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

Plant diversity

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Background
Scientists, forest ecologists, wildlife biologists and the public have express considerable concern over the potential effects of forest operations on native forest flora especially the loss of species and structural diversity and to a lesser extent the introduction of exotic “weed” species (Mosquin *et al*. 1995, Bunnell 1998, May 1998). Forest management, especially intensive forest management, is often cited as a major contributor to the loss of species from forest communities (Mosquin *et al*. 1995). Each silvicultural intervention (i.e., harvesting, site preparing, planting, and tending) can affect plant richness, abundance, and evenness differently. To the extent that each activity is successful, managed plantations may lack the diverse tree species, the multilayered canopy, and the diverse number of indigenous plant species that exist in natural forests (Mosquin *et al*. 1995).

Forest management practices are known to change plant diversity. Clear-cutting, for example, affects bryophyte (moss) diversity by changing microhabitats. Disturbing or removing woody material and organic matter, increasing air or soil temperatures, and the drying of logs and stumps all contribute to this effect (Laaka 1992, Hämet-Ahti 1983). Recent research in Ontario has shown that bryophytes and lichens show species-specific responses to herbicides (triclopyr and glyphosate) after clearcutting (Newmaster *et al*. 1998). Colonists and drought tolerant species are somewhat resistant even when subjected to twice the normal application rate. The mesophytic forest species can be eradicated using only half of normal application rates. Very little is known about the effects of shelterwood harvesting and typical site preparation treatments in white pine stands on plant diversity.

Objectives

? To examine the effects of shelterwood harvesting and site preparation treatments on plant species richness, abundance and succession.

? More specifically this research will help define which forest management practices will:
  a) lead to the loss of indigenous plant species,
  b) create single layered single species tree monocultures, and/or
  c) provide opportunities for the establishment of exotic species.

Methods
Five 10 m x 10 m (100 m^2) sub-plots were established in each of the 15 treatment plots. Botanical surveys were conducted in August of each year from 1995 to 2000. Each of the plants species identified in the 75 subplots was given a foliar cover estimate to the nearest 5 % by forest ecosystem classification layer:
L1 – dominant tree cover
L2 – subdominant tree cover
L3 – 2.0 to 10.0 m shrub layer
L4 – 0.5 to 2.0 m shrub layer
L5 - < 0.5 m shrub layer
L6 – herb, grass, sedge & fern layer
L7 – bryophyte and lichen layer
L8 – fungi layer
For this analysis, each species was summed across layers within a treatment to obtain total foliar cover by species and treatment. Species richness was calculated for each of the 5 treatment plots and 3 blocks for the pre-treatment (1995) and for 3-yr post-treatment (2000). Species

richness within several life forms was compared among the test treatments.

Results

In 1995, the mature undisturbed forest contained 144 species consisting of 41 woody species, 40 herbs, 8 sedges/grasses, and 55 cryptogams (ferns, mosses and lichens). Diversity increased from the forest floor to the overstory, with 110 species near the forest floor compared to 18 species in the overstory. Before harvesting and site preparation, the total number of species and the number of species within each life form was similar among treatments. Three years after disturbance, species richness increased in all treatments, except for plots harvested and treated with herbicide, where there was a slight decrease in total number of species. When the data was examined more closely, it became apparent that, although there was an overall increase in the number of species, some species were lost and others were gained (Table 1). Even plots that were not disturbed showed changes in species composition, indicating that the system is dynamic and not totally dependent on disturbance for change.

Harvesting also had an effect on plant abundance, as assessed by ocular estimates of ground cover. Pre-harvest abundance, partitioned by life form, was evenly distributed among the plots. Woody vegetation covered approximately 100% of the plots, herbs 20%, grasses and sedges 7%, ferns 33% and mosses 6 %. Harvesting and site preparation increased the abundance of some life forms and decreased others. The cover of cryptogams was reduced by all harvest and site preparation treatments, with the cover of bryophytes reduced by chemical site preparation. Fern cover was reduced in plots treated with mechanical scarification. The cover of grasses and sedges were reduced on plots that were treated with herbicides, both alone and in combination with mechanical scarification. The cover of herbs, shrubs and small trees was reduced in all the harvested plots.

References

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Table1. Species lost and gained from 1995 to 2000.

Life Form	Treatment[1]									
	C		H		M		MH		NC	
	Gain	Loss	Gain	Loss	Gain	Loss	Gain	Loss	Gain	Loss
Crypotogams	9	6	8	17	14	11	11	15	19	8
Grass/Sedge	7	0	7	0	14	0	12	0	3	0
Herbs	10	9	8	10	22	3	20	4	10	2
Woody	7	5	7	9	4	5	4	6	4	1
Total	***33***	***20***	***30***	***36***	***54***	***19***	***47***	***25***	***36***	***11***
Net Change	***+11***		***-6***		***+35***		***+22***		***+25***	

1. C=Cut, no site preparation, H=cut, herbicide site preparation, M=cut, mechanical site preparation. MH=cut, mechanical and herbicide site preparation, NC=no cut, no site preparation.