyzed for *G. autumnalis* from Mobile Bay and *G. multispinosus* from DeFuniak Springs. Spinule counts for *G. autumnalis* (n = 48) ranged from 10-19, with an average of 15 spinules. While spinule counts for *G. multispinosus* (n = 109) ranged from 13-25, with an average of 19 spinules. While tibial spinule counts for what is a new species (the third population of Howden 1961) ranged from 11-21 (n = 24), with an average of 16 spinules.

In addition to this variation between individuals, it should be noted that both tibiae were counted on each specimen. Individual differences (right vs. left) in tibial counts averaged 1.5 spines, with a maximum difference of 7, and more than 70% of the specimens had different counts. Subtle differences appearing in these averages are less meaningful, considering the vast variation that occurs in these widely overlapping data sets.

This overlapping variability of nearly all previously used characters made species recognition tenuous at best. For practical purposes many characters were ultimately ignored and species level questions for the genus were readdressed. However, as Howden (1961: 811) stated, "Since the females are flightless ...



the existence of distinct races separated by seemingly minor ecological barriers is not unlikely."

The region where *Gronocarus* occurs is divided (primarily north-south) into several isolated sections by rivers with broad flood basins: Alabama, Escambia, Blackwater, Yellow, Choctawhatchee, and Apalachicola Rivers. Except where they occur on or near the barrier islands, the distribution of *Gronocarus* is bounded by the Apalachicola River to the east and Mobile Bay to the west. On the barrier islands, populations circumvent the river basins, extending the range further east and west.

Sorting specimens based on locality showed some regional variation (as with *G. autumnalis* vs. *G. multispinosus*) but one relatively major, consistent, sexually dimorphic character led to the species concepts below. Presence or absence of this character is sharply divided east and west of the Choctawhatchee River. This boundary also separates the Florida species of the *Polyphylla pubescens* species group.

Henry Howden (pers. comm.) had no objection to the potential synonymy of *G. multispinosus* with *G. autumnalis*, stating "I did the best I could with the limited data available." This is how science progresses. Thus, I must make the same statement about what is presented here regarding *Gronocarus*. A more detailed analysis of characters such as the aedeagus, including the internal sac, mouthparts, female and larval morphology, or DNA tied in with a better physiographic understanding of the region may lead to different results.

Additional References. Howden 1971: 1463-1464; Woodruff 1982: 97; Woodruff and Deyrup 1994: 402-403 (spiny burrowing June beetle).

Gronocarus autumnalis Schaeffer
(Figures 50-57, 100)

Gronocarus autumnalis Schaeffer 1927: 213-215.
Gronocarus hiemalis Schaeffer 1927: 215 [*nomen nudum*].
Gronocarus multispinosus Howden 1961: 810-811, **new synonymy**.

Diagnosis. Found west of the Choctawhatchee River in sandy uplands or on barrier islands of the Florida panhandle, and in coastal areas of Alabama and Mississippi. Males are readily distinguished by the presence of a small lobe at the middle apex of abdom-

Figures 64-66. *Polyphylla* spp. male genitalia in dorsal, lateral, and apical views, scale line = 0.5 mm. 64-66) *P. hammondi;* 67-69) *P. brownae;* 70-72) *P. pubescens;* 73-75) *P. woodruffi;* 76-78) *P. donaldsoni*.

inal ventrite V (absent in *G. inornatus*) and genitalia. Females are presently not distinguishable from *G. inornatus*, except by location of capture and association with a male.

Description. The following paragraph supplements the generic description above to formally describe this species.

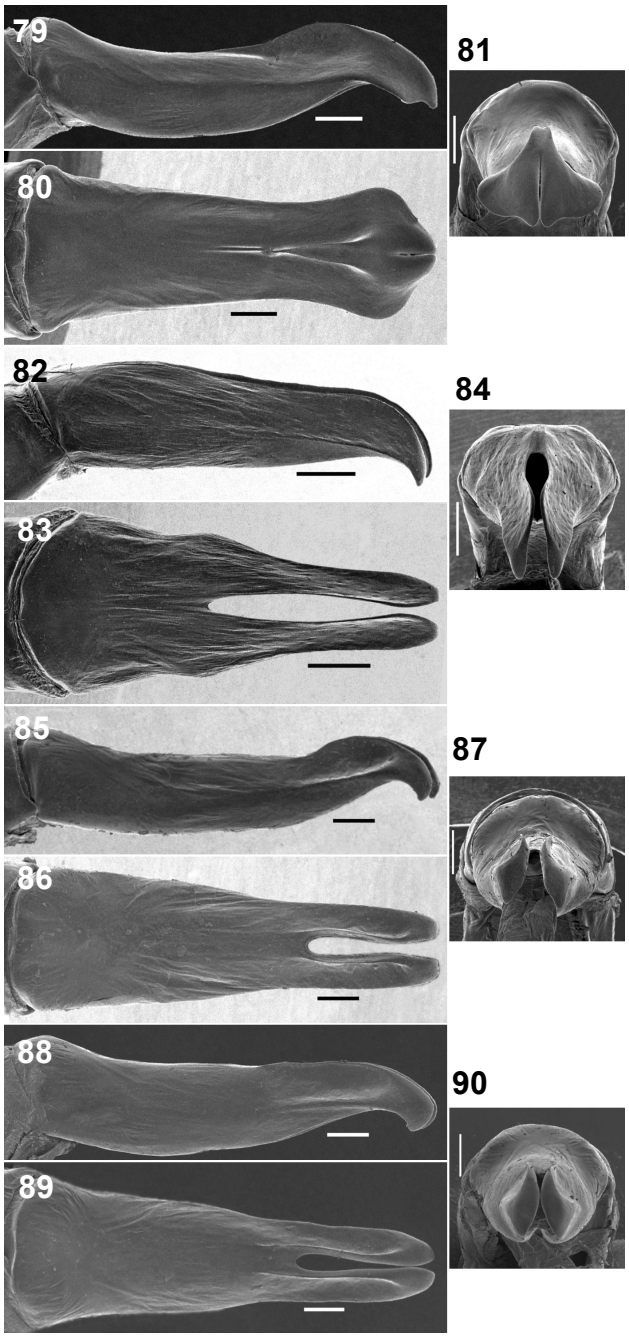
Length 9.7-16.0 mm, width 4.5-7.2 mm. Male paramere length 2.0-2.5 times width (Figs. 50-53). Abdominal ventrite V with caudal margin at middle rugose, with a lobe of variable shape and width (Figs. 54-57), but almost always broad with 2 small teeth on its outside corners.

Type Materials. *Gronocarus autumnalis* Schaeffer: holotype male "/ [white paper, red ink] Type/ [white paper, black ink] Baldwin Co. Ala., XI.9.24, H. P. Loding/ [white paper, black ink] BROOKLYN MUSEUM COLL 1929/ [small folded white paper, red ink] Gronocarus autumnalis Schff., Type, [male symbol] / [red paper] Type No. 40960 U.S.N.M./ [white paper with 2 red lines outlining edge] Gronocarus autumnalis Schffr./" [NMNH, pers. comm. N. Adams]. Several specimens were collected by Löding around 1924-1925 in Baldwin Co., AL (listed below). Even though they do not bear paratype labels, they should at least be considered topotypic.

Gronocarus mutispinosus Howden: holotype male, DeFuniak Springs, Florida, March 18, 1954, in spider web, H. F. Howden (CNC No. 7508), not studied. Paratypes of *G. multispinosus* that were studied are listed in the data below.

Additional Specimens. (326 males, 55 females total, map Fig. 100). Unless otherwise noted, collectors of the specimens from the 1990s were R. H. Turnbow, M. C. Thomas, and/or P. E. Skelley. Their names have been deleted from the list in the interest of reducing space.

ALABAMA: [county unknown]: Delolampes [hand written, illegible], 7-XI, Schaeffer coll. [2 + 1 female, paratype G. autumnalis]; **Baldwin Co**., 1-XI-1925, H. P. Loding [1 FSCA]; same locality except 16-XI-1924, H. P. Loding [1 + 1 female HAHC, 1 TAMU]; same locality except labeled as paratypes of *G. autumnalis* [4 + 2 females NMNH]; same locality except 9-XI-1924, H. P. Loding [2 + 3 females NMNH, paratypes *G. autumnalis*]; same locality except 15-XI-1933, H. P. Loding [2 + 2 females NMNH]; Daphne, 15-XI-1931, H. P. Loding [2 + 2 females NMNH]; nr. gate to Ft. Morgan, 30-I-1993 [1 PESC]; Ft. Morgan, 30-I-1993 [2 FSCA]; 2.4mi E hdqrts. Bon Secour Wildlife Refuge, 30-I-1993 [1 RHTC]; 5.7mi W Bon Secour Wildlife Preserve, 30-I-1993 [1 FSCA]; 3.7mi W jct. 59 & 180, 30-I-1993 [8 PESC]; Hwy 180 3.3-4.3 mi W jct. Hwy 59, 11-I-1994 [29 RHTC]. **FLORIDA: Escambia Co.**, 0.1mi N Big Lagoon St. Rec. Area, 17-XII-1994 [4 PESC]; Santa Rosa Island nr. Navarre Beach, 17-XII-1994 [4 PESC]; **Okaloosa Co.,** Deerland, 12-I-1993 [1 RHTC]; Eglin AFB road 602, 1mi N SR 123 & SR 85, 13-II-1995 [5 PESC]; Eglin AFB, T2N-R23W-sec. 28, Okaloosa Fire Tower, Hwy. 85S, 5-I-1998, K. E. M. Galley, flying in heavy rain [11 FSCA]; Eglin AFB, T2N-R23W-sec. 28, 21-XII-1999, K. E. M. Galley, flying during rain, 6 am, attracted to light? [5 FSCA]; Eglin AFB, RR 602, 13-II-1995, K. E. M. Galley, flying after rain [1 FSCA]; same locality and date except R. H. Turnbow [4 RHTC]; Tropic Tr. at Hwy. 98, 14-I-1995 [1 RHTC]; **Walton Co.**, DeFuniak Springs, 26-II-1960, V. O. Kelley [1 FSCA, paratype *G. multispinosus*]; same locality except, 18-III-1954, H. Howden [1 NMNH, paratype *G. multispinosus*]; same locality except 28-XI-1992 [1 PESC]; same locality except 18-III-1954, H. Howden, in spiderweb [1 HAHC, paratype *G. multispinosus*]; same locality except 28-I-1994, R. H. Turnbow [1 RHTC]; 1.8mi W DeFuniak Springs, 13-I-1992 [1 FSCA]; 5.3mi W DeFuniak Springs, 28-I-1992 [5 + 3 females RHTC]; 6mi W DeFuniak Springs, 6-II-1992 [14 FSCA]; same locality except 30-I-1993 [1 FSCA]; 6mi W DeFuniak Springs on US 90, 3-XII-1990 [8 FSCA, 2 PESC]; same locality except 17-XII-1994 [6 PESC]; 6.2mi W DeFuniak Springs, 27-XII-1991 [54 + 2 females RHTC]; same locality except 13-I-1992 [6 FSCA, 9 + 1 female RHTC]; same locality except 23-I-1992 [2 RHTC]; same locality except 24-XI-1992 [8 + 5 females RHTC]; same locality except 5-I-1993 [1 female RHTC]; same locality except 12-I-1993 [8 + 1 female HAHC, 6 JWIC]; same locality except 29-XII-1993 [10 females PESC, 3 females RHTC]; same locality except 28-I-1994 [2 + 5 females RHTC]; same locality except 14-I-1995 [20 RHTC]; same locality except 6-II-2002 [3 + 1 female RHTC]; same locality except 3-I-2004 [1 RHTC]; 6.5mi W US 90 & Rt. 187, 29-I-1993 [1 PESC]; DeFuniak Springs, 1mi N US 90 on Rt. 83, 29-I-1993 [1 PESC]; W of DeFuniak Springs, 6.2mi W US-331 & 90, 6-II-1992 [16 + 1 female PESC, 5 UNSM, 10 HAHC]; W of DeFuniak Springs, 6.5mi W Co. 187 & US 90, 29-XII-1992 [3 + 5 females PESC]; W of DeFuniak Springs, 6.7mi W Co. 331 & US 90, Girl Scout Rd, 30-XII-1992 [23 + 1 female PESC, 2 each in JCBC, UNSM, JWIC, UGAC, PKLC, MSUC, CMNC]; 1.3mi NW Mossy Head, 8-II-1992 [1 RHTC]. **MISSISSIPPI: Harrison Co.**, Biloxi, 25-I-1928, J. F. Kislanke, in sandy soil [2 females NMNH, 1 female



Figures 79-90. *Polyphylla* spp., male genitalia in dorsal, lateral, and apical views, scale line = 0.5 mm. 79-81) *P. occidentalis;* 82-84) *P. gracilis;* 85-87) *P. comes;* 88-90) *P. variolosus.*

PKLC]; **Jackson Co.**, Horn Island N atl. P., 13-14-IV-1995, T. C. Lockley, pitfall trap [1 female PKLC]; same locality except, nr. ranger station, 27-V-2004, P. K. Lago, sifted from sand around roots of dune grasses [1 PKLC, found dead, pers. comm.].

Comments. Male parameres varied from slightly wider apically to distinctly narrowing apically (Figs. 50-52). This character was one used by Howden to help distinguish *G. autumnalis* from *G. multispinosus*. It must be noted that specimens showing parallel-sided to apically widened parameres occurred only in the DeFuniak Springs area. However, it was present in about half of the specimens studied. The remaining specimens possessed parameres indistinguishable from typical *G. autumnalis*. This regional variation may indicate that some isolation has occurred, but it is not enough to be considered a distinct species.

All specimens from Biloxi, MS, were female. Given the general difficulty in finding females without first finding males, this collection seems questionable. While it is possible that the species occurs there naturally, it is also possible that these females were transported to Biloxi in truck loads of sand used for construction (pers. comm., P. K. Lago). More work needs to be done to substantiate the record and the present occurrence of this species on the mainland around Biloxi.

Additional references. Skelley 1998:1-2; Howden 1971: 1463-1464.

Gronocarus inornatus Skelley, n.sp.

(Figures 4, 32-35, 58-63, 100)

Diagnosis. Found east of the Choctawhatchee River in the Florida panhandle in sandy uplands west of the Apalachicola River, and along barrier islands around the tip of river mouths to Panacea. Males are readily distinguished by the lack of a lobe at the middle apex of abdominal ventrite V (present in *G. autumnalis*) and genitalia. Females are presently not distinguishable from *G. autumnalis*, except by location of capture and association with a male.

Description. Holotype male length 12.0 mm, width 5.5 mm. Body above glabrous, shining, brown in color, base of head and clypeus darker; shape moderately elongate.

Head with frons and vertex convex, punctures coarse and widely scattered, fronto-clypeal suture sinuate and mildly impressed. Clypeal surface impunctate. Eyes of male large and prominent. Antennae 9 segmented, last 3 forming a lamellate club, which is longer than all basal segments combined.

Pronotal punctures same size as those on frons. Elytral surface coarsely punctate, size of punctures larger than those on pronotum. Metathoracic wings

(flight wings) present. Body below densely clothed with yellowish hairs, obscuring many structures.

Protibiae strongly bidentate. Metafemur slightly wider than apical width of metatibia. Meso- and metatibia dilated at apex (metatibia more so), both with complete transverse carina at middle bearing long spinules; both apically with 2 spurs, mesotibial spurs narrowed, metatibial spurs flattened.

Penultimate and ultimate abdominal ventrites more coarsely punctate at middle, sparser at sides; abdominal ventrite V with apical edge smooth, lacking any hint of a medial tooth (Figs. 60-61).

Male parameres simple (Figs. 62-63), length 2.5-3.5 times width; sides parallel-sided, slightly narrowed to truncate apex; opening in parameres for internal sac distinctly elongate.

Allotype female. Similar to male above except for the standard sexually dimorphic characters and the following. Pronotal punctures slightly more coarse. Protibia with a small third tooth. Ventral setae sparser, not obscuring structures.

Variation. Length 8.0-13.4 mm, width 4.3-6.5 mm. This species is as variable as *G. autumnalis* in all characters. Available specimens indicate that the coastal populations east of the Apalachicola River (near Panacea) are generally smaller in body size than those found west of the river. No other characters studied would indicate a difference.

Type materials. Holotype male and allotype female of *Gronocarus inornatus*: "/FLORIDA: Jackson Co., 1 mi. N. Calhoun Co. on Rt-167; 8-XII-1996, P. Skelley, burrow in sand/" [both FSCA].

Paratypes (84 total, map Fig. 100): Unless otherwise noted, collectors of the specimens from the 1990s were R. H. Turnbow, M. C. Thomas, and/or P. E. Skelley. Their names have been deleted from the list in the interest of reducing space.

FLORIDA: Bay Co., Panama City, 16-XI-1959, C. W. Hollister, St. Augustine grass lawn [1 + 1 female FSCA]; Panama City, 7-XII-1959, C. W. Hollister, St. Augustine grass lawn [1 + 2 females FSCA]; Panama City, 22-XII-1959, C. W. Hollister, St. Augustine grass lawn [1 + 1 female FSCA]; **Calhoun Co.**, 2.2mi NE Rt-231 / 75 & Rt-167, 8-XII-1996 [1 PESC]; 2.2mi N jct.231 on Hwy 167, 7-XII-1997 [2 + 1 female RHTC]; Co. Rd. 274, 2.6mi E jct. 167, 31-I-11-IV-1999, *Geomys* pitfall [1 female RHTC]; 5.1mi W Clarksville, 8-22-XII-1996, *Geomys* pitfall trap [1 female PESC]; nr. Clarksville, 20-III-1954, H. Howden, dead under light [1 HAHC, paratype *G. multispinosus*]; **Jackson Co.**, SW Mariana on CR-167, just N. of Calhoun Co. line, 7-8-XII-1999 [1 HAHC, 2 JWIC, 2 RMC, 2 WBWC, 1 JCBC, 2 UGAC, 1 EGRC, 4 PESC]; 1.0mi N Calhoun Co. line on Rt-167, 8-XII-1996 [10 + 1 female PESC]; 0.8mi N Calhoun Co. line on Hwy. 167, 11-II-1995 [7 PESC]; 0.8mi N Calhoun Co. line on Hwy. 167, 7-XII-1996 [2 NMNH, 2 UNSM, 4 RHTC]; 0.8mi N Calhoun Co.line on Hwy. 167, 22-XII-1999 [10 RHTC]; 2.8mi N Calhoun Co.line on Hwy. 167, 12-XII-1999 [1 RHTC]; Nortek Blvd., 1.1mi W jct. Hwy. 167, 22-XII-1999 [1 RHTC]; **Wakulla Co.**, St. Mark's Nat. Wldlf. Ref., 1mi south of Panacea, 25-XI-1977, C. R. Smith [11 FSCA]; St. Mark's Nat. Wldlf. Ref., 31-I-1993 [1 + 1 female RHTC]; Alligator Point, 31-I-1993 [1 RHTC]; Panacea, 31-I-1993 [3 FSCA].

Comments. This species shows an interesting distribution, being found primarily on inland sandhills west of the Apalachicola River, but also near the coastal dunes east of the river. It is postulated that populations of *G. inornatus* occur, or did occur, on the barrier islands that circumvent this major river barrier. Coastal dunes are well known to move over time, and flightless beetles could easily have walked or burrowed on these dunes to their present distribution. More field work is needed to substantiate this distributional hypothesis.

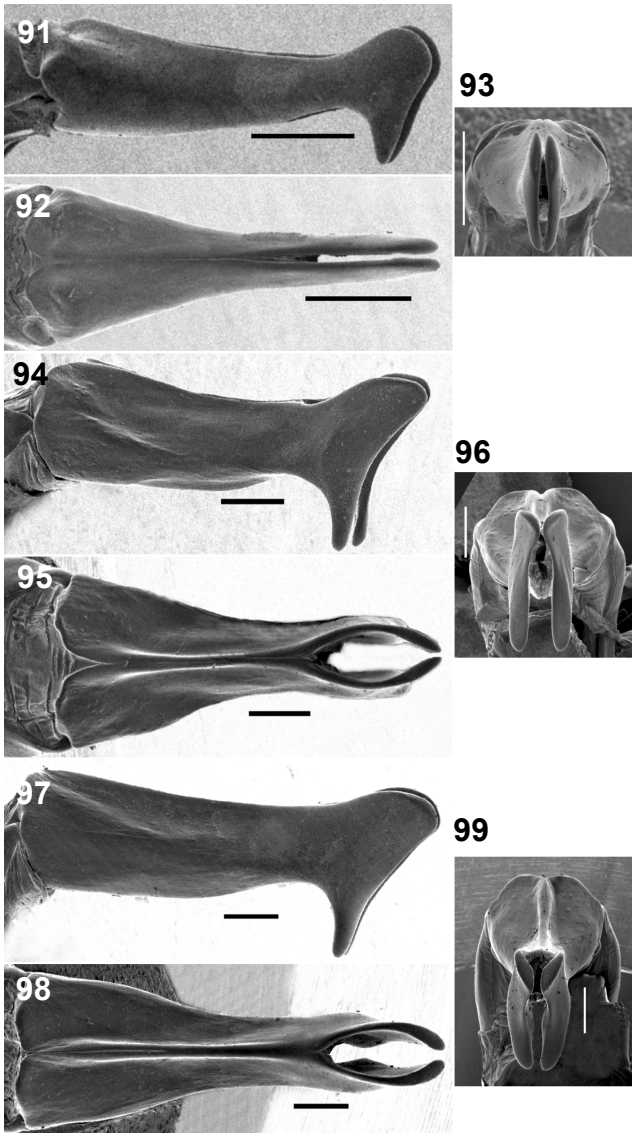
Phyllophaga Harris

Phyllophaga Harris 1827: 7.

Type species. *Melolontha hirticula* Knoch 1801, subsequent designation of Glasgow 1916.

[Harpootlian (2001) and Woodruff and Beck (1989) provide full citations and lengthy synonymies which include lists of subgenera.]

Diagnosis. Because of its diversity, *Phyllophaga* is difficult to briefly diagnose. Body with vestiture variable, glabrous to densely setose, pubescent, glaucus, etc.; when present, setae variable, long hair-like to short scale-like; vestiture usually not arranged to produced striped patterns. Antenna 9-10 segmented, with a 3 segmented club in both sexes (southeastern US species). Tarsal claws quite variable, but rarely if ever simple, adjoining claws with accessory developments (teeth, clefts, serrations, etc.) equally developed in southeastern US species. Sexual dimorphism often evident in antennal club, metatibial apex, tarsal claws, and abdominal sterna, but usually not pronounced.



Figures 91-99. Male genitalia in dorsal, lateral, and apical views, scale line = 0.5 mm. 91-93) *Hypotrichia spissipes;* 94-96) *Hypothyce osburni;* 97-99) *Hypothyce burnei.*

Comments. An extremely diverse and speciose genus, considered by many to be found worldwide. Some relatives have been recognized with generic status, leaving the majority of the New World members unstudied. The entire group is in dire need of work to sort out generic level problems on a planetary scale.

There are probably 75-80 species occurring in the southeastern United States. Keys and illustrations for use in identifying species and discussions of their biologies can be found in Harpootlian (2001, South Carolina, 55 spp.), Woodruff and Beck (1989, Florida, 58 spp.), Riley (1988, Louisiana, 62 spp.), and Luginbill and Painter (1953, entire US). For tracking additional information on their biologies consult Forschler and Gardner (1990).

Polyphylla Harris

Polyphylla Harris 1841: 30.
Polylamina Hardy 1974: 6-7; Coca-Abia 2000: 11-22.

Type species. Of *Polyphylla*, *Melolontha variolosa* Hentz 1830, subsequent designation of Young 1988: 20-21. Of *Polylamina*, *Polyphylla pubescens* Cartwright 1939, by monotypy.

Diagnosis. A member of the Melolonthinae, Melolonthini, distinguished from all other genera (at least natives in North America) by the males having a 7 segmented antennal club and females a 5 segmented club (Figs. 7-8). Other useful characters are presented in Evans' (2002) and Hardy's (1974) keys to melolonthine genera in North America.

Comments. *Polyphylla* is a well known genus of large melolonthine scarabs. Several species, like *Polyphylla decemlineata* (Say), the 'ten-lined June beetle,' are considered agricultural pests. Members of the genus are Holarctic in distribution, and in the US are most diverse west of the Mississippi River.

Polyphylla is a complicated genus, full of taxonomic difficulties. Young (1967, 1988) provided the most recent taxonomic foundation and he divided the North American species into several species complexes. Almost all southeastern US species are placed in the *occidentalis* complex. The exceptions being *P. brownae* Young and *P. hammondi* LeConte which are in the *hammondi* complex, and *P. pubescens* Cartwright, which was intentionally omitted by Young (1998: 3, 14), as he followed Hardy (1974) in considering it a distinct genus.

The taxonomic history of *P. pubescens* is of interest here as the 2 new species proposed here are its sisters. Vestiture and male genitalia in *Polyphylla* are used as important taxonomic characters, but vary tremendously across the genus and within some species. Howden (1968) commented on the similarity of *P. pubescens* to species of *Thyce* LeConte and *Hypothyce* Howden, being intermediate in a number of characters. This led Hardy (1974) to create the genus *Polylamina* for *P. pubescens*.

Although creation of *Polylamina* is probably justifiable, it was questioned by some workers. Recently, Coca-Abia (2000) performed a small phylogenetic analysis which placed *P. pubescens* as a member of

Polyphylla, and she reduced *Polylamina* to a full synonym of *Polyphylla*. Even though I am presently following this action, it is not due to the data or conclusions made in that study. Coca-Abia's study was not robust enough to make the conclusions meaningful. She stated that "all" available data were considered. However, only 9 characters and 6 six species were used in her analysis of this large diverse group. Also, some of the taxa chosen are not 'typical' representatives of their genera. For these reasons, I believe most of the conclusions of that study are poorly supported. This study should be repeated using many more taxa and more characters with additional data sets of female and larval morphology, and possibly molecular data. This broader analysis should be performed before more generic-level nomenclatural changes are proposed.

Following the general characters as outlined in Young (1988), *P. pubescens* would belong in the *occidentalis* complex. Young (1967) stated "The eastern species complex, *occidentalis*, is much more distinct than the other three [complexes], suggesting that it originated at some very early state in the divergence of this genus." Morphological data and unpublished molecular data of Dave Russell (2000, and pers. comm.), indicate that the *occidentalis* complex is distinct from the remaining members of the genus and highly diverse within itself. Differences in some species of the *occidentalis* complex approach degrees that might indicate generic rank.

Recent collections and studies have discovered 2 new species closely related to *P. pubescens*. While considered to be members of the *occidentalis* complex, these species form a tight species group, which I will call the *pubescens* group. Russell's molecular data (2000, and pers. comm.) indicate that these 3 species are more divergent from each other than most species of *Polyphylla* from each other. Their uniqueness within *Polyphylla*, as well as the differences among themselves, indicate rapid character evolution, long term isolation, or both. A case could be made to place them in their own subgenus or genus, which would require resurrection of the name *Polylamina*. For reasons outlined above, this will not be done here and they are considered a species group.

Hammondi Species Complex

Diagnosis. Young (1967, 1988) defined this complex on distribution, male genitalia, and a few other characters.

Polyphylla hammondi LeConte

(Figures 22, 24, 28, 30, 64-66)

Polyphylla hammondi LeConte 1856: 228. [see Young 1988, for a full synonymy with 16 names]

Diagnosis. Length 24.8-35.5 mm, width 11.5-17.0 mm. A large *Polyphylla*, distinguishable from other species east of the Mississippi River by its almost total lack of stripes or mottling, having scales ventrally, males with distinctive genitalia (Fig. 64-66) and tridentate protibia, and females with short antennomere III. East of the Mississippi River, it occurs only in isolated populations in Mississippi, Illinois, Indiana, and Wisconsin.

Comments. As the lengthy synonymy in Young (1988) indicates, *P. hammondi* is highly variable in coloration with vittate and avittate forms. It is widespread in the western US, with several isolated populations east of the Mississippi River (Young 1972, 1986, 1988). In the southeastern United States, *P. hammondi* is known from several counties along the Mississippi River and a few isolated areas in northern Mississippi (specimens in PKLC, NMNH). Specimens from Mississippi are typical members of the species, indistinguishable from avittate populations occurring just west of the Mississippi River in Arkansas.

Polyphylla hammondi is the central member of the *hammondi* complex, for which several species are recognized, based on good morphological characters (like *P. brownae*). However, many western members of the complex still need more detailed study.

Polyphylla brownae Young

(Figures 25, 31, 67-69, 101)

Polyphylla brownae Young 1986: 47-49.

Diagnosis. *Polyphylla brownae* is readily recognized by its large body size, lack of recumbent scales (Figs. 25, 31) with no notable color pattern, coarse puncture pattern on pronotum, elongate antennomeres I and III, and its restricted distribution, being known only from southern Alabama and Mississippi.

Description. **Male**. This list of characters for the male is meant to supplement Young (1986, 1988).

Length 27.0-29.3 mm, width 13.5-15.5 mm. Antennomeres I and III each elongate, gradually widening to tip, length 3-4 times apical width; antennomere IV-V enlarged and part of club. Protibia slightly

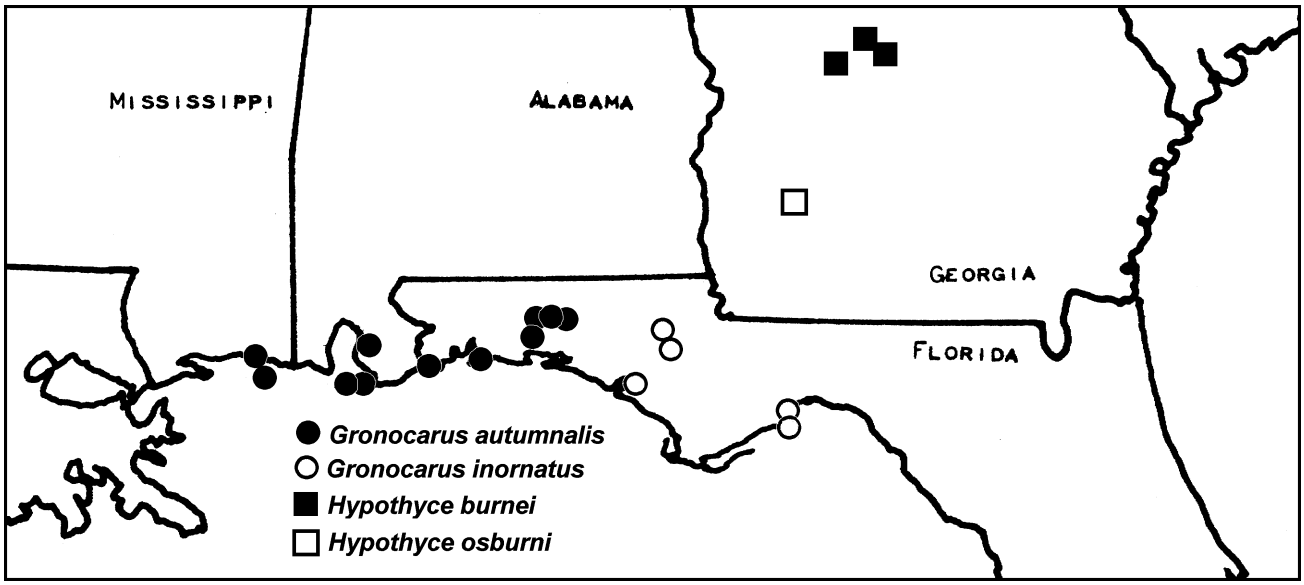


Figure 100. Distribution map: solid circle *Gronocarus autumnalis*, open circle *Gronocarus inornatus*, solid square *Hypothyce burnei*, open square *Hypothyce osburni*.

tridentate, with proximal tooth reduced. Mesotibia and metatibia slightly widened at apex, teeth on outer edge both small. Genitalia shape typical for the *hammondi* group (Figs. 67-69), but with apex dorsoventrally flattened.

Female. Length 25.5 mm, width 13.9 mm (Fig. 25). Body pubescence, punctation and other general morphology as in male except for the following noted structures. Clypeus broadly rounded at sides, distinctly toothed at middle, distinctly separated from eye by a broad constriction. Antennomere III elongate, length 3.5 times apical width; antennomeres IV-V gradually expand into club; antennomere V = half expanded length of antennomere VI; antennal club lamellae length 3 times width at base in dorsal view. Protibia deeply tridentate. Mesotibial teeth on outer edge strong. Metatibia strongly widened at apex, middle tooth strong, basal tooth tuberculate.

Type materials. Three males, all from Alabama, Washington Co., Calvert (Young 1986, 1988). The holotype, deposited in the Academy of Natural Sciences, Philadelphia PA, was not studied . Young's description and the species distribution was enough to confidently identify the specimens discussed below.

Paratypes (not studied) are reported to be deposited in the California Academy of Sciences, San Francisco CA, and the Museum of Comparative Zoology, Harvard, MA.

Additional Specimens. (3 specimens, map Fig. 101) **ALABAMA**: **Monroe Co.**, Haines Island Park, 31°43'23"N, 87°28'10"W, 24-25 July 1995, M. J. MacGowan, blacklight [1 PKLC]; Haines Island Park, 2-3-VI-2000, R. Morris, MV/UV light [1 female RFMC]. **MISSISSIPPI**: **George Co.**, ca. Lucedale, VII-10-1962, C. Porter [1 FSCA]. The Mississippi specimen was collected near a locality called "Mr. Thurston's Fish Camp" along the west bank of the Pascagoula River, west of Lucedale (pers. comm., C. Porter).

Robert Woodruff (pers. comm.) reports having seen specimens of this species from the western Florida panhandle. While it is possible this species occurs there, to date I have not been able to locate specimens to confirm this observation.

Comments. All known specimens of *P. brownae* are from old river systems in southern Alabama and Mississippi. It has been postulated that it lives in old, inactive sandbars in the flood plain of these rivers (pers. comm., R. Morris). More collecting is needed to substantiate this, as it is just as likely to live on the remnant sandy ridges just outside of the flood plains. Specimens either lacked specific locality data or were collected at light and could have flown in from some distance.

Additional References. Young 1988: 75-77, 114 figures 69-70.

Occidentalis Species Complex

Diagnosis. Young (1967, 1988) defined this complex based on distribution, parameres of male genitalia

with lateral grooves (Figs. 70-90), and a few other characters. It includes *P. occidentalis*, *P. gracilis*, *P. variolosa*, *P. comes*, and the *pubescens* species group.

Comments. In numerous character states, members of this complex show striking divergences from each other and all other *Polyphylla* spp. More detailed studies are needed to better understand the relationships among these species.

Polyphylla occidentalis (Linnaeus)

(Figures 23, 27, 79-81)

Scarabaeus occidentalis Linnaeus 1767: 555.
Melolontha occidentalis (Linnaeus): Fabricius 1775: 32.
Polyphylla occidentalis (Linnaeus): Burmeister 1855: 408.

Diagnosis. Length 20.2-25.5 mm, width 9.0-10.0 mm. The pale striping of the body (Fig. 27), and characters given in the key, will readily distinguish this from all other species in the southeastern United States.

Type Materials. Neotype male (USNM 71423) in the NHMH (Young 1988), not studied.

Comments. Widespread in the southeastern US. Attracted to lights and apparently active throughout the warm summer months. Larvae are discussed by Ritcher (1966) and Young (1988). Details about its biology are not known.

Additional references. For a list of references citing *P. occidentalis*, distribution data and other information, consult Young (1988: 33-35).

Polyphylla gracilis Horn

(Figures 7-8, 26, 82-84)

Polyphylla gracilis Horn 1881: 75.

Diagnosis. Length 18.8-21.6 mm, width 7.8-9.1 mm. A smaller species readily recognized by the unidentate protibia of the male and its mottled elytral color pattern, bearing a broad lateral stripe (Fig. 26).

Type Materials. Lectotype male (ANSP 3642.1) and 7 paralectotypes in the Academy of Natural Sciences, Philadelphia (Young 1988), not studied.

Comments. *Polyphylla gracilis* can be found in Florida, southeastern Alabama, and southwestern Georgia. It is uncommonly collected because its adult flight period is during early spring (April to May). Most specimens have been collected at lights. I have observed this species a number of times in north central Florida, flying at dusk and mating on needles of long leaf pine (*Pinus palustris* Miller) several meters above the ground. Distribution records and personal observations indicate *P. gracilis* live in upland habitats with a deep, well drained sand substrate, primarily sandhills. Other details about its biology are not known.

Additional references. For a list of references citing *P. gracilis*, distribution data and other information, consult Young (1988: 30-33).

Pubescens Species Group

Diagnosis. Males are unique in *Polyphylla* by having dense, short dorsal pubescence (Figs. 42-45, 48-49), lacking any squamose patterns and male genitalia with apex laterally flattened (Figs 70-78). Many specimens have an elytral pattern appearing when light reflects at a specific angle (Figs. 44-45, 48-49), but this is usually not visible. This pattern is not stripes, like in other *Polyphylla*, but consists of lines radiating out from the elytral suture near the scutellum (Fig. 45, 49). Use of scanning electron micrsocopy (SEM) shows that this phenomenon is due to the pubescence being oriented at slightly different angles.

Females differ from males in being more robust, having a 5-segmented reduced antennal club, lacking dorsal pubescence, having protibial teeth much more pronounced, hind legs much more robust, apical clypeal ridge reduced, and a number of other more subtle characters.

Description. The following description for the *pubescens* species group supplements Hardy's (1974) description of *Polylamina*.

Male. Length 15.3-21.5 mm, width 6.9-10.0mm. Body lacking scales, densely covered with setae arising from fine punctures. Antennal club 7 segmented; lamellae as long as head and clypeus; antennomere III long, length 3 times apical width. Labrum concave in anterior view. Clypeal margin with some setae visible visible in dorsal view. Labial palp terminal segment elongate with elongate anterior-lateral sensory area slightly impressed.

Protibia slightly tridentate (proximal tooth reducedl), preapical tooth shorter than width of tibia. Mesofemur parallel-sided; mesotibia slender, not notably widened at apex. Metafemur swollen at middle; metatibia relatively slender (Figs. 14, 16, 18) (see

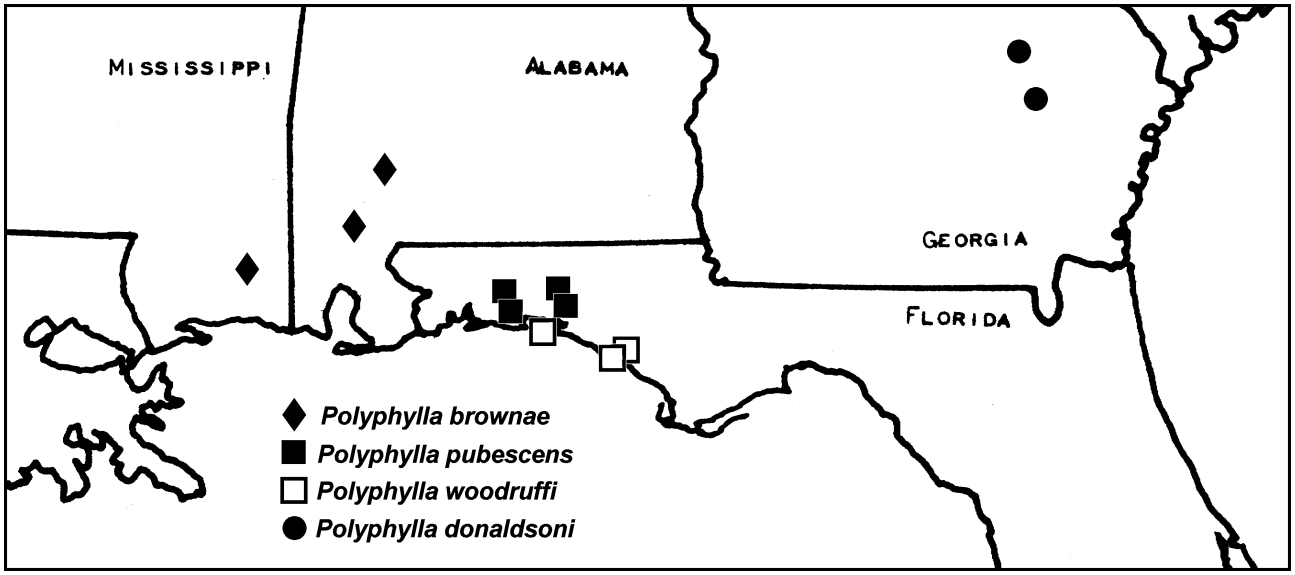


Figure 101. Distribution map: solid diamond *Polyphylla brownae*, solid square *Polyphylla pubescens*, open square *Polyphylla woodruffi*, solid circle *Polyphylla donaldsoni*.

species accounts, compare with female); upper metatibial spur exceeds length of first 2 metatarsomeres; apical spurs on metatibia slender to spatulate. All legs with tooth on anterior tarsal claw slightly larger than tooth on posterior claw (Fig. 11).

Parameres long, slender in dorsal view; basally compressed dorso-ventrally; apical cleft about a third length, cleft usually broadest at base; shallow longitudinal groove located to each side of apical cleft, strongest near tip, disappearing towards base; paramere tips often touching at apex, laterally compressed, forming a broadly rounded hook in lateral view.

Female. Same as male above except for the following. Length 15.0-20.0 mm, width 6.9-11.0 mm. Body much less densely pubescent than male, dorsally appearing mostly glabrous and glossy. Antennal club 5 segmented, club lamellae length less than in male, lamellae as long as antennomere III.

Protibia with preapical tooth length greater than width of tibia. Metatibia stout, distinctly widened apically (Figs. 15, 17, 19); apical spurs on metatibia spatulate to foliate. All legs with tooth on anterior tarsal claw positioned at middle of claw, tooth on posterior claw at basal third.

Comments. Hardy's (1974) genus name *Polylamina* applies to this group of species. If this group is ever recognized at the genus or subgeneric level, that name will need to be resurrected.

The only reason males were selected as holotypes, instead of females, was to maintain comparability with other *Polyphylla* species. Females are more morphologically distinct from each other than are males in this group. More emphasis on female morphology in the taxonomy of *Polyphylla* could prove informative. However, females for many of the rarer and more interesting species remain unknown.

The 3 species recognized here have many characters too variable to be of any usefulness. Other characters are only slightly variable within a species and aid tremendously in species recognition. These characters show an interesting mix of relationships in that both of the Florida species have characters more similar to the Georgia species than to each other. This supports the hypothesis that these 3 are distinct species. A phylogenetic study to help illuminate more precise relationships will have to wait for further studies.

Additional References: Woodruff 1982: 87-89; Woodruff and Deyrup 1994: 379-381 (panhandle beach scarab).

Polyphylla pubescens Cartwright
(Figures 14-15, 20, 44-47, 70-72, 101)

Polyphylla pubescens Cartwright 1939: 362-363; Coca-Abia 2000: 11-22 (part).

Diagnosis. A member of the *pubescens* species group as defined above and by Hardy (1974), readily recognized by its diverging metatibial edges, a strong lateral elytral margin reaching the base (Fig. 20), and

distribution, being found inland on or near Eglin Air Force Base in Florida west of the Choctawhatchee River.

Description. **Male**. The following list supplements the full descriptions provided by Cartwright (1939) and Hardy (1974).

Length 17.5-19.0 mm, width 8.0-9.0 mm (Figs. 44-45). Clypeal margin broadly rounded, strongly reflexed. Antenna with scape black and club paler. Scutellum with punctures nearly coalescing over entire surface. Elytral lateral margin strong, reflexed, reaching base; groove adjoining margins as wide or wider than margin at basal third of elytra.

Mesotibia with external tooth at middle of outer edge large, sub-carinate; tooth at basal fourth lacking, indicated by slight swelling and stout setae. Metatibia stout, diverging most of length (Figs. 14); distinctly wider at apex than length of abdominal ventrite III at middle; inner tibial margin straight, not notably curved at apex. Hind leg usually same color as pronotum, paler in some. All tarsi with tooth on posterior claw half length of tooth on anterior claw. Length of parameres in dorsal view 3.5 times basal width (Figs. 70-72).

Female. Similar to male as described by Cartwright (1939) and supplemented above, except for the following characters.

Length 19.0-20.0 mm, width 10.0-11.0 mm. Body wider beyond middle of elytra (Figs. 46-47). Clypeal margin strongly reflexed, broadly rounded. Pronotal lateral margin strong, at middle slightly explanate. Elytral suture near scutellum nearly glabrous, with few scattered setiferous punctures; lateral margin strong, narrowly explanate, reaching base.

Mesotibia slender, strongly toothed at middle, possible vestige of tooth at basal fourth indicated by stout setae; distinctly widened at apex; apical spurs spatulate, upper spur longer and much more curved downward than lower spur. Metatibia divergent most of length (Fig. 15); with strong tooth at middle of outer edge; apex equally abruptly widened on inner and outer edges; apical spurs slightly curved downward; lower spur spatulate, upper spur foliate; portions of apical tibial plate above and below tarsal junction equal in size.

Type Materials. The holotype of *P. pubescens* label data, "/ [white, hand written] 4.7 mi.W. of Niceville, Fla VI-7-38, F. Young/ [red paper] Type No. 53415 U.S.N.M./ [red paper] Holotype Polyphylla pubescens Cartwright/" [male, NMNH, studied]. The type is from Okaloosa County.

Additional Specimens. (100 specimens, map Fig. 101) **FLORIDA**: **Okaloosa Co.**, 10-VI-1999, K. E. M. Galley, Eglin AFBase, T2N-R23W-Sec.28, Okaloosa Fire Tower [2 FSCA]. **Walton Co.**, Eglin AFB, Range Rd. 205, 4.5mi W Hwy 331, 16-17-VI-1995, P. E. Skelley et al., flying in late afternoon [3 HAHC, 5 CMNC, 13 PESC, 1 WBWC, 2 JWIC, 1 UNSM, 1 NMNH]; same locality except 17-VI-1995 [not flying] [1female each in HAHC, PESC, WBWC]; same locality except 16-VI-1995, MV + Blacklight [2 RFMC]; [same locality only presented as] Eglin AFB, jct. rg. rd. 205 & 331, 18-VI-1995, R. Turnbow [49 RHTC, 2 PESC, 2 UGAC, 4 UNSM, 4 NMNH]; Eglin AFBase, 23-VI-1994, K. E. M. Galley, long leaf pine restoration project, site 6A nr. C-72 [*ca.* 7mi SW of DeFuniak Springs, 3 FSCA]; same locality except 16-VI-1999, flying in heavy rain [2 FSCA]; Eglin AFB, 1-VI-1973, light trap [1 PKLC].

Comments. Males of *P. pubescens* were collected flying in the late afternoon, 3-4 hours before sunset and a few at light, in sandy uplands. Most have been collected on sunny days, but a couple in the pouring rain. The 3 known females were collected by following males in an area of planted sand pine (*Pinus clausa* (Chapman ex Englemann) Vasey ex Sargent): one was crawling on the surface, one was 4 cm under the surface, and one was about 12 cm under the surface in deep organic leaf litter. Females, which possess flight wings, may be incapable of flight.

Live females were allowed to lay eggs in an attempt to rear larvae for description. The females died after about a week in captivity, one laying over 25 eggs. The reason these females died so rapidly is not known, but they may be short lived in the field. The eggs began to hatch after a month, and a few first instar larvae were preserved (PESC). The remaining larvae all died within 2 months and were not preserved. It is suspected that the food sources offered were inadequate.

Additional References. Howden 1968: 547.

Polyphylla woodruffi Skelley, n.sp.

(Figures 11, 16-17, 21, 48-49, 73-75, 101)

Polylamina pubescens (Cartwright): Hardy 1974: 6-7.
Polyphylla pubescens Cartwright 1939: 362-363; Coca-Abia 2000: 11-22 (part).

Diagnosis. A member of the *pubescens* species group as defined above and by Hardy (1974), readily recognized by its diverging metatibial edges, elytral mar-

gin not reaching the base (Fig. 21), and distribution, being found on the coastal dunes of the Florida Panhandle, east of the Choctawhatchee Bay.

Description. Holotype male. Similar to the descriptions of *P. pubescens* provided by Cartwright (1939) and Hardy (1974) except as noted here.

Length 17.5 mm, width 8.2 mm (Figs. 48-49). Head between eyes with similar punctures to clypeus. Clypeal margin broadly rounded at sides, but somewhat truncate at middle, reflexed. Antenna unicolorous pale brown. Scutellum with punctures dense, but bearing small glossy areas in middle at base. Elytra with lateral margin not strongly reflexed, sharp edge and groove adjoining margin not reaching base, groove as wide as margin at basal third of elytra.

Mesotibia with external tooth at middle of outer edge small, tuberculate, only slightly larger than tooth at basal fourth which is indicated by slight swelling and stout setae. Metatibia stout, diverging most of length (Fig. 16); distinctly wider at apex than length of abdominal ventrite III at middle; inner tibial margin straight, not notably curved at apex. Hind leg paler in color than pronotum. All tarsi with tooth on posterior claw half length of tooth on anterior claw (Fig. 11). Length of parameres in dorsal view 3.5 times basal width (Figs. 73-75).

Allotype female. Similar to male except for the following characters.

Length 18.3 mm, width 9.3 mm. Clypeal margin slightly reflexed, broadly rounded, but slightly concave at middle. Pronotal lateral margin fine, at middle not explanate. Eytral suture near scutellum nearly glabrous, with few scattered setiferous punctures; lateral margin slightly explanate, not reaching base.

Mesotibia slender for entire length, tooth at middle of outer edge smaller than tooth at basal fourth; gradually widened at apex; apical spurs spatulate, upper and lower spur equal in length, upper spur curved downward more than lower spur. Metatibia divergent entire length (Fig. 17); slightly toothed at middle of outer edge; not abruptly widened at apex; apical spurs nearly straight on lower edge; lower spur spatulate, upper spur somewhat foliate; portions of apical tibial plate above and below tarsal junction equal in size.

Variation. Length 15.3-17.5 mm, width 6.9-8.2 mm. Mesotibial basal tooth lacking in many specimens. Male metatibial color occasionally dark and tibia occasionally narrowed, appearing not divergent.

Type Materials. Holotype male "/ St. Andrews St. Pk., FLA / R. E. Woodruff, coll. 19-V-60/ Flying over dunes in P. M./" [FSCA]. Allotype female with same data only with additional label "... /Genitalia on slide # 216/ ...." [FSCA].

Paratypes (184 total, map Fig. 101): **FLORIDA: Bay Co.**, same data as holotype [102 + 1female FSCA, 12 NMNH, 8 JWIC, 5 PESC, 8 RFMC, 4 WBWC,4 UNSM, 2 HAHC]; same locality except V.30.1930, L. J. Bottimer coll., on sand [1 + 1 female HAHC]; same locality except 12-V-1985, R. H. Turnbow, Jr [17 RHTC, 1 WBWC, 1 PKLC]; same locality except 23-V-2004, R. Turnbow [1 RHTC]; St. Andrew's St. Rec. Area, 18-V-1985, E. Riley & D. Rider, collected at black light [5 EGRC]; same data except found crawling in sand at night [1 female EGRC]; same data except found dead on sand dunes [1 female EGRC]; ½ mi W St. Andrews State Park, Fla, sand dunes 5/30/60, L. J. Bottimer coll.[1 HAHC]; Panama City, V-13-1948, Nuttig and Werner [1 NMNH]. **Okaloosa Co.**, Destin, 18-V-60, R. E. Woodruff, at light [1 FSCA]; same locality except V-14/15-1948, beach sand dunes, W. Nutting & P. Werner [2 FSCA, 6 NMNH]; Ft. Walton Bch, V.29.1960, L. J. Bottimer [1 HAHC]; Ft. Walton Beach, near Henderson Beach State Park., 6-V-2000, H. Douglas, backside of barrier island [1 HDIC].

Etymology. Named for Robert E. Woodruff, advisor and friend, for his many contributions to our knowledge of scarabs, and who collected most of the type series.

Comments. *Polyphylla woodruffi* seems restricted to coastal areas east of the Choctawhatchee Bay in the Florida Panhandle. These coastal areas are under serious developmental pressures. While populations may persist in some developments and managed natural areas, the future of this species is of concern. More survey work is needed to substantiate the distribution and locate additional populations.

Almost all specimens of *P. woodruffi* were collected flying in the middle to late afternoon in secondary dunes on barrier islands in the Florida panhandle. A rare individual comes to light.

Hardy (1974) never saw a specimen of true *P. pubescens*. Label data for specimens studied are all now considered to be *P. woodruffi*. Coca-Abia (2000), working at the NMNH, may have studied the holotype, but her dissections (studied) and character codings for the analysis were based on specimens of *P. woodruffi*.

***Polyphylla donaldsoni* Skelley, n.sp.**
(Figures 18-19, 42-43, 76-78, 101)

Diagnosis. A member of the *pubescens* species group as defined above and by Hardy (1974), readily recognized by its narrowed, parallel-sided metatibia; more elongate male genitalia; distinctive apex of female metatibia; and distribution, being found in central Georgia on dunes associated with the Ohoopee River.

Description. **Holotype** male. Similar to the description of *P. pubescens* provided by Cartwright (1939) except as noted here.

Length 18.2 mm, width 8.5 mm (Figs 42-43). Head between eyes finely punctate, notably smaller than punctures of clypeus. Clypeal margin broadly truncate at front, slightly reflexed. Antenna unicolorus pale brown. Scutellum with punctures widely scattered on disc, surface mostly smooth and glossy. Elytra with lateral margin strong, reflexed, reaching base; groove adjoining margins as wide or wider then margin at basal third of elytra; elytral pattern of radiating lines not found.

Mesotibia with external tooth at middle of outer edge small; tooth at basal fourth lacking, indicated by slight swelling and stout setae. Metatibia slender, parallel-sided most of length (Fig. 18); wider at apex, width = length of abdominal ventrite III at middle; inner tibial margin slightly curved at apex. Hind leg same color as pronotum. All tarsi with tooth on anterior claw three fourths length of tooth on anterior claw. Length of parameres in dorsal view 4 times basal width (Figs. 76-78).

Allotype female. Length 20.0 mm, width 9.8 mm. Similar to holotype except for normal sexual dimorphism and in the characters listed here. Clypeal margin slightly reflexed, truncate. Pronotal lateral margin strong, explanate at middle. Elytral suture near scutellum densely punctate, pubescent; lateral margin strong, narrowly explanate, reaching base.

Mesotibia slender for entire length, tooth at middle of outer edge strong, tooth at basal fourth lacking; gradually, slightly widened at apex; apical spurs spatulate, slightly curved downward, upper spur shorter than lower spur. Metatibia parallel-sided most of length (Fig. 19); tooth at middle of outer edge strong; abruptly widened on inner edge near apex; apical spurs curve downward on lower edge; lower spur spatulate, upper spur somewhat foliate; portion of apical tibial plate below tarsal junction distinctly larger than upper part.

Variation. Length 16.5-21.5 mm, width 8.0-10.0 mm. The elytral pattern of radiating lines in reflected light is not visible in most specimens. Two specimens studied had patterning identical to the other members of this group. Body color also varied from light brown to dark brown, almost black.

Type Materials. Holotype male: "/ GEORGIA: Tattnall Co., nr. Ohoopee R., 2 mi.E. GA-147, 5-VI-1999, R. Morris, at light/" [FSCA]. Allotype female: "/ GA: Tattnall Co., 2mi.e.147 along Ohoopee Riv., 10-VI-1-VIII-1998, R.Morris PFT/" [PFT= pitfall trap, FSCA]

Paratypes (354 total, map Fig. 101) **GEORGIA: Tattnall Co.**, same locality as holotype except 15-VI-2001, Morris and Donaldson [8 RFMC, 1 PESC]; same locality except 11-VI-1999 [1 PESC]; same locality except 20-V-1998, Wappes & Morris [26 JWIC, 6 PESC, 2 CMNC]; 3mi E of 147 along Ohoopee Riv., 19-VI-1998, BLT, Morris/Wappes [9 + 1 female RFMC]; same locality except 22-VI-1998 [1 PESC]; same locality except 12-13-VI-1998, Morris and Donaldson [8 RFMC, 8 PESC, 2 WBWC, 4 HAHC]; 4mi S Reidsville, 28-VI-1998, mv+bl, R.Turnbow [2 RHTC]. **Emanuel Co.**, I-16 + US-1, Gar Rd., 9-VI-2000, R. Morris at blacklight [8 + 1 female RFMC]; same locality except 12-VI-1999 [1 PESC]; jct. I-16 & hwy. 1, 9-VI-2000, mv+bl, R. Turnbow [4 RHTC]; Ohoopee Dunes Natural Area, 32°31'51"N- 82°27'23"W, 17-21 June 2002, T. Schiefer, J. MacGowan, Malaise trap in pine-oak dune woodland, W. H. Cross Expedition [26 MEMC, 8 JCBC, 12 HAHC, 8 PKLC, 4 UGAC, 2 HDIC, 26 PESC, 4 EGRC]; same data except 17-21 June 2002, T. Schiefer, J. MacGowan, Lindgren funnel [2 MEMC]; same data 16 June 2002, J. A. MacGowan, flying at dusk [7 MEMC]; same data except 16 June 2002, T. L. Schiefer, flying at dusk [8 MEMC, 4 TAMU]; same data except 16 June 2002, R. L. Brown, blacklight trap [7 MEMC, 21 PESC]; same data except 17 June 2002, J. A. MacGowan [2 MEMC]; same data except 17 June 2002, J. A. MacGowan, blacklight trap [7 MEMC, 4 WBWC]; same data except 17 June 2002, T. L. Schiefer, blacklight trap [8 MEMC, 7 UNSM]; same data except 18 June 2002, J. A. MacGowan, blacklight trap [7 MEMC, 5 PESC, 2 PKLC]; same data except 18 June 2002, T. L. Schiefer, blacklight trap [8 MEMC, 6 PESC]; Ohoopee Dunes Natural Area, 32°32'15"N- 82°27'40"W, 17-21 June 2002, T. Schiefer, J. MacGowan, Malaise trap in pine-oak dune woodland, W. H. Cross Expedition [8 MEMC, 7 NMNH, 13 UGAC]; Ohoopee Dunes Natural Area, 32°31'17"N- 82°26'42"W, 19 June 2002, J. A. MacGowan, blacklight trap in pine-oak dune woodland, W. H. Cross Expedition [1 MEMC]; same data

except 19 June 2002, T. L. Schifer, blacklight trap [7 MEMC, 5 NMNH, 20 FSCA, 5 PESC].

Etymology. Named to honor Edwin Donaldson, who assisted in the first collections of this beetle, and for his many hours of assistance to Roy F. Morris, II, collecting beetles in central Georgia. Their work has added greatly to our knowledge of this poorly known region.

Comments. The MEMC series was located by a haphazard web search for '*Polylamina pubescens*,' which found a page discussing an expedition to the Ohoopee Dunes. For further information about that trip, go to <www.msstate.edu/org/mississippientmuseum/Crosstrips/Crosstrip2002.html>. The author, T. Schiefer, provided the following additional information about the large series collected at the Ohoopee Dunes Natural area (*in litt.*):

"We arrived at the dunes a short time before dark to set up sheets for blacklighting and immediately saw scarabs flying low over the dunes about a foot over the ground.... As it turns out, this species was one of the most abundant species of Coleoptera on the dunes during our visit. We saw numerous individuals flying about before dark each day of our visit, and caught numerous individuals at blacklight and in Malaise traps. We found it interesting that this beetle would stridulate when held...." According to R. Morris (pers. comm.) the series collected with E. Donaldson were active and behaved identically, except the females were not flying. The majority of known specimens were collected at lights.

Hypotrichia Leconte

Hypotrichia LeConte 1861: 137.

Type species. *Hypotrichia spissipes* LeConte 1861, by monotypy.

Diagnosis. Accessory teeth of adjoining tarsal claws distinctly different in size. The lobe-like tooth of the anterior tarsal claw (Fig. 9) of all legs will distinguish both males and females of this species from any other melolothine in the United States. Females (Figs. 40-41) differ dramatically from males (Figs. 38-39) in being stouter, having less dorsal pubescence, having the metafemur and apex of metatibia much more expanded, etc. More detailed descriptions of males and females can be found in Hubbard (1884) and Hardy (1974).

Comments. Only one species presently occurs in ths genus, *H. spissipes*, which occurs in peninsular Florida.

Additional references. Hardy 1974: 27-28; Horn 1867: 166, 170; Howden 1968: 542; Hubbard 1844: 215-217; Woodruff 1982: 95; Woodruff and Deyrup 1994: 419-421 (Florida Hypotrichia).

Hypotrichia spissipes LeConte
(Figures 9, 38-41, 91-93)

Hypotrichia spissipes LeConte 1861: 137.

Diagnosis. Length 12.4-16.0 mm, width 5.2-6.6 mm. Readily distinguishable from all melolonthine scarabs in the United States by the uniquely lobed tarsal claws (Fig. 9), small size and lack of scale-like hairs (Figs 38-41). Male genitalia (Figs. 91-93) are similar to those of *Hypothyce* species in having a laterally compressed apex with a subapical spine on the ventral edge.

Comments. Until the use of Malaise and flight intercept traps, specimens of *Hypotrichia* were rare in collections. If the trap is located in a population, males are readily captured during flights.

As discussed by Hubbard (1884), *Hypotrichia* fly only in the rain. On several occasions, I observed afternoon flights and mating on a grassy lawn at an apartment complex during summer rains, which can be sudden and extremely heavy in Gainesville, FL.

Males were observed flying no more than 0.5 meters above the surface searching for females. Following males to locate females proved impossible as they flew too fast and erratically. It seemed more efficient to stare at patches of grass hoping to see males dropping or movement on the ground. Mating balls consisting of one female and a dozen or more frenzied males were found in this manner. Each such aggregation was found as I turned back to look at a patch after a couple of minutes looking elsewhere, so it appears that males are quick to find females when they first come to the surface. Given the sexually dimorphic antennal club, and the speed at which males were apparently able to find females, it is suspected females release a pheromone to signal readiness to mate.

Exactly what triggers activity (males to fly, females to come to the surface) is not known. However, it has been postulated that the vibration of rain pounding the earth triggers the beetle activity (Skelley 1998).

Males have been found after rains, just beneath the surface under small pushups similar to those described for *Gronocarus*. Although no extensive survey has been made for *Hypotrichia*, it is hoped that the same survey technique, applied in a systematic manner, will yield more specimens of both males and females.

Five females from Gainesville, FL, were maintained to attempt rearing of larvae, as described for *Gronocarus*. All females died after a week in captivity, which would indicate they are short lived in the field. The maximum number of eggs laid by a single female was 10. Eggs began to hatch after a month, and several first instar larvae were preserved (PESC). As with *Gronocarus* and *P. pubescens*, rearings failed and it is suspected the food source was inadequate.

Hypotrichia is endemic to the upland sand ridges of peninsular Florida. The relationships of these ridges and their isolation from each other has led to speciation in many taxa. Although females have fully developed wings, it is suspected they rarely or never fly. It is possible that cryptic species hide under the name *H. spissipes*. However, this needs more study and collections from many more populations.

Hypothyce Howden

Hypothyce Howden 1968: 542.

Type species. *Hypothyce mixta* Howden, by monotypy.

Diagnosis. Members of the genus *Hypothyce* are similar in appearance to members *Hypotrichia* and the *Polyphylla pubescens* species group, with 3 segmented antennal club, tarsi with accessory teeth distinctly different in size, and in some characters of the male genitalia. Females of *H. mixta* from Texas differ from males in a number of characters, similar to the differences seen in *Hypotrichia* and the *Polyphylla pubescens* species group. Females are not presently known for the species discussed below.

Comments. Until this paper, *Hypothyce* contained 2 species, *H. mixta* from Texas and *H. osburni* from Georgia. *Hypothyce mixta* appears to represent a species complex that can be easily distinguished from the Georgia species by having a distinctly tridentate protibia, metatibial spurs longer than the 2 basal tarsomeres, and occurring in Texas. The Texas populations of *Hypothyce* have been under investigation by E. Riley, C. Wolfe, and W. Godwin for several years. There is a tremendous amount of variation among populations, and a pattern to distinguish species that accounts for all known populations has yet to emerge (Riley and Wolfe 2003: 20, and E. Riley pers. comm.).

The 2 known Georgia species of *Hypothyce* show some striking morphological differences. In addition, these differences are associated with different physiographic regions (Wharton 1978) having different soil types and different river drainages; one flowing to the Gulf of Mexico, the other to the Atlantic Ocean.

Larvae of *H. mixta* were described by Ritcher (1973), and the biology of the species is discussed by Barfield and Gibson (1975). It is suspected that the Georgia *Hypothyce* behave in a similar fashion where males fly in the late afternoon or early evening to mate with females that do not fly.

Hypothyce osburni (Cartwright)

(Figures 5, 12, 94-96, 100)

Thyce osburni Cartwright 1967: 238-240.
Hypothyce osburni (Cartwright): Hardy 1974: 9-10.

Diagnosis. *Hypothyce osburni* is readily distinguished from other *Hypothyce* by its clypeal shape and punctation pattern (Fig. 5), scutellum with smooth lateral edge lacking setae (Fig. 12), bald prosternal process and restricted distribution, known only from around Albany, GA. Female unknown.

Description. A full description is presented by Cartwright (1974) and Hardy (1974), for which the following list of characters supplements.

Length 20.0-23.0 mm, width 9.0-11.0 mm. Body nearly black, elytra rich brown; generally covered with dense white pubescence, pronotum with distinct median stripe of white hairs, scutellum and ventral thorax obscured by white hairs. Clypeal margin truncate, slightly concave, broadly and deeply recurved; surface with punctures coarse and widely separated at middle, becoming finer and denser laterally. Scutellum along lateral edges depressed and bare, setae widely separated from edge. Prosternal posterior process lobe-like, large area on apex glabrous.

Protibia bidentate, slightly tridentate. Mesotibial spurs unequal in length; upper reduced to 0.25-0.50 times length of lower spur, often appearing as a thickened apical spinule; lower spur length about 0.75 times length of first mesotarsomere. Metafemur black. Metatibial spurs shorter than 2 basal tarsomeres. Parameres abruptly widened at base in dorsal view,

tip with ventral teeth divergent in caudal view, apex curved upward from half length (Figs. 94-96).

Type materials. (20 specimens studied, map Fig. 100) Holotype male [NMNH, "USNM 691180"] and 19 paratypes [17 NMNH, 1 FSCA, 1 HAHC] from black-light trap in pecan orchard, 4.75 miles southeast of Albany, Doughtery Co., Georgia. They were collected on various dates: 1 on 1 July 1964, 12 on 19 May 1966, and 6 in July 1966. A few of the paratypes were not located.

Comments. It is difficult to make conclusions based on the type series from a single locality, however, the area around Albany has fossil dunes that were deposited along the Flint River. Given what we know about *Hypothyce* in Texas, it seems likely that the type series was collected on or near one of these dunes.

The largest and best dune of the Albany area is located on the eastern campus of Albany State College. However, this large dune is now nearly gone due to the use of off-road recreational vehicles (pers. obs.). Given the extent of sandy soils deposited along the Flint River that might harbor populations, it is premature to comment on the future survival of this species due to the impact of development and other human activity. However, this species, which is fairly large in body size and is attracted to lights, has not been taken since the mid-1960s. There is a clear need to locate additional populations of this species of southeastern scarab beetle.

Hypothyce burnei Skelley, n. sp.

(Figures 6, 10, 13, 36-37, 97-100)

Diagnosis. *Hypothyce burnei* (Figs. 36-37) is readily distinguished from other *Hypothyce* by its clypeal shape and punctation pattern (Fig. 6), scutellum with setae reaching lateral margin (Fig. 13), long mesotibial spurs, and restricted distribution, known only from around Macon, GA. Female unknown.

Description. Holotype male. Similar to the description of *H. osburni* provided by Cartwright (1967) except as noted here.

Length 19.8 mm, width 9.5 mm. Body nearly black, elytra rich brown; generally covered with dense white pubescence, pronotum with a distinct median stripe of white hairs, scutellum and ventral thorax obscured by white hairs. Clypeal margin broadly rounded and convex at middle, broadly and deeply recurved; surface with punctures dense, uniform in size and distribution across surface. Scutellum sharp along lateral edges, setae reaching edge. Prosternal posterior process entirely setose.

Protibia bidentate, slightly tridentate. Mesotibial spurs equal in length and development, lower spur length equal to first mesotarsomere. Metafemur pale brown. Metatibial spurs shorter than 2 basal tarsomeres. Parameres evenly narrowed at base in dorsal view, tip with ventral teeth nearly parallel in caudal view, apex curved upward on apical quarter (Figs. 97-99)

Variation. Length 17.8-21.0 mm, width 9.0-10.1 mm. No notable variation was observed.

Type Materials. Holotype male "/ GA: Monroe Co., Off Hwy. 74, 12 Km W. of County Line, 4 June 1997, J. C Burne" [FSCA].

Paratypes (20 total, map Fig. 100) **GEORGIA: Monroe Co.**, same data as holotype [1 FSCA, 4 PESC, 1 WBWC; 2 each in JCBC, HAHC, UGAC, NMNH, UNSM]; **Bibb Co.**, south side of campus, Macon State College just off Rte. 80, 8 June 1996, J.C.Burne, beaten off felled pine tree [2 JCBC]; **Jones Co.**, off Rte. 129, 19.5km N of Gray, 6 June 1996, J.C. Burne, beaten off felled pine tree [1 UGAC]; **Wilkinson Co.**, Beaver Dam Wildlife Res. off Rte. 112, 30 May 1998, J.C. Burne, beaten off felled pine tree [1 UGAC].

Etymology. This species is named after its collector, Jeffery C. Burne, who graciously allowed me to share the few known specimens with various museums.

Comments. The region where this species occurs is deeply eroded by various river systems that drain into the Atlantic Ocean and is generally characterized as having more clay soils. An effort was made to collect more specimens and visit each of the sites indicated by label data. All of the localities are uplands with a layer of sandy soils. It is felt the species may be more widespread than the known data indicate.

The Monroe County series was collected at a porch light. The others were beaten from cut or fallen pine trees. The association with pine trees may be coincidental as pines are farmed on these sandy hill tops. More field work is needed to make behavioral observations.

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