Foothills Model Forest
Natural Disturbance Research
1996-2002

The Alberta Chamber of Resources and
The Foothills Model Forest
Research Workshop

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Organization of The NDP Team

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- Greg Branton, ANC
Project Partners

- Weyerhaeuser Canada Ltd.
- Blue Ridge Lumber Ltd.
- Millar Western Forest Products, Ltd.
- Forestry Canada, NOFC.
- LFS, Edmonton Fire Centre
- Western Fire Centre
- Banff National Park
- AFPA
The FMF Natural Disturbance Program: Why?

- Began from a common desire among partners to maintain biodiversity.
Biodiversity:

“... the variability among living organisms and the ecosystems of which they are a part.”

*Canadian Council of Forest Ministers*
How Does One Maintain Biodiversity?

Option 1: Eliminate cultural activity over a very large area.

Not a feasible option:

1. Forest fire control
2. Towns, roads, gas and oil activity = people.
3. Forest harvesting
How Does One Maintain Biodiversity?

**Option 2**: Issue-based Approach. What are the requirements to maintain each species or value on the landscape? *(i.e. Habitat Models)*

<table>
<thead>
<tr>
<th>Pluses</th>
<th>Minuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species as indicators</td>
<td>Do we know the right species?</td>
</tr>
<tr>
<td>Long history of research</td>
<td>Lots of research left to do</td>
</tr>
<tr>
<td>Target most important issues</td>
<td>Targets, goals are subjective</td>
</tr>
<tr>
<td>Concepts easily grasped</td>
<td>Not always simply translated</td>
</tr>
</tbody>
</table>
How Does One Maintain Biodiversity?

**Option 3:** Natural Disturbance Approach. What patterns historically maintained natural levels of all species and values?

**Pluses**
- Holistic, inclusive
- Study of cause vs. effect
- Directly quantifiable
- Solution space oriented

**Minuses**
- Past as model for the future?
- Can we figure it all out?
- If we build it, will they come?
- New science, no precedents
The study of disturbance tells us a lot about how and why forest landscapes are dynamic

= “natural range of variation” = NRV

Recall that “Biodiversity is … the variability among living organisms and the ecosystems of which they are a part.”
The BEST approach to biodiversity management is to combine both.

1) The weaknesses of one are complemented by the strengths of the other.

2) The questions from one form the basis of integrated research using the other.

3) We are finding that the conclusions are in agreement.
Summary of the ND Approach

Species are ecologically and evolutionarily adapted to the historical range of patterns.

If we learn from, and use natural patterns as a template, we are more likely to conserve biodiversity over the long term.

As a foundation for management, it is gaining favour and acceptance everywhere.

However, it is not a perfect solution. The best overall strategy is to merge issue-based efforts with natural pattern research.
So there are good reasons for studying and understanding natural disturbance.

What makes the FMF program so special?
Weldwood has a “stand origin” map – the ONLY one of its size in the world.
- and we made it better.
Accuracy of Stand Origin and Inventory Map Ages

No. of 10-year Age-Classes Older than Actual

Frequency

Stand Origin Ages
AVI Ages

No. of 10-year Age-Classes Older than Actual
Other Data:

- We completed the stand origin map for the foothills (E4, E5, E9, E11, Switzer, Hinton)
- Tande’s detailed mapping of the Montane in JNP
- Highly detailed pre and post fire interpreted spatial files for 25 individual fires on the front range. (28 – 17,000 ha)
- Detailed tree-ring data for part of the Montane
- Detailed structural, compositional, and age data across 53 riparian corridors on the Weldwood FMA
- 20 edge transects in the Virginia Hills fire (so far)
- 20 residual heterogeneity transects in the Virginia Hills fire (so far)
2. The Program Extent (partial list only)

- **2-5***: How many disturbance regimes are there?
- **0**: Range of seral-stage percentages
- **5-10**: Stand replacing or stand maintaining fires?
- **1-2**: Within-stand age cohorts
- **>10***: Patch size distribution
- **>10***: Patch shape distribution
- **0**: How are patch shape and size related to non-forested?
- **2***: Numbers and sizes of island remnants
- **1**: Topographic “hot” and “cold” spots
- **0**: Change in structure through riparian strips
- **0**: Edge architecture
- **1**: Within fire heterogeneity
- **3-5**: Coarse woody debris
- **5-10**: Dead standing

* USING INVENTORY DATA
The ND Program Includes Many Projects, Defined by Scale

- **Region**: Foothills Model Forest
- **Landscape**: Upper Foothills Natural Sub-region
- **Disturbance**: Gregg River Burn
- **Stand**: Remnant island
3. A Highly Practical Focus

Every project is considered both a legitimate research issue, and a valuable practical question that needs to be answered.

Annual work plans are developed using both a long-term research plan (which outlines 20-25 research questions), and the needs, questions, and priorities of the individual partners.
4. Understanding the “Solution Space”

The most important and consistent “pattern” we have discovered so far is *variability*.

Nature is highly variable – within certain bounds. We can use that attribute to our advantage.
Project Example #1:
Managing Age-Class Distributions on the Weldwood FMA

**Practical Question:**
What amounts of old growth forest are appropriate to manage for on the FMA over the long term from a biodiversity perspective?

**Scientific Question:**
What are the natural, historical levels of all seral-stage percentages over the last 2-300 years?
Older Forest as of 1950 on the Weldwood FMA

<table>
<thead>
<tr>
<th>Landscape</th>
<th>% of Forest &gt;200 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Foothills</td>
<td>0</td>
</tr>
<tr>
<td><strong>Upper Foothills</strong></td>
<td>4</td>
</tr>
<tr>
<td>Subalpine east</td>
<td>15</td>
</tr>
</tbody>
</table>
Landscape in 1950 (no fire control, no harvesting)

AC Distribution

4%
BUT...

These numbers only represent a single slice through time.

And we know that fire activity is highly variable.
# A Brief History of Forest Fire Activity on the Weldwood FMA

- Upper Foothills (UF) Area -

<table>
<thead>
<tr>
<th>Period</th>
<th>Percentage Burnt</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1830-1849</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>1850-1869</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>1870-1889</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>1890-1919</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>1910-1929</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>1930-1949</td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>
Landscape in 2020?

AC Distribution

10%
Landscape in 2020?

AC Distribution

16%
Landscape in 2100?

AC Distribution

12%
Research Ex. #1: How Much Old Forest to Maintain on the Weldwood FMA?

Landscape  \%>200 yrs in 1950

Lower Foothills  0
Upper Foothills  4
Subalpine        16

The easy answer (a single historical target)

The right answer (a range of historical percentages)
Has Weldwood Used this Stuff?

Landscape  %>100 yrs in 1950  in 1995
Lower Foothills  16  48
Upper Foothills  21
Subalpine  45

Red Flag!!

There is no historical precedent for the large amount of old forest in the Lower Foothills area today.
Seral-Stage NRV in Weldwood Planning

Proportion of "Old" Mixedwood

10-year Time-steps

NRV
Seral-Stage NRV in Planning

Why are we going beyond NRV?

..... riparian protection.

NRV

Proportion of "Old" Spruce

10-year Time-steps
Original Question:
What amounts of old growth forest are appropriate to manage for on the FMA over the long term from a biodiversity perspective?

Answer:
There is no single amount of old, mature, or young forest that is more “natural” than many others. Weldwood now has a series of seral-stage ranges of natural variation with which to compare long-term planning projections.
… PLUS We Learned That:

1. Natural subregions have ecological relevance.
2. “Old growth” moves around in time and space. Operational-sized areas experience severe ranges of conditions, and often “run out” of old growth.
3. Forest management planning / decision-support models and methods need to adapt to take advantage of NRV.
4. Compliance and effects monitoring targets must both respect “ranges” as being more ecologically relevant.
5. We have some small-scale issues that potentially conflict with some natural patterns. (ie, riparian, green-up, etc).
6. Using ranges is one way of dealing with the risk of natural disturbance.
Project Example #2:
Disturbance Events and Patch Sizes

**Practical Question:**
What is an ecologically appropriate way to design harvesting blocks within operating areas?

**Scientific Question:**
How do natural disturbances arrange themselves in space?
Most fires are small, but the large ones count for most land.
13 Patches 8,886 ha

54 Patches 697 ha

15 Patches 28 ha

76 Patches 1,163 ha

... but patches cluster to form disturbance events
Small Dispersed Blocks

15% by Area Disturbed
Small Dispersed Blocks

- 15% by Area Disturbed
- 25% Interior Forest Remaining
Variable Sized Dispersed Blocks

15% by Area
Disturbed
Variable Sized Dispersed Blocks

15% by Area Disturbed

45% Interior Forest Remaining
Variable-Sized Clustered Blocks

15% by Area Disturbed

“Event” areas are outlined in green
Variable-Sized Clustered Blocks

15% by Area Disturbed

65% Interior Forest Remaining
Where We Want To Go

Current
Patch sizes similar
Less core forest
More roads

“Natural”
Patch sizes variable
More core forest
Less roads
Example #2 Summary

Original Question:
What is an ecologically appropriate way to design harvesting blocks within operating areas?

Answer:
Move towards larger patches, clustered into disturbance events.
Harvest block sizes are now being planned at a range of sizes, both within and beyond the FMF partners.

Operational planning (laying out blocks and roads) is beginning to experiment with large, single-pass “events”.

Policy and groundrules are being re-examined. (which limit block sizes, green-up requirements, etc).
Project Example #3:
Island Structure Within Disturbances

**Practical Question:**
What is an ecologically appropriate way to leave forested islands within harvest blocks?

**Scientific Question:**
How much, and where are unburnt island remnants left by fire naturally?
What is left behind as “residual”, how much, where, and what type?
Area in Unburnt Island Remnants

Probability

Percent Area in Islands

- 0-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- >30

Probability Distribution

- 0.4
- 0.35
- 0.3
- 0.25
- 0.2
- 0.15
- 0.1
- 0.05
- 0

0.2
0.5

Numbers of Island Remnants per Patch

Increases with Patch Size
Island Remnant Types

Of 5,100 Islands in our Database:

- 10-30% survived the fire intact.
- 50-75% were partially affected by the fire.
- 5-20% were heavily affected by the fire.
Island Remnant Locations
Are Island Remnants More Likely to Form in Riparian Zones?

<table>
<thead>
<tr>
<th>Fire Number</th>
<th>Percent Land in Riparian Zone</th>
<th>Island Remnant Average</th>
<th>Fire Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>15</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>20</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>25</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Yes

No
## Are Islands More/Less Likely to Form on Specific Topographic Locations?

<table>
<thead>
<tr>
<th>POSITION</th>
<th>N</th>
<th>NE</th>
<th>E</th>
<th>SE</th>
<th>S</th>
<th>SW</th>
<th>W</th>
<th>NW</th>
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<tbody>
<tr>
<td>Valley</td>
<td>+++</td>
<td>+</td>
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<td>---</td>
<td>-</td>
<td>+++</td>
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<td>Ridge</td>
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<td>Sl. Valley</td>
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<td>Sl. Ridge</td>
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<td>Gentle Sl.</td>
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</tbody>
</table>
Original Question:
What is an ecologically appropriate way to leave islands within harvest blocks?

Answer: A combination of factors:
- Leave anything between 4-20% of the block area in islands.
- The larger the block, the more islands to leave.
- Most islands should be at least partially disturbed.
- Most islands are very small (< 1 hectare).
- Island locations tend to be related to topographic features.
How is Jasper Using This Knowledge?

- The Park has committed to “restoring” more natural disturbance processes (for ecological and social reasons). Involves controlled burns.

- So how do we know if those burns are achieving “natural” conditions?

- Using specific island remnant research output to establish target ranges of types, amount, sizes, and locations of islands.
What Else We Learned

... there are lots of unresolved issues:

- Planning and compliance monitoring must adapt to deal with probabilities

- Groundrule formats are awkward / underpowered to handle full range of findings.

- Are islands foregone wood or 2nd pass? (in & out vs. maintaining road network)

- Where are the lines of responsibility? Who plans islands?

- Aesthetics planning interactions

- Mechanical and productivity issues

- Effectiveness monitoring – how the heck....?
How many disturbance regimes are there?

Range of seral-stage percentages

Old growth spatio-temporal tendencies

Stand replacing or stand maintaining?

Within-stand age cohorts

Patch size distribution

Patch shape distribution

How are patch shape and size related to non-forested?

How are patch size and shape related to fire size?

Numbers and sizes of island remnants

Topographic “hot” and “cold” spots

Change in structure through riparian strips

Edge architecture

Within fire heterogeneity

Coarse woody debris

Mineral soil exposure

Surviving seed trees
Summary So Far

The natural disturbance model is potentially a powerful and defendable basis for forest management.

The FMF ND program is one of the best around. The data, research, and results are leading edge.

The implications of the findings are deeper and broader than we imagined.

We do more than research.
Research Group Question: What are the patterns and processes of natural disturbances?

- research.

Model Forest Question: What are the most relevant issues pertaining to the integration and use of the natural pattern strategy?

- research + understanding + education + communication + trials + integration + facilitation.
But We are Far From Done.

A few Good Questions:

- What is the difference between natural patterns, and our current patterns?

- Are some “patterns” more important than others?

- What is the significance of residual island, clusters of disturbances, ... etc, on what species / ecological process, and for how long?

- What are the ecological dangers / complications of moving outside of NRV for pattern X?

- What are the social and economic costs of staying within NRV for pattern X?

- What are alternative mechanisms for implementing NRV concepts in policy and practice?
An NRV Decision Template?

1. What is the natural pattern in question?

2. What is the current pattern?

3. What are the (ecological, cultural, economic) reasons for the differences? (gap analysis)

4. With this in mind, choose a desired future forest condition.

5. Reassess, defend, monitor, and adapt to this standard.
Example: Island Area

1. NRV range (based on research) = 3-50%

2. Other ecological obj. (small mammal research) = 3-50%

3. Socially and culturally, more is better, so 3-50% is fine.

   - Economically, would prefer to limit “leave areas”, but if it can be worked into alternative silvicultural plans (ie, modified harvesting techniques), can take second pass, so leave areas could vary between 3-50%.

4. **NRV (3-50%) = DFFC (3-50%) < CC (0%)**

5. No problem here, so go ahead and implement.
1. NRV suggests = 1-100,000 ha
2. Current range is 10-40 ha
3. - Other ecological concerns about wind, erosion. Not comfortable with going above 2,000 for now operationally.
   - Economically, below 10 ha is quite costly.
   - Socially, the acceptance line is about 2,000 hectares, but it is a moving target.
4. NRV (1-100,000) ne DFFC (10-2,000) ne CC (10-40 ha)
5. Implement, but revisit social and economic needs and wants. Reword objective to reflect “current acceptance” and allow for flexibility over time? Possible to go >2,000 and <10 ha on trial basis?
The natural disturbance model is more than a bunch of good ideas that we can integrate into the current system....

....it has the potential to fundamentally change the way forest management is practiced.
(Poor) Incremental Change =

The BC Biodiversity Guidelines

- Management & groundrule framework did not change from “multiple use”
- Created a new level of planning within the old one
- Created very small, sustainable “landscape units” – that have very little meaning ecologically
- Established hard seral-class targets (vs ranges)
- Established patch size ranges that are out of context (patch vs event)
- NO OTHER natural patterns were / have been included. Cherry-picking.
Fundamental Change = Mistik Management Pilot Project

- SERM decreed that management and monitoring would be based on “natural baselines”

- Agreed to harvest an entire compartment – “one pass” based on overall percentage of merchantable wood removal.

- in-and-out within 5 years, leave no roads, no island harvesting, no blowdown recovery.

- deviated from probabilities of what a fire would have left to favour “leave areas” for other reasons.
  - aesthetic, winter cover, mechanical difficulties, steep terrain, existing trails, structures, and local outfitter preferences.

- Local SERM and Mistik working together to create new “rules” and compliance monitoring system.
The basic research should, and will continue for several years. We are in exciting, but unexplored territory. We started with about 15 questions, and are now at closer to 25.

But have begun to, and will continue to shift emphasis as below to feed partner needs.

Summary