Activity Patterns of Carabidae and Staphylinidae in Centipedegrass in Georgia[1]

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ABSTRACT Pitfall traps were used to determine the carabid and staphylinid fauna in managed centipedegrass turf during 1989-1991. Twenty-one species of carabids and 16 species of staphylinids were identified. The relative activity and species composition of the two families of beetles varied with year and site of study. Seasonal activity patterns, as indicated by the pitfall trapping method, for the most abundant species are presented.

KEY WORDS Insecta, centipedegrass, carabids, staphylinids, seasonal activity.

Growing concerns about the potential problems associated with pesticide use, such as ground water contamination and hazards to human health, have spurred interest in adoption of alternative pest management methods in the urban environment. Factors limiting development and implementation of integrated pest management for urban turfgrass systems include a lack of knowledge of the basic biology and ecology of beneficial arthropod communities that occur in such settings (Potter and Braman 1991). Beneficial arthropods including carabid and staphylinid beetles occurring in turf have been mentioned by several authors (e. g., Bohart 1947, Reinert 1978, Mailloux and Streu 1981, Cockfield and Potter 1984). Effects of chemical management on beneficial invertebrates in turf have also been assessed (e.g., Cockfield and Potter 1983, Potter et al. 1990, Vavrek and Niemczyk 1990, Braman and Pendley 1993).

Studies characertizing the turfgrass arthropod faunal composition and seasonality are needed to facilitate three areas of improved pest management: prediction of pest and beneficial arthropod phenology, manipulation of selected taxa, and biological control. While carabids and staphylinids are abundant in many managed ecosystems, their potential as predators and scavengers in southern turfgrass is unknown. Results reported here describe the species composition and seasonal activity of adult Carabidae and Staphylinidae in centipedegrass turf in central Georgia.

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Materials and Methods

Plots in established centipedegrass turf were located at two University of Georgia research sites in Griffin. Site 1, 45.7 m × 30.5 m, was surrounded by 3.2 ha of turfgrass, and site 2, 45.7 m × 30.5 m, was bordered by woods, pasture, and agricultural crops. Ground-dwelling arthropods were monitored using uncovered pitfall traps containing ethylene glycol solution (Morrill 1975). Contents of pitfall traps were washed with tap water through a 52-mesh screen and stored in 70% ethyl alcohol.

During 1989 four blocks (= plots), each 232.5 m^2, were established at both sites with two traps per plot, totalling eight traps per site. Traps were emptied weekly from 7 April 1989 through 21 February 1990. During 1990 experimental sites were subdivided for application of herbicide (pendimethalin at 2.76 kg[AI]/ha, sethoxydim at 0.23 kg[AI]/ha, and atrazine at 1.38 kg [AI]/ha), insecticide (chlorpyrifos twice at 0.92 kg[AI]/ha), or fertilizer treatments according to the schedule presented in Braman and Pendley (1993). Three replications of five treatment combinations (83.7 m^2 per treatment) were used in a randomized complete block design. Thus, fifteen traps per site were operated from 1 March 1990 through 29 October 1990 and from 9 January 1991 through 28 October 1991. Effects of treatment application on Araneae, Formicidae, Staphylinidae, Carabidae, parasitic Hymenoptera, oribatid Acari, and Collemobola were discussed elsewhere (Braman and Pendley 1993). Few significant effects of treatment application were observed on the taxa discussed here. Carabids were unaffected by treatment each year. Staphylinids occasionally, but not consistently increased in abundance in herbicide- and insecticide-treated plots. Here we present the relative seasonal activity of the most abundant species of Carabidae and Staphylinidae encountered during these studies. Voucher specimens have been placed in the museum in the Entomology Department, Griffin, GA.

Shannon-Weaver indices of diversity (H') and evenness (J) were used to compare carabids and staphylinids at both sites:

$$(H' = \Sigma[n_i/N] \log_c [n_i/N]),$$

where n_i is the number of individuals in the i^{th} species, and N is the total number of individuals in the sample; $J = H'/\log_c S$, where S is the number of species collected. Sorenson's index of similarity (SI) (Sorenson 1948) was used to compare species composition between the two sites and among the three years of study

$$SI = [2c] / [A + B]$$

where A = number of species in the first category, B = number of species in the second category and c = number of species common to both categories.

Results and Discussion

Twenty one carabid species and sixteen staphylinid species were identified from pitfall trap collections (Table 1). Relative abundance of these species in our traps varied with site and among years (Fig. 1 and 2). A total of 3,538

Table 1. Carabid and staphylinid taxa collected from pitfall traps in centipedegrass in Griffin, GA, 1989-1991 (from Braman and Pendley 1993).

Carabidae
Agonum punctiforme Say
Harpalus sp. prob. *pennsylvanicus* DeGeer
Scarites subterraneus F.
Notiophilus novemstriatus LeConte
Anisodactylus furvus LeConte
Amara aenea DeGeer
Abadicus permundus Say
Amara sp.
Calosoma sayi Dejean
Notiophilus semistriatus Say
Cratacanthus dubuis Beauv.
Calathus opaculus LeConte
Selenophorus pedicularis Dejean
Cyclothrachelus brevoorti LeConte
Anisodactylus rusticus (Say)
Harpalus gravis LeConte
Amara obesa Say
Anisodactylus dulcicollis (LaFerte)
Chlaenius impactifrons Say
Selenophorus palliatus F.
Selenophorus fatuus LeConte
Staphylinidae
Apocellus sphaericollis (Say)
Attheta macrops Notman
Coproporus laevis LeConte
Bryoporus rufescens (LeConte)
Echiaster brevicornis (Casey)
Meronera venustula (Erichson)
Quedius neomolochinus Korge
Astenus fusciceps (Casey)
Philonthus nr. fimetarius (Garv.)
Stenus sectilifer Casey
Astenus prolixus (Erichson)
Philonthus hepaticus Erichson
Acrotona hebeticornus Notman
Sepedophilus sp.
Aleochara verna Say
Belonuchus rufipennis (F.)

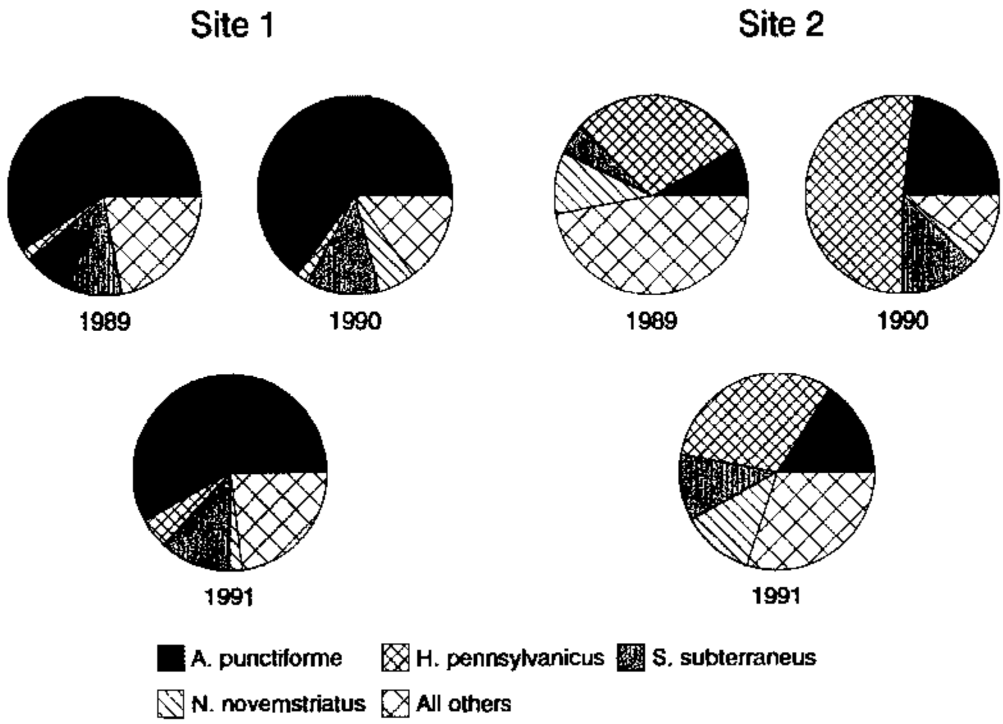

Fig. 1. Relative abundance of species of Carabidae in centipedegrass, Griffin, GA 1989-1991.

staphylinids and 2,151 carabids was collected. *Agonum punctiforme* Say was the most frequently collected carabid at site 1 during all three years of study and comprised 61% of the total collection at that site (Fig. 1). Only 17% of the total carabid collection at site 2, however, consisted of *A. punctiforme*. The most frequently trapped carabid at site 2 was *Harpalus* sp. prob. *pennsylvanicus* DeGeer, comprising 40.4% of the total three year collection.

Diversity and evenness values for the three year total collection of carabids were: site 1, H' = 1.46, J = 0.49; and site 2, H' = 2.00, J = 0.65. This indicates that the carabid fauna at site 2 was richer than that found at site 1, perhaps due to the increased diversity in surrounding habitat types. The carabid community at site 1 was more similar during 1990 and 1991 [SI = 0.72] than during 1989 and 1990 [SI = 0.60] or 1989 and 1991 [SI = 0.64]. Carabids at site 2 were also more similar during 1990 and 1991 [SI = 0.86] compared with 1989 and 1990 [SI = 0.74] or 1989 and 1991 [SI = 0.65]. SI values were also used to compare carabid species compositions between sites. Carabids were most similar between sites during 1991 [SI = 0.81]. Values during 1989 and 1990 were relatively low (SI = 0.67 and 0.64, respectively).

In the present study *A. punctiforme, H. pennsylvanicus, S. subterraneus, Notiophilus novemstriatus* LeConte, *Anisodactylus furvus* LeConte, *Amara aenea* DeGeer, and *Abadicus permundus* Say represented 93 and 87% of the

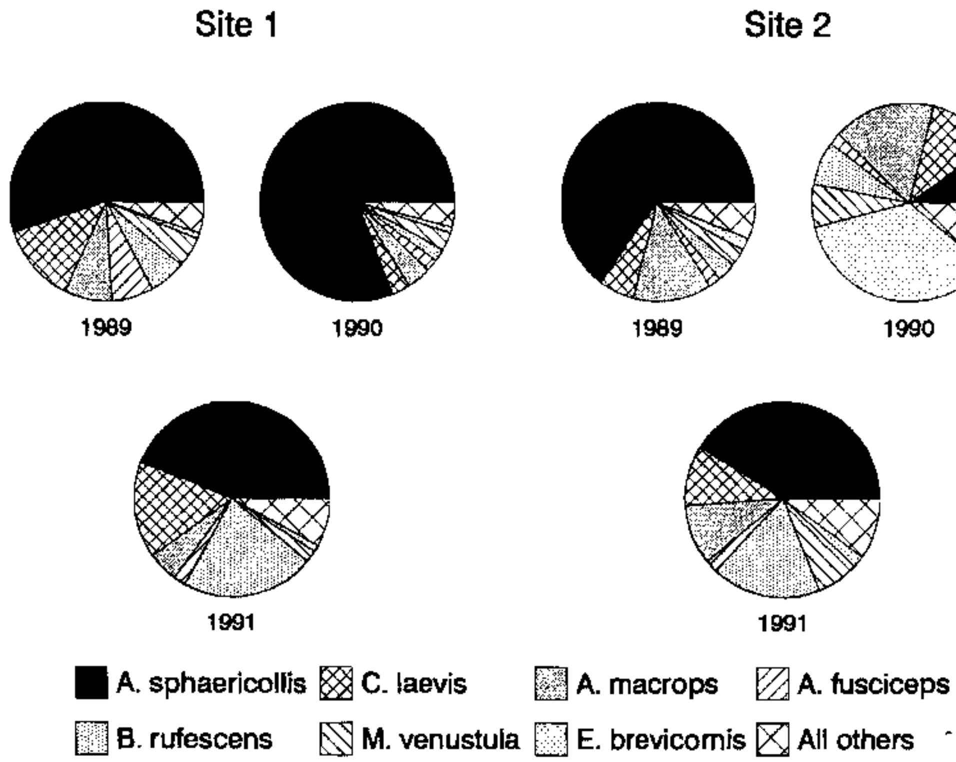

Fig. 2. Relative abundance of species of Staphylinidae in centipedegrass, Griffin, GA 1989-1991.

carabid samples at sites 1 and 2, respectively. Morrill (1992) determined that five carabid species represented 94% of the total pitfall trap catch in Georgia grasslands during 1975 and 1976. *Abacidus sculptus* (LeConte), *H. pennsylvanicus, Evarthrus unicolor* (Say), *S. subterraneus quadriceps* Chadoir, and *S. subterraneus subterraneus* F. were the most abundant of the 22 species of carabids collected in that study. Differences in species composition may be due to differences in plant height, level of chemical management, presence of prey, or other undetermined factors.

Agonum punctiforme adult activity patterns were characterized by early and late season peaks in abundance (Fig. 3). *Harpalus pennsylvanicus* also exhibited two peaks (Fig. 3 site 2, see especially 1989 and 1991). *Scarites subterraneus* was most often collected during the summer months, while *N. novemstriatus* was most often collected during the late winter or early spring. In total, the adult carabids collected in this study exhibit trimodal peaks in activity.

The staphylinid *Apocellus sphaericollis* (Say) was the dominant species in turfgrass at both sites every year except for site 2 during 1990 (Fig. 2). This species represented 65.3 and 52.2% of the staphylinids collected at sites 1 and 2, respectively. Other abundant species collected were: *Atheta macrops* Notman, *Coproporus laevis* LeConte, *Bryoporus rufescens* (LeConte), and *Echiaster brevicornis*

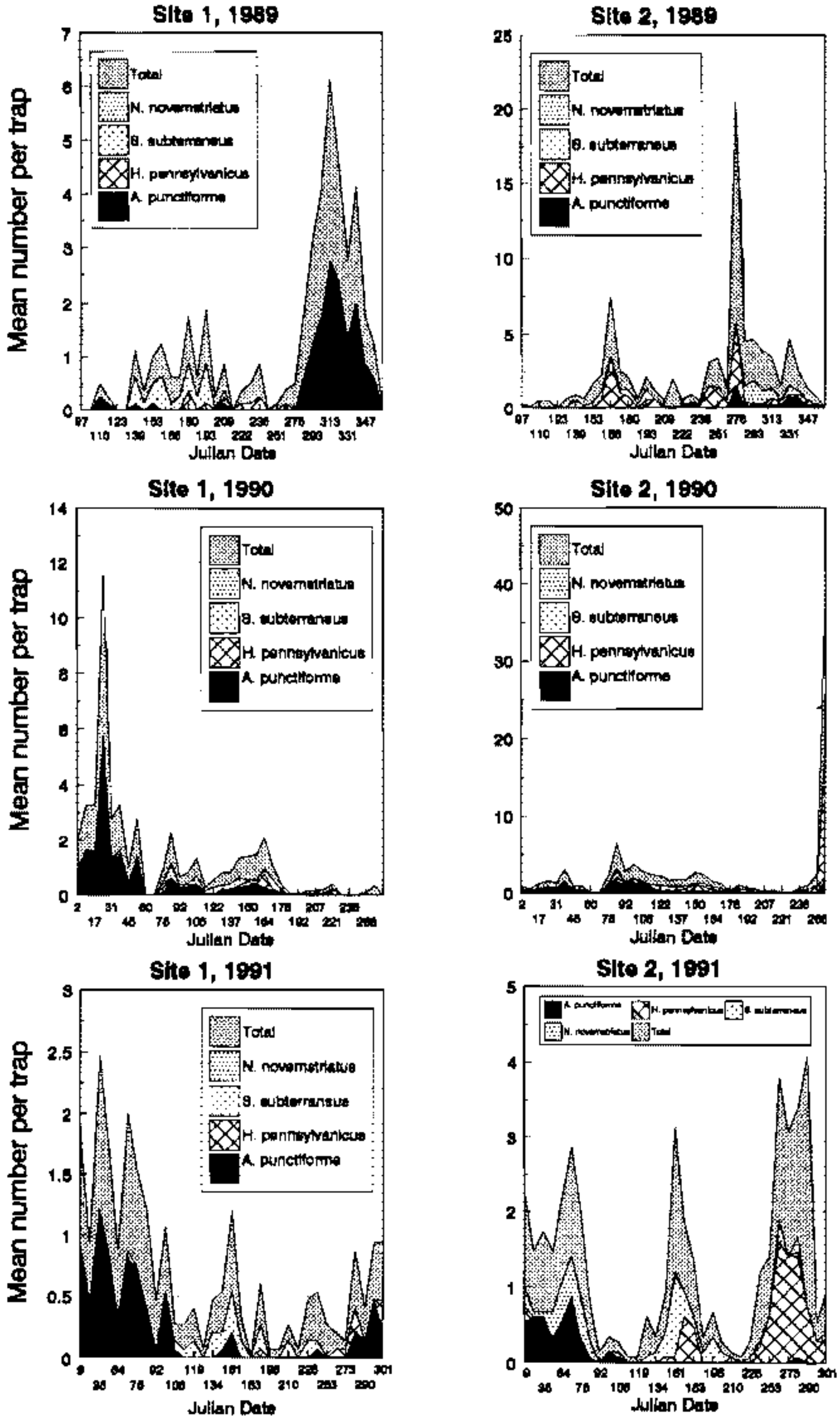

Fig. 3. Seasonal activity of species of Carabidae in centipedegrass, Griffin, GA 1989-1991. Scales on x and y axes are not similar among years and locations.

(Casey). Diversity and evenness of total staphylinids collected during 1989-1991 were: site 1, H' = 1.39, J = 0.49; and site 2, H' = 1.74, J = 0.61. This indicates that although similar numbers of species were present between sites, the distribution of individuals among the species present was more even at site 2. There was a high degree of similarity of staphylinids among years at both site 1 [SI's ranged from 0.81 - 0.89] and site 2 [SI's ranged from 0.76 - 0.89]. Staphylinid species composition was most similar between sites during 1989 [SI = 0.90] and 1991 [SI = 0.93]. During 1990 this value (SI = 0.74) suggested that fewer species were common to both locations.

The staphylinid *A. sphaericollis,* the most common rove beetle in our traps, is poorly known from the literature. Chittenden (1915) reported that this common insect is generally known as a scavenger, feeding on humus and decaying vegetation. He also considered it an "enemy to violets and other succulent ornamental plants" for its occasionally injurious habits. Mailloux and Streu (1981) describe population fluctuations of the more common staphylinids which were in the genera *Meronera, Philonthus, Atheta,* and *Tachyporus* in New Jersey turfgrass in relation to hairy chinch bug biology.

Staphylinid activity of the species collected in this study was most often characterized by bimodal peaks (Fig. 4). Collections during 1989 began too late in the year to detect this pattern. Subsequent years reveal two general periods of increasing activity for *A. spaericollis, C. laevis,* and *B. rufescens,* in particular.

Several species of carabid and staphylinid beetles are abundant in turfgrass in Georgia. Some similarities in species composition and seasonal activity patterns between managed turfgrasses and agricultural systems are apparent. *Harpalus pennsylvanicus,* for example, has been collected in all of the contiguous United States and most of southern Canada (Kirk 1973). This species is commonly collected in alfalfa (Barney and Pass 1986), soybean (Bechinski and Pedigo 1981, House and All 1981), corn (Best et al. 1981), and grassland (Morrill 1992). Activity patterns indicate asynchronous temporal distribution (summer, fall, and spring) of the various potential predators. This suggests that activity of these predators will coincide with that of different pest groups, e. g., cutworms (spring), spittle bugs, armyworms, chinchbugs (summer), or white grubs (fall). Further research is needed to define the role of carabids and staphylinids in turfgrasses.

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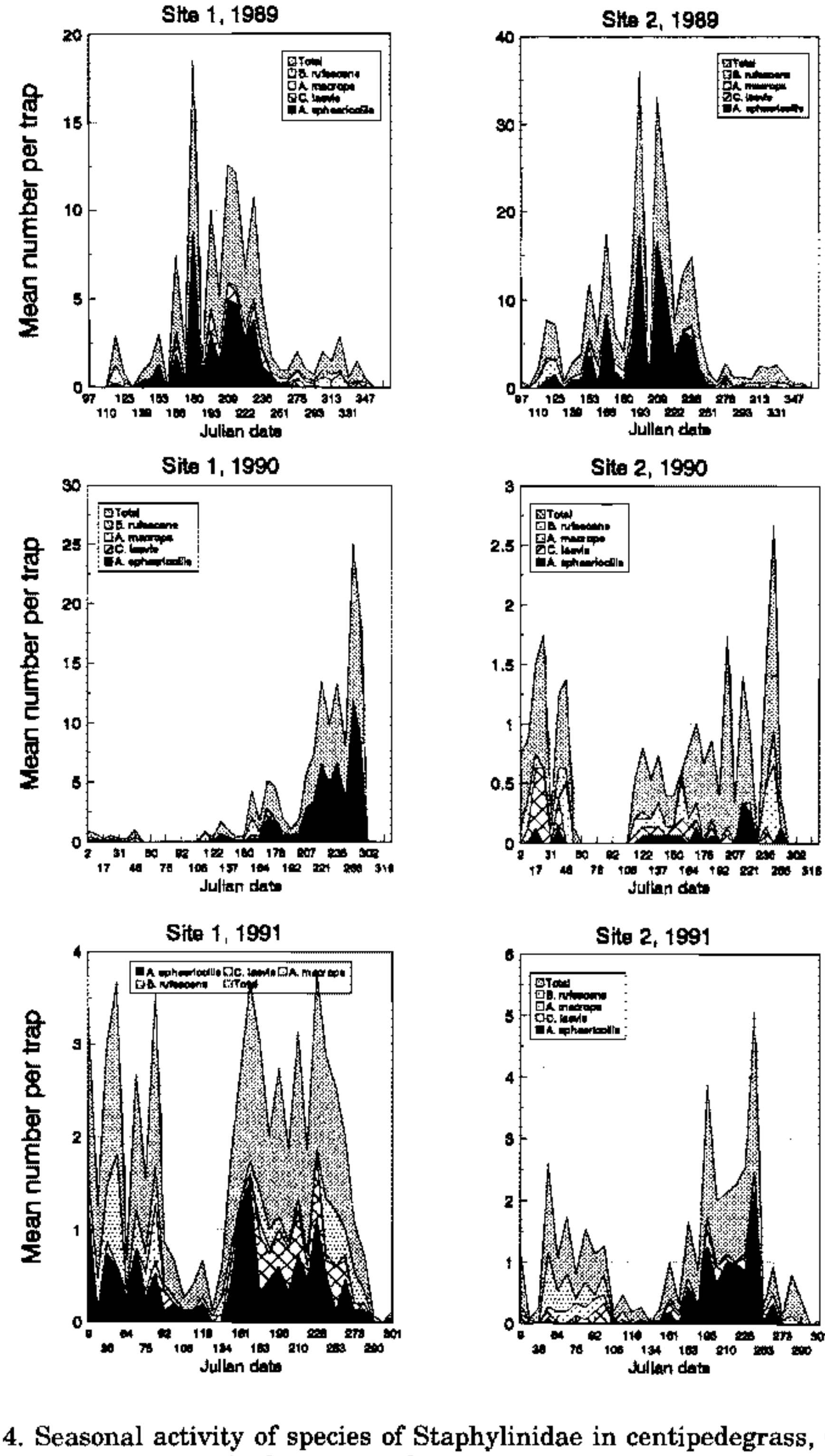

Fig. 4. Seasonal activity of species of Staphylinidae in centipedegrass, Griffin, GA 1989-1991. Scales on x and y axes are not similar among years and locations.

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