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Diversity and Seasonal Activity of Carrion Beetles (Coleoptera: Silphidae) in Northeastern Georgia'

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The Family Silphidae is a small but widespread group of primarily necrophagous beetles. Approximately 175 species are found throughout the world with 30 of these occurring in North America (Arnett and Thomas 2001, American Beetles Vol. 1: 269). Silphids have been the subject of many studies on behavior and ecology and have some forensic importance as well (Carvalho et al. 2000, Mem. Inst. Oswaldo Cruz no. 1: 135-I 38). There is some evidence that silphids are negatively affected by habitat fragmentation (Gibbs and Stanton 2001, Ecol. Appl. 11: 79-85) and because they are easily surveyed, they may be useful environmental indicators.

Four carrion traps were operated 41 times between 3 June 2002 and 26 May 2003 in Whitehall Forest, Clarke Co., GA, to measure the abundance and diversity of silphids throughout the year. The traps were placed in three different habitats. One was placed in a small overgrown field exposed to direct sunlight and surrounded on three sides by a mixture of pine and hardwood. Another trap was placed in a young pine stand with partial shade. The other two traps were placed in mature deciduous forest in full shade.

The carrion was protected from vertebrate scavengers inside a 30 x 30 x 30 cm cage. Chicken wire covered five sides of each cage. The sixth side, which faced the ground, was left uncovered. Zinc bolt snaps were used to secure each cage to the metal stakes driven in on each side. These allowed access to the cages without having to remove the stakes. Each cage was positioned over a collecting bucket (15 cm diam opening) buried to ground level. The buckets were half-filled with diluted (50%) propylene glycol which both killed and preserved the captured insects. We used dead chickens (approximately 831 g each) which were provided by a local broiler producer and frozen until needed. Each chicken was wrapped in cheesecloth and suspended from the top of the cage with string to prevent maggots and pieces of decomposing chicken from falling into the bucket below. The traps were operated for

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3 days at a time after which the chicken remains were discarded, and the silphids were identified and counted.

We collected 8 species of silphids with 4 species (Oiceoptoma *inaequale* (F.), 0. *noveboracense* (Forster), *Necrophila americana* (L.), and *Nicrophorus orbicollis* Say) each accounting for over 20% of the total number (1,662) of silphids collected (Table 1).

Although the 4 most common species were collected in similar numbers, their abundances throughout the year differed noticeably. Among silphids, *0. inaequale* and *0. noveboracense* are among the earliest emerging species (Anderson 1982, Can. J. Zool. 60: 1314-1325) and are reproductively active earlier as one goes from north to south (Peck and Kaulbars 1987, Proc. Entomol. Soc. Ont. 118: 47-81). In Ontario, Anderson (1982, Can. J. Zool. 60: 1314-1325) continued to collect both 0. *inaequale* and *0. noveboracense* into late August while our last captures occurred in mid-June (Fig. 1). In contrast, the other two common species, *Nicrophorus orbicollis* and *Necrophila americana,* were more active throughout the summer (April to November and April to September, respectively), and with longer periods of activity than the *Oiceoptoma* species (Fig. 1).

Nicrophorus tomentosus Weber accounted for 8.6% of silphids collected (Table 1). We observed two distinct periods of *N. fomentosus* activity. The species was collected in high numbers throughout June followed by two months of relative inactivity before the population peaked again for a second time between the months of September and November (Fig. 1). The period in July and August during which we rarely collected *N. tomentosus* corresponds to the period of highest activity for *N. orbicollis* (Fig. 1). In Michigan, N. *defodiens* displays a similar bimodal lifecycle to avoid competition with *N. orbicollis* (Wilson et al. 1984, Ecol. Entomol. 9: 195203). Trumbo (1990, Am. Midl. Nat. 124(2):1-11) found that *N. tomentosus* appears similarly early in North Carolina, but that the species delays reproduction until September when

Table 1. Total number of silphids collected in carrion traps in northeastern Georgia

Species	Trap 1	Trap 2	Trap 3	Trap 4	Total	% silphids
Oiceoptoma inaequale (F.)	29	*162*	*157*	47	**395**	23.77
Necrophila americana (L.)	*68*	118	*144*	64	**394**	23.71
Nicrophorus orbicollis Say	39	135	139	41	354	21.30
Oiceopfoma noveboracense (Forster)	2	184	107	48	341	20.52
Nicrophorus tomentosus Weber	10	55	57	21	143	8.60
Necrodes surinamensis (F.)	1	7	21	3	32	1.92
Nicrophorus pustulatus Herschel	0	0	2	0	2	.12
Nicrophorus marginatus F.	0	0	0			.06
Total	149	661	627	225	1662	100

* Trap 1: overgrown field, Traps 2 & 3: deciduous forest, Trap 4: young pine stand.

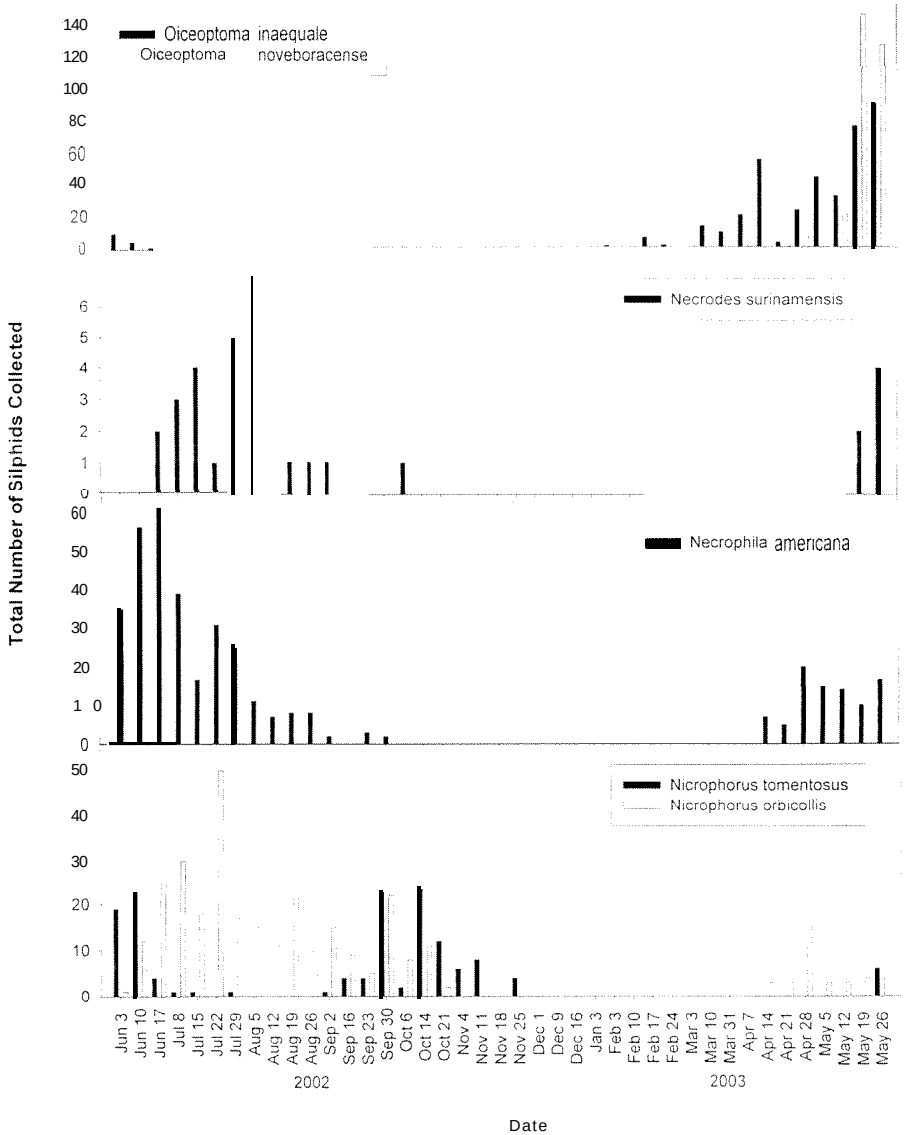

Fig. 1. The number of silphids collected throughout the year in northeastern Georgia.

competition with N. *orbicollis* is less severe. Checking June specimens of N. tomentosus for reproductive activity would be needed to clarify the life cycle of this species in Georgia.

Less than 2% of the specimens collected were *Necrodes surinamensis* (F.) (Table 1). They appear to be a mid-to-late summer species, with only *Nicrophorus tomentosus* emerging later in the year (Fig. 1).

We collected *Nicrophorus marginatus* F. and *N. pustulatus* Herschel in extremely low numbers (1 and 2 specimens, respectively). A similar survey conducted in Maryland (Shubeck and Blank 1982, Proc. Entomol. Soc. Wash. 84: 409-410) produced equally few specimens of each species. The apparent rarity of *N. marginatus* is not surprising because this species is uncommon in the Southeast (Peck and Kaulbars 1987). *Nicrophorus pustulatus* is a widespread species more commonly collected at lights than at traps baited with carrion (Peck and Kaulbars 1987). It has never been observed using a small carcass in the wild (Robertson 1992, Psyche 99: 189-197), and recently larvae of N. *pustulatus* have been found in the eggs of black rat snakes (Blouin-Demers and Weatherhead 2000, Ecoscience 7: 395-397). Due to the unusual habits of this species, it may be more common than carrion-based surveys suggest.

We collected several times more silphids in the deciduous forest plots (traps 2 and 3) than in those located in the overgrown field (trap 1) or young pine stand (trap 4) (Table 1). This may be due to both a general habitat preference (Shubeck 1993, Ent. News, 704: 88-92) and to decreased competition with fire ants (*Solenopsis invicta* Buren) in the deciduous forest. Fire ants maintained mounds immediately next to and around the traps in the overgrown field and young pine stand, but were nearly absent in the deciduous forest. Because fire ants have been found to decrease the number of silphids collected at carrion (Stoker et al. 1995, Environ. Entomol. 24: 817-822), they may have reduced the number of silphids collected in these plots.

In this study, we collected 8 of the 13 silphid species known to occur in the Southeast. *Nicrophorus americanus* Olivier occurred here historically, but is now missing from most of its former range (Peck and Kaulbars 1987). *Nicrophorus carolinus* (L.) and *Oiceoptoma rugulosum* Portevin are found further South while *Nicrophorus sayi* Laporte and N. *defodiens* Mannerheim occur further North than the area addressed in this study (Peck and Kaulbars 1987). Another survey conducted on the Coastal Plain would be useful in further understanding the composition and seasonality of southeastern silphid communities.