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Project final report

May 2004

Title of Project

Effects of Forestry Practices on Plant Diversity: Monitoring vascular plants and bryophytes in permanent quadrats

Project number (office use)	**Budget Approved (office use)**	**Date (office use)**

Joint report of: **Drs. Kate Frego and Mark Roberts**	**Report Date** 7 June 2004
Organization UNB – Saint John and Fredericton	**Position** Full Professors
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Research by Individual ( ) **Team (X)**	**Length of Study (years)** **9th of 12**
Working Group **ETM**	**Start Date** 12 May 2003 **End Date** 30 April 2004
Total Funding ($) Requested ($9,600 bryo + $7,100 vasc) **$16,700 total**	**FMF Fiscal Year** 2003-4
Research Partners **J.D. Irving Ltd.**	

10 Key Words
bryophyte, disturbance, diversity, forest floor, monitoring, moss, permanent, recovery, regeneration, vascular plants

Summary

This is the ninth year of this long-term project monitoring the responses of understory plant communities in 175 permanent plots (quadrats) in the Hayward Brook Watershed from 1995 (pre-harvest). Aside from providing insight into the earliest stages of disturbance response (0-12 years), this project is unique in that (a) spatially specific pre-disturbance data allow us to document with certainty the changes in community composition (unlike dependence on the assumptions associated with chronosequence approach); and (b) the intensive sampling procedure and fine-filter approach allows us to document extremely sensitive species (such as the liverworts) that are overlooked in most other studies. The regeneration of seedlings and saplings on these sites is now sufficiently advanced that many of the pre-harvest microhabitat conditions (such as temperature, humidity and light regimes) at the forest floor are likely to have returned; this is may be a critical stage in community assembly.

In 2002, due to shortage of funds, we postponed sampling but spent considerable effort in remarking all the quadrats as the markers were degrading. In 2003 we proposed to resample the existing quadrats, along with a suite of environmental characteristics, to continue documenting the processes of community changes associated with forest management practices used in this area. However, along with the minor delays related to a late spring and other set-backs in the linked "Leave patch" project, we have experienced a major delay: thinning in the area removed almost all of our markers (most, deliberately) and deposited a great deal of material that had to be quantified. As a result of the former, in particular, we are likely to finish sampling only approx one half of the quadrats in 2003, and will need a second field season to amass the full dataset.

Introduction and background

In 1995, we established and sampled all vegetation in 156 quadrats (each 1.25m^2 for bryophytes and 5m^2 for vascular plants) throughout several blocks of the Hayward Brook watershed that were slated for clearcut. In 1996, we established an additional 19 quadrats in the adjacent riparian buffer, resampled those in the cut to describe the disturbance effects of the harvest operation, and have since resampled in 1997 and 1999 to monitor the changes/recovery of the forest floor community. Our results have documented:

1. immediate changes in the community in response to (a) canopy removal, (b) slash deposition, and (c) substrate disturbance (scarification), including loss of many species (Peterson 1999, Zhu 1998);
2. gradual changes in subsequent years, including decline of some species (e.g., some 20 species of vascular plants), invasion of some new species, and spread of some survivors (Fenton et al. 2003, Roberts and Zhu 2002);
3. bryophyte species, especially liverworts, that appear to be at risk (#1 and 2) persist at least 4 years in tree islands, in relation to height of residual canopy and degree of substrate disturbance (Fenton 2001);
4. the riparian buffer does not act as a refugium for bryophyte and vascular species likely to be impacted by harvesting in upland stands because it contains a different suite of species from those communities.

The coincidence of species that declined in the clearcut, their continued absence in plantations, and even from naturally regenerated stands of a range of ages (Ross-Davis and Frego 2002, Ramovs 2001, Ramovs and Roberts 2003) and their absence or infrequency in

the bryophyte diaspore rain and propagule bank (Ross-Davis 2001), suggest that at least some of the forest floor species are at serious risk.

PROJECT OBJECTIVES

The goal of this project is to fill the knowledge gap concerning the dynamics of the earliest stages of disturbance response (0-12 years). Results of our other studies indicate that, in order to document changes in the rare and potentially most sensitive species (about which least is known, globally, such as the liverworts) this must be done (a) using repeated sampling (b) at a fine scale.

The objective, therefore, is to assess changes in the permanent quadrats relative to (a) their preharvest condition, (b) management treatment at the fine scale, (c) through time since disturbance. More specifically, the objectives are to:

1. improve the quantitative understanding of the forest floor (including bryophyte, vascular plant and tree regeneration) component of forest ecosystem structure and function, by:
(a) contributing to the knowledge of native biodiversity of these species (Year 1), and
(b) contributing to the knowledge of the ecological processes involved in re-establishment of forest floor communities after various levels of disturbance (following years).

2. relate changes in vascular plant and bryophyte diversity to operational forest management procedures: clear-cut, clear-cut plus scarification, herbicide application, residual tree canopy, riparian buffer strips.

3. fill information gaps in terms of ecological data on ecologically important but poorly understood plant species

METHODS

Field sampling

Regeneration of seedlings and saplings on these sites is now sufficiently advanced to form a closed canopy for the forest floor, hence many of the pre-harvest microhabitat conditions (such as temperature, humidity and light regimes) at the forest floor are likely to have changed dramatically; this is likely to be a critical stage in community (re)assembly. The quadrats were relocated and remarked in 2002 to prevent loss.

To date, we have resampled 70 of the 155 existing quadrats, quantifying the vascular plants and bryophytes along with a suite of environmental characteristics, to continue documenting the processes of community changes associated with forest management practices used in this area. (Over one half of these have been completed at time of writing.)

Analysis

Comparisons will be made (a) within quadrats over time, and (b) among treatment categories (e.g. cut vs cut and scarified vs residual patches) using both univariate (species by species) and multivariate (guilds and community composition) approaches, building on the protocol of Fenton (2001). Species response patterns will be interpreted in relation to ecological traits such as mode(s) of regeneration, substrate specificity, and life-form, and related to the results of our other studies in this area. We will continue to test and refine our list of species

indicators of sustainable forest management, such as the ~20 vascular species identified by Roberts and Zhu (2002).

Progress to date

Sampling is much slower than expected. The reasons for this reflect the interrelated nature of our two projects ("Leave patches" and "Hayward Brook Permanent Quadrats").

1. Late start to field season. This year's unusually late spring delayed sampling of vascular vegetation.

2. Personnel limitations. The budgets for this Hayward Brook and the Leave Patches projects are linked, and personnel are shared to some degree. Because the work on the Leave Patches is constrained by the harvest operation schedule, all personnel were needed urgently on the Leave Patch project at the beginning of the season. Based on previous years' sampling in Hayward Brook, there was sufficient time for completion (especially having remarked the Hayward Brook transects and quadrats last year to speed quadrat location). However, partway into the field season, one graduate student in the Leave Patches project was forced to leave the project for health reasons, leaving us short-handed.

3. Loss of plot markings. Sampling was dramatically slowed by activities of thinners in the area. Unfortunately, thinning removed all the flagging tape markers, and most of the marking stakes were deliberately removed, and even chopped into bits. As a result, the team was forced to spend an unusual amount of time in simply locating the quadrats. The debris created by the thinning has also increased their sampling time, as it must be quantified.

Expected impact of delays

Given the setbacks in this project, and related setbacks in the Leave Patches project with consequences for this project, we finished only about one half of the permanent quadrats this year, before the weather and hence the vegetation changes. This is an unprecedented situation for us, but it was unavoidable. After lengthy discussion, we have determined that the data for this long-term monitoring project will not be unduly affected, and we are completing the sampling this summer (2004).

However, it does mean that there are no data to report in this document.

Financial reports

Attached.

References cited:

Fenton, N. 2001. Factors influencing re-assembly of forest floor bryophyte communities after forest harvest: disturbance severity and potential refugia. M.Sc. thesis, Biology, UNB Saint John.

Fenton, N., Frego, K. and Sims, M. 2003. Changes in forest floor bryophyte (moss and liverwort) communities four years after harvest. Canadian Journal of Botany (accepted March 2003).

Peterson, J. 1999. The effects of forest harvest on bryophyte recolonization in a mixed forest in New Brunswick. M.Sc. thesis, Biology, UNB Saint John.

Ramovs, B. 2001. Understory plant composition, microenvironment and stand structure of maturing plantations and naturally regenerated forests. M.Sc.F, thesis, Forestry, UNB Fredericton.

Ramovs, B., and Roberts, M. 2003. Understory vegetation and environment responses to tillage, forest harvesting and conifer plantation development. Ecological Applications (accepted March 2003).

Roberts, M. and Zhu, L. 2002. Early response of the herbaceous layer to harvesting in a mixed coniferous-deciduous forest in New Brunswick, Canada. Forest Ecology and Management 155: 17-31.

Ross-Davis, A. 2001. Forest floor bryophyte community composition and structure in relation to habitat conditions and propagule availability. M.Sc. thesis, Biology, UNB Saint John.

Ross, A.L. and K.A. Frego. 2002. Comparison of three managed forest types in the Acadian forest: diversity of forest floor bryophyte community and habitat features. Canadian Journal of Botany 80: 21-23.

Zhu, L. 1998. The effects of harvesting on the species composition and diversity of the herbaceous layer in a mixed forest in New Brunswick. M.Sc.F, thesis, Forestry, UNB Fredericton.

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Financial & Administrative Services

gust 26, 2003

Fundy Model Forest
Fiscal 2003/04
Statement of Expenditures
May 1/03 to August 31/03
Effects of Forestry Practices on Plant Diversity

Dr. Kate Frego

	DGET	ACTUAL	Balance
ue	9,600.00	$ 4,800.00	$ 4,800.00
ıt Salary	8,400.00	$ 9,523.68	$ (1,123.68)
	450.00	$ 230.21	$ 219.79
modations	750.00		$ 750.00
als and Supplies	-	$ 80.92	$ (80.92)
l Expenses	9,600.00	$ 9,834.81	$ (234.81)
e of 03/04 funding	-	$ (5,034.81)	
nds carried forward from 02/03		$ 2,838.38	
t balance		$ (2,196.43)	
by Fundy Model Forest		**$ 4,800.00**	