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The Natural Disturbance Program for the Foothills Model Forest: A Foundation for Growth

David W. Andison

Abstract

For two years the Foothills Model Forest in Alberta supported an extensive natural disturbance research program across more than 2.5 million hectares including Jasper National Park and the Weldwood of Canada Forest Management Agreement in Hinton, Alberta. This long-term integrated program consists of over 20 individual projects, from landscape-level pattern descriptions, to island remnant studies, to understanding fire edge architecture. The complexities of natural disturbance processes are such that the program strategy is allowing us to develop a complete picture of disturbance patterns and processes across scales. Almost half of the projects have begun, and we are beginning to publish, interpret, and implement some of the results both on the Forest Management Agreement and in the Park. We are also using experimentation as a means of testing biological responses to some of our interpretations and testing the potential for reintroduction of fire in some areas. Furthermore, the recently initiated biodiversity monitoring program has already decided to use "natural range of variability" results from the Foothills natural disturbance program as baseline biological indicators.

Introduction

The Foothills Model Forest, in cooperation with Weldwood of Canada, Jasper National Park, Weyerhauser Company, and the Alberta Lands and Forests Service, has been involved in an extensive natural disturbance research and development program for the past three years. The area of study covers approximately 2.5 million hectares of fire-dominated eastern Rocky Mountain foothills and mountain land in Canada. The Foothills Model Forest includes the Weldwood Forest Management Agreement, Jasper National Park, and other Alberta provincial land. To date, we have completed three field seasons, initiated eight projects, and expect to have several more underway in the next two or three years. We have at least preliminary results for four of the projects (Andison 1997; MacLean et al. 1997), have submitted manuscripts for three of them (Andison 1998; Andison et al. 1999; Farr et al. 1999), and are in the process of transferring the results to the partners' area managers and planners.

Expending this much effort to understand natural disturbance may seem to some to be extravagant, or even unnecessary. Like all responsible science, however, the answers must address the questions asked. In this case, a single question posed at the outset precipitated the research: *What are the historical "natural" disturbance patterns and processes on the Foothills Model Forest?*

We are not the first to pose this question, nor are we the first to recognize the tremendous potential of using a natural disturbance paradigm to reach ecosystem management goals (Burton et al. 1992; Franklin 1993; Sapsis and Martin 1994). From the beginning, however, we have recognized that we placed ourselves in a precarious position by selecting a natural disturbance strategy to achieve ecosystem management ideals. Consider that our collective knowledge of disturbance as a process is quite limited. We are only beginning to grasp the complexities of natural disturbance processes in many environments, and in most, we do not have the necessary data. Given that situation, it is ironic that accepting a natural disturbance strategy necessitates assuming that whatever patterns we study and quantify are meaningful in terms of biodiversity. We have no empirical evidence to show that incorporating natural patterns in management strategies results, for more than a handful of species, in higher levels of ecological sustainability. In other words, we are taking a leap of faith that the patterns we measure and subsequently adopt are directly associated with a positive, linear ecological response.

This does not mean that the natural disturbance strategy has no merit, but rather (1) that we are obligated to conduct thorough research, and (2) that we should not take for granted the connection between observed pattern and ecological integrity. It is easy to think we are emulating "natural" patterns and thus being more ecologically sustainable, when in reality we may not be. The key to successful emulation strategies is mainly in the questions we ask and in how we answer them. Three examples from the natural disturbance research program at the Foothills Model Forest demonstrate the importance of asking the right questions and carefully designing research to successfully answer them.

Example 1

A commonly asked question in natural disturbance work is, "What is the frequency and/or cycle of disturbance?" In asking this question, we refer to the frequency with which disturbance affects a given land area or location (Johnson 1992). From frequencies and cycles, we can infer information on the amount of "old-growth" forest to retain, either as a minimum criterion as in the case of the Biodiversity Guide of the Forest Practices Code of British

Columbia (BC Forest Service 1995), or as an average. The question of frequencies or cycles can be answered in simple terms (with the right dataset) using various methods of age reconstruction (Johnson 1992). For the Foothills Model Forest, we found that the fire cycles varied by ecological subregion from 80-90 years in the lower elevation areas of the eastern slopes to over 150 years in the subalpine areas (Andison 1997).

There is no argument that this is useful information, and it answers the question of fire cycles. But it does not fully address the question of natural pattern. The natural pattern of age-class distribution in these and other forests is highly variable and cannot be captured with a single number (Boychuk and Perera 1997; Andison 1996). For the Foothills Model Forest, if we take the last 160 years as a baseline and reconstruct the area consumed by forest fires by 20-year increments, we find average disturbance rates of between 15-25 percent (in 80 to 130 year fire cycles). The 20-year disturbance rate, however, varies from less than one percent to over 50 percent. Thus fire cycles vary depending on the time at which they are measured so that a single fire cycle estimate does not capture the natural pattern of disturbance (Andison 1998).

Abundance of forest in different age classes varies over time as well. For instance, the average proportion of mature forest (> 100 years) in the lower elevation mixed forest on the Weldwood Forest Management Agreement is 5 percent. A simulation exercise that spatially projects the variation in the rates of disturbance for the last 160 years, however, suggests that the amount of mature forest varies over time. Less than one percent mature forest existed 25 percent of the time (or for about 40 of the last 160 years); between two and three percent of mature forest existed another 25 percent of the time; between three and five percent mature forest another 25 percent of the time; and between five and 32 percent of mature forest the other 25 percent of the time. In this way, the natural pattern of mature forest abundance is variable and highly negatively skewed. If we simply had answered the first question about fire cycles and converted the answer to a percentage of mature forest, the management target based on fire cycle estimates would be a constant five percent. As it turns out, managing for a constant level of mature forest is entirely *un*natural.

Example 2

A second question often asked of disturbance analyses is: "What are the ranges of forest patch sizes?" These data are potentially useful for planning disturbances such as harvesting or prescribed burns. As with the fire cycle, this is not a difficult question to answer with the right dataset. Creating summaries of the youngest patch sizes by size-class is a simple process. Once again, this provides a good answer to the question of patch sizes, but taken alone, it is potentially misleading in terms of the natural pattern of patches on a landscape.

Defining a "patch" for the purposes of pattern analysis is not a simple task and many interpretations are possible (Gustafson 1998). For instance, if we look more closely at patch size distributions, we note that as they get larger, they become more complex in shape. This observation is neither new nor surprising. As fires grow, they experience a wider range of climatic and fuel conditions and thus have greater opportunity to change direction and intensity. If we consider the type of edge in each patch, we note that the proportion of edge associated with non-forested areas is higher than expected. For instance, although non-forested patches constitute only ten percent of the landscape on the Weldwood Forest Management Agreement, forest to non-forest edge accounts for almost 25 percent of the total amount of edge in the same area. Furthermore, the shape of non-forested patches is more complex than forested patches of the same size. These findings suggest two important pieces of information with respect to natural patterns of forest patches in the Foothills Model Forest.

(1) Simple patch size and shape metrics cannot be applied to landscapes blindly, or aspatially. Large forest openings tend to be location specific.
(2) Non-forested areas are an important part of the natural landscape pattern. Fortunately for Weldwood, only about ten percent of its landbase is non-forested vegetation. In most other boreal and subalpine landscapes, this percentage is closer to 50 percent. By ignoring the relationship between forested and non-forested patch patterns, we risk not capturing the true pattern of the system.

Example 3

The third and last question also commonly associated with natural disturbance research is: "What is the total area and spatial arrangement of unburnt island remnants (i.e., live vegetation left within the area of a fire)?" (Eberhart and Woodard 1987; DeLong and Tanner 1996). Other researchers have extended this work to look at refugia or island locations associated with permanent landscape features (Camp 1995). The information is potentially useful for harvest block design.

Eberhart and Woodward (1987) and Delong and Tanner (1996) asked and answered important questions that stand alone as scientific contributions. From the perspective of capturing natural patterns, however, better questions may be asked. The main problem is that the concept of "island remnants" is a human-defined construct and, as such, communicates some preconceived ideas. For example, it represents only one aspect of pattern at the scale of an individual fire. We could be considering many other factors.

Suppose we back away from the question of island remnants and look instead at how a fire behaves in relation to local weather patterns, biota, and the land. We could then consider other aspects of pattern at the scale of the individual disturbance. For instance, one could argue that the patch we see today as a fire in forest inventories or satellite imagery is a single time-space snapshot. It is one possible outcome of the ecological processes at work, no different than a time-space snapshot of a landscape mosaic. If we accept that fire is not perfectly random (which is arguable) we can think of fire, as a process, to be either more or less likely to burn certain areas at certain times.

This model of fire is useful, since it introduces two new ideas that may help to better understand the natural pattern at the scale of the individual patch. First, all fire edges are potential islands that have not had time to develop. If we could follow an individual fire through a time series from ignition, we would see bits of edge break off from the fire perimeter. Only at this point is an island formed, yet there is always some edge affected by exactly the same processes of fire behaviour interacting with the land and biota – which is the process we are most interested in. Island remnant research studies only the islands, not the edges.

The second useful idea spawned by the concept of a fire as a time-space snapshot is that some locations have a higher than expected chance of burning while other locations have a lower than expected chance of burning. Island remnant studies focus only on the latter. Where islands and edges tend to form and where they tend *not* to form may be equally important. For example, on topographically complex landscapes such as those found in Jasper National Park, we found a strong *positive* relationship between slope position and the tendency to retain older forest. On the simpler landscapes of the eastern foothills, a *negative* relationship between older forest and certain topographic positions was evident. This suggests that the adoption of a model of positive and negative space for harvest block planning may provide a much clearer picture of the natural pattern than did the old model of island remnants.

Conclusions

The examples discussed here describe only part of the research we are conducting at the Foothills Model Forest (see Andison 1997 for details). They were used to demonstrate some of the risks of conducting natural disturbance research with the ultimate goal of maintaining ecological sustainability: not asking the right questions, not asking enough questions, or not addressing the questions in the best manner. These risks result both from our ignorance and our assumption that natural patterns are connected to ecological sustainability. Until we can provide substantial empirical evidence to support one form of pattern management over another, we must make a leap of faith that all forms of natural pattern are directly linked to ecological function. This assumption means that we tend to accept what is known as ecological truth, when it may not be. For instance, should we worry about harvest block sizes and shapes when we have not looked at how blocks are oriented on the landscape relative to other patches? Similarly, patch size may be irrelevant if we have a limited understanding of what age and structural characteristics exist within those patches or if we assume they are all homogeneous and even-aged.

The success of the natural disturbance strategy will depend on how well we minimize risks. The best way do this is to develop rigorous natural disturbance research programs. The examples given in this paper demonstrate how easy it is to think that one has captured the natural pattern, when this may not be true. Along with research efforts, we should also be working to instill at least a small amount of doubt about what we think we know, thereby gaining respect for what we have yet to learn. We should not assume that all simple questions and answers represent a linear connection to ecological truth. Links to biodiversity monitoring programs are a constructive way of dealing with this problem.

It is clear that the leap of faith we must take when we use the natural disturbance paradigm has potentially serious consequences for our ability to develop truly ecologically sustainable forest management practices. We are obliged to take seriously the research of natural patterns, which extends from the questions asked, to the methods and data sources used, to interpreting results. Finally, given the range of possible interpretations, we should also be very careful about what we label "ecosystem management."

References

Andison, D.W. 1996. Managing for natural patterns in sub-boreal landscapes of northern British Columbia. Ph.D. thesis, University of British Columbia, Vancouver, BC.

Andison, D.W. 1997. Landscape fire behaviour patterns in the Foothills Model Forest. Foothills Model Forest internal report. Hinton, AB.

Andison, D.W. 1998. Temporal patterns of age-class distributions on foothills landscapes in Alberta. Ecography 21:543-550.

Andison, D.W., H. Lougheed, and G. Stenhouse. 1999. Managing for natural levels of age-class variability on fire dominated landscapes. Ecological Applications (forthcoming).

BC Forest Service. 1995. Biodoversity guidebook: Forest Practices Code of British Columbia. British Columbia Ministry of Forests, Victoria, BC.

Boychuk, D., and A. Perera. 1997. Modeling temporal variability of boreal landscape age-classes under different fire disturbance regimes and spatial scales. Canadian Journal of Forest Research 27:1083-1094.

Burton, P.J., A.C. Balisky, L.P. Coward, S.G. Cumming, and D.D. Kneeshaw. 1992. The value of managing for biodiversity. Forestry Chronicle 68:225-237.

Camp, A.E. 1995. Predicting late-successional fire refugia from physiography and topography. Ph.D. thesis, University of Washington, Seattle WA.

DeLong, S.C., and D. Tanner. 1996. Managing the pattern of forest harvest: Lessons from wildfire. Biodiversity and Conservation 5:1191-1205.

Eberhart, K.E., and P.M. Woodard. 1987. Distribution of residual vegetation associated with large fires in Alberta. Vegetatio 4:412-417.

Farr, D.R., C.P. Spytz, and E.G. Mercer. 1999. Structure of forest stands disturbed by wildfire and logging in the Rocky Mountain Foothills. (in preparation)

Franklin, J.F. 1993. Preserving biodiversity: Species, ecosystems, or landscapes? Ecological Applications 3:202-205.

Gustafson, E.J. 1998. Quantifying landscape spatial pattern: What is the state of the art? Ecosystems 1:143-156.

Johnson, E.A. 1992. Fire and vegetation dynamics: Studies from the North American Boreal Forest. Cambridge University Press, New York, NY.

MacLean, K., D. Farr, and D.W. Andison. 1997. Island remnants within fires in the Foothills and Rocky Mountain Natural Regions of Alberta: Part I. Methodology. Internal Foothills Model Forest Report. Hinton, AB.

Sapsis, D.B., and R.E. Martin. 1994. Fire, the landscape, and diversity. A theoretical framework for managing wildlands. Pp. 270-278 *in* Proceedings of the 12th Conference on Fire and Forest Meteorology, 26-28 October 1993, Jekyll Island, GA. [www.wildfiremagazine.com/sapsis.shtml].