Residual Heterogeneity Within Fires
A Research Proposal for SERUG Consideration

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SUBMITTED BY:
The Foothills Model Forest Natural Disturbance Program, Hinton, Alberta

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INTRODUCTION

The Foothills Model Forest (FMF) and its' partner organisations initiated a long-term research program in 1995 to study and describe natural and cultural disturbance patterns and processes across over two million hectares in the Rocky Mountains and Foothills natural regions of Alberta (Andison 1999). This cooperative program was intended to span several years, and includes a detailed list of approximately 25 individual research projects from empirical research to communication to simulation modelling. Together, the FMF Natural Disturbance Program (NDP) projects are intended to form an integrated knowledge base with which to generate, discuss, and defend sustainable management strategies and policies in Alberta based on the natural pattern model. This research program is the most comprehensive of its' type in North America, and focuses on practical issues. Research findings from other NDP projects have already found their way into long-term management plans (Andison 1998), policy and regulation discussions, and a wide range of communication and educational vehicles.

To date, we have successfully quantified coarse-scale pattern, mainly with respect to how often, how large, and in what way fires burn across the landscape (Andison 1999b, 2000). We have now begun to delve into finer scale-issues. Last year, we initiated a pilot study to define the nature of non-island residual material on fires in Alberta's foothills. We are seeking $70,000 from RNP of a total 20001/02 project budget of $107,000 to expand the NDP Residual Heterogeneity project to a second full field season and initiate the analysis.

RESIDUAL MATERIAL IN FIRES

At least three formal studies of residual material in the boreal forest currently exist (including our own NDP study). However, all of them focus on clumps of residual material as "islands". Small-scale heterogeneity has been shown to have biological significance in the boreal forest (Niemela *et al*. 1996). To date, no knowledge exists at finer scales of the detailed structural and compositional characteristics of non-island residual live and dead material. Even the most

severe fires leave live and dead material scattered within them, as trees, understorey, or ground vegetation. One cannot claim to understand disturbance patterns, or use natural patterns as a template for management without looking at how, why, and at what spatial scale site-specific heterogeneity occurs. Nor should we be assuming that the "average" or "minimum density" approach to residual material adopted by BC, and more recently Ontario, emulates the natural range of variation at fine scales. Visual examination of recent fires alone tells us that non-island residual material patterns and amounts vary widely in space. Without scientific study, such guidelines are at best indefensible, and possibly wrong altogether (in that fires may not leave residual material in the manner in which they prescribe).

POTENTIAL APPLICATION OF RESULTS

In principle, our partners are committed to studying and understanding the full suite of natural patterns, and feel that the legitimacy of the "fire emulation" strategy of sustaining ecological values extends equally to fine-scale issues such as residual material. The general application of these results is thus to assist in the conservation of biological diversity in the Rocky Mountains and Foothills of Alberta through an improved understanding of natural disturbance processes at a range of spatial scales. With such understanding it will be possible to assess planned management activities at fine-scales such as forest harvesting and fire management tactics in relation to natural ranges of variability. Specifically, knowledge of fine-scale patterns has implications for not only harvesting methods and targets, but also burn planning targets, and biodiversity monitoring guidelines. This knowledge will help define "natural" target ranges for the distribution, spacing, density, and types of residual patterns at the site-scale in cultural disturbances. We fully expect these results to interconnect logically, and practically, with the findings from both the Island Remnant study, and the Edge Architecture study. This demonstrates the power of an integrated research program of which this project is a part.

OBJECTIVES

To quantify the pattern, if possible the processes responsible for, and the relevant spatial scales of, "non-island" residual material leftover after a fire in the foothills and mountain areas of central Alberta, including live standing material, dead standing material, and mineral soil exposure. Over the longer term, we also hope to be able to follow the progression of these transects over time to reveal any temporal patterns.

METHODS

The methods described below have already been reviewed by independent experts, and field-tested during the summer of 2000.

The pattern of post-disturbance heterogeneity is ideally studied on recent fires. Aside from the winter fires of 1997, no recent fires (within the last 20 years) exist on the FMF. There are only two other recent forest fires close to the FMF in which small-scale patterns may be studied and reasonably extrapolated to the

FMF area: the Virginia Hills fire north of the Weldwood FMA (~177,000 ha), and the Moose fire immediately adjacent to the Jasper Park boundary in the Robson District of BC (~2,500 ha). Both of these fires will be used as the sample population.

It is understood that even the most thorough study of fine-scale heterogeneity on two fires does not necessarily represent the full range of conditions on fires in Alberta's foothills. These fires burnt under specific fire weather and fuel conditions. However, fires of any significant size are not common in this area, and these represent a tremendous opportunity to allow us to begin understanding the nature of some pattern details of fires in these forests. At the very least, we will have sampled one fire from the foothills area (Virginia Hills), and one from the sub-alpine (Moose).

The areas of interest for sampling are those areas that have been completely consumed by fire, the assumption being that all other areas would be defined as "islands" of some type. To create a map of such areas, we will first use maps that Millar Western Forest Products and Blueridge Lumber have provided which classify the study area by burn type (partial or complete). The sample frame will be limited to those parts of the fires that are not, and will not be affected by salvage cutting, cultural disturbance, or mechanical fire control activities.

Belt transects 5m wide and up to 50m long will be randomly located throughout the eligible area. The total sample size for the Virginia Hills fire is 50, and for the Moose fire 20. We expect less than half of this number to actually be completed in the 2000 field season, the remainder of which will be installed in 2001.

Note that for efficiency, the method of transect sampling outlined here has been designed to match that of another NDP project on Edge Heterogeneity of fires, which has also been submitted as a proposal to SERUG.

Square quadrats $25m^2$ will be sampled continuously along each transect. In each transect the following information will be recorded; counts of live and dead standing trees by species, breast height diameter (nearest cm), height class (nearest 5m class), slope, aspect, elevation, topographic position, and ecological classification. At 5m intervals beginning at 2.5m (the center of the first quadrat), mineral soil exposure (as a percent of total area), and estimates of ground cover will be calculated on $4m^2$ square sub-plots. In each $25m^2$ quadrat, a tree core will be taken at stump height on at least three dominant or sub-dominant trees (if they exist). All tree cores will be labelled, stored in straws, glue mounted, sanded, and aged using a microscope. Line intersect sampling (LIS) will be used to measure the amount and type of coarse woody debris. The distance, species, height above ground, and diameter of all downed material will be noted where it crosses the centre line of the belt, and recorded within the relevant quadrat.

Analysis will include simple descriptive summaries of the average, range, and

standard deviation of amounts of live and dead standing stems, dead downed material, mineral soil exposure, and ground vegetation coverage. Regression, and possibly Principle Components Analysis will determine any relationships between the measured residual pattern metrics and the various GIS or field measured site features. Finally, semi-variograms will be developed by grouping adjacent quadrats to test for the presence of multi-scale spatial preference in the patterning of residual stems, material or mineral soil exposure.

Finally, while not a formal part of this project, every effort will be made to make these transects permanent. Re-measurement at five-year intervals will provide invaluable information about how residual material changes over time, and natural regeneration responses to those patterns.

Sampling will take place over two years. A total of (50+20=) 70 samples were chosen, and the target sample size for the 2000 field season was 20 transects for Virginia Hills, all of which were successfully installed. We are seeking funds to install the remaining 50 transects in 2001/02, and initiate the analysis.

RESEARCHERS INVOLVED

The Principle Investigator (PI) for this project is Dr. David Andison (author of the proposal). Dr. Andison is a landscape ecologist with extensive experience in the study of forest fire patterns at multiple scales, fire research techniques, simulation modelling, and sampling methodologies. Dr. Andison is also an Adjunct Professor with the University of BC Forest Sciences Department. As a trained forester, he and works directly with several western Canada forest companies and provincial governments providing advice, workshops, and presentations towards integrating natural pattern concepts into forest management. Dr. Andison has been the PI for the FMF NDP for five years.

Ms. Kristina McCleary (Bandaloop Landscape-Ecosystem Services) is the program biologist, and is responsible for coordinating field data collection, and assisting with the analysis and reporting. Ms. McCleary has a Master's in Biology, and has seven years experience coordinating and leading ecological research and large field programs in Montana and BC, and 1½ years experience with natural disturbance research.

COLLABORATORS, BUDGET, TIMELINE, and the MASTER PLAN

The tremendous interest in this research has attracted several research partners, including several who for the first time are collaborating with the Foothills Model Forest. In our pilot year, we completed all of the pre-sampling work for both Virginia Hills and the Moose fires, and installed 20 transects in the Virginia Hills fire for about $54,000. Next year, we propose installing another 30 transects in Virginia Hills, plus 20 in the Moose fire. This will require a substantial increase in resources that we do not have under our current budget forecast. In support of this goal, we are requesting a total contribution of $70,000 from the RNP. It is important to understand that the field sampling for this project, along with an

edge architecture study, and an island remnant detail study, all take place in the same locales. Access is difficult and expensive, and thus there are certain economies of scale to be gained by completing the fieldwork for all three at once. If SERUG helps support this and the edge architecture study, the NDP partners will fund the remaining island remnant study. It is also important to note that the total annual budget for the NDP research, of which this project is a part, has been at least $225,000 for the last five years. The details of the other research partners and their past and proposed contributions for this particular project are given below. In-kind contributions include Millar-Western Forest Products, Blueridge Lumber, and AES.

Research Partner	**00/01 $Contribution**	**Proposed 01/02 $Contribution**
Foothills Model Forest	3,000	3,000
Alberta Newsprint Co.	2,000	2,000
Alberta Environment	5,000	5,000
Weldwood of Canada Ltd.	20,000	15,000
Alberta Forest Products Association	15,000 (one-time)	-
Jasper National Park	1,000	1,000
Blueridge Lumber	8,000	8,000
BC Parks	-	2,000
BC Ministry of Forests	-	1,000
RNP Funds Requested	-	*70,000*
TOTAL	**54,000**	**107,000**

Budget details for this project are available upon request.

LITERATURE CITED

Andison, D.W. 2000. Landscape-level Fire Activity on Foothills and Mountain Landscapes of Alberta. Alberta Foothills Disturbance Ecology Research Series Report No. 2. Foothills Model Forest, Hinton, Alberta

Andison, D.W. 1999. FMF Natural Disturbance Program Long-Term Research Plan. FMF Internal Report, Hinton, Alberta.

Andison, D.W. 1999b. Assessing Forest Age Data in Foothills and Mountain Landscapes in Alberta: Laying the Groundwork for Natural Disturbance Research. Alberta Foothills Disturbance Ecology Research Series Report No. 1. Foothills Model Forest, Hinton, Alberta.

Andison, D.W. 1998. Patterns of temporal variability and age-class distributions on a Foothills landscape in Alberta. Ecography 21:543-550.

Neimela, J., H. Haila, and P. Punttila. 1996. The importance of small-scale heterogeneity in boreal forests: variation in diversity in forest-floor invertebrates across the succession gradient. Ecography 19: 352-368.