Final Report

Microhabitat use by Carrion Beetles (Coleoptera: Silphidae) in Nova Scotia Forests

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The goal of this project was to determine microhabitat use of forest-dwelling Carrion Beetles (Coleoptera: Silphidae) in the Antigonish area. By restricting the study to forests, only one species, *Thanatophilus lapponicus* was not caught at all, and another, *Nicrophorus vespilloides* was caught sparingly. The former appears to be a specialist of beach habitats, whereas the latter is commonly trapped in meadows and other open areas. The only other Nova Scotian Silphid not caught in this study was *Nicrophorus investigator*, but this species has never been caught on mainland Nova Scotia.

Carrion beetles can be divided into two subfamilies, the Silphinae (including the genera *Necrodes, Necrophila, Oiceoptoma and Thanatophilus*) and the Nicrophorinae, which has only the one genus, *Nicrophorus*. The latter are known as the Burying Beetles because adults will bury a small carcass (e.g. mouse, sparrow) and rear their young on it. In contrast, the genera within the Silphinae normally lay their eggs near or on a larger carcass, and leave the young then to fend for themselves. It is the Burying Beetles that have drawn a lot of attention by entomologists and sociobiologists since rearing of young by any invertebrate, is almost non-existent (i.e. most lay their eggs and abandon them).

One species of the Burying Beetles, *Nicrophorus pustulatus*, does things differently from the others. Up until about a decade ago, it was not clear at all why researchers did not catch this species burying small carcasses in the wild. It was attracted to lights, but many others are, too. A few clues started surfacing in the literature about this beetle not being confined to the ground, as its close relatives are. Finally, in 2000, Blouin-Demers and Weatherhead published an account of this beetle as a parasitoid of snake eggs in Ontario. However, the beetle's range extends beyond that of egg-laying snakes, so there had to be more to the story…and that is where this project took off.

General Methods

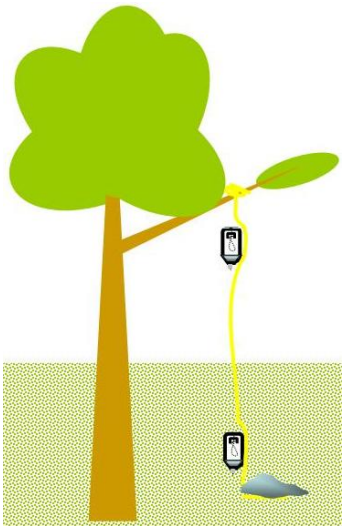

Figure 1 The trap set-up used in this experiment. The upper trap is at 10 m, the lower trap is 1.0 m off the ground.

I hired Amanda Lowe, a second-year undergraduate at St. Francis Xavier University to carry out the field work and lab work for this project. After several weeks with me as her partner in the field, she brought other students from the department with her; Natasha d'Entremont and Corinne Dewar were the ones most-often present.

We used chicken legs as bait in milk jug traps (Fig. 1); each trap consisted of two trap heads, situated at 1.0 and 10 m above ground. There were six double traps, spaced at 10 m intervals, at each of two sites, Bethany (a deciduous forest ravine on the outskirts of town) and Fairmont (a hemlock-red maple forest east of the community of Fairmont, Fig. 2). Traps were checked weekly for 14 weeks; beetles were washed, identified and either pinned or stored in 70% isopropanol.

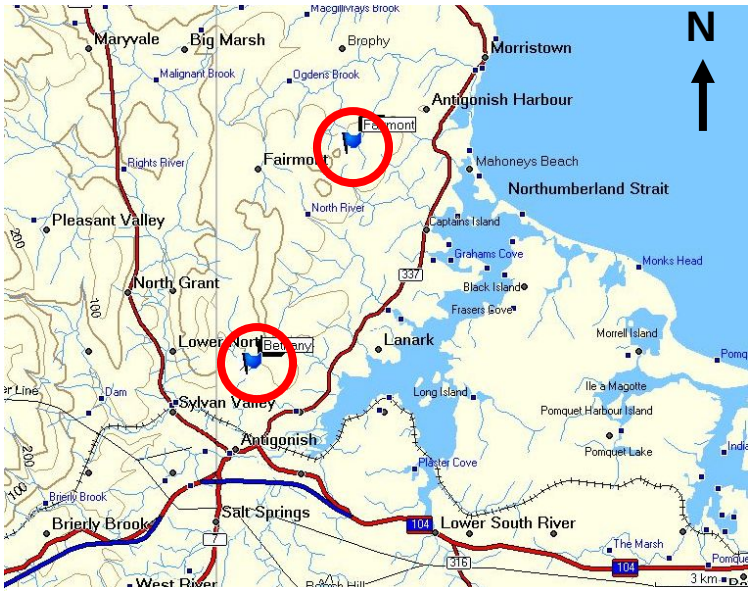

Figure 2 The two study areas in this project.

Results

Just over 8000 beetles were captured, with an approximately equal number arising from each site (Fig. 3). Over 1000 beetles were caught in the last week, indicating that the project could have gone on for some time.[1]

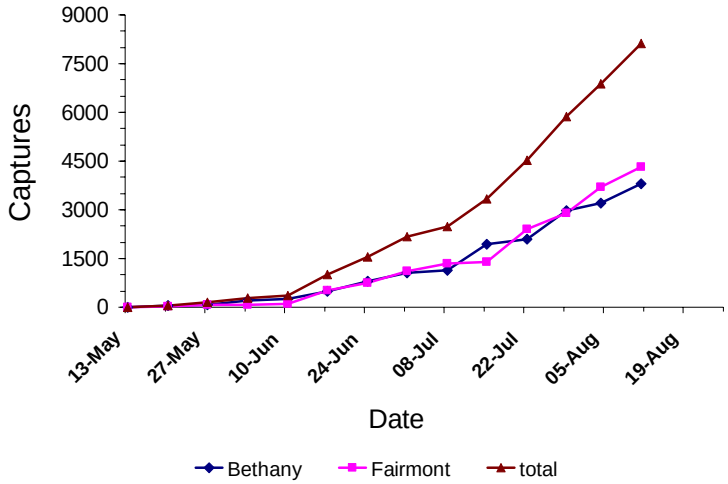

Figure 3 Cumulative captures for the project as a whole and at each of the study sites.

Habitat Preferences

Most carrion beetle species had a small, but significant preference for forest type (Fig. 4). In no case did any species *strongly* prefer one habitat over the other though.

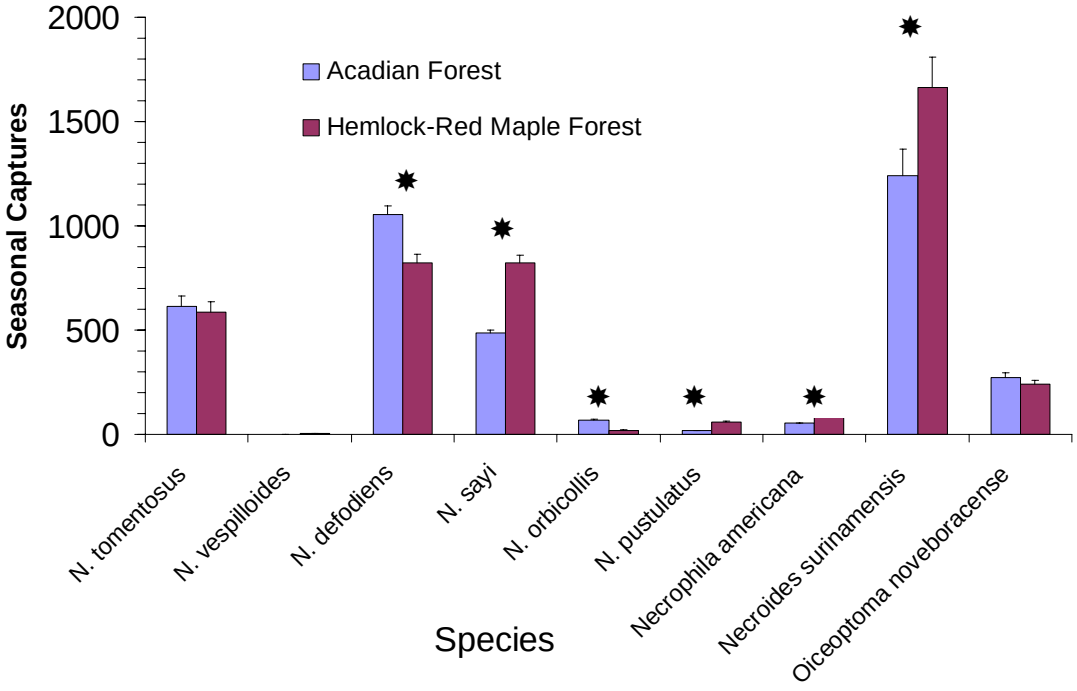

Figure 4 Habitat preferences of carrion beetles. The asterisks denote significant differences between habitats.

[1] High school student, Ria van der Linden, did a scaled down version of this project in Guysborough County. She used only one double trap in each of two habitats, but continued her project for ***25 weeks***, until October 13th, when she was still catching beetles in small numbers. Her project, which I supervised, will be the basis for her science fair entry.

Microhabitat Preferences

Microhabitat differences were much more pronounced than habitat differences. Most species were caught dominantly in the lower traps, with *Necrophila americana* avoiding the canopy almost completely (Fig. 5). Only *N. pustulatus and N. tomentosus* were more routinely (and significantly) caught in elevated traps.

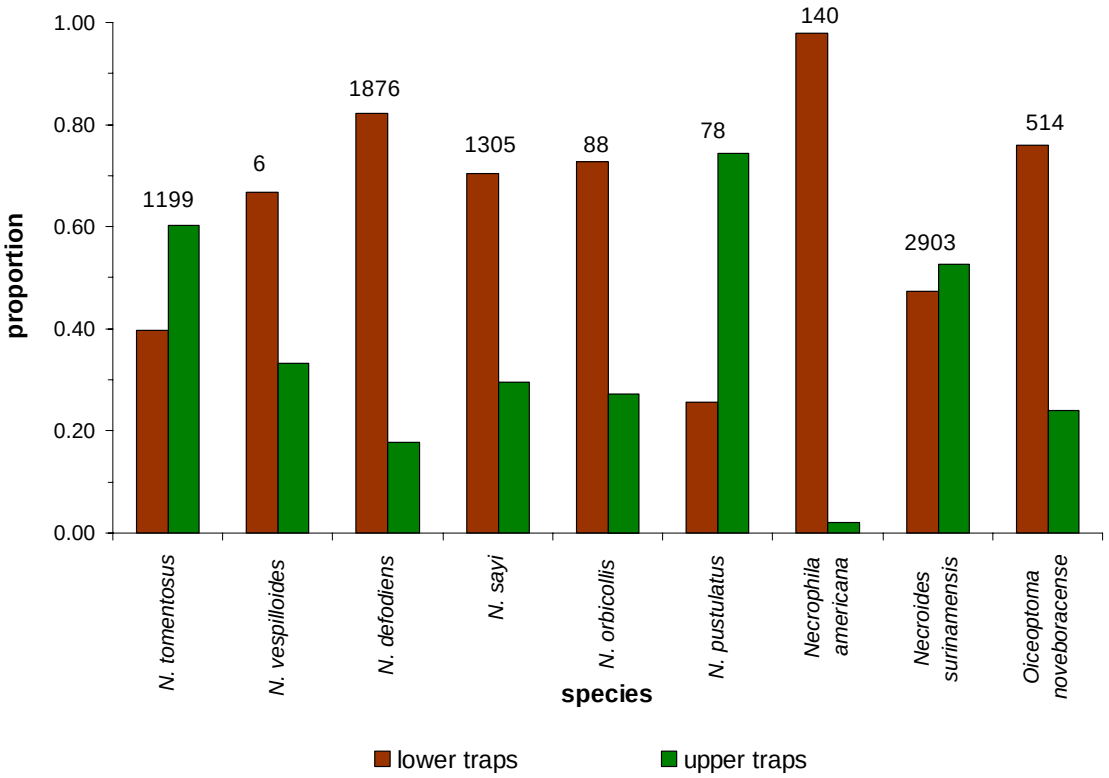

Figure 5 Microhabitat preferences of carrion beetles; the lower traps were one metre off the ground, the upper traps were well in the canopy at 10 m off the ground. Numbers above pairs of columns indicate sample size.

Activity Periods

Two of the four most abundant silphids captured were most prevalent in the spring and early summer (Fig. 6), with the other two making late summer appearances only. *N. pustulatus* was more like the former two species in that its primary period of activity was found to be late spring and early summer; teneral adults started appearing in early August.

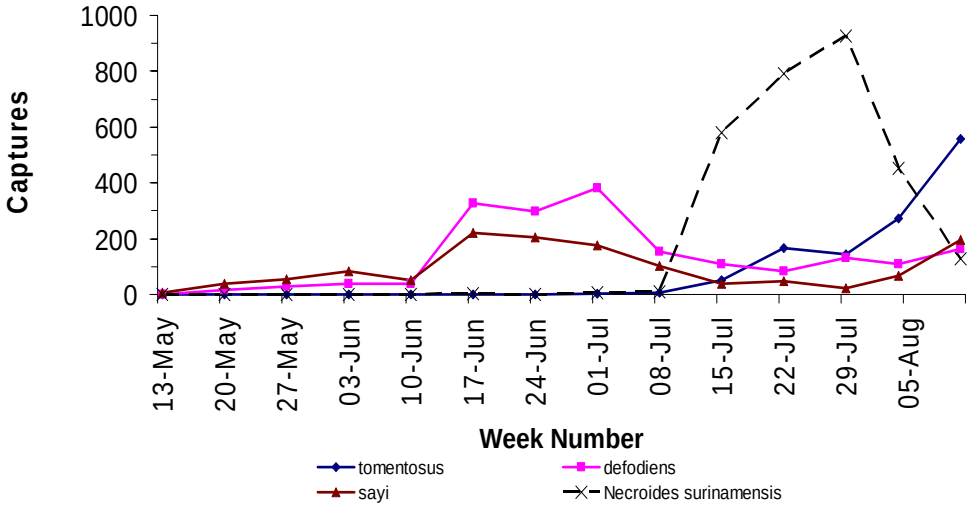

Figure 6 Phenology of the four most abundantly captured

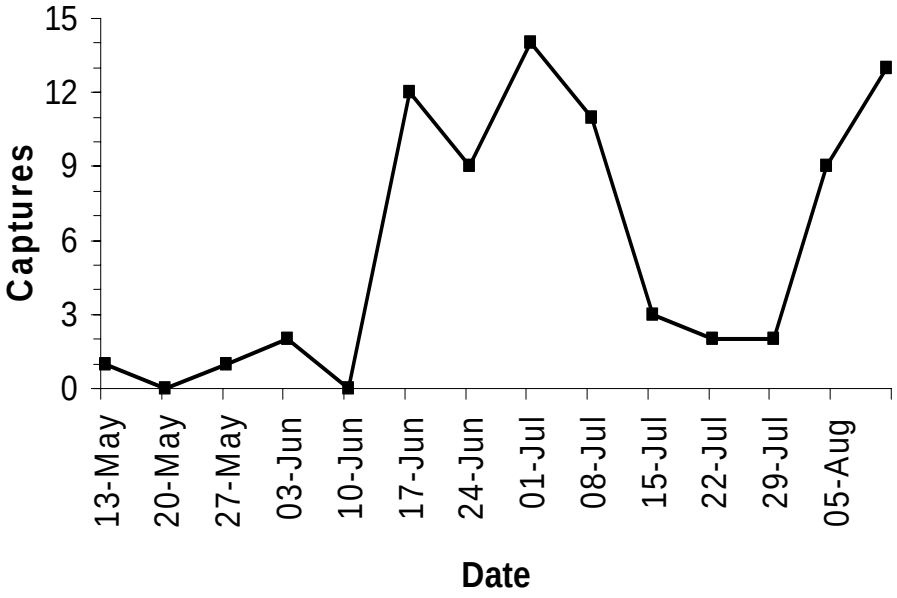

Figure 7 Weekly captures of *N. pustulatus*.

Discussion

During the course of this study, more *N. pustulatus* were captured than exist in all of the insect collections in Nova Scotia…combined! Clearly, entomologists have been misinterpreting the relative abundance of these animals for quite some time. Classically, carrion beetles are trapped in chicken-baited pitfall traps, though few, if any, *N. pustulatus* ever get caught this way. By *elevating* the traps (even my "ground" traps were one metre off of the ground), *N. pustulatus* is quite easily caught.

No forest-dwelling carrion beetle has a strong preference for the two forest types tested in this experiment (Fig. 4). However, microhabitat preferences were in some cases quite strong, with most species preferring the ground-level trap over the canopy traps (Fig. 5). *N. pustulatus* (and to a lesser extent, *N. tomentosus*) preferred the canopy traps.

This both confuses and enlightens the known biology of *N. pustulatus*. In the wild, the only documentation of breeding occurred in the subterranean nests of Black Rat Snakes (*Elaphe obsoleta*; Blouin-Demers and Weatherhead, 2000). John Gilhen (*pers. comm.*), former curator of herpetology at the Nova Scotia Museum of Natural History, mentioned that of all the snake and turtle nests he's uncovered, none had been also discovered by beetles. Why then, are the beetles not caught in pitfalls, and more confusingly, why are they caught in elevated traps, with a preference to the higher traps in the canopy?

The clear preference for canopy traps in Eastern Hemlock-Red Maple forest is newly-discovered information that will be published in the near future. The results of 2008 have set the stage for a more refined project this coming year; I'm lucky to have my summer student (Amanda Lowe) from last year returning to carry on the project. We will be attempting to solve the conundrum of canopy preference found in this study with subterranean snake nest use found in the previously-mentioned study. We will set up sites in Eastern Hemlock-Red Maple associations and use similar traps baited with eggs and

deceased birds[2]. The purpose is to find out if *N. pustulatus* is using any abandoned eggs (reptilian or avian), or perhaps even the deceased, abandoned nestlings (as would occur if the parent bird was depredated). Additionally, my colleague DNR Biologist Mark Pulsifer, is aware of my beetle project and is watching for these beetles in the nests of the Wood Turtles he works with.

Therefore, this project has been successful in two ways. One, we've outlined the phenology, habitat and microhabitat preferences of most of Nova Scotia's silphids. Two, we've set the stage for the culmination of this project this coming season, with experiments to determine egg/nestling preferences.

Literature Cited

Blouin-Demers, G. & Patrick J. Weatherhead. 2000. A novel association between a beetle and a snake: Parasitism of *Elaphe obsoleta* by *Nicrophorus pustulatus*.

Acknowledgements

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[2] Most of these birds will have come from window kills.