A Review of the Scientific Literature on the Biology and Distribution of the Genus *Phyllophaga* (Coleoptera: Scarabaeidae) in the Southeastern United States[1]

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J. Entomol. Sci. 25(4): 628-651 (October 1990)

ABSTRACT A review of the scientific literature on the biology and management of *Phyllophaga* (Harris) in the southeastern United States indicates that at least 91 species of the genus occur in the region. Adults reportedly defoliate host plants including pines, pecans, other hardwoods, and various row crops. The immatures reside in the soil feeding within the root zone inflicting damage to pasture and turf grasses, new plantings of trees, and row crops. Economic thresholds do not exist for most crops attacked. Cultural and insecticidal tactics are generally recommended for control, but often are not economical or effective. Alternate management strategies (i.e., natural enemies, host plant resistance) have not been extensively investigated. In addition, surveys of occurrence and distribution are incomplete, out-of-date, or nonexistent for many of the southeastern states. Distribution maps and adult flight period data for selected species were compiled from available survey information.

KEY WORDS *Phyllophaga,* literature review, distribution, southeastern United States.

Beetles in the genus *Phyllophaga* (Harris 1827) are commonly known as May or June beetles. At least 153 species have been reported from the United States and Canada with 91 species and 3 varieties from the southeastern United States (Luginbill and Painter 1953). Over 680 scientific publications contain information or data on the biology or management of members of the genus (Pike et al. 1976). However, adults and larvae remain economic pests of trees, pasture, and row crops (Metcalf et al. 1951, Drooz 1985, Tashiro 1987). Although Forbes (1907), Davis (1918), Luginbill and Painter (1953), Tashiro (1987), and Woodruff and Beck (1989) have reviewed various aspects of *Phyllophaga* in the United States, no one has specifically reviewed information on *Phyllophaga* in the Southeast. Therefore, the purpose of this study was to review biological and distributional data relating to the occurrence of *Phyllophaga* in the southeastern United States. In addition, distribution maps of selected species were constructed by compiling previous flight records from published sources.

[1] Accepted for publication 31 August 1990.

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Taxonomy and Morphology

Most publications on *Phyllophaga* from the Southeast are lists of species collected by trapping adults attracted to lights or collected from host plants. These lists include Fattig (1944) (70 species in Georgia), Sanderson (1944) (44 species in Arkansas), Manee (1909) (9 species in Florida), Langston (1927) (46 species in Mississippi), Brimely (1938) (45 species in North Carolina), Loding (1945) (63 species in Alabama), Kirk (1969/1970) (51 species in South Carolina), Luginbill (1928) (31 species in South Carolina), Blatchley (1929) (30 species in Florida), Schwarz (1878) (6 species in Florida), Young and Thames (1948) (42 species in Florida), Woodruff and Beck (1989) (54 species in Florida), and Riley (1988) (62 species in Louisiana). Taxonomic keys to the adults are included by Fattig (1944), Langston (1927), Luginbill (1928), Woodruff and Beck (1989), Riley (1988), and Blatchley (1929). Taxonomic descriptions of selected species also are provided by Sanderson (1942 and 1950), Cartwright (1935 and 1946), Langston (1924 and 1926), Lago (1980), and Gordon and Anderson (1981). Two recent publications (Riley 1988, Woodruff and Beck 1989) contain systematics, biological information, and lists of synonyms for the species covered.

Taxonomy of the larvae is not as complete as the adult taxonomy. Characters generally used in larval taxonomy include labrum and mandibular setal arrangements and ephipharynx and raster morphology (Boving 1942, Ritcher 1966). Adult characters commonly used include body shape and color, clypeus and pronotum shape, elytra and metasternal punctures and pubescence, claw and hind tibial spur form, and genitalia (Smith 1889, Riley 1988). Taxonomic keys to the *Phyllophaga* larvae including several species from the Southeast are provided by Boving (1937 and 1942) and Ritcher (1966). Woodruff and Beck (1989) provided a key to the known larvae from Florida.

Biology and Ecology

Oliver and Chapin (1988) noted that the life cycles of *Phyllophaga* in the South range from 1 to 3 years. This agreed with the work of Speers and Schmiege (1961) who observed that the 2-year life cycle is most common among southern *Phyllophaga.* In Georgia, *P. crassissima* (Blanchard), *P. ephilida* (Say), *P. tristis* (Fabricius), and *P. micans* (Knoch) exhibited 2-year life cycles while *P. fusca* (Froelich), *P. hirticula* (Knoch), *P. ulkei* (Smith), and *P. luctousa* (Horn) exhibited 3-year cycles (Fattig 1944). Kard and Hain (1988) also reported that *P. anixia* (LeConte) and *P. fusca* have 3-year life cycles in North Carolina. Rolston and Barlow (1980) observed that *P. ephilida* was univoltine in Louisiana. In Arkansas, *P. crassissima* had a 2- or 3-year life cycle (Miner 1952).

Johnson and Eaton (1939) stated that white grubs in South Carolina have a 2- or 3-year life cycle with overlapping generations so that from year to year beetle emergence does not fluctuate greatly. They further stated that, of those species that emerge in the early spring, 75% complete their life cycles in 2 years while the remainder take 3 full years to complete their cycles. Species that emerge in the spring of the year were observed to overwinter as adults while those emerging in the summer pupate in the spring. They did not, however, mention any species by name. Several *Phyllophaga* exhibit shorter life cycles in southern latitudes than in more northern latitudes. For example, *P. crassissima* had a 2- or 3-year life cycle in

Arkansas (Miner 1952) and a 3- to 4-year cycle in Indiana (Davis 1916). Rolston and Barlow (1980) reported that *P. ephilida* was univoltine in Louisiana, but Fattig (1944) observed that it had a 2-year cycle in Georgia.

In general, the biology and habits of *Phyllophaga* are known. Miner (1948) published a rearing technique for *Phyllophaga* in the Southeast. Adults are known to be active after sunset when feeding begins and mating occurs (Johnson and Eaton 1939, Speers and Schmiege 1961, Fattig 1944, Kard and Hain 1990). Adults feed on a wide variety of deciduous trees and shrubs while a few prefer coniferous host plants (Langston 1927, Fattig 1944, Sanderson 1944, Loding 1945, Luginbill and Painter 1953, Riley 1988, Woodruff and Beck 1989). Though adult *Phyllophaga* are attracted to standard Japanese beetle (*Popillae japonica* (Newman)) feeding attractants, there seems to be no competition for adult food sources with *P. japonica* (Regniere et al. 1981).

Johnson and Eaton (1939) correlated adult behavior patterns with time of emergence. They observed that adults of species emerging in the spring drop to the ground under the host plant during daylight. Adults of species emerging in the summer fly 100 - 300 ft (31 - 93 m) before seeking cover during the day.

Oviposition occurs 8 to 10 days after mating and continues over the next 1 to 3 weeks. Fecundity has been listed at ca. 50 eggs/females (Fattig 1944). Eggs are deposited singly in earthern balls 2 - 6 inches (5 - 15 cm) beneath the soil surface in clusters of 5 to 10 eggs (Fattig 1944, Johnson and Eaton 1939, Speers and Schmiege 1961).

Larvae hatch in 1 to 4 weeks after oviposition (Johnson and Eaton 1939, Fattig 1944, Riley 1988). Neonates first feed on organic matter and then on plant roots. The remaining larval instars also feed on plant roots (Speers and Schmiege 1961). Lateral movement of grubs has been estimated at 5 - 7 ft. (1.6 - 2.2 m) and 6 - 9 ft. (1.9 - 2.8 m) in the first and second years, respectively, of their life cycles (Johnson and Eaton 1939). Overwintering grubs also move vertically in response to soil temperature and plant growth (Speers and Schmiege 1961, Kard and Hain 1988, 1990). Regniere et al. (1981) suggested that interspecific competition may affect *Phyllophaga* larval distributions in turf when Japanese beetle larvae are present.

Johnson and Eaton (1939) claimed an annual grub mortality of 85 - 90% due to parasites, predators, fungus, climate, and cannibalism. Luginbill and Painter (1953) and Langston (1927) also noted the impact of natural enemies on southern *Phyllophaga.* Fattig (1944) listed 18 parasitoid species representing 7 families reared from *Phyllophaga* grubs, 26 insects representing 3 families as predators of grubs, and 3 scarcophagidid species as parasitoids of adults. Birds and small mammals also are cited as predators in the Southeast (Fattig 1944, Langston 1927).

Entomogenous diseases reported from *Phyllophaga* outside the southeastern region include a microsporidian (Dutky and White 1940), a rickettsia (Dutky and Gooden 1952), a protozoan (Berberet and Helms 1969), and bacteria (Dutky 1941). The only entomopathogen reported from the southern range of *Phyllophaga* is the fungus *Cordyceps* (Riley 1880). However, both *Beauveria bassiana* (Balsamo) Vuillemin and *Metarhizium anisopliae* (Metchnikoff) Sorokin have been isolated from *P. hirticula* larvae in Georgia (Forschler and Gardner, unpublished data).

Economic Importance

Both the adult and larval life stages of *Phyllophaga* feed on and are capable of inflicting economic damage to trees, turf, pasture, or row crops (Metcalf et al. 1951, Tashiro 1987, Drooz 1985). At the turn of the century, *Phyllophaga* infestations caused an estimated $12 million of damage in several north central and northeastern states (Davis 1918). Damage from *Phyllphaga* in the southeastern states during those years was considerably less important (Davis 1918). Therefore, *Phyllophaga* species were not considered economically important pests in the Southeast.

Langston (1926) listed factors contributing to the reduced importance of *Phyllophaga* in the southeastern states. He cited a lack of suitable pastures, a higher level of parasitism in the warm climate, a shorter larval life stage with concomitant reduced larval feeding, and a longer growing season with reduced conspicuous adult injury as factors. In addition, Luginbill and Painter (1953) attributed gradual adult emergence that results from steady increases in spring temperatures, constant cultivation of fields, summer heat, and activity of natural enemies as factors responsible for the lower economic impact of *Phyllophaga* in the Southeast than in more northern latitudes.

Location and intensity of *Phyllophaga* infestations seem dependent on available larval and adult food sources, soil type and condition, local weather, and natural enemies (Fluke et al. 1931 and 1932, Chamberlin and Callenbach 1943, Hammond 1948, Ueckert 1979, Lentz 1985, Stone and Bueno 1987). Areas at high risk for grub damage include lands in pasture for many years; crops planted in recently plowed pasture; young pine plantings and tree seed beds, and; continuous crop plantings near adult food sources, especially sugarcane and corn crops (Lentz 1985, Johnson and Eaton 1939, Luginbill and Painter 1953, Kard and Hain 1987).

Reported *Phyllophaga* pests that damage southeastern crops include *P. hirticula* and *P. inversa* (Horn) on pecan tree foliage (Smith and Lewis 1906), *P. pruniculina* (Burmeister) and *P. fosteri* (Burmeister) on pine nurseries (Drooz 1985), *P. micans* on loblolly pine flowers (McLemore 1973), *P. anxia* and *P. fusca* on young pine seedlings (Kard and Hain 1987), *P. micans* and *P. nova* (Smith) on hardwood nursery plants and woodlands (Brass 1893), *P. ephilida* on sweet potatoes (Rolston and Barlow 1980), *P. latifrons* (LeConte) on sugarcane (Gordon and Anderson 1981), and *P. congrua* (LeConte) and *P. implicita* (Horn) on soybeans (Lentz 1985). Other reports list damage by *Phyllophaga* to hardwood tree foliage (Kent 1889, Devereaux 1889, Langston 1927), and pines (Oliver and Chapin 1988).

Control

Cultural methods, especially discing and bottom plowing while grubs are in the root zone (Langston 1927, Oliver and Chapin 1988), have been and continue to be listed as effective control tactics for *Phyllophaga*. On the other hand, chemical control of grubs is limited. Many effective and persistent insecticides (i.e., chlorinated hydrocarbons) have been banned and/or are no longer registered for use. Recent data indicate that efficacy of registered insecticides varies from year to year. Kard and Hain (1986) found that isazophos and diazinon provide the most consistent control of three *Phyllophaga* species in North Carolina. Applications of entomogenous nematodes to pastureland scheduled for planting of Christmas trees reduced

populations of *P. anxia* and P. *fusca* grubs (Kard et al. 1988). Fensulfothion, terbufos, and isofenphos were listed as effective insecticides against *P. ephilida* attacking sweet potatoes (Rolston and Barlow 1980). Although adults can be killed with a variety of insecticides, frequent reapplication is often required to control defoliation of host plants because of the ability of the adults to reinfest previously treated areas (Kard and Hain 1986).

Management of damage by *Phyllophaga* grubs is highly dependent upon sampling and estimations of grub density. Sampling is necessary to time insecticidal applications with the arrival of grubs in the root zone. Such timing is critical in preventing significant root damage because different species of *Phyllophaga* arrive in the root zone at different times (Kard and Hain 1986).

Grub densities also differ with type and quality of ground cover. Kard and Hain (1988) reported that of six ground covers evaluated, clover and dead grass supported the lowest grub densities. In a related study, Kard and Hain (1987) found that mowed grass areas supported high densities of grubs while herbicide-treated areas and unmowed grass areas supported significantly fewer grubs. Differential feeding damage to several sweet potato cultivars was reported by Rolston et al. (1981) and served as the basis for their suggestion of using host plant resistance techniques to reduce *Phyllophaga* damage.

Little information is available on the economic thresholds of *Phyllophaga* in the Southeast. However, Kard and Hain (1986) stated that a preplanting density of 10 grubs/m^2 was an economic injury level for new plantings of white pine seedlings. Oliver and Chapin (1988) reported that 1 grub/30 cm^2 caused significant seedling damage. In grass sod Short and Reinert (1977) report 1 grub/0.09 m^2 as the damage threshold.

Distribution and Flight Records

Luginbill and Painter (1953) listed the distribution of over 90 species of *Phyllophaga* found in the Southeast. This listing indicated only the state from which the species were collected without identifying specific collection sites. Other publications contain more detailed data on *Phyllophaga* distribution within individual states including South Carolina (Luginbill 1928, Kirk 1969, and 1970), North Carolina (Brimely 1938), Arkansas (Sanderson 1944), Alabama (Loding 1945), Mississippi (Langston 1927), Louisiana (Riley 1988), Florida (Woodruff and Beck 1989), and Georgia (Fattig 1944, Forschler and Gardner, unpubl. data). Only Tennessee and Virginia lack comprehensive state-wide surveys of *Phyllophaga*; however, Luginbill and Painter (1953) list the species known from both states.

Figures 1-10 contain county (parish) distribution maps of 39 species of *Phyllophaga* in the Southeast. Table 1 lists flight periods for the same 39 species. These species were selected on the basis of reported occurrence from at least 5 of the southeastern states rather than level or frequency of occurrence. County distributions (Fig. 1-10) and flight periods (Table 1) were compiled from state surveys cited in the previous paragraph. In addition, flight data from Kard and Hain (1990) in North Carolina were included in the flight period summary. Information on distributions and flight periods is critical to the effective timing of management tactics to control *Phyllophaga* damage.

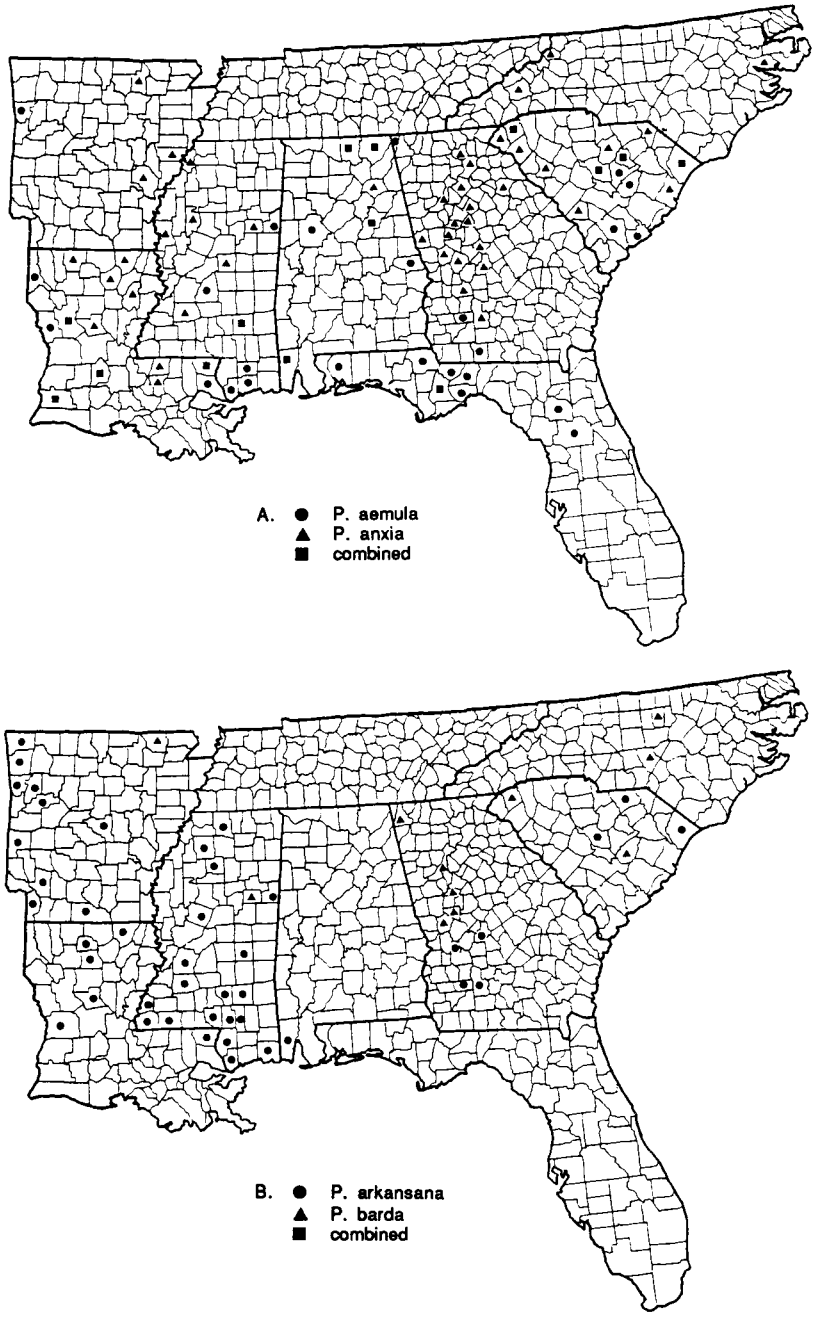

Fig. 1. Distribution of *P. aemula* and *P. anxia* (A) and *P. arkansana* and *P. barda* (B) in the southeastern United States.

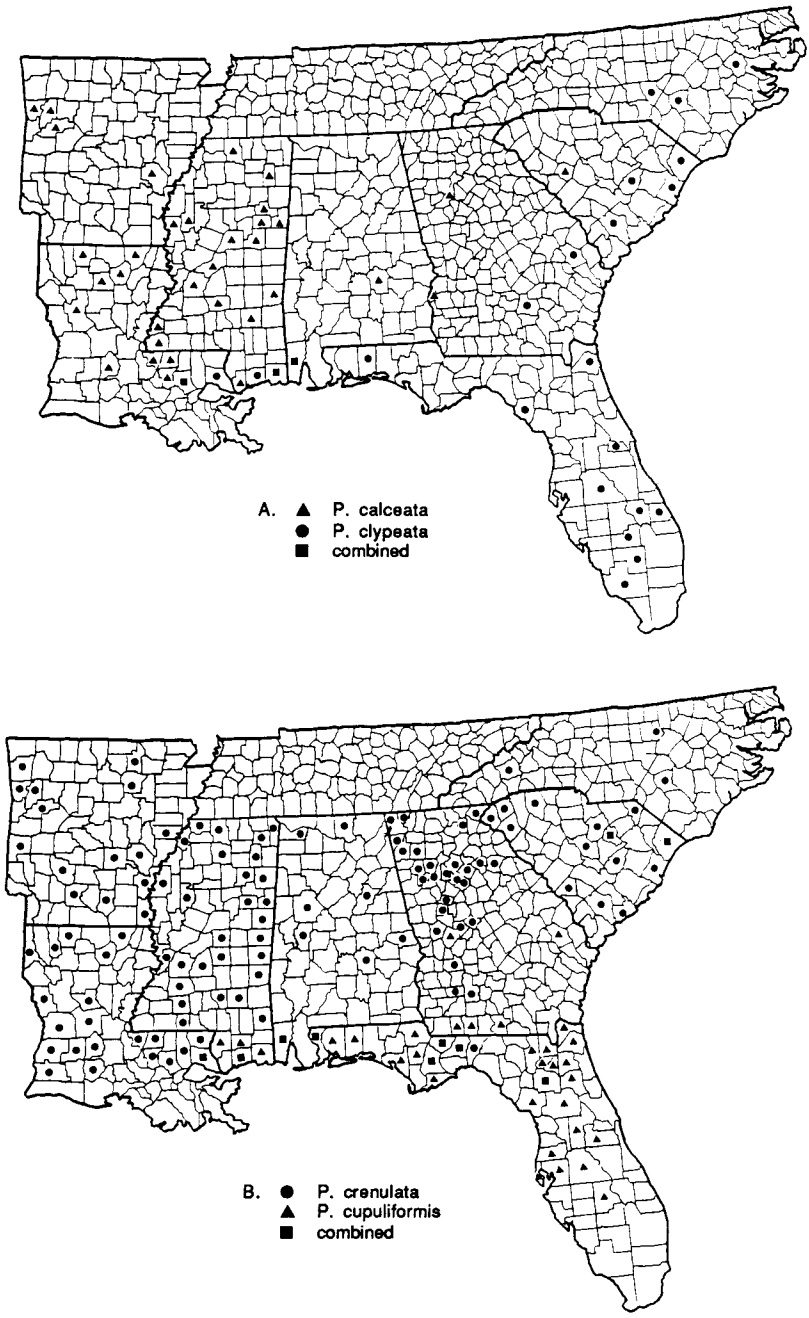

Fig. 2. Distribution of *P. calceata* and *P. clypeata* (A) and *P. crenulata* and *P. cupuliformes* (B) in the southeastern United States.

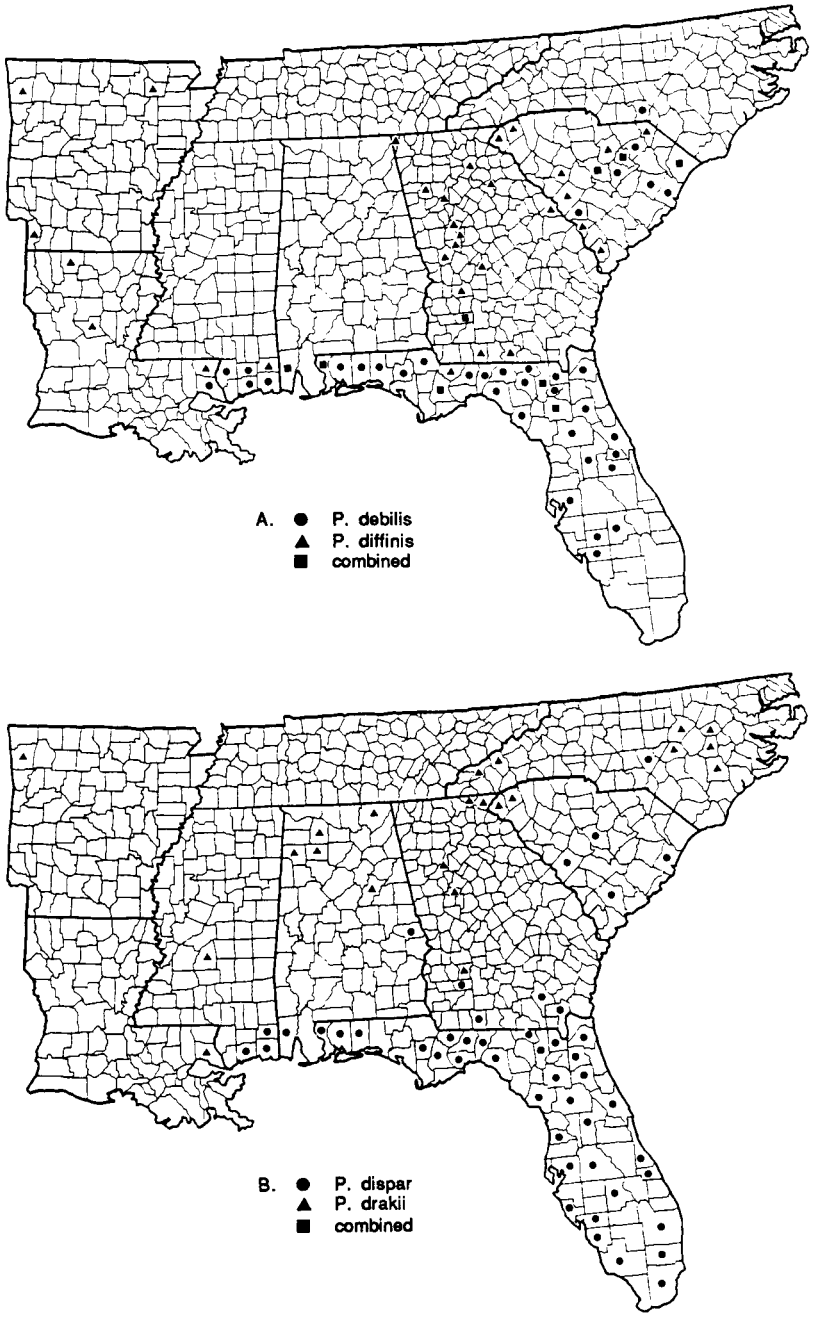

Fig. 3. Distribution of *P. debilis* and *P. diffinis* (A) and *P. dispar* and *P. drakii* (B) in the southeastern United States.

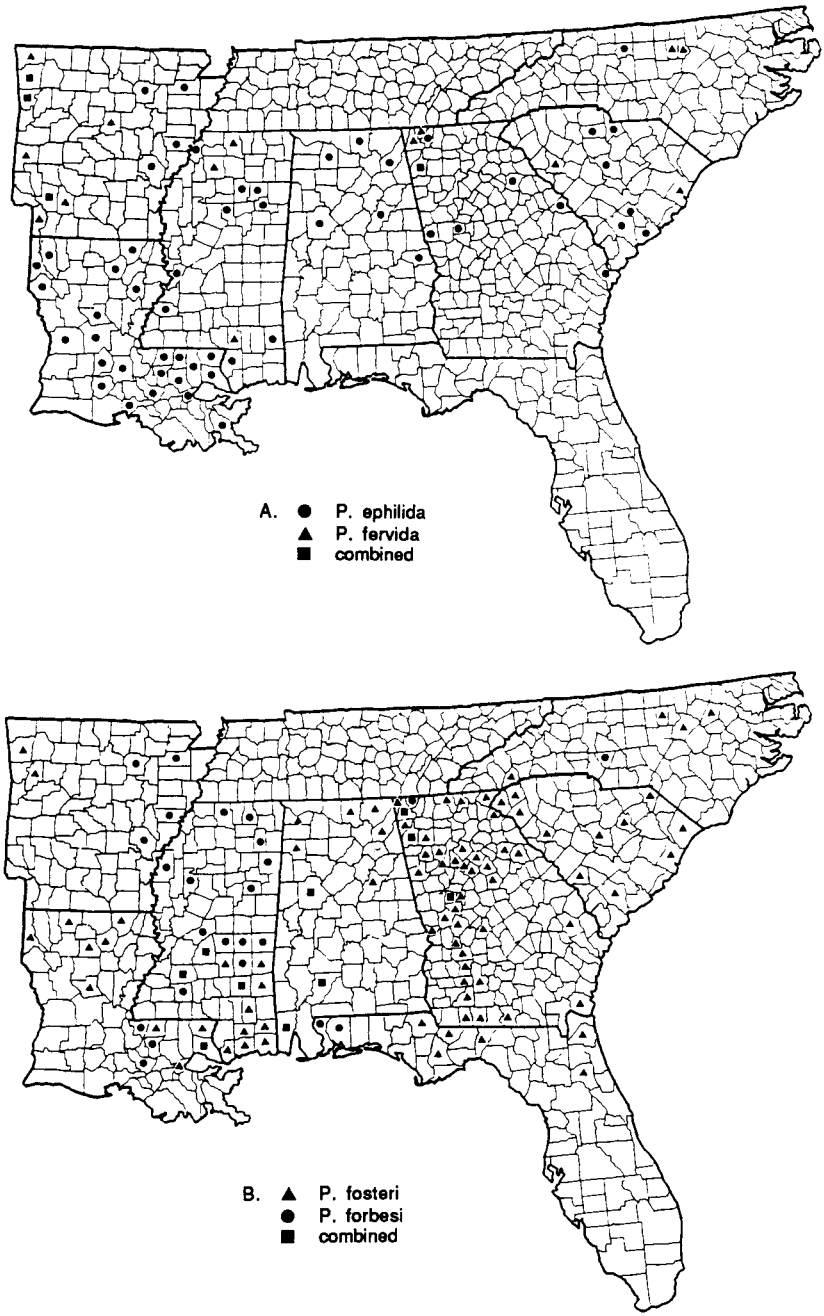

Fig. 4. Distribution of *P. ephilida* and *P. fervida* (A) and *P. fosteri* and *P. forbesi* (B) in the southeastern United States.

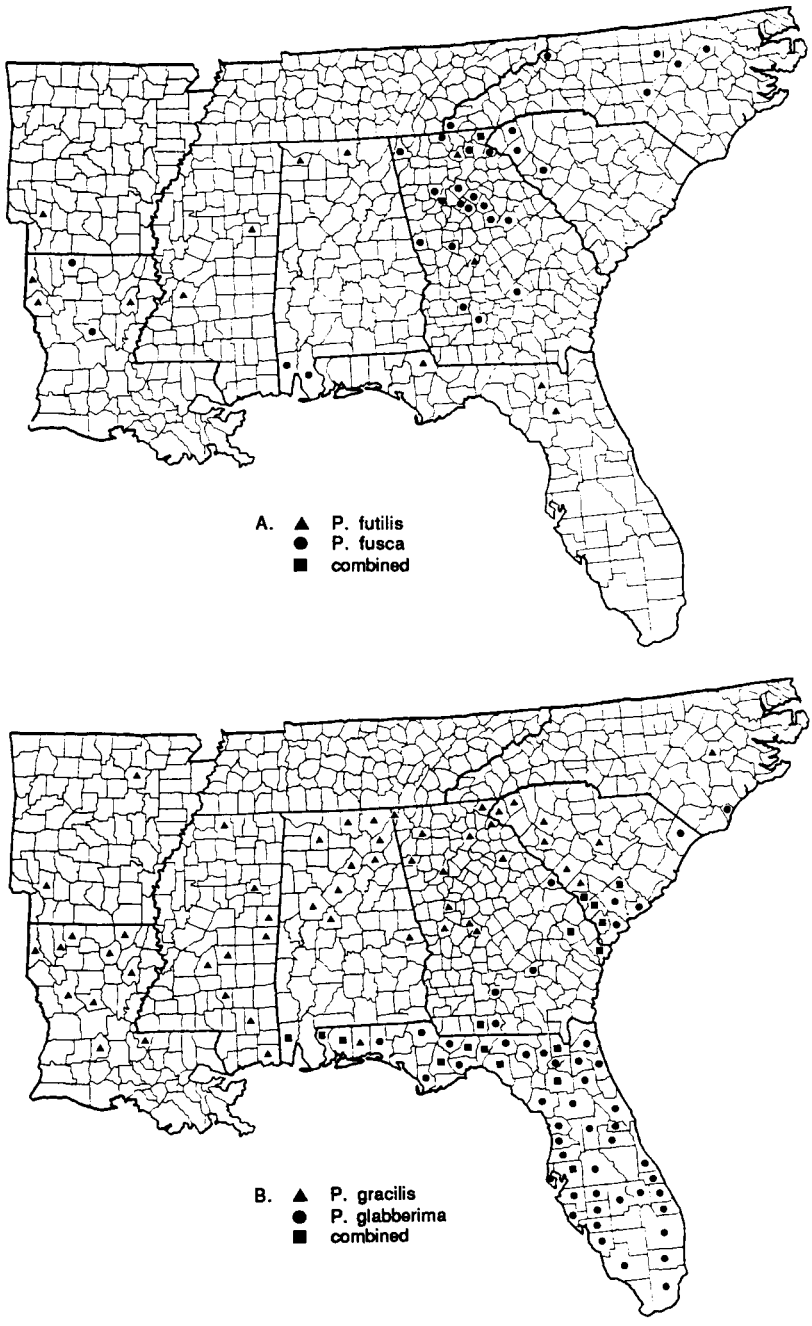

Fig. 5. Distribution of *P. futilis* and *P. fusca* (A) and *P. gracilis* and *P. glabberima* (B) in the southeastern United States.

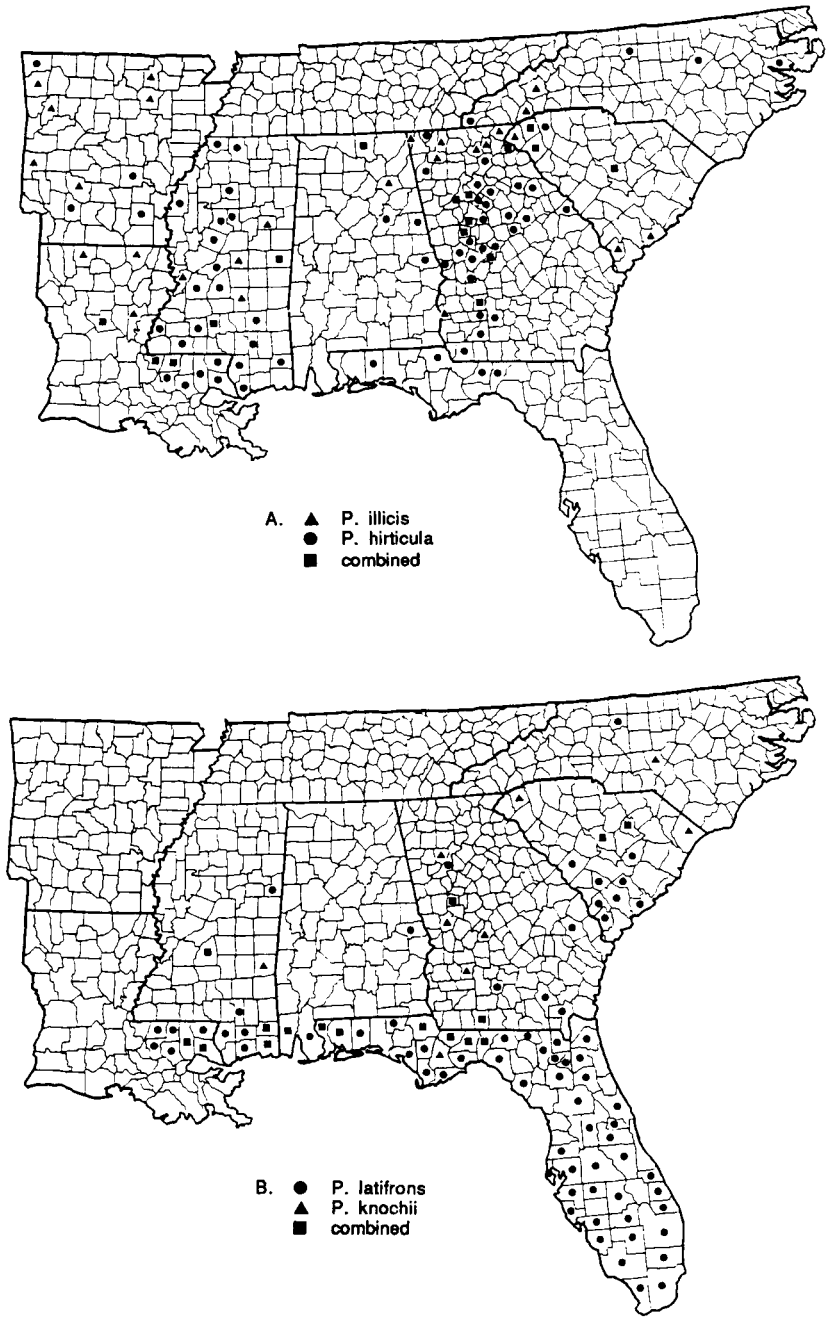

Fig. 6. Distribution of *P. illicis* and *P. hirticula* (A) and *P. latifrons* and *P. knochii* (B) in the southeastern United States.

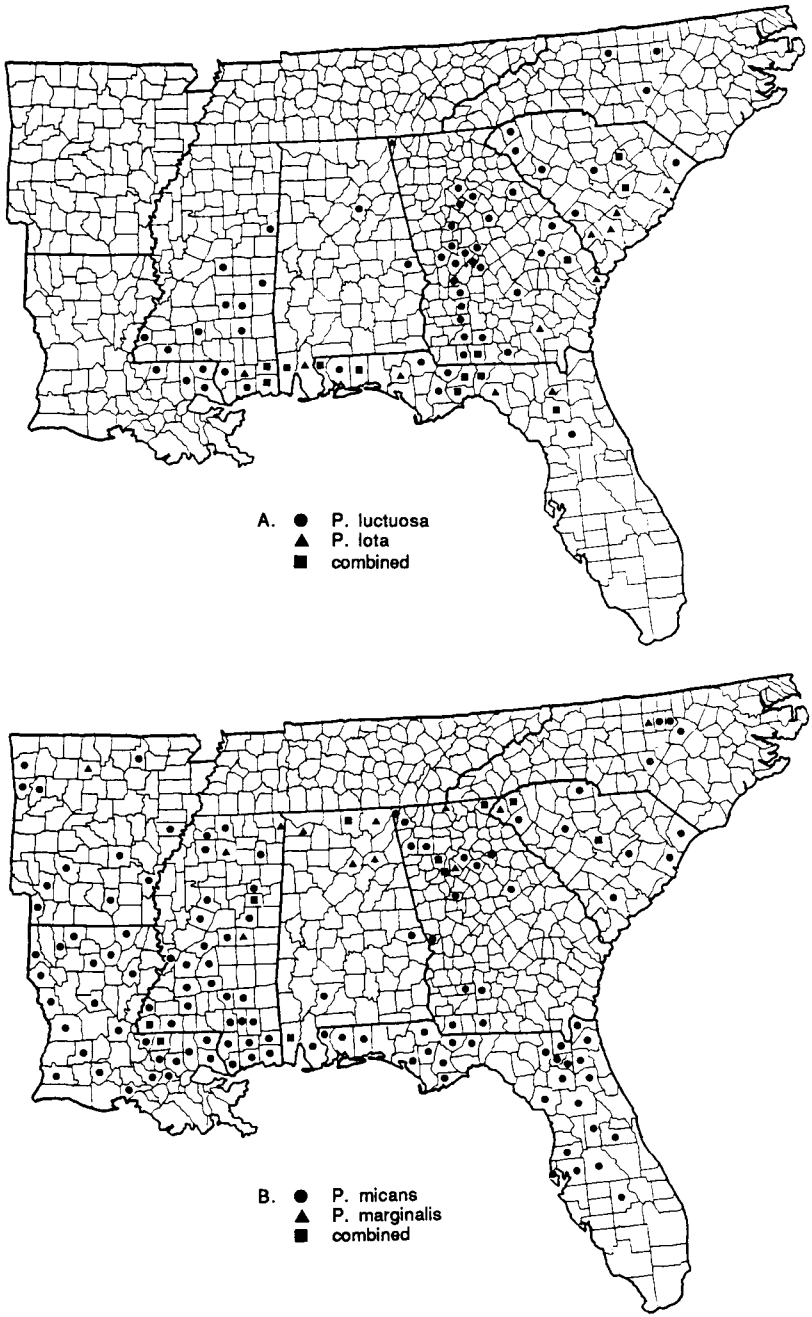

Fig. 7. Distribution of *P. luctuosa* and *P. lota* (A) and *P. micans* and *P. marginalis* (B) in the southeastern United States.

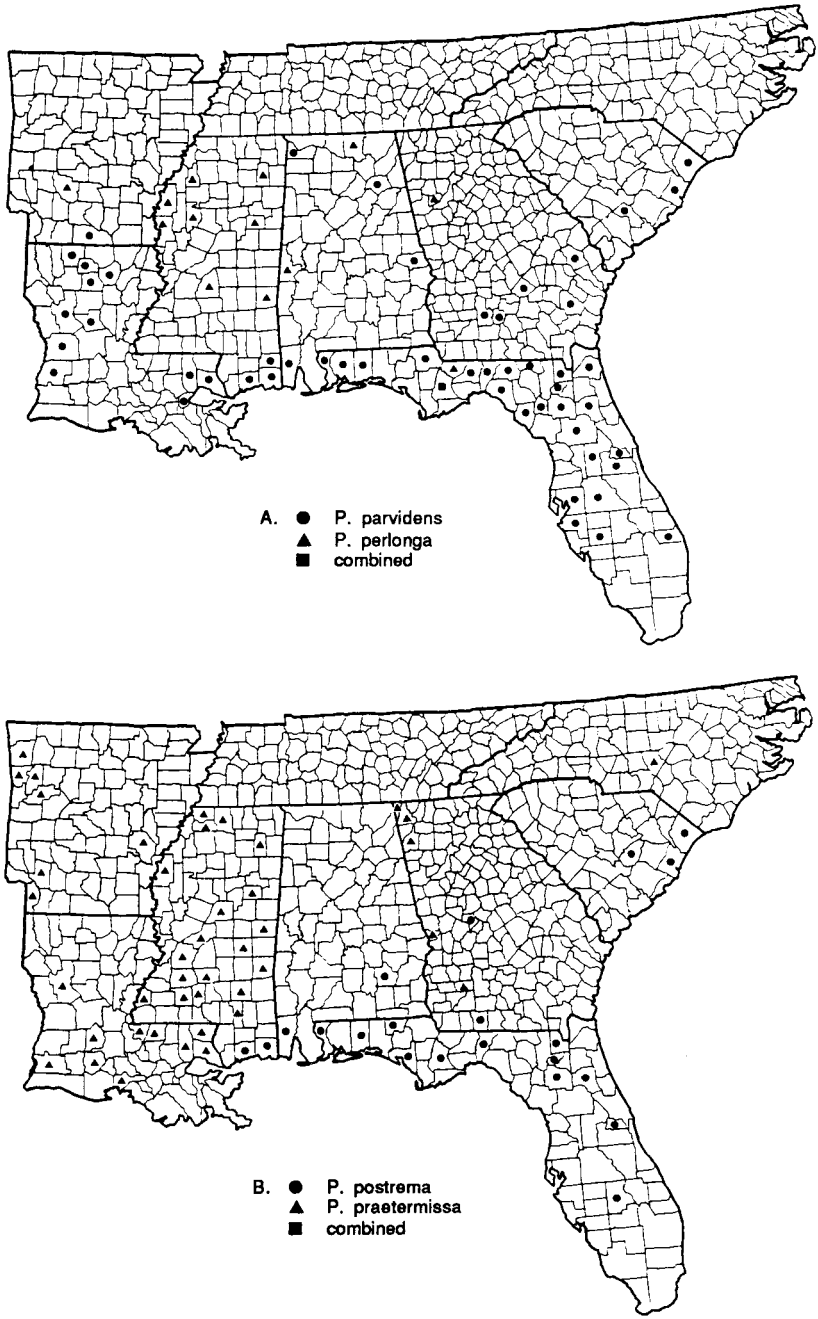

Fig. 8. Distribution of *P. parvidens* and *P. perlonga* (A) and *P. postrema* and *P. praetermissa* (B) in the southeastern United States.

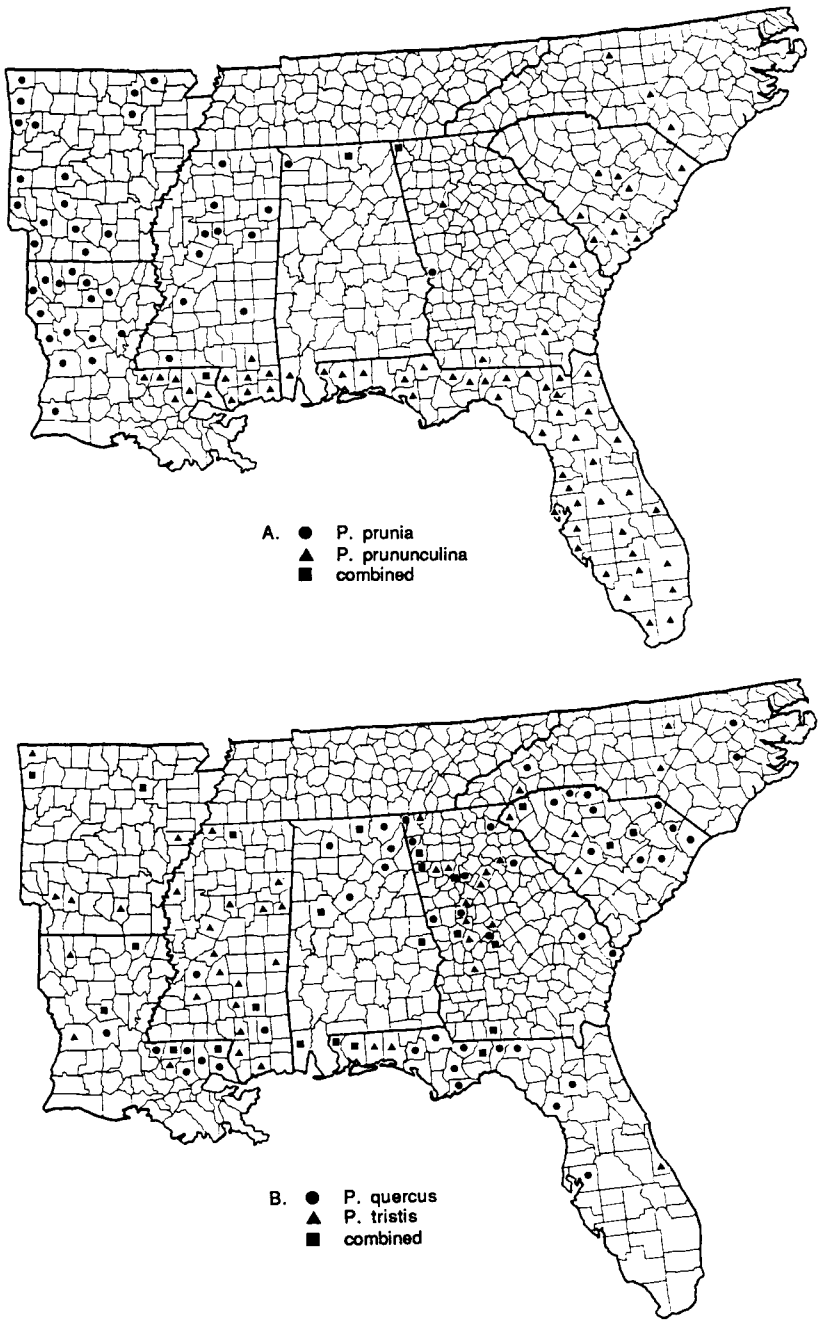

Fig. 9. Distribution of *P. prunia* and *P. prununculina* (A) and *P. quercus* and *P. tristis* (B) in the southeastern United States.

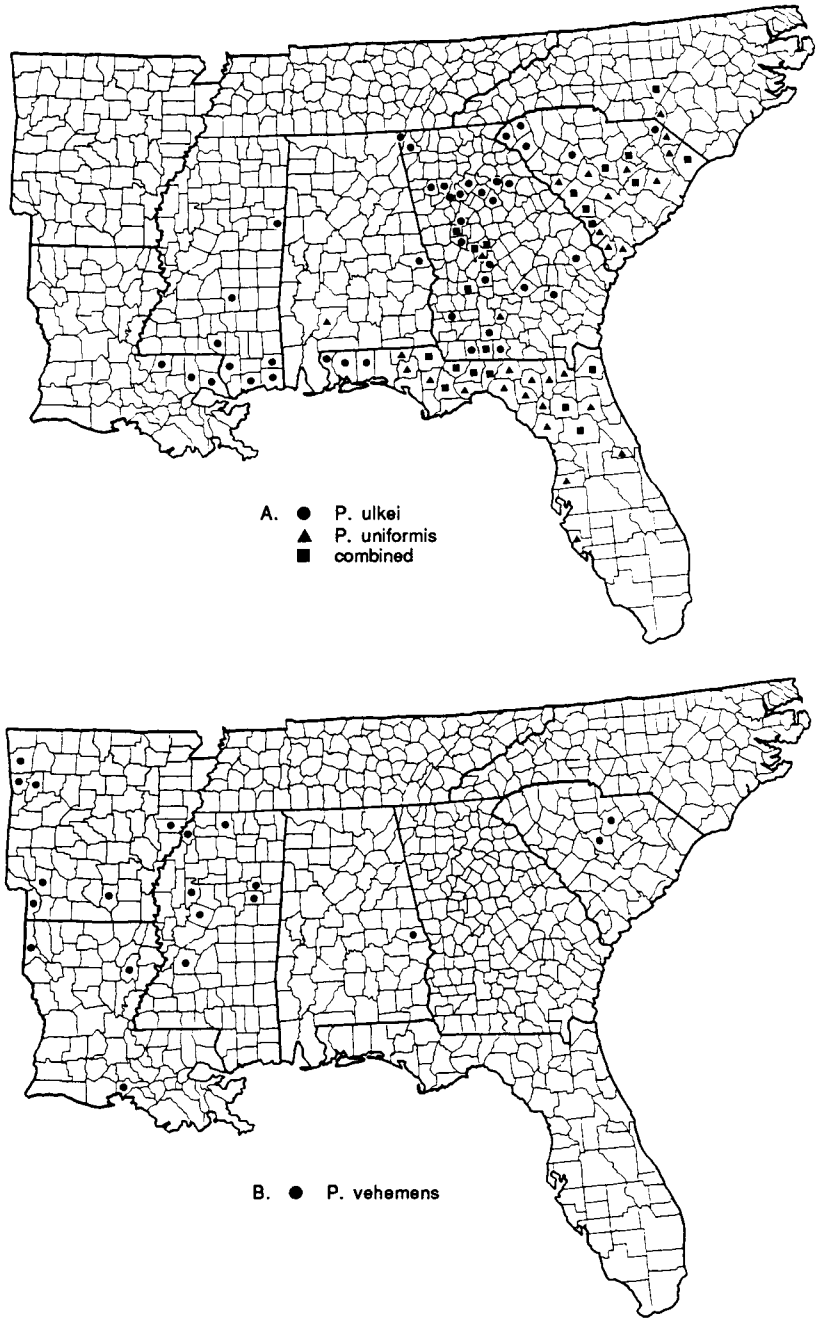

Fig. 10. Distribution of *P. ulkei* and *P. uniformis* (A) and *P. vehemens* (B) in the southeastern United States.

Table 1. Flight times of selected adult *Phyllophaga* in the southeastern United States in which they occur as compiled from published state surveys.

		Monthly occurrence									
Species	State	FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. aemula	SC					XX	XX	XX			
	GA			XX	XX	XX					
	AL					XX					
	MS				XX	XX	XX	XX			
	AR						XX				
	LA					XX	XX	XX			
	FL			XX	XX	XX	XX	XX	XX	XX	
P. anxia	NC		XX	XX	XX	XX	XX				
	SC			XX	XX	XX	XX				
	GA	XX	XX	XX	XX	XX					
	AL					XX					
	MS		XX	XX	XX						
	AR				XX						
	LA			XX	XX	XX	XX				
	FL			XX	XX	XX	XX				
P. arkansana	SC			XX	XX	XX	XX				
	GA			XX	XX						
	AL		XX	XX							
	MS		XX	XX	XX						
	AR		XX	XX	XX	XX					
	LA			XX	XX						
P. barda	NC			XX	XX						
	SC		XX	XX							
	GA		XX	XX	XX	XX					
	MS		XX	XX	XX						
	AR				XX						
P. calceata	NC					XX	XX				
	SC				XX						
	GA			XX	XX						
	MS		XX	XX	XX	XX					
	AR			XX	XX						
	LA	XX	XX	XX	XX	XX					
P. clypeata	SC					XX	XX	XX			
	GA					XX	XX	XX			
	MS					XX	XX				
	LA					XX	XX	XX	XX	XX	
	FL	XX	XX	XX	XX	XX	XX				
P. crenulata	SC			XX	XX	XX	XX	XX			
	GA		XX	XX	XX	XX	XX	XX			
	AL			XX	XX	XX					
	MS		XX	XX	XX	XX	XX				
	AR		XX	XX	XX	XX	XX	XX			
	LA		XX	XX	XX	XX	XX	XX			
	FL		XX	XX	XX	XX	XX	XX			

Table 1. Continued.

Species	State	Monthly occurrence									
		FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. cupuliformis	SC			XX	XX						
	GA		XX	XX	XX						
	AL			XX							
	MS		XX	XX	XX	XX					
	LA			XX	XX						
	FL	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
P. debilis	NC					XX					
	SC				XX	XX					
	GA				XX	XX					
	AL					XX	XX				
	MS					XX	XX	XX			
	LA				XX	XX	XX				
	FL		XX	XX	XX	XX	XX				
P. diffinis	SC		XX	XX	XX	XX	XX				
	GA		XX	XX	XX	XX					
	AL				XX						
	MS		XX	XX							
	AR			XX	XX						
	LA			XX	XX						
	FL		XX	XX	XX						
P. dispar	NC					XX					
	SC					XX	XX	XX			
	GA					XX	XX				
	AL						XX				
	MS					XX	XX	XX			
	FL	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
P. drakii	NC			XX	XX	XX	XX				
	SC			XX	XX	XX	XX		XX		
	GA			XX	XX	XX	XX				
	AL					XX					
	MS				XX	XX	XX				
	AR					XX					
	LA				XX						
P. ephilida	NC					XX	XX	XX	XX	XX	
	SC					XX	XX	XX	XX		
	GA					XX	XX	XX	XX		
	AL				XX						
	MS					XX	XX	XX			
	AR					XX	XX	XX			
	LA				XX	XX	XX	XX	XX		
P. fervida	NC					XX					
	SC			XX							
	GA			XX	XX						
	MS			XX	XX						
	AR		XX	XX	XX	XX					

Table 1. Continued.

Species	State	Monthly occurrence									
		FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. forbesi	NC		XX	XX	XX						
	SC		XX	XX	XX	XX	XX				
	GA		XX	XX	XX	XX	XX	XX			
	AL					XX	XX				
	MS		XX	XX	XX						
	AR				XX						
	LA		XX	XX	XX	XX	XX				
	FL		XX	XX	XX	XX					
P. fosteri	NC						XX				
	GA					XX					
	AL					XX	XX				
	MS			XX	XX	XX	XX	XX			
	AR					XX	XX				
	LA				XX	XX	XX				
	FL				XX	XX	XX	XX	XX		
P. fusca	GA				XX	XX					
	AL					XX					
	MS		XX	XX	XX						
	AR				XX						
	LA			XX	XX						
	FL			XX							
P. futulis	NC			XX	XX	XX	XX				
	SC			XX	XX						
	GA		XX		XX	XX	XX				
	AL			XX	XX	XX					
	LA			XX	XX						
P. glabberima	NC			XX		XX	XX	XX			
	SC					XX		XX			
	GA				XX	XX	XX	XX			
	AL				XX	XX	XX				
	MS				XX	XX	XX				
	AR					XX	XX	XX			
	LA					XX	XX	XX			
	FL			XX	XX	XX	XX	XX	XX		
P. gracilis	NC					XX					
	SC			XX	XX	XX		XX			
	GA				XX	XX	XX	XX			
	AL			XX	XX	XX					
	FL	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
P. hirticula	NC			XX	XX	XX	XX				
	SC	XX	XX	XX	XX	XX	XX	XX			
	GA		XX	XX	XX	XX	XX	XX			
	AL					XX					
	MS			XX	XX						
	AR			XX	XX	XX	XX				
	LA			XX	XX	XX					

Table 1. Continued.

Species	State	Monthly occurrence									
		FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. illicis	NC			XX	XX	XX					
	SC			XX	XX	XX	XX				
	CA		XX	XX	XX	XX	XX				
	AL		XX	XX	XX						
	MS		XX	XX	XX	XX					
	LA			XX	XX	XX					
	FL		XX	XX	XX	XX					
P. knochii	NC					XX					
	SC					XX	XX	XX			
	GA				XX	XX	XX	XX			
	AL				XX	XX					
	MS				XX	XX	XX	XX			
	LA				XX	XX	XX	XX	XX	XX	XX
	FL		XX	XX	XX	XX	XX	XX	XX	XX	XX
P. latifrons	NC				XX				XX		
	SC		XX	XX	XX	XX	XX				
	GA		XX	XX	XX	XX					
	MS		XX	XX	XX	XX					
	AR			XX	XX	XX					
	LA		XX	XX	XX	XX	XX				
	FL		XX	XX	XX	XX					
P. lota	NC		XX	XX	XX	XX					
	SC		XX	XX	XX	XX	XX				
	GA		XX	XX	XX	XX					
	AL			XX	XX						
	MS			XX	XX	XX	XX				
	LA			XX	XX	XX	XX				
	FL	XX	XX	XX	XX	XX					
P. luctuosa	NC				XX	XX					
	SC					XX	XX				
	GA				XX	XX	XX	XX	XX	XX	
	MS					XX	XX				
	LA					XX	XX	XX			
	FL				XX	XX	XX	XX	XX		
P. marginalis	NC			XX	XX	XX					
	SC		XX	XX	XX	XX	XX				
	GA		XX	XX	XX	XX	XX	XX	XX	XX	
	AL		XX	XX							
	MS		XX	XX	XX	XX					
	AR		XX	XX	XX	XX					
	LA		XX	XX	XX	XX					
P. micans	NC				XX						
	SC			XX	XX	XX	XX	XX			
	GA		XX	XX	XX	XX	XX				
	AL					XX					
	AR				XX						
	LA				XX						

Table 1. Continued.

Species	State	Monthly occurrence									
		FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. parvidens	SC				XX	XX					
	GA			XX	XX	XX					
	AL			XX	XX	XX					
	MS			XX	XX	XX					
	AR			XX							
	LA			XX	XX	XX					
	FL	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
P. perlonga	GA			XX							
	AL					XX					
	MS		XX	XX	XX	XX					
	LA		XX	XX	XX						
	FL		XX	XX							
P. postrema	SC					XX	XX				
	GA				XX	XX					
	AL				XX						
	MS			XX	XX	XX					
	LA		XX	XX	XX						
	FL		XX	XX	XX	XX	XX	XX	XX	XX	
P. praestermissa	NC			XX							
	GA			XX	XX						
	MS		XX	XX	XX	XX					
	AR		XX	XX	XX						
	LA			XX							
P. prunia	GA			XX	XX	XX					
	AL					XX					
	MS		XX	XX	XX	XX					
	AR		XX	XX	XX	XX					
	LA			XX	XX	XX	XX				
P. prununculina	NC					XX	XX				
	SC				XX	XX	XX	XX			
	GA			XX	XX	XX	XX	XX			
	AL					XX					
	MS				XX	XX	XX	XX			
	LA					XX	XX	XX	XX	XX	
	FL			XX	XX	XX	XX	XX	XX	XX	XX
P. quercus	NC					XX	XX	XX	XX		
	SC				XX	XX	XX	XX			
	GA					XX	XX	XX	XX		
	AL				XX	XX	XX				
	MS				XX	XX	XX	XX			
	AR						XX				
	LA					XX	XX	XX	XX		
	FL		XX	XX	XX	XX	XX	XX	XX	XX	XX

Table 1. Continued.

Species	State	Monthly occurrence									
		FE	MA	AP	MA	JU	JL	AU	SE	OC	NO
P. tristis	NC			XX							
	SC		XX	XX							
	GA		XX	XX	XX						
	AL		XX	XX		XX					
	MS		XX	XX	XX	XX	XX				
	AR		XX	XX	XX						
	LA		XX	XX	XX						
	FL			XX							
P. ulkei	NC			XX							
	SC		XX	XX	XX	XX					
	GA		XX	XX	XX						
	AL					XX					
	MS		XX	XX	XX						
	LA			XX	XX						
	FL		XX	XX	XX	XX	XX	XX	XX		
P. uniformis	NC					XX	XX		XX		
	SC				XX	XX	XX				
	GA				XX	XX	XX	XX			
	AL					XX	XX				
	FL		XX	XX	XX	XX	XX	XX	XX	XX	
P. vehemens	NC			XX							
	AL				XX						
	MS		XX	XX	XX						
	AR			XX	XX						
	LA			XX	XX						

Acknowledgments

We thank D. J. Kinard and M. Beaman for their assistance in compiling the distribution maps and flight period summaries.

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