

***Phyllophaga* and Related Species (Coleoptera: Scarabaeidae) Collected in Black-light Traps in Alabama Pastures¹**

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Abstract This study reports the occurrence of the adults of *Phyllophaga* spp. and other major scarab species in three different geographic regions of Alabama. Thirty-three species of *Phyllophaga* were found during the trapping study. Five species accounted for 97% of the specimens of *Phyllophaga* trapped in Marion Junction: *P. crinita* (Burmeister), *P. forbesi* (Glasgow), *P. hirtiventris* (Horn), *P. mississippiensis* Davis, and *P. perlonga* Davis. Two species accounted for 55% of the specimens trapped in Camp Hill: *P. micans* (Knoch) and *P. hirticula* (Knoch). At Winfield, *P. crenulata* (Froelich), *P. ephillida* (Say), *P. latifrons* LeConte, *P. micans*, and *P. quercus* (Knoch) were the most abundant species, making up 49% of the specimens. Of these 11 most abundant species, 5 species were collected in spring (March, April and/or May): *P. crenulata*, *P. hirticula*, *P. micans*, *P. mississippiensis*, and *P. perlonga*. *Phyllophaga hirtiventris* adults were collected in late May-June. Adults of *P. crinita* were collected in June and early July, and were abundant in each year, suggesting that the species has an annual life cycle in Alabama. *Phyllophaga ephillida*, *P. forbesi*, *P. latifrons* and *P. quercus* adults were collected in mid-summer (June, July and/or August). Six species of *Phyllophaga* found during this study have not been previously reported from Alabama: *P. bipartita* Horn, *P. congrua* (LeConte), *P. hirtiventris*, *P. mississippiensis*, *P. praetermissa* (Horn), and *P. soror* Davis. *Cyclocephala lurida* Bland, *Dyscinetus morator* (F.), *Euetheola humilis rugiceps* (LeConte), and *Ligyris gibbosus gibbosus* (DeGeer), other potential pests of grasses, were abundant in the black-light traps. The dung beetle, *Onthophagus gazella* F., an African species that was purposely introduced into the United States, was abundant at all three sites.

Key Words *Phyllophaga*, Scarabaeidae, black-light trapping

More than 90 species of May or June beetles, *Phyllophaga* spp. (Coleoptera: Scarabaeidae), have been found in the southeastern United States (Luginbill and Painter 1953). Loding (1945) lists 63 *Phyllophaga* species from Alabama. Adults of most species feed on various hardwood trees and shrubs, and some species are recognized pests of pecan trees (Smith and Lewis 1906). Larvae, c-shaped white grubs, feed on plant roots, including forage and turfgrasses, corn, sorghum, small grains, conifers, strawberries, and sweet potatoes (Forschler and Gardner 1990, Metcalf and Metcalf 1993, Teetes 1973).

In Alabama, *Phyllophaga* grubs have their greatest economic impact in turfgrass, perennial grass pastures and hayfields, and conifer nurseries and plantations. Each year, one or more species of white grubs is locally abundant, causing economic

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damage. Periodic, widespread outbreaks of *Phyllophaga* can occur, such as in 1985-86, when some 800 ha of fescue pasture in the blackland prairie soil region were devastated by an unidentified species (Ball and Reed 1986).

The grubs of *Phyllophaga* species are difficult, if not impossible, to identify using existing keys. However, sound pest management strategies are dependent on knowledge of the identity and life cycle of the pest white grub species (Forschler and Gardner 1991). The following species are known as turfgrass pests in the United States: *P. anxia* (LeConte), *P. crinita* (Burmeister), *P. ephilida* (Say), *P. fraterna* Harris, and *P. hirticula* (Knoch) (Crocker et al. 1995). Ritcher (1940) found that seven species of May beetles were abundant in pastures in Kentucky: *P. hirticula*, *P. ephilida*, *P. crenulata* (Froelich), *P. bipartita* Horn, *P. inversa* (Horn), *P. micans* (Knoch), and *P. fraterna*. It is not known which species of *Phyllophaga* are primarily responsible for damage to forage grasses and turfgrasses in Alabama.

Other species of white grubs can cause economic damage to perennial forage grasses and turfgrasses in Alabama, including masked chafers, *Cyclocephala* spp., and green June beetle, *Cotinis nitida* L. In recent years, the green June beetle has been a serious pest in pastures and hayfields where organic matter has been used as fertilizer (Flanders and Cobb 1996). Japanese beetles, *Popillia japonica* Newman, are found in eastern Alabama, south to Auburn, and in the area around Tuscaloosa. In the past few years, damaging populations of a *Polyphylla* species have been found in bahiagrass pastures and hayfields in southwest Alabama. The sugarcane beetle, *Euethola humilis rugiceps* (LeConte), causes damage to young corn plants, particularly in fields where corn is planted into ground newly converted from perennial forage grasses.

The study reported here was designed to gain more information on the seasonal occurrence of the adults of *Phyllophaga* and other major scarab species in three different geographic regions of Alabama. This information can be used to determine what species of *Phyllophaga* are locally abundant and that may be responsible for damage to forage grasses and turfgrasses. Although species that are common in black-light traps may not all be potential pests, the information presented here will help determine what *Phyllophaga* species are important in Alabama. This study is intended to complement a similar trapping study (Forschler and Gardner 1991) which identified common species of *Phyllophaga* and other phytophagous scarabs in the coastal plain region and piedmont plateau region of Georgia.

Materials and Methods

An Ellisco Model 110103 General Purpose Black Light Insect Survey Trap (Ellisco Inc., Philadelphia, PA) was operated continuously from early March through early October, 1995 to 1997 in each of three locations: (1) Marion Junction, Dallas Co., in the Blackland Prairie Region (Major Land Resource Area 135, [USDA Soil Conservation Service 1981]) in west central Alabama; (2) Camp Hill, Tallapoosa Co., in the Southern Piedmont Region (MLRA136) in east central Alabama; and (3) Winfield, Marion Co., in the Southern Coastal Plain Region (MLRA133A) in northwest Alabama. Damaging populations of *Phyllophaga* grubs have occurred at the Marion Junction site in the past. The Piedmont area is also prone to damaging infestations of *Phyllophaga* grubs, although none had occurred recently at the Camp Hill site. Traps were placed in the midst of perennial grass pastures and hayfields. At Camp Hill and Winfield, substantial areas of hardwood trees were 100 to 300 m away. At Marion

Junction, scattered hardwoods were located within 300 m. The traps at Camp Hill and Marion Junction were located in small, open-sided sheds where they were readily visible but protected from heavy rains. The Winfield trap was in the open and visible from all directions.

Dichlorvos strips (Revenge® Bug Strip, Roxide International, Inc., New Rochelle, NY) placed in the top of the collecting container were used as the killing agent. Traps were emptied every Monday, Wednesday, and Friday. The trap samples were frozen until the *Phyllophaga* specimens could be sorted, pinned, labeled, and their genitalia extracted (necessary for identification to species). Seasonal abundance data were produced by pooling trap captures into 7-d periods and determining the average daily trap catch for each period.

Selected scarab species, other than *Phyllophaga*, were sorted and counted because of their potential as plant pests, their ecological importance as dung feeders in livestock operations, or their rarity. *Cyclocephala* sp. were not recorded in 1996. *Anomala flavipennis* Burmeister, *A. innuba* (F.), and *A. undulata* Melsheimer were counted only in 1997. *Bolbocerosoma* sp. were sorted in 1996-1997.

Insects were identified to species by author Lago. Voucher specimens have been deposited in the insect museum in the Department of Entomology and Plant Pathology, 301 Funchess Hall, Auburn University, Auburn, AL 36849.

Results and Discussion

Thirty-three species of *Phyllophaga* were collected from the blacklight traps in this study. Fourteen species were trapped at Marion Junction; half of these were found only at this site. Twenty-two species were trapped at Winfield, seven of which were unique to that site. Seventeen species were trapped at Camp Hill, of which four species were found only at this site. Most of the species collected in the piedmont region of Georgia (Forschler and Gardner 1991) also were collected somewhere in Alabama. However, few of the species collected from the lower coastal plain of Georgia were found at our study sites.

Five species accounted for 97% of the specimens of *Phyllophaga* trapped in Marion Junction: *P. crinita*, *P. forbesi* (Glasgow), *P. hirtiventris* (Horn), *P. mississippiensis* Davis, and *P. perlonga* Davis. *Phyllophaga crinita* was the most abundant, accounting for 80% of all the specimens trapped at Marion Junction. Two species accounted for 55% of the specimens trapped in Camp Hill: *P. micans* (Knoch) and *P. hirticula*. At Winfield, *P. crenulata*, *P. ephilida*, *P. latifrons* (LeConte), *P. micans*, and *P. quercus* (Knoch) were the most abundant species, comprising 49% of the specimens. These 11 species, presented in alphabetical order, deserve closer attention to determine which, if any, of these species are causing economic damage to perennial grasses in Alabama.

Phyllophaga crenulata is common throughout the eastern half of the United States, with the exception of Florida and northern New England (Woodruff and Beck 1989). It was collected from Camp Hill and Winfield, but not from Marion Junction (Table 1). Most *P. crenulata* specimens were collected in April and May (Table 2). The spring flight period suggests that the insects pupated the previous year and overwintered as adults (Riley 1988), which is characteristic of species with a multiple-year life cycle. Ritcher (1940) reported that this species has a 2 or 3-yr life cycle. Host plants of the adult include persimmon, blackberry, sycamore, elm, walnut, and oaks (Ritcher 1940).

Table 1. Black-light captures of adult scarabs at three locations in Alabama, 1995-1997

	Marion Junction (Blackland Prairie Region)			Camp Hill (Southern Piedmont Region)			Winfield (Southern Coastal Plain)		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
<i>Phyllophaga</i> species									
<i>P. anxia</i>	1	—	—	11	2	1	3	1	—
<i>P. balia</i> (Say)	—	—	—	—	—	—	—	1	—
<i>P. bipartita</i> *	1	1	—	—	—	—	—	—	—
<i>P. calceata</i> (LeConte)	—	4	—	—	—	—	—	—	—
<i>P. congrua</i> *	—	1	—	—	—	—	—	—	—
<i>P. crenulata</i>	—	—	—	6	2	—	27	34	10
<i>P. crinita</i>	222	1122	468	—	—	—	—	—	15
<i>P. delata</i> (Horn)	—	—	—	—	—	—	1	2	—
<i>P. diffinis</i> (Blanchard)	—	—	—	—	—	3	—	—	—
<i>P. drakii</i> (Kirby)	—	—	—	3	—	—	4	—	—
<i>P. ephilida</i>	—	—	—	—	—	—	3	28	3
<i>P. forbesi</i>	2	34	24	—	—	1	—	1	2
<i>P. forsteri</i> (Burmeister)	—	—	1	7	2	4	2	2	1
<i>P. fraterna</i>	—	—	—	—	—	1	—	—	—
<i>P. futilis</i> (LeConte)	2	29	5	—	—	—	—	—	—
<i>P. gracilis</i> (Burmeister)	—	—	—	—	—	1	1	2	—
<i>P. gracilis angulata</i> (Burmeister)	—	—	—	—	—	—	1	5	13
<i>P. hirsuta</i> (Knoch)	—	—	—	6	2	4	—	—	—
<i>P. hirticula</i>	—	—	—	32	7	10	1	1	—
<i>P. hirtiventris</i> *	3	97	6	—	—	—	—	—	—
<i>P. ilicis</i> (Knoch)	—	—	—	1	3	1	—	1	—
<i>P. latifrons</i>	—	—	1	2	—	2	9	19	12
<i>P. luctuosa</i> (Horn)	—	—	—	—	—	—	2	1	—
<i>P. micans</i>	3	2	—	34	12	18	60	3	37
<i>P. mississippiensis</i> *	3	83	11	—	—	—	—	—	—
<i>P. (Phytalis) obsoleta</i> (Blanchard)	—	—	—	—	—	—	—	2	2
<i>P. perlonga</i>	6	103	9	—	1	—	—	1	—
<i>P. praetermissa</i> *	—	—	—	—	—	—	1	—	—
<i>P. quercus</i>	—	—	—	3	1	8	—	11	20

Table 1. Continued.

	Marion Junction (Blackland Prairie Region)			Camp Hill (Southern Piedmont Region)			Winfield (Southern Coastal Plain)		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
<i>P. soror</i> *	2	—	—	—	—	—	—	—	—
<i>P. subtonsa</i> (LeConte)	—	—	—	—	—	—	3	1	2
<i>P. tristis</i> (F.)	—	—	—	—	—	2	—	—	—
<i>P. ulkei</i> (Smith)	—	—	—	—	—	12	—	2	4
Total	245	1476	525	105	29	68	118	118	131
Other scarabs									
<i>Anomala flavipennis</i>	nc**	nc	28	nc	nc	2	nc	nc	18
<i>Anomala innuba</i>	nc	nc	—	nc	nc	19	nc	nc	86
<i>Anomala marginata</i>	4	9	9	22	13	21	56	25	7
<i>Anomala undulata</i>	nc	nc	—	nc	nc	20	nc	nc	—
<i>Bolbocerosoma farctum</i> (F.)	—	—	—	—	—	8	—	—	6
<i>Bolbocerosoma tumefactum</i>	—	—	—	—	22	2	—	11	—
<i>Cyclocephala lurida</i>	2232	nc	2014	1483	nc	1759	1076	nc	2069
<i>Diplotaxis blanchardi</i>	—	—	—	—	—	1	—	—	—
<i>Diplotaxis liberta</i>	—	—	9	4	1	25	11	1	6
<i>Diplotaxis sordida</i>	—	—	—	—	—	—	—	—	1
<i>Dyscinetus morator</i> (F.)	1286	1224	2608	1918	583	1620	907	492	379
<i>Euetheola humilis rugiceps</i>	1152	1305	490	929	160	697	1085	1093	648
<i>Ligyrus gibbosus gibbosus</i>	1	7	17	186	52	149	145	222	396
<i>Onthophagus gazella</i>	5144	4721	4468	19197	6082	9180	2076	5179	5521
<i>Onthophagus taurus Schreber</i>	—	—	—	—	5	—	—	1	—
<i>Serica alabama</i>	—	—	—	—	1	2	—	—	—
<i>Serica floridana</i>	—	—	—	—	—	—	—	3	—
<i>Serica georgiana lecontei</i>	—	—	—	—	1	4	—	—	—
<i>Serica loxia</i>	—	—	2	—	—	—	—	2	—
<i>Serica mystaca</i>	—	—	—	—	—	—	—	1	—
<i>Serica vespertina vespertina</i>	—	—	—	2	1	2	1	—	1

* This species has not been previously reported from Alabama.

** "nc" = not counted in that location that year, "—" = not found.

Table 2. Seasonal occurrence of Scarab species in Alabama, 1995-1997

Species	Number of specimens captured*							
	March	April	May	June	July	August	September	October
<i>Phyllophaga</i> species								
<i>P. anxia</i>		X	XX	X				
<i>P. balia</i>			X					
<i>P. bipartita</i>		X	X					
<i>P. calceata</i>		X	X					
<i>P. congrua</i>			X					
<i>P. crenulata</i>		XX	XX	X	X	X		
<i>P. crinita</i>			XX	XXXX	XXX	X		
<i>P. delata</i>			X	X				
<i>P. diffinis</i>		X						
<i>P. drakii</i>		X		X				
<i>P. ephilida</i>					XX	X		
<i>P. forbesi</i>				XX	XX	X		
<i>P. forsteri</i>	X	X	X		X			
<i>P. fraterna</i>	X							
<i>P. futilis</i>	X	XX	X					
<i>P. gracilis</i>				X	X			
<i>P. gracilis angulata</i>				XX	X	X		
<i>P. hirsuta</i>	X	XX						
<i>P. hirticula</i>		XX	XX	X	X			
<i>P. hirtiventris</i>		X	XX	XX				
<i>P. ilicis</i>			X	X	X			
<i>P. latifrons</i>				XX	XX	XX		
<i>P. luctuosa</i>			X					
<i>P. micans</i>	X	XX	XX	X				X
<i>P. mississippiensis</i>	X	XX	XX	X				
<i>P. (Phytalis) obsoleta</i>				X	X			
<i>P. perlonga</i>	XX	XX	XX	X				
<i>P. praetermissa</i>		X						
<i>P. quercus</i>					XX	XX	X	
<i>P. soror</i>				X				
<i>P. subtonsa</i>		X	X	X				
<i>P. tristis</i>	X	X						
<i>P. ulkei</i>	X	X	X					

Table 2. Continued.

Species	Number of specimens captured*							
	March	April	May	June	July	August	September	October
Other scarabs								
<i>Anomala flavipennis</i>			X	XX	X			
<i>Anomala innuba</i>				XX	XX			
<i>Anomala marginata</i>			X	XXX	XX	X		
<i>Anomala undulata</i>	X	XX	X					
<i>Bolbocerosoma farctum</i>			X	X	X	X	X	
<i>Bolbocerosoma tumefactum</i>				X	X	XX	X	X
<i>Cyclocephala lurida</i>		XX	X	XXXX	XXXX	XXX		
<i>Diplotaxis blanchardi</i>				X				
<i>Diplotaxis liberta</i>			XX	XX	X	X	X	
<i>Diplotaxis sordida</i>				X				
<i>Dyscinetus morator</i>	XXX	XXXX	XXXX	XXXX	XXXX	XXX	XXX	X
<i>Euethola humilis rugiceps</i>	XX	XXXX	XXXX	XXXX	XXX	XXX	XXX	XX
<i>Ligyris gibbosus gibbosus</i>		XX	XXX	XXX	XX	XX	XX	
<i>Onthophagus gazella</i>	X	XXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXX
<i>Onthophagus taurus</i>			X		X			
<i>Serica alabama</i>			X					
<i>Serica floridana</i>			X					
<i>Serica georgiana lecontei</i>		X	X	X	X			
<i>Serica loxia</i>			X		X			
<i>Serica mystaca</i>			X					
<i>Serica vespertina vespertina</i>		X	X	X				

*X = 1–9 specimens, XX = 10–99 specimens, XXX = 100–999 specimens, XXXX = 1000–9999 specimens.

Phyllophaga crinita was the most abundant *Phyllophaga* species in our black-light traps. It is recognized as a pest of turfgrass and grain crops in Texas (Merchant and Crocker 1995, Teetes 1973). In Alabama, this species was collected from the western side of the state. Peak flight period for this species in June and early July (Fig. 1) would suggest that it has an annual life cycle in Alabama, and that it does not overwinter as an adult. Numerous specimens were collected each year, which also lends credence to the assumption of an annual life cycle. It has an annual life cycle

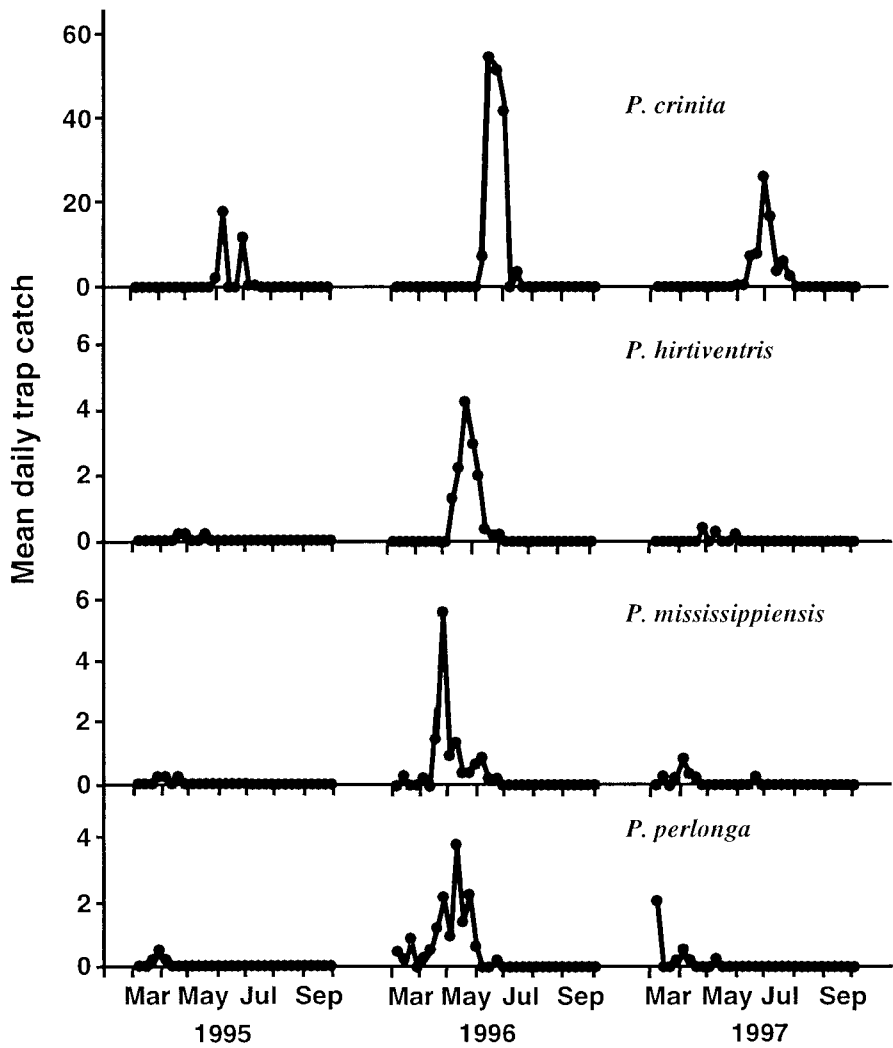


Fig. 1. Seasonal occurrence of *Phyllophaga crinita*, *P. hirtiventris*, *P. mississippiensis*, and *P. perlonga* in black-light samples from Marion Junction, AL, 1995-1997 (Blackland Prairie Region).

in Texas, where it overwinters in the larval stage, then pupates in spring (Merchant and Crocker 1995). Reported host range for this species is Alabama, Mississippi, Louisiana, Texas, and New Mexico (Riley 1988).

Phyllophaga ephilida was relatively common in Winfield in 1996. A recognized pest of turfgrass (Crocker et al. 1995), this species is found throughout most of the eastern half of the United States (Woodruff and Beck 1989). This species is common in the outer bluegrass region of Kentucky, where 50% of the grubs in grass sod were *P. ephilida* (Ritcher 1940). Characteristic host plants for the adults include white oak, elm, ash, locust, walnut, sycamore, and willow (Ritcher 1940), as well as persimmon and pecans (Fattig 1944). In Kentucky, *P. ephilida* has an unusual 2-yr life cycle, where it overwinters as a grub, pupates in June and emerges later the same season. In Alabama, *P. ephilida* was most common in July, and was most abundant in 1996, which is consistent with the multiple-year life cycle reported in Kentucky.

Most of the *P. forbesi* specimens were collected from June through August in Marion Junction. Adults have been reported from April through July (Luginbill and Painter 1953). This species occurs in the southeastern states and mid-South states, as far north as Illinois, Indiana, and Missouri (Woodruff and Beck 1989). This species can be numerous, particularly in Mississippi (Langston 1927). Adults of *P. forbesi* feed on plants such as elm, hickory, locust, oak, persimmon, *Philadelphus* sp., plum, poplar, and rose.

Phyllophaga hirticula, the second-most abundant species at Camp Hill, was also the second-most abundant species collected in the Piedmont region of Georgia (Forschler and Gardner 1991). This species is found throughout most of the eastern half of the United States (Woodruff and Beck 1989). It is recognized as a pest of turfgrasses (Luginbill and Painter 1953, Crocker et al. 1995) and also of pecan tree foliage (Smith and Lewis 1906, as cited in Forschler and Gardner 1990). It is the main injurious species in Kentucky, where both adults and larvae can cause considerable damage (Ritcher 1940). Eighty percent of grubs found in Kentucky bluegrass sod in the inner bluegrass region of Kentucky were *P. hirticula*. Adult host plants include bur oak, chinquapin oak, pin oak, walnut, red oak, elm, hickory, and birch (Ritcher 1949). Adults of this species begin to emerge in April in Alabama, suggesting that it has a multiple-year life cycle. Elsewhere, it has been reported to have a 2 to 3-yr life cycle (Hayes 1925, Ritcher 1940).

Phyllophaga hirtiventris was found only in Marion Junction. It occurs throughout the south-central United States (Luginbill and Painter 1953), as well as in Iowa and Indiana (Riley 1988). Adults of this species feed on plants such as persimmon, elm, blackberry, oaks, pecan, and willow (Ritcher 1940, Langston 1927). This species was most numerous from mid-May through early June in 1996; very few were collected in 1995 or 1997 (Fig. 1). These collection data suggest that *P. hirtiventris* has a multiple-year life cycle in Alabama. Ritcher (1940) reported that the life cycle of this species is similar to 2-yr life cycle of *P. ephilida*, which pupates in the spring and emerges the same season.

Phyllophaga latifrons was primarily collected at Winfield but was found at all three sites. The species occurs in the eastern Gulf states and the central and south Atlantic states (Woodruff and Beck 1989). Host plants for the adults include beech, cypress, oak, pecan, loblolly pine, and walnut (Fattig 1944, Langston 1927, Luginbill and Painter 1953). In Alabama, adults were collected in June through August, which may suggest an annual life cycle for this species, or a *P. ephilida*-like life cycle. Langston

(1927) collected the beetles from May through August, while Luginbill and Painter (1953) reported a flight period from March through late-July.

Phyllophaga micans was one of the few species that was found at all three sites. It was the most abundant species collected from Camp Hill and Winfield. This species occurs in the eastern U.S., with the exception of New England and Florida (Luginbill and Painter 1953, Woodruff and Beck 1989). It is especially numerous in the Southeast. *Phyllophaga micans* is reported to have a wide host range, including persimmon, oaks, sumac, sweet gum, and tulip poplar (Ritcher 1940, Langston 1927). The flight period in Alabama was from March through June (Fig. 2) with peak collection in late-April or early-May. A few specimens were collected in early October, just before trapping was discontinued for the year. These data suggest that *P. micans* has a multiple-year life cycle in Alabama, and that it overwinters in the adult state. Riley (1988) suggested a 2-year life cycle for this species in Louisiana.

Phyllophaga mississippiensis is apparently restricted to blackland prairie soils. It was found only at Marion Junction, with highest populations occurring in 1996. Previously, *P. mississippiensis* had been collected only from Louisiana and Mississippi (Luginbill and Painter 1953). At times it can be numerous in Mississippi. Host plants of the adults include ash, beech, dogwood, ebony, elm, hackberry, lily, oak, olive, peach, persimmon, pecan, pulse, redbud, rose, sycamore, walnut, willow, and *Smilax* sp. (Langston 1927, Luginbill and Painter 1953). Adults were found from March to

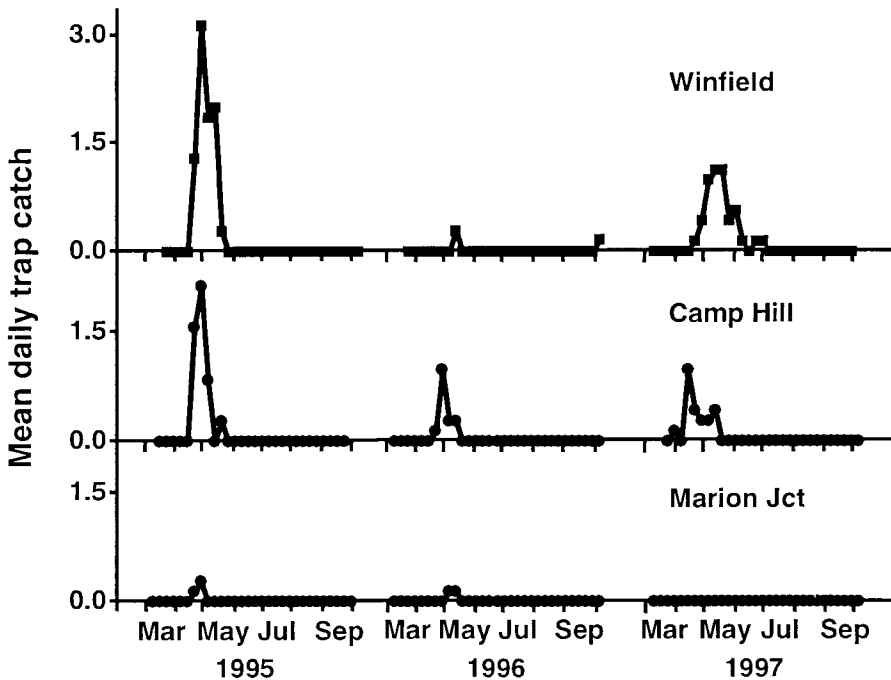


Fig. 2. Seasonal occurrence of *Phyllophaga micans* in black-light samples from three locations in Alabama, 1995-1997.

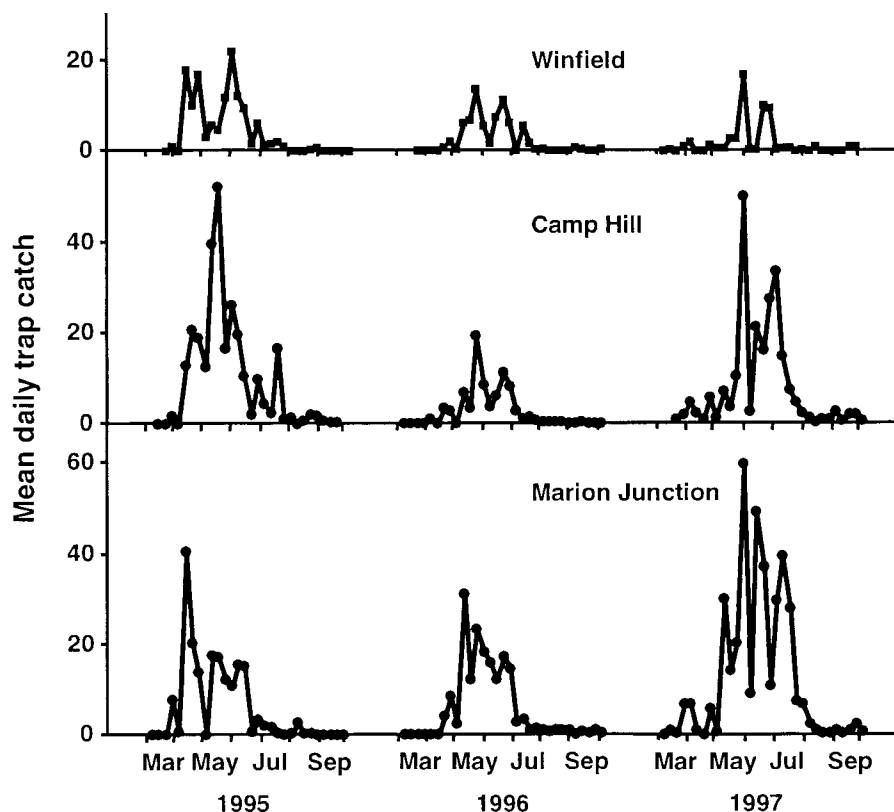


Fig. 3. Seasonal occurrence of *Dyscinetus morator* in black-light samples from three locations in Alabama, 1995-1997.

May in Alabama (Fig. 1), but peak collection occurred from mid-April through mid-May, suggesting a multiple-year life cycle.

Phyllophaga perlonga was collected at all three sites, but was most numerous in Marion Junction in 1996. The flight period of this species begins in March, if not before (Fig. 1). These data suggest that *P. perlonga* overwinters as an adult, and has a multiple-year life cycle in Alabama. It occurs throughout the south-central U.S. and is not a common species throughout much of its range (Luginbill and Painter 1953, Woodruff and Beck 1989). However, it can be numerous in Mississippi (Langston 1927). Host plants of the adults include ash, beech, elm, hickory, oak, olive, pecan, pulse, walnut, and willow (Langston 1927, Luginbill and Painter 1953, Ritcher 1940).

Phyllophaga quercus was found at Camp Hill and at Winfield. It ranges in the eastern half of the U.S. north to Kansas and New York (Woodruff and Beck 1989). This species is rare in Kentucky (Ritcher 1940) but is relatively common in Georgia (Forschler and Gardner 1991) and Mississippi (Lago, unpubl. data) and has been reported to be abundant in eastern Tennessee (Ritcher 1940). Host plants of the adults include hickory, oak, black gum, locust, persimmon, pecan, honey locust, and

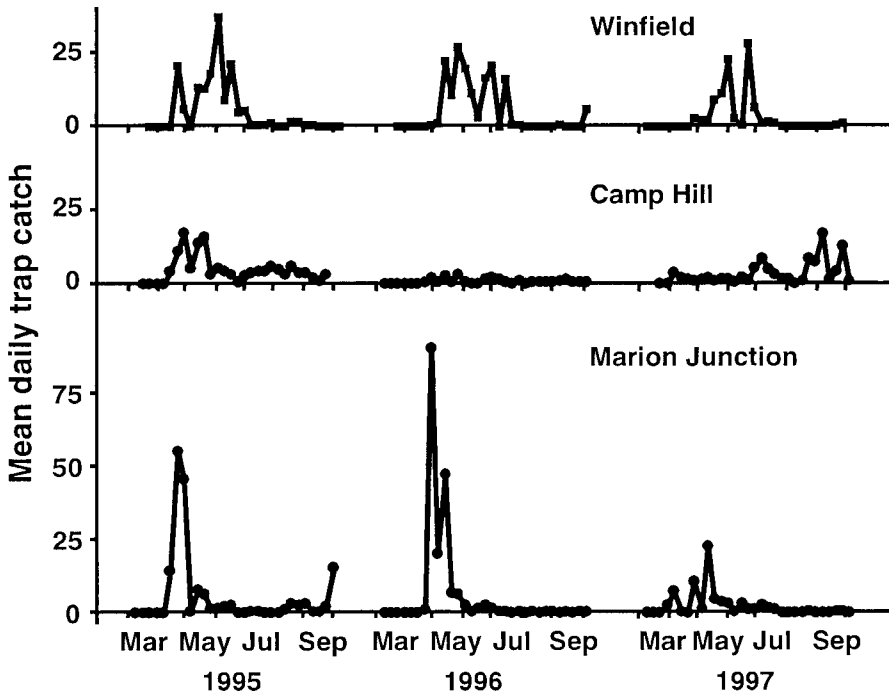


Fig. 4. Seasonal occurrence of *Euetheola humilis rugiceps* in black-light samples from three locations in Alabama, 1995-1997.

sassafras (Fattig 1944, Langston 1927). Ritcher (1940) reported a 2-yr life cycle for this species, similar to that of *P. ephilida*. Adults of this species were found in Alabama from July through September, which supports a *P. ephilida*-like life cycle.

Six species of *Phyllophaga* found during this study have not been previously reported from Alabama: *P. bipartita*, *P. congrua* (LeConte), *P. hirtiventris*, *P. mississippiensis*, *P. praetermissa* (Horn), and *P. soror* Davis.

Other scarabs collected in this study included four *Anomala* species, *A. flavipennis*, *A. innuba*, *A. marginata* (F.), and *A. undulata* (Table 1). Larvae of *Anomala* species feed on grass roots (Hayes 1925) and can be abundant in pastures in Kentucky (Ritcher 1966). These species are reported to have an annual life cycle (Hayes 1925). In Alabama, adults of *A. undulata* were collected in early spring, whereas the other species appeared in late spring and summer (Table 2).

Bolbocerosoma farctum F. and *B. tumefactum* (Beauvois) belong to the subfamily Geotrupinae; adults are attracted to lights. *Bolbocerosoma tumefactum* is recognized as a pest of golf courses because of its habit of digging burrows, the mouths of which are surrounded by sand (Sim 1930).

The southern masked chafer, *Cyclocephala lurida* Bland, is an annual white-grub that can damage turfgrasses (Crutchfield and Potter 1995, Merchant and Crocker 1995). *Cyclocephala lurida* was a very common species at all three locations in Alabama. More than 1,000 specimens were collected at each site each year. Peak

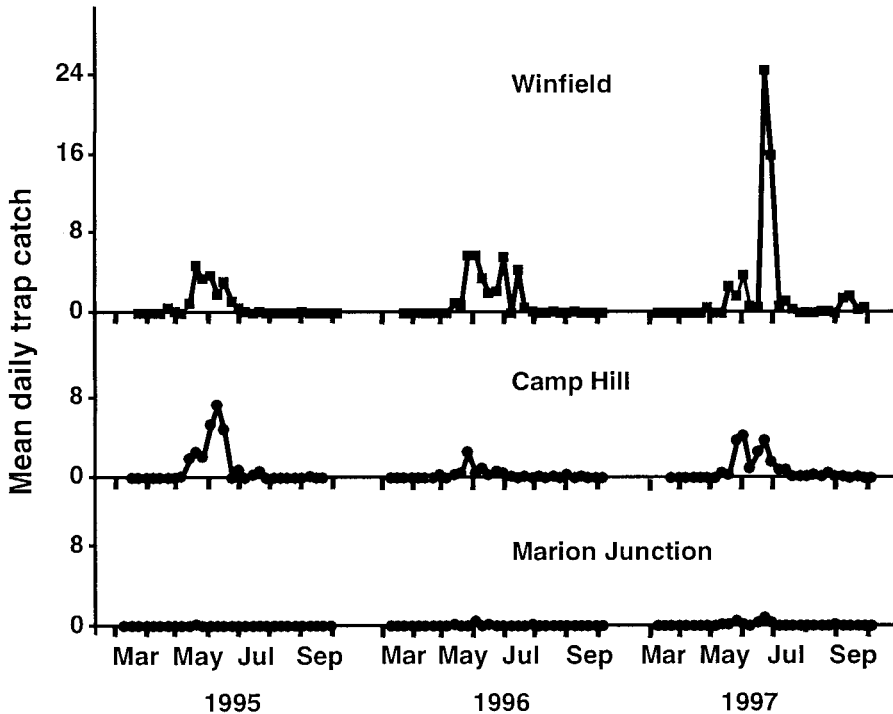


Fig. 5. Seasonal occurrence of *Ligyrus gibbosus gibbosus* in black-light samples from three locations in Alabama, 1995-1997.

flight period occurred in June and July each year, suggesting that this insect has an annual life cycle in Alabama.

Three species of *Diplotaxis*—*D. blanchardi* Vaurie, *D. liberta* (Germar), and *D. sordida* Say—were attracted to the black-light traps. *Diplotaxis* adults were collected from May until September in our traps. Adults feed on foliage of plants such as oak, walnut, rose, apple, apricot, peach, and pear (Ritcher 1966). Larvae are primarily grass feeders, but have been known to damage pine seedlings in New York (Heit and Henry 1940).

Dyscinetus morator (F.), the rice beetle, was a commonly-collected species. In Alabama, this species was collected from March through September, with peak flight period occurring in May and June (Fig. 3). In southern Florida, a second peak flight period occurs in November (Woodruff 1970). Our traps were not run in late fall, and we therefore may have missed a generation. Larvae feed on grass roots and are also found in compost heaps and pigpens (Ritcher 1966).

Euethoea humilis rugiceps, the sugarcane beetle, is primarily a pest of seedling corn in Alabama. In Louisiana, this insect has been reported as a serious pest of sugarcane and rice, particularly where large amounts of decaying organic matter occur (White 1990). Adults hibernate, then emerge in the spring to gouge holes in the side of stems, just above the roots (Phillips and Fox 1924). Eggs are laid in June and

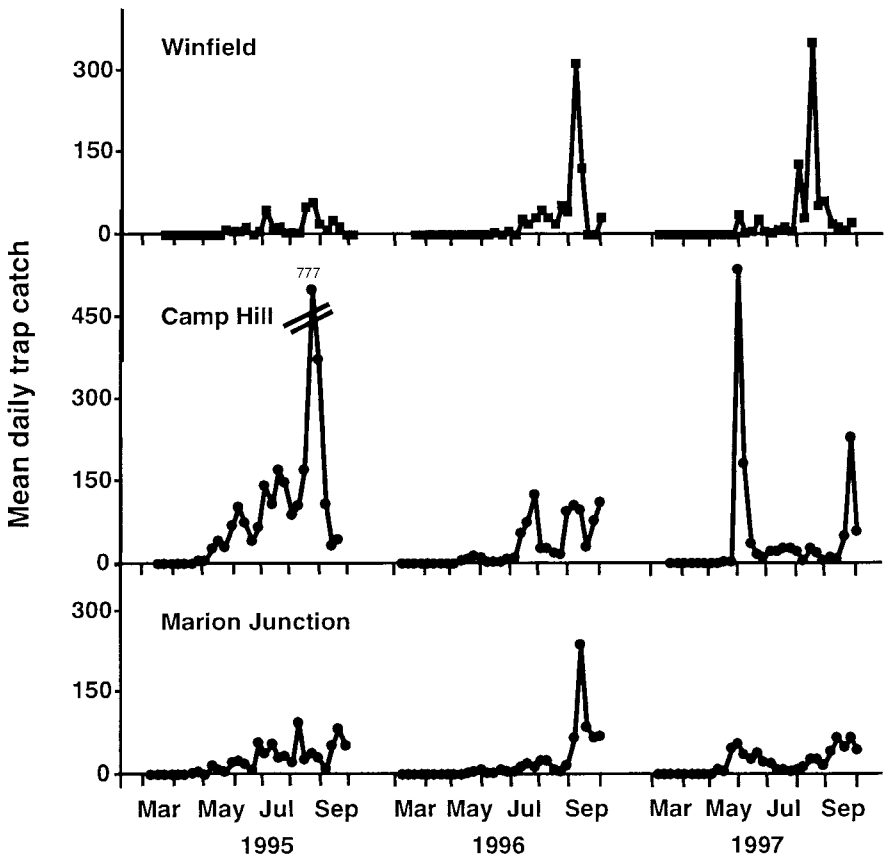


Fig. 6. Seasonal occurrence of *Onthophagus gazella* in black-light samples from three locations in Alabama, 1995-1997.

July. Larvae feed on decaying organic matter. In Marion Junction, adults were collected in spring (Fig. 4). In Camp Hill and Winfield adults were collected later in the season and had a more prolonged flight period. Phillips and Fox (1924) note that the last remaining overwintering beetles can overlap with the new generation of beetles, which begin to emerge in August in Virginia. There is one generation each year.

Ligyris gibbosus gibbosus (DeGeer) is the carrot beetle. The adult of this species can damage carrots, celery, parsnip, sunflowers, and other crops (Hayes 1917, Metcalf and Metcalf 1993). The adults are the overwintering stage. Larvae feed primarily on grass roots and decaying vegetation. This species is reported to have an annual life cycle. Adults were most common in our traps during May and June (Fig. 5).

Onthophagus gazella F., the brown dung beetle, was the most numerous of species that were sorted. *Onthophagus gazella* was purposely introduced into the U.S. from 1972-81, because of its potential value in recycling nutrients (Hunter and Fincher 1985). It was first collected in Alabama in 1983. Trap catches in Alabama would

suggest it has multiple generations, perhaps 3, each year (Fig. 6). Our data suggest that the flight period begins in April; adults were still being collected when trapping was discontinued at the end of September.

Six species of *Serica* were collected in the survey, *S. alabama* Dawson, *S. floridana* Dawson, *S. georgiana lecontei* Dawson, *S. loxia* Dawson, *S. mystaca* Dawson, and *S. vespertina vespertina* (Gyllenhal). Larvae feed primarily on the roots of grasses, and are uncommon in cultivated soils (Ritcher 1966). Adult *Serica* have been reported as serious pests of sugarcane in India (Hayes 1925). *Serica* adults have also been reported to damage avocado and tree fruits in California (Essig 1958).

In this study, we have been able to determine what species of *Phyllophaga* are commonly collected in light traps in Alabama, and to determine when adults of other plant-feeding scarabs can be found. Future studies will attempt to identify to species those *Phyllophaga* larvae that occur at densities high enough to cause damage.

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