Comparison of the Carabid Assemblages of a Deciduous and a Coniferous Stand in Aylmer, Quebec's Boucher Forest

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1 Abstract

The objective of this research project was to compare the makeup of the carabid beetle (Coleoptera: Carabidae) assemblages of a coniferous and a deciduous stand of Aylmer, Quebec's Boucher Forest. Pitfall trapping for a period of three months was used to collect the sample. A comparison of the abundance and frequency of each species found is presented, by stand. Comparison is made to findings by Work *et al.*[4] and to ecological information from Lindroth[1]. It is found that the dominant species are nonindigenous and prefer cultivated ground, and the implications of this are discussed.

2 Introduction

As potential habitat indicators, carabid beetles benefit from reliable taxonomy[1] and exhaustive biological study, especially of nearctic species. Thus, study of the carabid populations of an ecosystem allows for inferences to be made regarding the nature of the system.

Pitfall trapping "involves the capture of ground surface-active arthropods that fall into a pit-like trap sunk into the ground"[3]. The primary benefit of pitfall trapping is the constant, unattended collecting, in one location, without the human bias present in hand-collecting. Essentially, pitfall trapping is an efficient method for sampling the assemblages of these arthropods. It is, however, primarily a qualitative sampling method[3], as some species may more easily evade traps, or may be restricted to small ranges and specialized habitats which do not include the traps. Two primary measures in this study emphasize the qualitative aspect, but add more weight to quantitative data. Firstly, having several traps in each sample area provides aggregated data to reduce localized trends—combining this data may produce some indication of actual abundance. Second, the calculation of relative frequency (see Section 3) emphasizes widespread species that are less likely to be captured in the traps. Thus, the occurrence of the species across the sample area is favoured over the number of individuals of the species in the total catch.

A forest "stand" is here defined as "a group of trees occupying a given area and sufficiently uniform in species composition ... so as to be distinguishable from the forest on adjoining areas."[2] In this study, the stands are differentiated on the basis of being dominated by either coniferous (evergreen) or deciduous trees.

In interpreting the data, this study will rely primarily on work by Work *et al.*[4] which aims to associate certain carabid species with different types of forest stands on a national scale. Also, information about the ecology of beetles is taken from Lindroth[1].

3 Methodology

Two sample sites were selected in the Boucher Forest based on satellite imagery from Google Earth, taken in October 2008. As the imagery was taken in the autumn, deciduous and coniferous cover was clearly distinguishable in the photograph. Each sample site consisted of nine pitfall traps aligned in a 3×3 grid, separated by about 30 m. The first deciduous trap was located at about $45.427°$, $-75.816°$, with traps running west and south, respectively. The first coniferous trap was located at about $45.425°$, $-75.829°$, with traps running north-west and north-east, respectively.

The pitfall traps were made with 600 mL plastic glasses, with the top rim removed, and a second cup cut to fit inside the first (for easier servicing). Rain covers were made of equilateral triangles of tin sheet metal, and the three corners were folded down to stand the rain cover over the cup.

Ethylene glycol was initially used as preservative, but, due to some disturbances by animals, propylene glycol was later used. The glycol was mixed with one to three parts of water, with a small amount of dish soap to break the surface tension. Preservative was replaced periodically.

Traps were serviced weekly: specimens were collected, and kept in 70% isopropyl alcohol, separated by trap number and by date. Specimens were then counted, identifying Insecta to the order level, and other arthropods to the class. Carabids were removed, pinned, and identified to the species. Other specimens were returned to alcohol for storage.

Collection ran from May 9 to August 19, 2009, with fourteen servicings at approximately weekly intervals. 213 carabid beetles were collected in the coniferous stand, and 112 in the deciduous.

For the carabid beetles, relative abundance and relative frequency were calculated for each stand, and for both combined (see Table 1). To calculate relative frequency, the number of traps in which a given species occurred was divided by the total number of traps in the given stand. Relative abundance was calculated as the number of specimens of a given species in the given stand divided by the total number of carabid specimens in the given stand. Thus, relative frequency indicates the probability that a particular species would be captured at a trap in the given stand. Relative abundance indicates the abundance of a given species as a fraction of the total carabid sample in the given stand, allowing for comparison of the makeup of the carabid population in each stand.

4 Results

Table 1: Relative abundance and frequency for carabid species collected from May 9–August 19, 2010

	Abundance			Frequency		
	Deciduous	Coniferous	Cumulative	Deciduous	Coniferous	Cumulative
Pterostichus melanarius (Illiger)	0.55	0.65	0.62	0.89	0.89	0.89
Carabus nemoralis Müller	0.05	0.07	0.06	0.44	0.44	0.44
Platynus decentis (Say)	0.07	0.05	0.06	0.44	0.44	0.44
Sphaeroderus stenostomus lecontei Dejean	0.06	0.06	0.06	0.44	0.56	0.44
Pterostichus coracinus (Newman)	0.00	0.08	0.05	0	0.44	0.22
Poecilus lucublandus lucublandus (Say)	0.12	0	0.04	0.67	0.11	0.39
Pterostichus mutus (Say)	0.08	0	0.03	0.44	0	0.22
Oxypselaphus pusillus (LeConte)	0	0.04	0.03	0	0.11	0.06
Pterostichus luctuosus (Dejean)	0	0.02	0.02	0	0.11	0.06
Pterostichus tenuis (Casey)	0.01	0.01	0.01	0.11	0.11	0.11
Chlaenius tricolor tricolor Dejean	0.02	0	0.01	0.22	0	0.11
Chlaenius emarginatus Say	0.01	0	0	0.11	0	0.06
Olisthopus parmatus (Say)	0.01	0	0	0.11	0	0.06
Calathus gregarius (Say)	0.01	0	0	0.11	0	0.06
Myas cyanescens Dejean	0.01	0	0	0.11	0	0.06
Agonum melanarium Dejean	0	0	0	0	0.11	0.06

Figure 1: Relative abundance of most abundant carabids

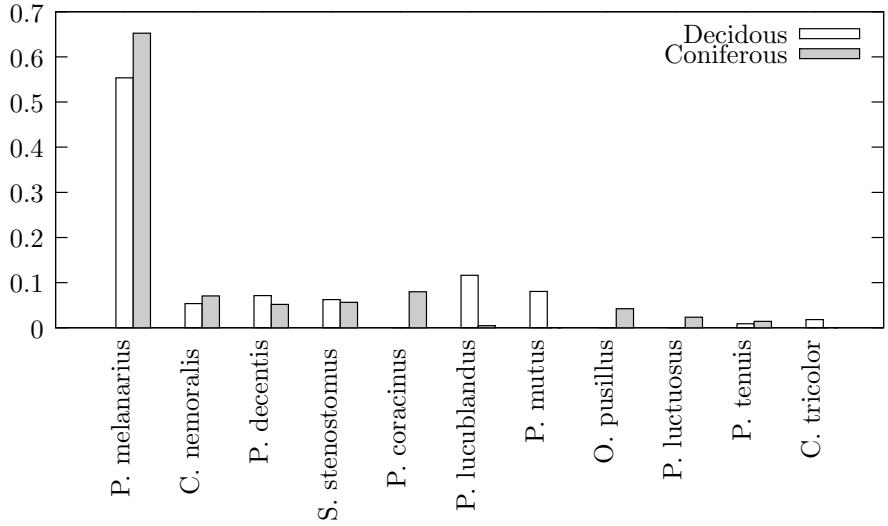
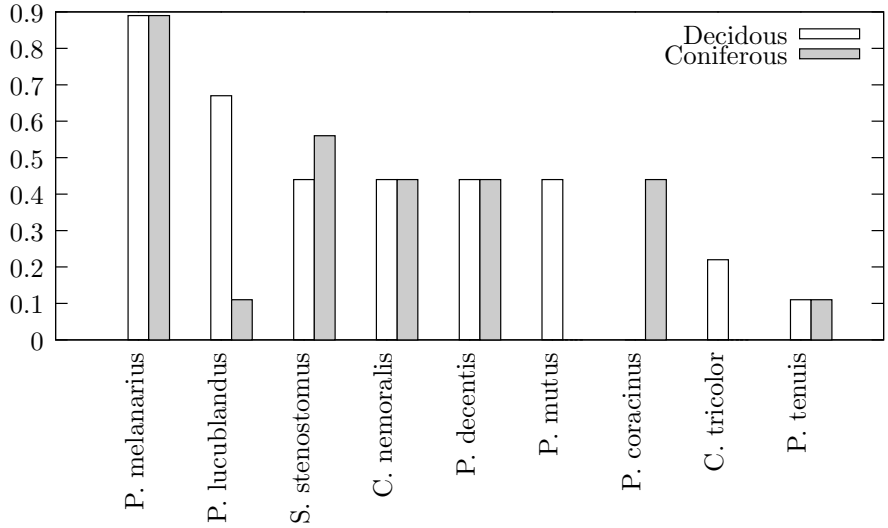


Figure 2: Relative frequency of most frequent carabids



Pterostichus melanarius (Illiger) was clearly the dominant species in both stands, comprising approximately 60% of the total carabid specimens and occurring at about 90% of traps in each stand. *Carabus nemoralis* Müller, *Sphaeroderus stenostomus lecontei* Dejean and *Platynus decentis* (Say) were about equally abundant and frequent in both stands.

Pterostichus coracinus (Newman) was found exclusively in the coniferous stand, while *Poecilus lucublandus lucublandus* (Say) and *Pterostichus mutus* (Say) were found almost exclusively in the deciduous stand.

5 Discussion

The exclusive occurrence of *Pterostichus coracinus* in the coniferous stand corresponds to Work's findings that the species "defined" conifer-dominated stands. The near-exclusive occurrence of *Poecilus lucublandus lucublandus* in the deciduous stand also corresponds to Work's findings. However, similar frequency and abundance between stands was found for *Sphaeroderus stenostomus lecontei*, while Work found this species to be indicative of deciduous stands.[4, 401]

The varying correspondence with Work's results may be explained by the varying dependence of particular species upon specialized habitats provided by each stand. As the sample areas were separated by only one kilometre, and the coniferous sample site immediately bordered a deciduous portion of the forest, some overlap from species with larger ranges or less specialized habitats is to be expected.

Several factors suggest that the forest ecosystem is unhealthy. Primarily, the dominance of *Pterostichus melanarius* is notable because, according to Lindroth, it prefers " light forest ... open meadows, cultivated land [and] waste places."[1, 492] Additionally, it is nonindigenous. *Carabus nemoralis*, frequent in both stands, is both nonindigenous and preferring "cultivated ground, even in parks and gardens in the middle of towns and cities."[1, 38] Even the indigenous species *Pterostichus mutus*, fairly abundant in the deciduous stand, prefers "light forests [and] cultivated soil", being "clearly favored by man."[1, 490] The occurrence and abundance of these beetles, especially the dominance of *P. melanarius*, suggests that the Boucher forest is lacking the diverse, undisturbed microhabitats required to support a greater abundance of indigenous forest species.

To confirm health of these habitats required by carabid beetles, more information about the habitat associations of the species found is necessary to more accurately interpret the data. Additionally, further sampling of carabids and profiling of their habitats would, with comparison to other regional forest stands, indicate ecological affecting the overall health of the system. Additionally, sampling over a longer period, for example, from April to October, might reveal additional trends and species.

6 Acknowledgements

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References

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