Final report for 2002-2003

Title of Project:

Effects of forestry practices on plant diversity: Monitoring vascular plants and bryophytes in permanent quadrats

Proponents:

Dr. Kate Frego (with Dr. Mark Roberts)

Summary:

Our work in the Hayward Brook Watershed and elsewhere in the FMF has determined that many forest floor species decline immediately following forest harvest, with differential sensitivity to (a) canopy removal, (b) slash deposition, and (c) substrate disturbance (scarification) (Peterson 1999, Roberts and Zhu 2002). Another group of species decline gradually in subsequent years, while others invade. As the community re-assembles, the relative contributions of such invaders, closed-canopy survivors, and colonizing closed-canopy species vary with management components. For example, a large proportion of the bryophyte community survives in "tree islands" of residual canopy >1m with no substrate disturbance (Fenton 2001), while a suite of invaders occurs in scarified areas. Many species lost immediately after canopy removal at Hayward Brook were absent in plantations >20 yrs, and even in naturally regenerated stands (Ross Davis and Frego 2002, Ramovs and Roberts 2003). While this suggests that at least some forest floor species are at serious risk of extirpation, (a) we cannot be sure, in the latter chronosequence study, that these species were present in the stands before harvest, and (b) we do not know what precludes their re-establishment. Ross Davis (2001) showed that, for bryophytes, continued absence of key species may well be related to low propagule availability and/or dispersal limitations.

Monitoring the permanent plots at Hayward Brook is critical (a) to provide insight into the earliest stages of disturbance response (0-12 years), (b) to document with certainty the changes in community composition compared to its pre-disturbance state; and (c) to document the responses of extremely sensitive species (such as the liverworts) that are overlooked in most other studies.

In expectation of continued monitoring, we remarked the permanent quadrats: replaced broken, missing or decomposing wood stakes with new, painted stakes and replacing flagging tape markers with fresh tape (orange and black stripe, to contrast with those used by forest managers in the area). This will ensure that quadrats can be easily and accurately relocated in 2003.

***Indicators of Forest Harvesting Effects*:** Before sustainable forest management can be successfully implemented, we require accurate predictive models of forest community response to management treatments, including valid indicators of forest

harvesting effects that can be used in monitoring. This project, begun in 1995 with FMF support, is one of the few to investigate the responses of the forest floor plants (herbaceous vascular plants and bryophytes) using rigorous methods that detect with a high degree of certainty community changes at a scale relevant to the most sensitive species in this guild (i.e. the liverworts).

Long-term objectives of project:

1. Improve the quantitative understanding of the forest floor (including bryophyte) 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.

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.

In 1995 (Year 1), 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 clear-cut. In 1996, we established an additional 19 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 in areas that (a) remained uncut (leave strips), (b) were clear-cut, and (c) were cut, scarified and planted. Our results have documented:

1. immediate changes in the community, related to (a) canopy removal, (b) slash deposition, and (c) substrate disturbance (scarification), including loss of many species (Peterson 1999, Roberts and Zhu 2002);
2. gradual changes in subsequent years including decline of some species, invasion of some new species, and spread of some survivors (Fenton et al. 2003);
3. bryophyte species that appear to be at risk (#1 and 2) persisted at least 4 years in “tree islands”, under residual canopy >1m tall without substrate disturbance (Fenton 2001);
4. the minimal conservation contribution of riparian buffer strips, which do not act as refugia for bryophyte species likely to be impacted by harvesting in upland stands because they contain a different suite of species from those communities.

The co-incidence of species that declined in the clear-cut, their continued absence in plantations, and even from naturally regenerated stands, of a range of ages (Ross-Davis and Frego 2002,Ramovs and Roberts 2003) and the absence or infrequency of these species in the bryophyte diaspore “rain” and propagule bank (Ross-Davis 2001), suggests that at least some of the forest floor species are at serious risk.

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

The overall objective, therefore, is to assess changes in the communities in permanent quadrats relative to
(a) their preharvest condition,
(b) management "treatment" at the fine scale,
(c) through time since disturbance.

Methods. Although we were not funded to resample the existing quadrats iin 2003, we were able to remark the quadrats. This entailed replacing original wooden stakes (many of which were decomposing or broken) with new, painted stakes, and refreshing labels and flagging tape markers to ensure that all quadrats could be found in subsequent years.

Status. All quadrats were found and successfully remarked as planned. With current funding, the vegetation and environmental features of each will be resampled in 2003 as planned.

Future. Data collected in 2003 (Year 9 of the project, 8 years post harvest) will be used to compare (a) changes within quadrats over time, and (b) among treatment categories (e.g. cut vs cut and scarified vs leave/buffer strips) 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. As we tease apart the impacts of management components, we will identify those with critical impacts on the forest floor community.

References cited:

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