# Variation in Carabid Community Structure Associated with Forest Successional Stages

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## Introduction

The project that is currently under way is designed to assess how forestry practices affect carabid community structure. Specifically, the objectives are to gather and quantify data on carabid community structure in each of four successional stages, and to assess changes in species composition and diversity associated with changes in forest age. Carabid beetles (Coleoptera: Carabidae) have been selected for this study for a number of reasons: they have been well worked out taxonomically; they are relatively abundant and diverse; they are easy to trap; and they are highly sensitive to habitat changes (see Niemelä *et al.* [1993]). In addition, as predators near the top of the invertebrate food chain, they are an important component of any ecosystem (Coddington *et al.* 1991).

## Study Areas, Materials and Methods

Data are being collected in two study areas located in the southeastern region of Vancouver Island, referred to as Koksilah and Greater Victoria Watershed South. Both areas are dominated by stands of coastal Douglas-fir and were selected because each contains timber stands of four different ages (i.e., a complete chronosequence) within a 5 x 5 km area. The different aged successional stages are referred to as: 1) regeneration (3–8 years old); 2) immature (25–45 years old); 3) mature (65–85 years old); 4) old growth (>200 years old).

Carabids are being collected by means of pitfall traps. These traps consist of two 450-ml plastic drinking cups, one nested within the other. The inner cup is filled approximately halfway with 35% propylene-glycol, which kills and preserves any insects that fall into the trap. The cups are placed in the ground so that the rim of the nested cup is flush with, or slightly below, ground level.

Twenty-four traps have been set in each successional stage, making a total of 96 traps in each study area. Trap placement is random within the confines of the subplots allotted for this study by project coordinators at Forestry Canada.

Traps are emptied on a monthly basis. Carabids are sorted from the rest of the traps' contents and then identified to species.

## Results

Although there are much data yet to be collected and processed, the preliminary results suggest several trends. First of all, regardless of whether the data are looked at on a month-to-month basis, Koksilah independently of Greater Victoria Watershed, or all collected to date, the regeneration sites are the most diverse followed (in order) by the old growth, mature, and immature stages (Table 1). With equivalent successional stages and collection periods compared, the Koksilah site is more diverse than the Greater Victoria Watershed according to the Shannon and Simpson diversity indices (Ludwig and Reynolds 1988).

TABLE 1. Diversity of successional stages compared

| | Regeneration | Immature | Mature | Old Growth |
|---|---|---|---|---|
| Shannon's Index: H' | 2.10 | 1.35 | 1.77 | 1.99 |
| Simpson's Index: $\lambda$ | 0.133 | 0.310 | 0.205 | 0.155 |
| N2: $1/\lambda$ | 7.53 | 3.22 | 4.87 | 6.44 |

It is clear that different species of carabids respond differently to changes in forest cover. Some species, as exemplified by *Pterostichus herculaneus* Mannerheim, show a decrease in their populations after clearcutting (Figure 1). Within 25–45 years post-cutting, the population has reached or is near its old-growth density.

Species such as *Scaphinotus angusticollis* Mannerheim (and other species of this genus) are completely eliminated by clearcutting. Members of this genus are morphologically adapted to prey on snails (Lindroth 1961). Reduction in vegetation probably affects snail numbers. Population recovery appears to take place once the canopy is re-established (Figure 2).

A third type of response is seen with the species *Pterostichus algidus* LeConte, which appears to survive the clearcutting with just a reduction in number. However, it appears to suffer a continued decline such that none were found in the immature sites (Figure 3).

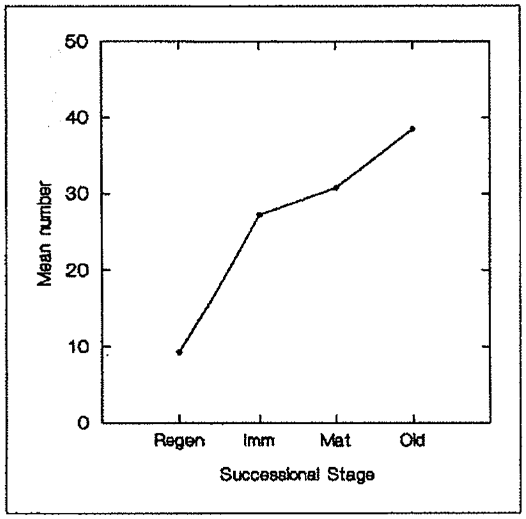


FIGURE 1. Mean number of *P. herculaneus* trapped per stage per month during spring and early summer.

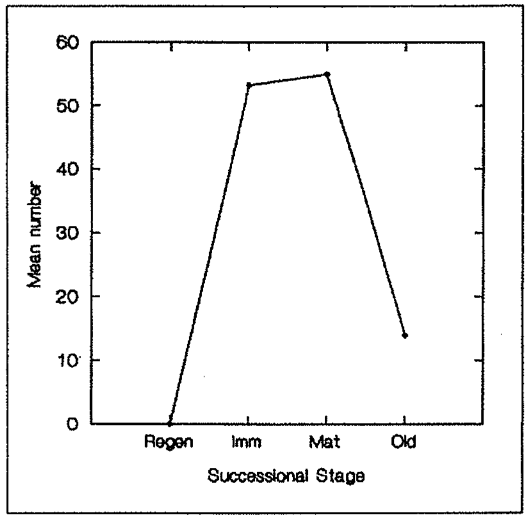


FIGURE 2. Mean number of *S. angusticollis* trapped per stage per month during spring and early summer.

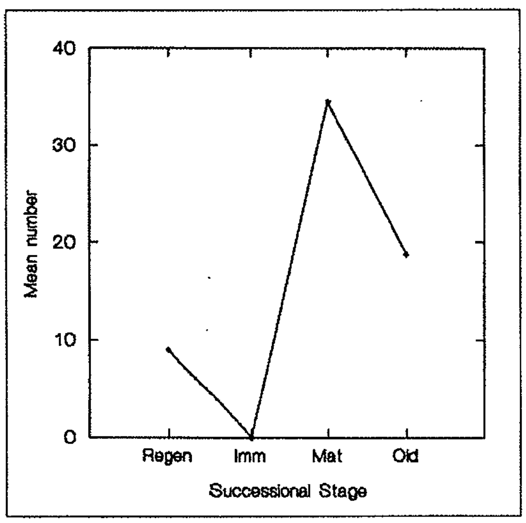


FIGURE 3. Mean number of *P. algidus* trapped per stage per month during spring and early summer.

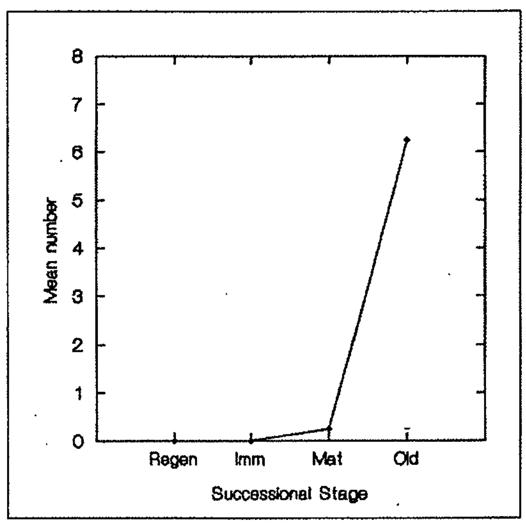


FIGURE 4. Mean number of *Z. matthewsii* trapped per stage per month during spring and early summer.

Finally, there is the true old-growth specialist, *Zacotus matthewsii* LeConte. This species is not found in the regeneration, immature, or even 65- to 85-year-old mature sites (Figure 4). As more old-growth forest is eliminated, such old-growth specialists will become endangered.

It is believed that the trends shown here will become reinforced as more data are processed.

**References**

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