some ecological effects of shelterwood harvesting and site preparation in white pine forests

Red-backed Salamanders

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Background

Ontario's Crown Forest Sustainability Act (RSO 1995) requires that resource managers sustain *large, healthy, diverse and productive crown forests and their associated ecological processes and biological diversity* through appropriate forest management practices. Eastern Red-backed salamanders have been identified as one species that should be monitored as part of evaluating the sustainability of forest management practices (McLaren 1998). Red-backed salamanders are small terrestrial amphibians that live in the forests of eastern North America (Conant and Collins 1991). They are found under stones, in and under logs, and within the organic layers on the forest floor (Heatwole 1962). A variety of characteristics make salamanders good indicators of environmental changes, including:

? Permeable skin – they readily absorb substances from the surrounding environment (Frisbie and Wyman 1991)

? No lungs – their skin must remain moist or it loses its ability to transfer oxygen, making salamanders sensitive to changes in microhabitat temperature and moisture (Heatwole 1962, Feder 1983)

? Act as both predators and prey – they play an important role in forest food webs as predators of forest floor invertebrates (Burton and Likens 1975, Pough 1983, Wyman 1988) and as prey for many other vertebrates (birds, small mammals, snakes), transferring energy from the soil and litter up the food chain (Pough 1983)

Forest management practices have the potential to reduce the abundance of or even eliminate red-backed salamanders from disturbed areas, largely through effects on forest floor microhabitats. Studies conducted in North America indicate that the effects of forest management practices on salamander abundance are related to the intensity of cutting. Clearcutting can temporarily reduce populations (Pough et al. 1987; Petranka et al. 1993, 1994) and has been cited as causing local extirpations of salamanders (Wyman 1988, Dupuis et al. 1995, Waldick et al. 1999). In contrast, small-scale disturbances, such as firewood cutting (Pough et al. 1987), thinning (Brooks 1999), and selection cutting (Enright 1998, Messere and Ducey 1998), appear to have little effect on salamander populations; whereas shelterwood cutting appears to have some effects (Harpole and Hass 1999).

The effect of shelterwood management of white pine forests on redback salamander abundance has not been studied or at least there is no information in the published literature. In addition, few of the existing studies with other tree species were designed to isolate and evaluate the effects of different site preparation treatments after harvesting, using a replicated design that includes pre-treatment and habitat data (DeMaynadier and Hunter 1995). Results from the study reported here will help to evaluate the sustainability of current white pine management practices in Ontario.

Objective

To assess and compare the effect of harvesting followed by 4 site preparation treatments on the relative abundance of red-backed salamanders in white pine stands in central Ontario.

Methods

Salamander abundance was monitored using cover boards based on the non-destructive sampling method of DeGraaf and Yamasaki (1992). A grid of 20 sample boards spaced 8-m apart was located within each of the 15 treatment plots, approximately 25 m from the edge of the plots. Rough-cut red pine boards, measuring approximately 76 x 20 x 2.5 cm were placed on the ground in complete contact with the forest floor but without removing forest litter. Boards were placed in the fall before the spring sampling period to allow for weathering and were checked pre-treatment in spring 1995 and post-treatment in the spring of 1998, 1999, and 2000 on approximately the same day each week. They were checked once a week for 10 weeks, beginning the first week of May. Boards were simply turned over and the number and species of salamanders counted. Animals were not handled.

Analysis

The salamander data were analyzed for each year individually using 1-way ANOVAs with randomized blocks (a 2-way ANOVA was considered, but could not be implemented because data did not meet the assumptions of homogeneity of variances). Data were

tested for homogeneity of variances using Levene's test and transformed when appropriate. Multiple comparisons were conducted using Ryan-Einot-Gabriel-Welsch-Q test (SPSS Inc. 1997) when significant effects were detected. Statistical significance was set at the 5% level.

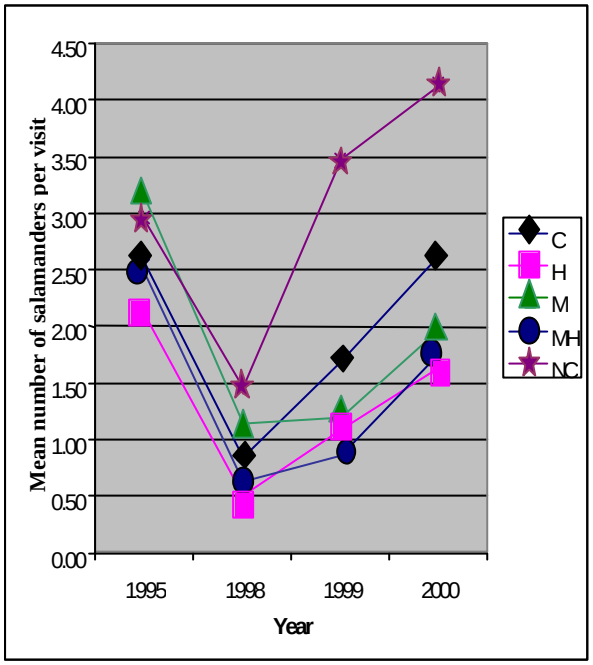

Figure 1. Changes in relative abundance of red-backed salamanders over time.

Initial Results

Shelterwood cutting and site preparation immediately affected the number of redback salamanders found under cover boards. The effects of cutting alone appear to be short term (<3 years), but site preparation appears to have longer-term effects. Preliminary analyses show that vegetative cover (understory woody vegetation and canopy cover) may be related to the relative abundance of salamanders found under the cover boards. Other researchers have indicated that this relationship is important (Pauley 1978a,b; Feder 1983; deMaynadier and Hunter 1998), and is a function of the effect of vegetative cover (and associated shade) on temperature and moisture conditions under the cover boards and in forest floor litter (Heatwole 1962, Harpole and Hass 1999).

Future Work

To better understand the effect of forest management practices tested in the study, the relationship between salamander abundance and several habitat features (DWD, ground cover of herbaceous and woody vegetation, canopy opening, litter depth, cover of mineral soil) will be tested using correlation analysis. Salamander abundance will be monitored annually for a minimum of 10 years to assess the persistence of treatment effects. A journal paper reporting on the first 5 years of the study will be available in 2003.

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