Banisteria, Number 30, pages 27-31

Four May Beetles New to the Virginia Fauna (Coleoptera: Scarabaeidae: Melolonthinae)

Richard L. Hoffman

Virginia Museum of Natural History
Martinsville, Virginia 24112

ABSTRACT

Four species of *Phyllophaga* are documented for Virginia for the first time: *P. nitida* (LeConte) from Scott County, and *P. latifrons* (LeConte), *P. prununculina* (Burmeister), and *P. postrema* (Horn) from various localities in the Atlantic Coastal Plain. The first is generally distributed in the northcentral states and southern Canada west of the Appalachians, the other three are recorded from Florida to New Jersey. Drawings for the metatibial apex of males are given for *P. nitida* and *P. postrema*, as well as illustrations of the everted aedeagus ("internal sac") for these species plus *P. prununculina, P. drakii* (Kirby), and *P. fusca* (Palisot de Beauvois).

Key words: aedeagal structure, beetles, *Phyllophaga*, Scarabaeidae, Virginia.

During the course of processing beetles in the Virginia Museum of Natural History collection, I recently identified several species of May beetles (genus *Phyllophaga*) apparently not so far documented as members of the Virginia insect fauna. Considering the deficient state of our knowledge of most arthropod groups in the Commonwealth, such discoveries are not particularly noteworthy *per se*, unless, as in the present case, substantial refinements of the known range are involved.

The occasion is taken to illustrate some important diagnostic characters previously represented only verbally or not at all. Although the male genitalia of these species were depicted photographically by Luginbill & Painter (1953), the small size of the images detracted from their usefulness and, for most species, only the configuration of the heavily sclerotized terminalia was shown.

While preparing specimens for examination of the male genitalia, I studied the aedeagal vesicle of several species for possible supplementary diagnostic characters, inasmuch as this normally concealed part of the male genitalia has proven to be of great taxonomic importance in other beetle groups (e.g., Carabidae) and by analogy might be expected to be useful in distinguishing species of *Phyllophaga*.

[1]The aedeagus was illustrated even earlier for the Louisiana species of *Phyllophaga* in a doctoral dissertation by E. G. Riley, submitted in 1988, which, being unpublished, does not have priority over the work by Woodruff & Beck in this context.

Phyllophagan aedeagi

Although the sclerotized abdominal copulatory apparatus of male scarab beetles has been employed to distinguish species for over a century (e.g., Smith, 1889), the possible taxonomic value of the aedeagus has only recently been addressed. One hundred years after Smith's pioneering utilization of the genitalia in *Phyllophaga*, Woodruff & Beck (1989)[1] presented a number of intriguing illustrations of the aedeagi of several species, as prepared in the everted condition for SEM imaging. While their procedure for producing permanent and fixed eversion produces excellent results, it is rather time-consuming and tedious. In many cases, a quick and easy approach yields excellent results for examination of these membranous structures. In the species which I have prepared in this context, simply immersing the genital capsule dissected from a pinned specimen in a weak solution (about 10%) of sodium hydroxide usually results in complete extrusion by osmotic pressure in just a few minutes. In some cases, longer time is required, and the process can also be expedited by careful manipulation of the sac with a fine insect pin. Neutralization of the caustic agent in boiled or distilled water (to avoid air bubbles) may also enhance inflation of the sac, again by osmotic effect. Storage in glycerin in a microvial has not caused evident shrinkage by removal of the water. While obviously not suited for SEM studies, this procedure gives

very acceptable results for visual examination and drawing. Specimens initially preserved in any solution containing formalin (often employed in pitfall traps) will not always give optimal results with this technique. The beetles which I studied were collected by UV light traps, using a preservative based on isopropyl alcohol. Specimens killed with ethyl acetate might yield the best results.

The prominent, sclerotized distal copulatory elements of the male genitalia in beetles are traditionally referred to as parameres (sometimes as penis or phallus). Since, in many kinds of *Phyllophaga* the two parameres are fused at the base (sometimes also apically) into a single unit, the name ***symparameres*** would seem a useful distinction. The transverse basal region is extended internally as a thin, sclerotized, conchoidal structure referred to as the *apodeme (cf.* Snodgrass, 1935, fig. 303C), which is provided with internal muscles for extension or flexion of the parameres (if they are moveable). The apodeme also contains a long, narrow, frequently doubled, median acicular sclerite designated by Snodgrass as the *aedeagal apodeme*, a continuation of the sclerotized basal part of the aedeagus. While this is true for the species he illustrated (*P. chiriquiana*) and others such as *P. prununculina* and *P. glaberrima*, the majority of eastern species known to me, including those illustrated herein, lack this modification and the internal apodeme is only loosely attached, if at all, to the vesicular region (the aedeagus in the strict sense). To avoid the complication of having a small "apodeme" operational inside another, larger one, I propose to use the new name ***baculum*** for the smaller internal structure which seems to be functionally analogous to the baculum bone that supports the penis of many kinds of mammals. I am not aware that the term has been used previously in an entomological context.

That a functional relationship exists was suggested by the fact that gentle pressure with the head of an insect pin on the "inner apodeme" often resulted in enhanced inflation of the vesicle when the entire structure was immersed in fluid. The details of this structure, and its modification into the condition illustrated by Woodruff & Beck (1989, fig. 449) and Figures 9 and 10 of this paper for *P. prununculina*, are being investigated for a more detailed future treatment, at which time the possible effects of geographic variation on form and armature of the aedeagus may also be considered.

Phyllophaga nitida (LeConte) Figures 1-2.

As depicted by Luginbill & Painter (1953), the range of this species extends across the southern edge of Canada from Alberta to Quebec, thence southward into the states of Minnesota, Wisconsin, Michigan, Ohio, Illinois, and Iowa (with an unattributed disjunct record for Georgia). West Virginia was added to this distribution by McCutcheon et al. (1994). VMNH has a male specimen from the following locality:

VIRGINIA: *Scott County*: Co. Rt. 653, ca. 0.2 km west of junction with Rt. 602 (ca. 8.2 km west of Dungannon), 24 June 2004, Anne C. Chazal. This site is approximately halfway between West Virginia and Georgia and thus lends some credence to the occurrence of *P. nitida* in the latter state. It also emphasizes the presence in southwestern Virginia of organisms typically native to the Interior Lowlands of North America.

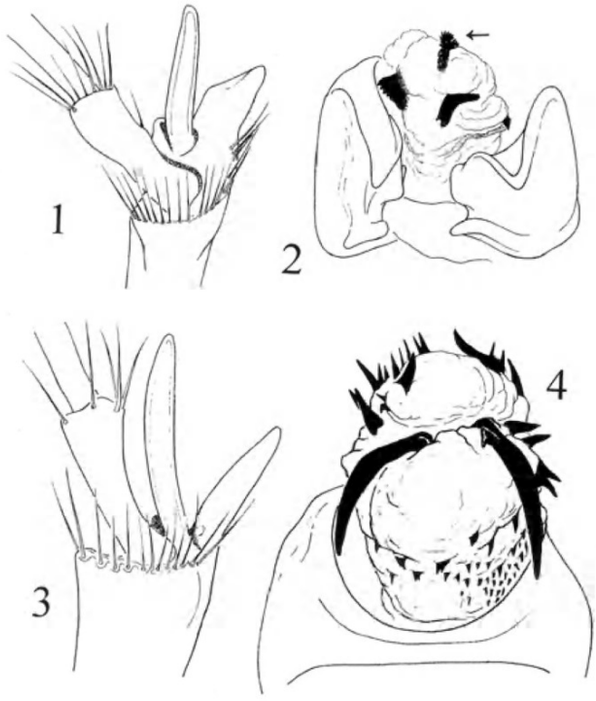
The lower (fixed) male metatibial spur (Fig. 1) is notably broad and subtriangular, angulate at midlength, and much wider than the upper spur. Both are thin and laminate, and together originate at the tibial apex somewhat produced beyond articulation of the basitarsus. The aedeagus (Fig. 2) is relatively small and does not expand out beyond the symparameres; its ornamentation consists of four small, irregular black sclerites with dentate or serrulate edges. In the extruded condition, these sclerites are most evident in a caudoventral aspect, from which the drawing was prepared. A possibly diagnostic feature not mentioned in descriptions of this species is that the scutellum is completely impunctate (at least in the specimen at hand), a condition not noted by me in any of the 24 other local species examined.

Phyllophaga postrema (Horn) Figures 3-5.

Originally described from "Florida," this species occupies a range in the southeastern Coastal Plain from eastern South Carolina to central Florida, thence westward to southern Mississippi (Woodruff & Beck, 1989). The species has been recently reported from Chatsworth, New Jersey by Robbins et al. (2006), so its capture in eastern Virginia merely fills in the lacuna that existed between New Jersey and South Carolina. The Virginia beetles agree in all external details, including those of the symparameres, with the good description and figures published by Woodruff & Beck (1989: 145, figs. 44, 104, 164, 224, 257, 347, 350, 451, and 564).

VIRGINIA: *Accomack County*: Assateague Island, Chincoteague National Wildlife Refuge, UV trap at "cattle gate marsh", 24 June 1998, S. M. Roble (VMNH 1♂). *City of Virginia Beach*: False Cape State Park, Barbour Hill entrance road at south end of marsh, live oak forest edge, 31 May 2005, Roble (VMNH 13♂♂).

Lower metatibial spur of males (Fig. 3) fused, symmetrically tapered distal, about 2/3rds as long as the upper spur, which is slightly but evidently curved ventrad, broadest near distal third, and substantially longer than basal tarsomere. Aedeagus (Figs. 4-5) with two long,



Figs. 1, 2. *Phyllophaga nitida* (LeConte), specimen from Scott County, Virginia. 1. Apex of metatibia showing configuration of fixed spur and origin of articulated spur somewhat *distad* to base of first tarsomere. 2. Male genitalia, posteroventral aspect with everted aedeagus. There are no sclerites except those shown, but the narrow, dorsal, spiculate sclerite (arrow) extends for some distance proximad along the upper side of the vesicle. Figs. 3, 4. *Phyllophaga postrema* (Horn), specimen from Accomack County, Virginia. 3. Apex of metatibia of male. 4. Everted aedeagus, dorsal aspect showing the two large paramedian spines. All major armature is shown in this aspect.

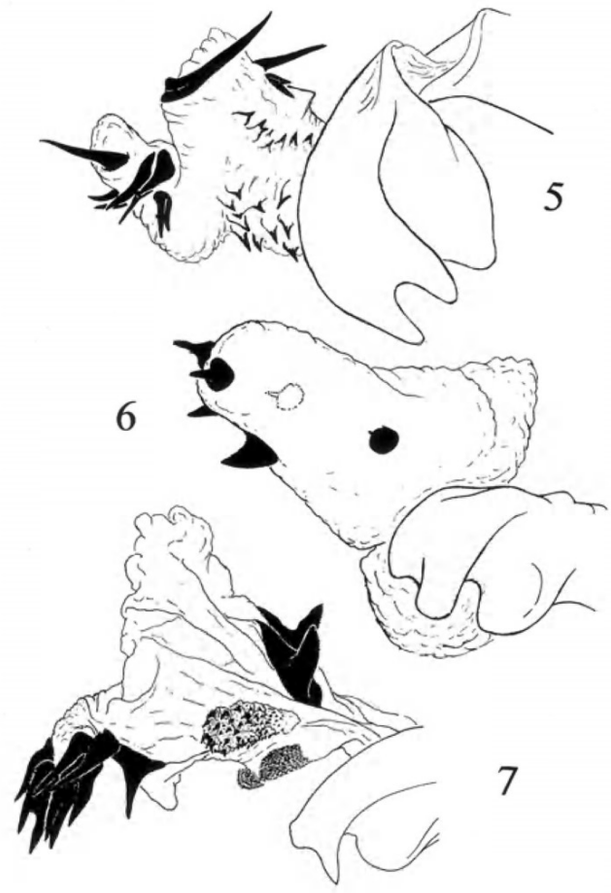


Fig. 5. *Phyllophaga postrema*, same specimen as in Fig. 4, lateral aspect of right paramere and everted aedeagus. Fig. 6. *Phyllophaga fusca* (Palisot de Beauvois). Specimen from Martinsville, Virginia. Everted aedeagus, right lateral aspect. The single spine on the left side is indicated by dotted lines. Fig. 7. *Phyllophaga drakii* (Kirby). Specimen from Richmond, Virgina. Everted aedeagus, right lateral aspect.

slender spines on the dorsal side and numerous small, subequal black spines dispersed generally over the surface.

Woodruff & Beck (1989) noted the external similarity of this species to *P. ulkei* (Smith) and *P. drakii* (Kirby), and all three also have the same general symparamere structure. Those authors provided excellent SEM photographs (Figs. 442-445) of the expanded aedeagus of *P. ulkei*, notable for the two elongated basal spines on the dorsal surface. Two similar spines are present in the same position in *P. postrema*, but this species differs in the presence of a large number of prominent black aedeagal spicules. In the inflated condition, the aedeagus forms two distal lobes, the proximal bearing the elongated paramedian spines, while the distal lobe and the basal stalk of the entire aedeagus are densely beset with numerous acute black spines over much of the surface, as shown in Figures 4 and 5.

The aedeagus of *P. fusca* (Fig. 6) is quite different from that of the two preceding species, having only about six small spines of similar size and shape dispersed over its surface, without a trace of the two enlarged spines shared by *P. postrema, P. drakii,* and *P. ulkei.*

A closer similarity in both external features and paramere structure can be seen with *P. drakii,* to which specimens will be identified in the Luginbill & Painter (1953) key according to the degree of clypeal emargination. To examine a possible relationship (the two taxa appear to be largely allopatric), I prepared the aedeagus of a specimen of *P. drakii* from western Virginia, and present here a drawing (Fig. 7) that shows significant differences in the armature on comparison with the same parts in *P. postrema.*

The large terminal cluster of eight large, elongated, heavily sclerotized spines is noteworthy, but an additional feature of this species is a cluster of small spines, each arising from a sclerotized base, which collectively fuse into a placoid structure adjacent to the base of the proximodorsal spines (Fig. 7). Immediately adjacent on the ventral side are two small fields of very slender, almost setiform, denticles.

Phyllophaga latifrons (LeConte) Figure 8

The range of this species as shown by Luginbill & Painter (1935: Fig. 20) and later by Woodruff & Beck (1989: Fig. 544) shows a familiar pattern: North Carolina to Louisiana in the Atlantic Coastal Plain, with disjunction to New Jersey. The basis for the latter record is unknown to me, perhaps confirmation by recent collections is desirable (Robbins et al. 2006 did not capture it using pheromones at Chatsworth).

All of the North Carolina material in the NCSU collection is from several Coastal Plain counties; a record for Winston-Salem (Brimley, 1938) seems improbable. Harpootlian (2001) cites collections from seven counties in South Carolina, all below the Fall Line.

VIRGINIA: *City of Virginia Beach*: False Cape State Park, light trap at the Wash Woods Environmental Education Center, 6-7 July 2005, S. M. Roble (VMNH 10♂♂, 4♀♀). *City of Suffolk*: Holland, several dates in June and July 1945, James M. Grayson (VPISU 13♂♂).

Considering the size of the two samples cited above, it seems odd that the species has not been found at such well-collected localities as First Landing State Park, Savage Neck Dunes Natural Area Preserve, and Assateague Island, all of which have been subjected to assiduous trapping with black light throughout the apparent season of adult activity for this species.

Among the Virginia species of *Phyllophaga* this one is readily distinguished by several structural modifications in males. As illustrated by Woodruff & Beck (1989: Fig. 542) and Fig. 8 in this paper, the caudal edge of the 8th sternite is provided with two prominent paramedian uncate projections (in some of the local specimens an approach to four such processes is evident). The 7th sternum is deeply concave and overhung by the marginal hooks, and sterna 5 and 6 are medially concave. The straight or slightly arcuate margin of the clypeus is a useful aid in associating isolated females. The surface pruinosity is so pronounced as to impart a distinctive frosty gray color when illuminated from the correct angle.

The male genitalia represent an approach to the condition seen in *P. prununculina* in that the aedeagus is reduced in size and borne at the apex of an elongated cylinder, composed in part of the sclerotized and expanded distal ends of the baculum. Illustration and discussion of this structure are deferred for a later treatment of this general subject.

Phyllophaga prununculina (Burmeister) Figures 9-10.

This interesting species has been documented by Luginbill & Painter (1935) for a southeastern Coastal Plain distribution: North Carolina to Louisiana with a disjunct record for New Jersey. The absence of Virginia records has been, therefore, only fortuitous as the species is not uncommon in our Coastal Plain. VMNH material is from the following localities:

VIRGINIA: *Accomack County:* Assateague Island, Chincoteague National Wildlife Refuge, 3 July 1998, A. C. Chazal (1). *Northampton County:* Savage Neck Dunes Natural Area Preserve, Custis Pond, 17 July 2003,

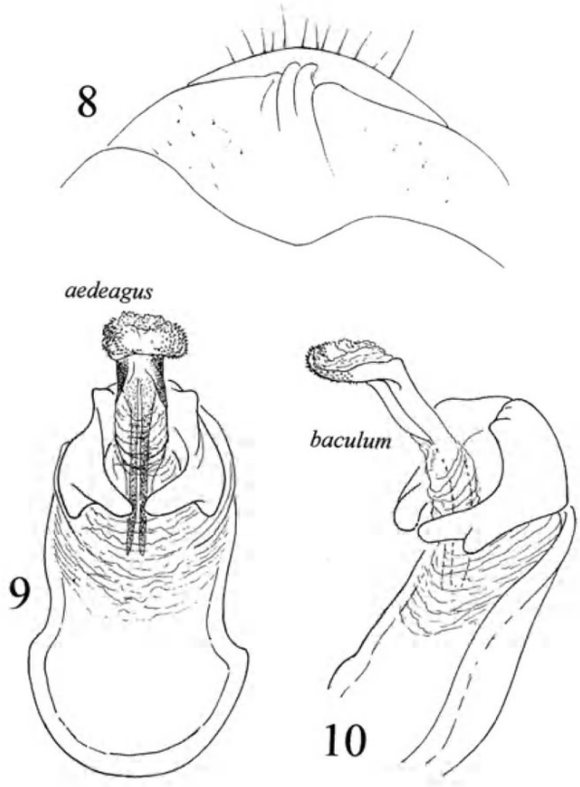


Fig. 8. *Phyllophaga latifrons* (LeConte). Sternum 8 of male, slightly oblique ventrolateral aspect, showing the two uncate median cusps. In true ventral aspect these are distinctly separated from each other and from the more lateral fold on each side. Figs. 9, 10. *Phyllophaga prununculina* (Burmeister). Fig. 9. Genitalia in ventral aspect, showing incorporation of baculum spicules distally into the sclerotized tube that supports the reduced aedeagus. In the other species discussed in this paper the baculum remains centered in the convexity of the apodeme when the aedeagus is everted. Fig. 10, Male genitalia with the baculum extruded, oblique lateral aspect.

Chazal & N. Van Alstine (2); 22 June 2004, Chazal & Field (1); 9 July 2004, Chazal (3). *City of Suffolk*: South Quay pine barrens, ca. 6 mi. south of Franklin, 20 June 2003, S. M. Roble (1); 5 August 2003, Roble (5). *City of Virginia Beach*: First Landing/Seashore State Park, 23 June-7 July 2003, Robert Vigneault (5). False Cape State Park, freshwater pond 0.3 km south Wash Woods Cemetery, 5 August 2005, Roble (32); main park road south of campground, 3 August 2005, Roble (1); main park road, 1.3 km south Wash Woods Cemetery, 4 August 2005, Roble (5).

Males of this species are easy to recognize by the combination of (1) lower metatibial spur vestigial or absent, (2) 8th sternum with an oval median depression bordered on each side by a setose protuberance, and (3) antennal club longer than stem. The parameres are also very distinctive, and in many specimens the baculum is fully extended. It is noteworthy that in this species, the true aedeagus is reduced to a small membranous cushion at the apex of the tube formed by coalescence of the expanded distal ends of the baculum spicules (Fig. 9).

There is little doubt that this beetle will be found at many additional localities in eastern Virginia. Its period of flight activity extends from late June to mid-August.

ACKNOWLEDGEMENTS

The Virginia Museum of Natural History continues to be under an obligation to Dr. Steven M. Roble (Division of Natural Heritage, Department of Conservation and Recreation) for providing the specimens reported here. Dr. Paul Lago, University of Mississippi, very kindly made or confirmed identifications. Robert L. Blinn made the North Carolina State University (NCSU) insect collection available, and Michael Kosztarab provided access to that at Virginia Polytechnic Institute & State University (VPISU). The anonymous peer review process brought to my attention publications, which I had overlooked, documenting the capture of *P. postrema* in New Jersey and *P. nitida* in West Virginia.

LITERATURE CITED

Harpootlian, P. J. 2001. Scarab Beetles (Coleoptera: Scarabaeidae) of South Carolina. Biota of South Carolina, vol.2. Clemson University, Clemson, SC. 157 pp.

Luginbill, P., & H. R. Painter. 1953. May beetles of the United States and Canada. U. S. Department of Agriculture, Technical Bulletin 1060: 1-102.

McCutcheon, T. W., J. E. Weaver, & M. C. Thomas. 1994. An annotated list of the West Virginia May or June Beetles (Coleoptera: Scarabaeidae: *Phyllophaga* spp.). Insecta Mundi, 8(3-4): 247-249.

Robbins, P. S., and 52 other authors. 2006. Trapping *Phyllophaga* spp. (Coleoptera: Scarabaeidae: Melolonthinae) in the United States and Canada using sex attractants. Journal of Insect Science 6: 39.

Smith, J. B. 1889. Notes on the species of *Lachnosterna* of temperate North America, with descriptions of new species. Proceedings of the United States National Museum 11: 481-525.

Snodgrass, R. E. 1935. Principles of Insect Morphology. McGraw-Hill, New York & London. 667 pp.

Woodruff, R. E., & B. M. Beck. 1989. The scarab beetles of Florida (Coleoptera: Scarabaeidae) Part II. The May or June beetles (genus *Phyllophaga).* Arthropods of Florida and Neighboring Land Areas 13: 1-225.