

# **APPENDIX #2**

## **FOOTHILLS MODEL FOREST NATURAL DISTURBANCE PROGRAM**



---

# FOOTHILLS MODEL FOREST NATURAL DISTURBANCE PROGRAM

---

Annual Progress Report  
March, 1999

Prepared By: D.W. Andison



## **INTRODUCTION**

In 1996, the Foothills Model Forest initiated a natural disturbance research program through Bandaloop Landscape-Ecosystem Services. The aim of the program was to conduct comprehensive, high quality research on natural disturbance patterns and processes on the Weldwood FMA, Jasper National Park, and other foothills lands, towards developing opportunities to integrate aspects of these patterns into land management planning. The ultimate goal of the program is to develop more ecologically sensitive, and more defensible strategies for management at all levels of planning. The same research can be used to help define benchmarks and perhaps even methods for biodiversity monitoring programs.

The logic of the development of a “program” of research projects is that the natural processes we are attempting to understand and quantify interact across many different spatial and temporal scales. This is the best way to gain understanding of the entire range of disturbance patterns and processes, as opposed to a piece-meal approach. The project definitions are therefore an attempt to compartmentalise the patterns and processes according to scale. This also facilitates the ability to ask better questions. However, it is the re-integration of the results of each that we expect to be most informative. In other words, we expect no single set of research results to provide the ultimate "answers", nor should individual project results be considered and interpreted in isolation. Rather, it is the combination of all of the current and proposed research that will meet the desired objectives. The true value of the research is its’ integrated nature, and the true impact of the interpretations will be an integrated approach to application.

## **THE FMF DISTURBANCE RESEARCH STRATEGY**

The natural disturbance team (comprised of representatives from each of the major FMF partners) has developed an annual disturbance research workplan each of the past three years based on the greatest perceived needs, scientific logic, and available resources. The background and reasons for the choice of the projects will not be given here, since they are explained in both the long-term research plan and the annual workplan from 1998/99. However, generally project topics have been moving from the coarser scales to finer. This strategy not only suits the needs of the partners, but lends itself well to a logical sequence of scientific studies.

## **THIS REPORT**

The following identifies the projects supported by the natural disturbance program in 1998/99, the progress made, changes in plans, ongoing tasks, and future possibilities. It also briefly outlines the steps yet to be taken to complete the project in each case. As an appendix, the 4<sup>th</sup> annual version of the long-term natural disturbance research plan is included, reflecting the changes and updates noted in this document. Refer to the schedule of projects at the end of the long-term document for an overview of project sub-component schedules. Due to some merging of projects, a total of 14 projects identified in the long-term documents are currently active. The 15<sup>th</sup> listed in the schedule, “Residual Structures” has completed phase 1 awaiting further work.

Also please note that this report includes all projects ongoing or initiated in 1998/99, but only provides detail for those projects for which Bandaloop has been responsible for running. For detail on the status of the three FMF NDP projects supported within Jasper National Park, please refer to the JNP annual project reviews.

## REVIEW OF THE 1998/99 PROJECTS (10)

### 1) Landscape Disturbance Regimes Project

This is an extensive project, and the foundation on which most subsequent natural disturbance research will be conducted. The nature of the data collection and analysis is such that this project includes project numbers 1, 2, 3, and 5 in the long-term research plan (Appendix A). Note that project number 5 (simulating age-class distributions) was initiated and sponsored wholly by Weldwood of Canada Ltd.

The landscape disturbance project is being done at the coarsest scales, with the most extensive datasets. The main objective of this project is to describe the types, frequencies, sizes, and shapes of disturbances on the FMF (items 2 and 5, appendix A), and identify where these characteristics are homogeneous for an area (items 1 and 3, appendix A).

This project was the first to be initiated, in 1996, with the collection of various spatial data layers for the FMF including inventory, fire history, soils, biophysical, historical lightning activity, and ecological classification sub-zones. In addition, areas of the FMA that had no inventory data or ages had to be mapped and sampled for ages to make one contiguous age-class coverage of the foothills east. Also, despite the extraordinary quality of the age data for the foothills east, these data were tested against independent data sources for accuracy and bias.

In 1997 a full analysis of these datasets was completed, and an FMF report produced. However, the analysis provided evidence that the ecological subzone boundaries (on which the summaries and report findings were based) could be improved upon to provide better differentiation between the subalpine and upper foothills areas. Since Weldwood already had similar indications from their growth and yield data, the boundaries were re-assessed in 1997.

If there was any other weakness of the original analysis, it was that the original dataset used for the landscape analysis was Phase III forest inventory, which does a poor job of differentiating between non-forested types. The new AVI inventory would provide far better non-forest classifications.

Finally, even after the 1996 field season of stand origin mapping, a considerable portion of the subalpine area of the foothills east had no fire history information.

Accordingly, Andison recommended to the activity team at the time to allow 1) the completion of the fire history map of the foothills east, and 2) a re-analysis of the small-scale spatial data based on the new sub-zone boundaries. It was also recommended that the new AVI forest inventory data be included as a layer, thus providing higher quality forest information. The delivery date of both the AVI and new sub-zone boundaries was to be the fall of 1997.

The additional stand origin mapping was completed and mapped by early 1998, and the sub-zone reclassification was also completed around the same time. However, the AVI data completion and delivery date was continually moved forward. As of the writing of this report, the completed, edge-matched AVI has still not been delivered, and is now being promised for April 1999.

As it stands now, the analysis for JNP is completed, and the non-spatial summaries of the foothills east are done (based on the new ecoregion boundaries). The fire history data for the foothills east is complete and has been compared to independent data for accuracy and bias. What remains is a closer look at spatial relationships between forested and non-forested areas, and using stand classifiers to help identify areas that may experience more (or less) fire activity than the rest of the FMF region. This can only be achieved when the new AVI data is delivered.

### **Tasks Completed as of March 31, 1999:**

- Completed contiguous coverage of stand origin dates for the foothills east area (E4 subalpine and Switzer Provincial Park). Results of two field seasons' work.
- Cross-referenced stand-origin ages with PSP or TSP age data from Weldwood records.
- The following spatial layers are available as ASCII raster overlays at 200m resolution for the entire FMF (except for the Willmore Wilderness Area): Age, phase III forest inventory, (JNP) biophysical, (foothills east) soils, cutblocks, lightning, natural sub-regions, rivers/riparian zones and roads for the new boundaries of the Model Forest.
- Non-spatial data files cross-referencing identifications to the spatial data layers, and listing types, locations, sizes, and shapes of each homogeneous polygon in the FMF.
- Complete age-class analysis of both JNP and the foothills east.
- Preliminary analysis of sizes, frequencies, and shapes based on old boundaries of sub-regions and Model Forest.
- One FMF (1997) internal report summarising the findings of the spatial and non-spatial analysis of the small-scale patterns on the FMF.
- Although these results will most likely be included in the FMF report of landscape patterns, the related reports and manuscripts produced from the spatial age-class simulation exercise on the Weldwood FMA are covered under a separate FRIAA project.

### **To be Completed in 1999/2000:**

- Compilation of historical weather station data for FMF area.
- *# Spatial analysis of new layers in combination with fire history and climate data. Partially complete – delays due to late delivery of data (AVI), new data layer availability*
- Archiving and distribution of spatial data layers as required.
- *# Report on age-class patterns on the FMF.*
- *# Report on patch patterns on the FMF.*
- At least one manuscript for journal submission on landscape patterns.

*# Were to be completed by March 31, 1999.*

### **Future Possibilities:**

- The fire history aging for the Willmore is not complete. LFS has assumed responsibility. If/ when these are collected will enhance FMF analysis at these scales. Will mean repeating some of the analyses for the Willmore.
- Complete stand age quality check for JNP – field data collected, but not summarized or transferred to Bandaloop
- New soils summarizing techniques by Weldwood / Timberline may enhance stratification / prediction (and therefore narrow range of variability) of frequencies, sizes, and shapes. Bandaloop can still try several methods of summarizing the raw soils data, so this may not be important, depending on the analysis that will be completed by April 1.
- DEM availability for entire FMA now feasible given computer speeds. May lead to another possible means of stratifying as the previous point discusses, based on topographic complexity.
- Regional-scale pattern analysis (mostly frequencies and sizes) with a very large landbase. The analysis of several million ha of fire history and other data layers surrounding the FMF may help explain some of the differences in age-class distributions; identifying “nodes” of fire activity, potential anchor points, and relative susceptibility. Would require data-sharing agreements. If/when such data become available, a very coarse-scale analysis of these data is possible.

## 2) Island Remnants Project

The name of this project is now a misnomer since the breadth of the study has grown to encompass several sub-components, including:

- island remnants (Project 7e, App. A).
- the study of the relationship between patches and disturbances,
- fire refugia (Project 7b, App. A)
- disturbance design (Project 7a, App A), and
- disturbance edge formation tendencies.

Although not originally envisioned as including all of these sub-components, the nature of the data collection methods was such that considerable economies have been gained by collapsing several distinctive projects (from the long-term plan) into one. Analysis effort will therefore be more than originally anticipated, as will the number of, and depth of the reports produced from this research.

This project had to increase the sample size (from last year) by at least two times to be meaningful in terms of analysis. Due to the rigour of our sampling design, this was no small feat. In fact, some of the original criteria had to be relaxed in order to accept a larger number of historical fires. As of the end of this year, a total of 25 fires had been interpreted (post-fire) and digitised, and ARC layers created. The methods from last year otherwise were sound, and remained largely intact. However, as the year progressed, additional items were added to the list of data being collected. As the list of deliverables from 1998/99 and 1999/2000 demonstrate, a fair amount number of items were added, and some have been delayed. The budget was proportionately larger than originally set as well. In the end, the net benefits in terms of greater depth and breadth of research findings will be more than equitable.

This original workplan did include a DEM for each fire, which has recently been completed by the FMF GIS lab. In addition, the workplan called for the digitising and inclusion of the pre-burn forest cover information from Phase 1 inventory maps. However, mid-way through the year, the decision was made to upgrade this information by interpreting, digitising, and overlaying pre-burn aerial photographs. The change will mean far higher resolution and data quality, and allow more reliable direct comparison with post-fire interpretation since this was also done to AVI standards. Olympic Resource Management (previously Simon Reid Collins) will complete these interpretations and delivery the data by March 31<sup>st</sup>. The cost of this upgrade was shared equally between the FMF and Weyerhaeuser Canada Ltd.

Fire weather and fire fighting information for many of the fires was also discovered mid-way through the year, and efforts were made to recover these data. The Alberta Environmental Protection, supported the salary of the project technician for several weeks to complete this dataset.

Due to the addition of these data layers, and the expansion of the project into other topic areas, the promised final report for the island remnants study was not completed by March 31<sup>st</sup>, 1999. However, considerable spatial and non-spatial analysis has been completed for the island remnants portion of the project, as well as several other sub-components. The final pieces of full analysis (for all sub-components) will not be possible until the delivery of the pre-burn digital coverages.

### **Tasks Completed by March 31, 1999:**

- Screen, document and select 25 historical fires across the front range according to selection criteria.
- Interpret and digitize all disturbance boundaries to AVI standards using post-fire historical photos.
- DEM's for 25 fires.
- \* *Pre-burn forest interpretation from historical aerial photographs, to AVI standards.*
- \* *Preliminary non-spatial analysis of all 25 fires (which include disturbance patches, islands, and edges).*

- \* *Digital information on fire fighting for each fire.*
- FMF Report outlining methodology, sampling criteria, and overview of the 25 fires chosen for the sample.
- Preliminary spatial analysis of distances and arrangements for the island remnants sub-component.
- Poster of the project and some preliminary findings.
- Fieldwork sampling of two fires.

**To be completed in 1999/2000:**

- # *Spatial summaries ongoing, but cannot be completed until the pre-burn forest cover are available.*
- Compilation of local fire weather (may be ready by March 31, 1999).
- \* *Draft internal FMF report on patch sizes and distributions (in conjunction with data from the landscape and meso projects).*
- # *Draft internal FMF report on island remnant material from forest fires in the foothills.*
- \* *Draft internal FMF report on fire refugia tendencies on the FMF (in conjunction with data from the meso project).*
- \* *Journal manuscripts for at least two of the above reports.*
- Archiving and distributing data as required.

*\* Represents deliverables that are at in part, above and beyond original 1998/99 workplan  
# Represents promised deliverables that will not be possible in 1998/99.*

**Future Possibilities:**

- More field sampling of selected fires to specifically identify the age-structure, and level of mortality and ingress across island boundaries. This will help to understand relative severity.
- Using the Virginia Hills fires to complement the database and analysis. This has already been suggested for the 1999/00 workplan. Despite the excellent database that has been compiled, our biggest problem has been interpreting burn patterns 20-30 years later. The database available from the 1998 fires is a great chance to offset that disadvantage, and improve the current database.
- As above, a higher quality DEM would allow us to study fine-scaled patterns across a wider range of scales. This is particularly relevant to the fractal (ie, multi-scalar) analysis, which is currently showing at least mild potential for predicting pattern behaviour.
- As above, if eco-phase or eco-site prove to be a good correlate with edge and island formation, if/when such data become available for a wider range of fires, this could be included in an analysis.
- Expand study to JNP.

### ***3) Montane Disturbance Dynamics Project***

This is the first project to take a detailed look at disturbance dynamics of a specific area or zone. The project is as much about studying the interaction of surface and crown fires in the montane zone as it is about establishing a viable, economical methodology for the study of similar mixed disturbance regimes. Fieldwork both seasons went as well, and the methods review after the first year were only altered slightly, since the original methods seemed to be as efficient as any. This reference number for this project in the long-term plan in Appendix A is #14.

There have been two unforeseen setbacks to this project. First, the raw field data of Tande from 1974 could not be completely reconstructed. Efforts by several Parks and U. of A people led to a single datafile of partial field tallies, but no related map of plot sample locations. These data would have been a tremendous addition to the field data being collected. Efforts have not ceased altogether to recover these data, but options are limited.

The second setback experienced by this project is the late delivery of the core and disk age data from the Forestry Canada tree-ring lab in Edmonton. The data from the 1997 field season was only just delivered this

month due to delays caused by personnel issues at the tree ring lab. It is hoped that the 1998 field data will not take as long to process, but the possibility is real since conditions have not significantly changed. Efforts to find alternate core and cookie analysis facilities with the same quality equipment and expertise were to no avail.

Despite these setbacks, we are moving ahead with field tally data entry (from both field seasons) and the analysis of the 1997 data. If all goes well we should have all field data analysed, and a model ready for testing by the end of March, 2000.

#### **Tasks Completed by March 31, 1999**

- Developed and adapted a grid-based 2-stage sampling method for stand aging.
- Preliminary time-since-fire maps created for two selected areas of JNP, both adjacent to area sampled in a similar manner by Tande.
- Detailed age data over representative area of JNP montane and sub-alpine transition. (2 field seasons).
- Core and disk samples stored, inventoried and delivered to Forestry Canada tree-ring lab in Edmonton.
- Field tallies entered in database from 1997.
- Dendroscan age files from 1997 field season.

#### **To be completed in 1999/2000:**

- Dendroscan files of tree-ring data from 1998 by Forestry Canada.
- Correction of (2) original stand origin maps.
- Additional stand age mapping in areas where prescribed burns in JNP are planned.
- Data entry of age and species database for all plots relating to the tree-ring files from 1998.
- Development of a predictive model for testing surface vs. crown fire tendencies in the montane.
- Draft preliminary report and presentation of results.
- Archive all field and age (dendroscan) data as well as resulting time-since-fire digital maps.

#### **Future Possibilities:**

- Field test the model of mixed fire regime. Depending on the predictive power of the analysis, it would be prudent to test the model through a combination of a mapping and field aging exercise.
- Expand field sampling in the montane. There is a slight chance that more sampling will be required. I doubt this will be necessary, but without having looked at the data, I cannot rule it out completely.
- Adapt the methods as necessary to conduct similar studies on other landscapes (ie, the lower foothills, upper foothills, the Berland areas in particular).

#### **4) Meso-scale patterns project.**

In the first year of the natural disturbance program, two areas of the foothills east had limited spatial data layers collected at high levels of resolution. This was a test, in effect, of the possibility that data at intermediate scales (finer than landscape, but not as detailed as individual patch studies such as the island remnants project) could provide valuable data either not available through, or in combination with other projects. The findings from this pilot study are presented in the 1997 FMF report on natural disturbance patterns on the FMF. They suggested that there was merit to gathering and analysing data at these scales, which prompted the expansion in 1997 to develop a large area of JNP similarly, and four additional areas of the foothills east in 1998.

The meso-scale project was only in a data collection phase in 1998/99. The size, number, and location of the study areas is as planned, and the data has now been delivered (ahead of schedule). Some (unscheduled) analysis will be done prior to March 31, 1999 for the workshop, but the full analysis must wait for the completed AVI maps, as above in the landscape project.

As with the “island remnants” project, this study includes several sub-components as it relates to the long-term research, including sub-regime detection (project 3, App. A), high disturbance frequency areas (project 4, App. A), and degree of patch design (project 7a, App A). It may also be extended to include a part of the riparian disturbance dynamics project (project 7d) at smaller scales.

#### **Tasks Completed to March 31, 1999.**

- Digital files of age, slope, aspect, other biophysical where available, elevation, creeks, and uncorrected AVI forest inventory data complete for six areas on the foothills east (2 from each major natural sub-region), and one large contiguous area from JNP at 50m resolution.
- Preliminary analysis of how/where fires move on two foothills east areas and on JNP.

#### **To be completed by 1999/2000.**

- Take delivery of corrected and edge matched AVI data, convert and integrate new files into six existing foothills east databases.
- Analysis of meso-scale patterns – mostly spatial, but some non-spatial
- Internal FMF report on meso-scale patterns, probably using some of the analysis from the island remnants project (see above).
- Draft and submit journal manuscript for submission (Ecology).

#### **Future Possibilities:**

- Based on the findings from the Riparian study, recommend expanding planned analysis to look specifically at riparian corridors at this scale for differences in expected behaviour of edge and island formation.
- Gather and compile small-scale ELC data as it becomes available to further predictive ability of pattern analysis. Potential link between fire movement and eco-phase or site to be investigated in the spring analysis – unknown how well this may act as a predictor.
- Conduct similar analysis at similar scale across subregion eco-tone boundaries. Of the seven areas used in the analysis above, only the JNP block crosses ecological boundaries. Yet boundaries may exhibit unique disturbance behaviour on the foothills east landscapes.
- Redo analysis at smaller scales – hypothesis being that finer-scaled factors or changes in topography are important for fire movement. The limiting factor now is the resolution of the existing DEM. If/when a more accurate model becomes available, further analysis is possible.
- Deliberately select areas that cross between eco-regions to study differences in pattern behaviour across ecotone boundaries.

### **5) *Riparian Study***

Project 7d in the long term plan (App. A). 1998 was a pilot year designed to determine the degree to which fires treat riparian areas differently than the surrounding matrix. Based on preliminary analysis, it seems the differences are minimal. Even still, since the sample size is low (15) and this is an important topic, it would be wise to extend the sampling to increase the sample size significantly – at the very least. The analysis also suggests continued pattern study at larger scales (with the right information) might yield more answers. This was discussed briefly above in the meso project.

### **Tasks Completed by March 31, 1999.**

- Selection criteria established and used to create a list of possible sample sites.
- Collect detailed age data across riparian areas in strips for 15 creek crossings.
- Preliminary field assessment (and some adaptation) of methods by sub-contractor JMJ Holdings Inc. of Nelson, BC.
- All cores and cookies (approx. 500 in total) delivered to Snowline Consulting for counting.
- Age all cores and cookies aged and recorded.
- Data entry of field tally information into database.
- Preliminary analysis and report of age patterns.

### **To be completed in 1999/2000:**

- 15-30 additional field transects installed, cores and cookies collected.
- Cores and cookies prepared and counted.
- Field tallies from 1999 entered into database.
- Full analysis (using two years of data) of evidence of disturbance history across transects.
- Depending on the results, potentially the development of a predictive model of differential disturbance impacts on riparian corridors on the FMF foothills east.
- Internal FMF report.

### **Future Possibilities:**

- Recommended fieldwork for summer 1999: Continue field sampling as before, but expand the transect into the matrix of the stand on each side by another 50m (to 100m total on each side) to better allow the detection of differences. Also recommend reducing the amount of mensurational data taken to a sample rather than a census along each transect. Try to sample another 30 transects in 1999, distributed evenly across all types of rivers and crossings. (recommend post-stratifying)
- Spatial analysis at slightly larger scales (see meso-scale project above).
- Expansion of study to JNP.

### ***6) Modelling Douglas Fir Populations in Canada's four mountain Parks.***

This project falls under the auspices of the study of arboreal dynamics and disturbance (project 10, Appendix A). It may form a template for similar studies in other areas of the FMF. This project will be completed by the end of this fiscal year, as promised, including a final report.

### **Tasks completed by March 31, 1999:**

- Final analysis and report.
- Predictive regeneration dynamics model for Douglas Fir in the montane.

### ***7) Historic Vegetation Change in Montane Landscapes of JNP***

This project is a Master's student thesis from U. of Manitoba involving repeating historical photography from various landscape vantage points in JNP. The vegetation changes described in this study would best fall under the general heading of understanding (historical or changes in) the disturbance regime characteristics (project 2, App. A). The student is currently on schedule, entering his third and final year of study. Reports, photographs, and final results will be available by April 1, 2000.

### **Tasks completed by March 31, 1999:**

- Project proposal and literature review.
- Photo analysis.

**To be completed in 1999/2000:**

- All fieldwork.
- Graduate thesis / final report.

**8) Montane Fire Effects Study**

This co-operative project focuses on measured, compared responses of vegetation and wildlife to fire, and therefore relies on having adequate burning windows. Last year, the hoped for window(s) did not materialise, and thus the workplan in 1999/2000 will again focus on getting the prescribed burns completed. The results of this project will provide important information not only on fire effects on vegetation and wildlife, but also on planning and doing prescribed burns in the greater Model Forest area, and therefore falls under "Using fire as a tool" project of the long term plan (project 24, App. A). Note that this was the first year of a planned five year project.

**Tasks completed by March 31, 1999:**

- Sampling and design methods.
- Constructed grazing enclosures.
- Fire guards constructed.
- Baseline (pre-burn) environmental data collected.

**To be completed in 1999/2000:**

- Re-sampling of some baseline environmental data (since the burn did not go last year).
- Burning of areas.
- Post-fire monitoring
- Development of methods for Doug Fir habitat burning scheduling.

**9) Natural Disturbance Workshop**

No workshops were included in the original 1998/99 natural disturbance program workplan. However, the communications department of the FMF sought to host workshops of each of the major research programs during the year, including the ND program. Accordingly, mid-way through the year, the decision was made by the project team to devote some additional resources towards preparing for and hosting a workshop directed at natural pattern integration, consistent with project 25 from the long-term plan (App. A).

Considerable planning has already gone into the workshop, scheduled for March 29-30 in Edmonton. The goal of the workshop is to establish a common-language framework for considering the issues and opportunities related to the integration of natural patterns at different scales and levels of planning. Over 60 participants were invited from companies, Parks Canada, research organisations, and both Federal and Provincial government agencies. A review of the workshop will be done early in April of 1999, and the major conclusions published on the FMF website.

**10) Experimentation**

Although not formally a part of the 1998/99 natural disturbance workplan, it is worth mentioning that in 1998 several experimental cutblocks were logged on the Weldwood FMA using preliminary results from the meso-scale study. These blocks were designed to test for differences in the ecological responses of several species to different amounts and patterns of island remnants and patch sizes. Project 21 in the long-term workplan (App. A).

## CONCLUSIONS

The 1998/99 work year can be summarised as being one of transition and opportunity. It was fortunate that the program structure was flexible enough, and those supporting the research were understanding enough, to allow taking advantage of such things as the workshop potential and the availability of higher quality data. Both the quality and quantity of the products that will result from these efforts will be higher than anticipated at the beginning of the fiscal year. At the same time, while the coincidental unavailability of other datasets such as AVI and tree-ring age data delayed some analysis and reports, these delays created the chances to pursue other data and avenues. In essence, the higher than anticipated data gathering activity, and the lower than anticipated report-producing activity during 1998/99 only rearranged the order in which tasks were to be completed from the long-term plan.

Although some of the short-term objectives did not materialise in 1998/99 due to unforeseen obstacles, the long-term effect of the shift in the emphasis of the 1998/99 program was probably to speed up delivery of the overall program results. The great amount of activity on many fronts in the FMF natural disturbance program is reflected in the latest version of the long-term research plan attached to this document, which indicates that there are no less than 14 active individual projects, or sub-components of projects.