2013-2014 Webinar Series
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Incorporating Principals of Natural Disturbance into Development and Evaluation of Forest Management Guides for the Boreal Forest Region of Ontario

Rob Rempel

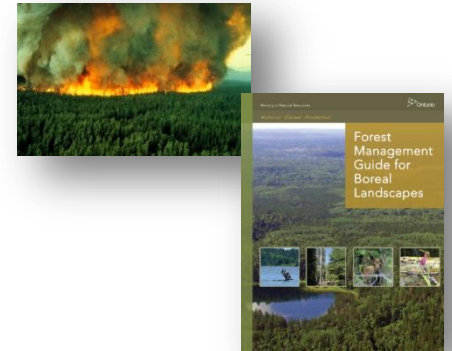Ontario Ministry of Natural Resources

Incorporating Principals of Natural Disturbance into Development and Evaluation of Forest Management Guides for the Boreal Forest Region of Ontario

Policy/Science Interface

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Outline

- Policy Context for Forest Management Guide Development

- Adaptive Management Framework

- Estimating the Range of Natural Variability

- Applying the Guide in Forest Management Planning

- Guide Effectiveness Monitoring - Policy as Hypothesis
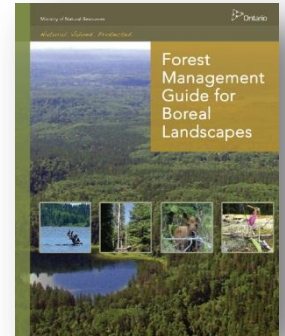
Policy and Legislative Context
– Crown Forest Sustainability Act

- "The purpose of the Act is to ensure the *long-term health of our forest ecosystems* for the benefit of the local and global environments, while enabling present and future generations to meet their material and social needs".

- Sustainability principals:
  - 1. Large, healthy, diverse and productive Crown forests and their associated *ecological processes* and *biological diversity* should be *conserved*.
  - 2. To provide for long term health and vigour of the forests, *emulate natural disturbances and landscape patterns* while *minimizing adverse effects* on plant life, animal life, water, soil, air and social and economic values.
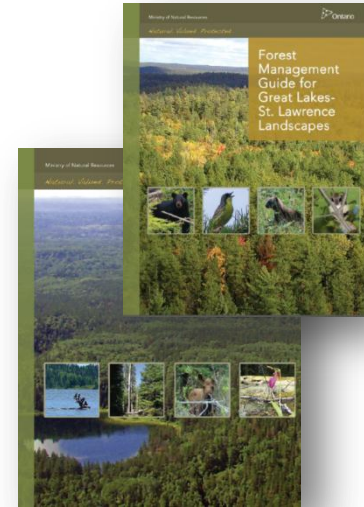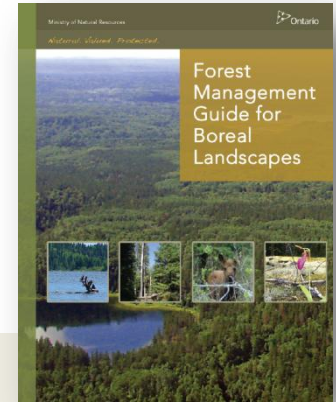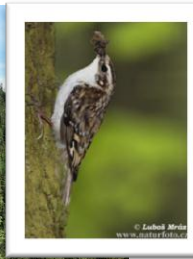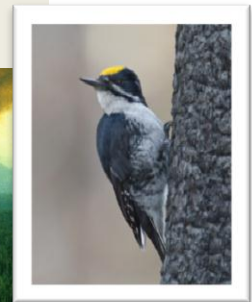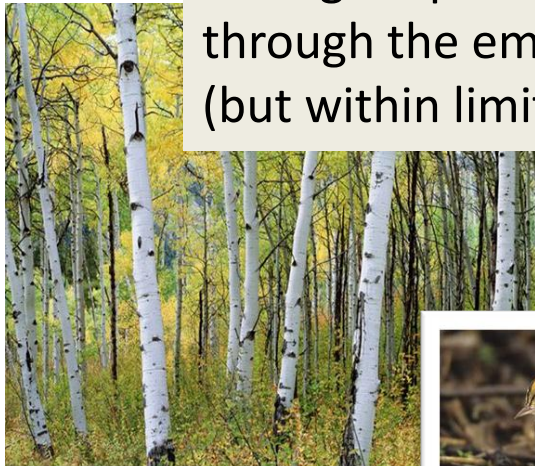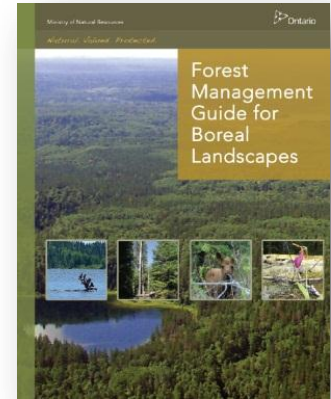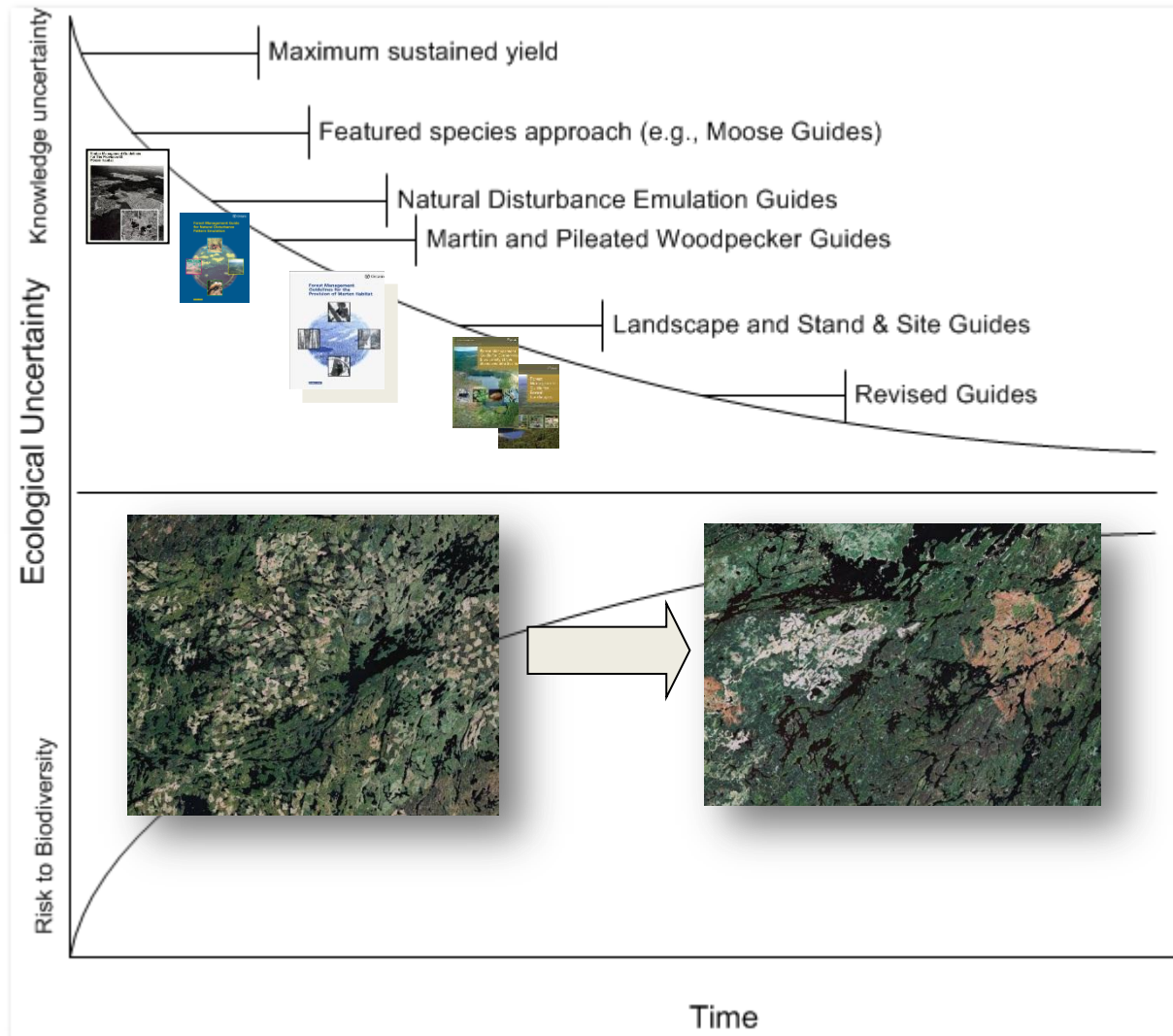
In a nutshell…

The Crown Forest Sustainability Act tells us to maintain ecosystem services by conserving biodiversity and ecological processes (ecological integrity), and do this through the emulation of natural disturbance processes (but within limits)

Guide Evolution in Ontario

Guide Evolution
Adaptive Management Framework

Science & management
Goals
Experience
Knowledge
Technology
Inventory

Sustainability Act Principles

Emulate Natural Disturbances & Landscape Pattern

Forest Practices (limits of silviculture)

Minimize Adverse Effects

Management
Ecoregional Direction (SRNV)

Science
Testable hypotheses

Science & management
Revised Goals
New Experience
New Knowledge
New Technology
Updated Inventory

DEVELOP

EVALUATE

IMPLEMENT

MONITOR

Science
Results, Tool & Support

Management
Landscape Guide directs FMP; OLT

Science
Effectiveness

Management
Compliance

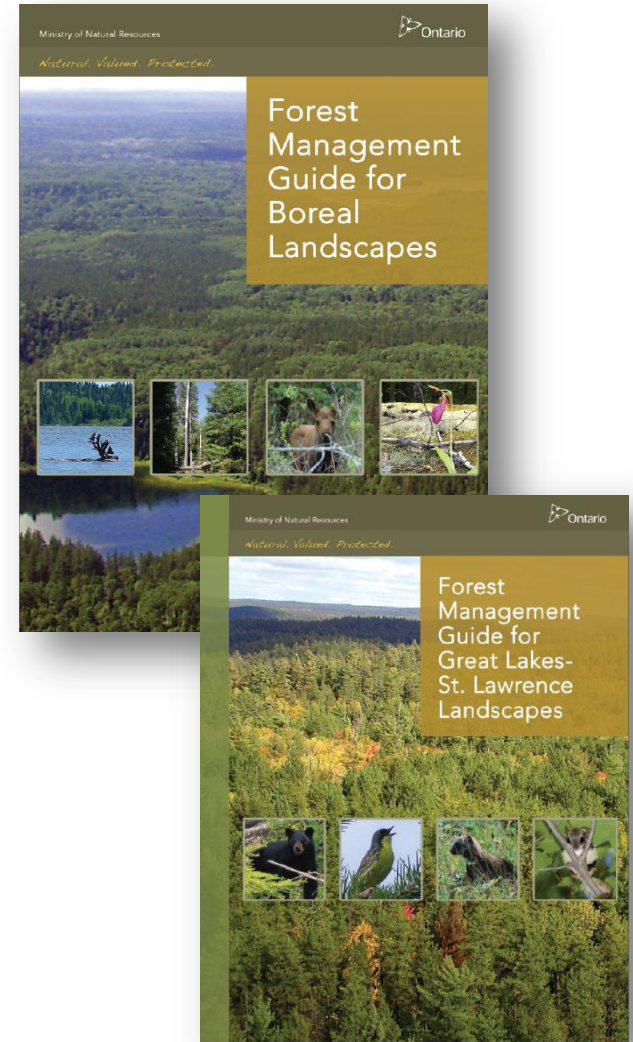**In a nut shell the Landscape Guides direct................**

Amount
- Caribou Habitat (where applicable)
- Landscape Classes
- Conifer (Boreal specific)
- Old Growth
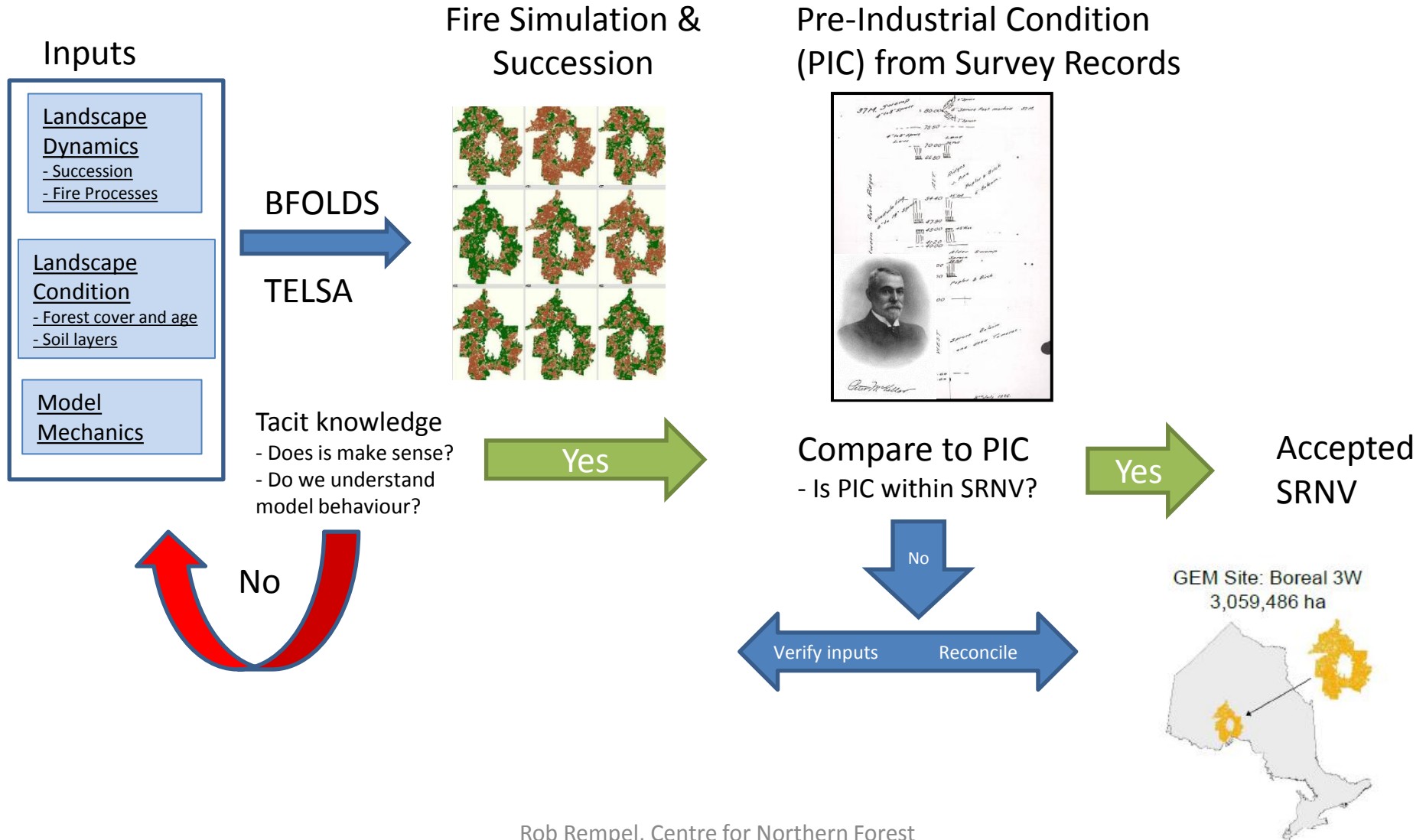- Red and White Pine (GLSL specific)
- Young Forest (GLSL specific)

Pattern
- Caribou Habitat (where applicable)
- Young Forest
- Mature and Old Forest

based on estimates of natural variation (SRNV).

Simulated Range of Natural Variation (SRNV)

Inputs

Fire Simulation & Succession

Pre-Industrial Condition (PIC) from Survey Records

Landscape Dynamics
- Succession
- Fire Processes

Landscape Condition
- Forest cover and age
- Soil layers

Model Mechanics

BFOLDS

TELSA

Tacit knowledge
- Does is make sense?
- Do we understand model behaviour?

Yes

No

Compare to PIC
- Is PIC within SRNV?

No

Verify inputs   Reconcile

Yes

Accepted SRNV

GEM Site: Boreal 3W
3,059,486 ha

Simulated Range of Natural Variation (SRNV) - pattern
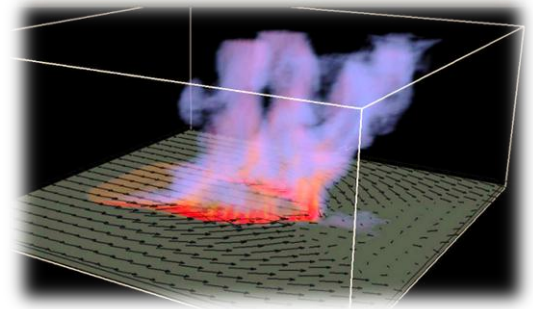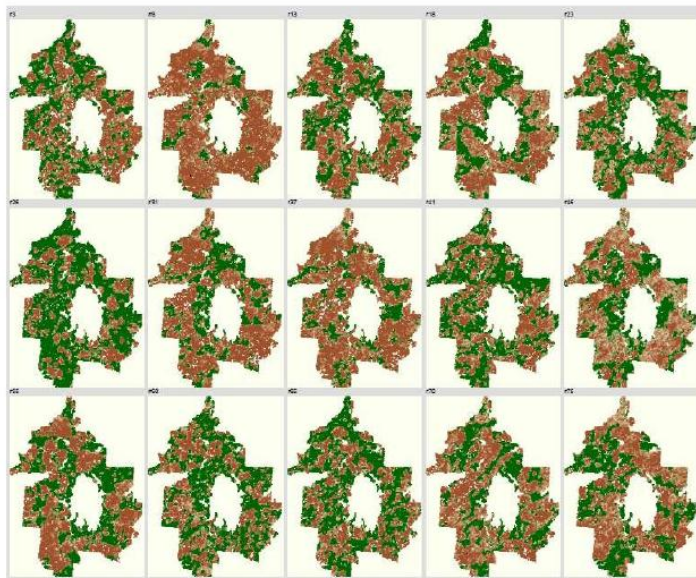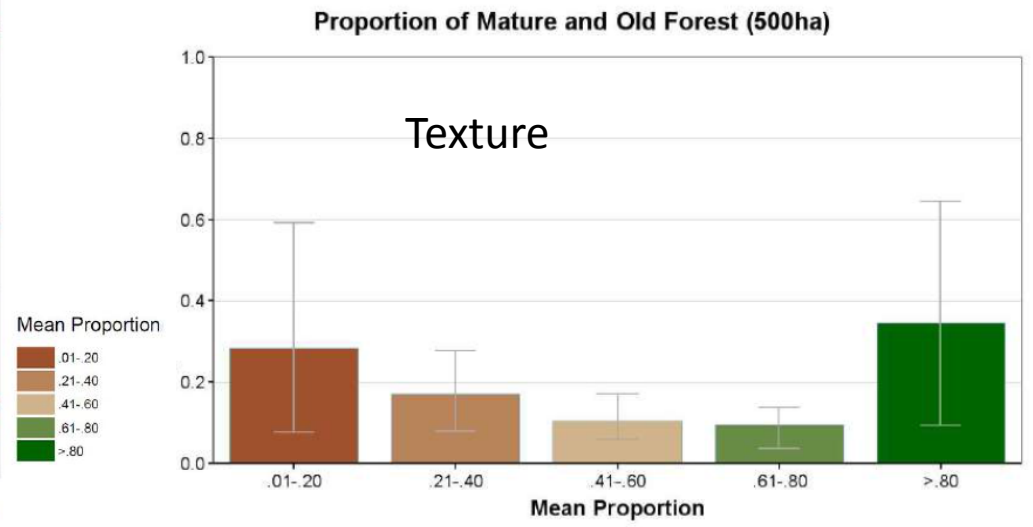

427 Mature+Old Forest - GEM Site: Boreal_3W: Years 100-150-200

Proportion of Mature and Old Forest (500 ha)

Mean Proportion
- .01-.20
- .21-.40
- .41-.60
- .61-.80
- >.80

0 50 100 km

This is 15 of 60 replications – 'snap-shots' in simulation time *example* maps: one for each year and fire intensity

Proportion of Mature and Old Forest (500ha)

Texture

Mean Proportion: .01-.20, .21-.40, .41-.60, .61-.80, >.80

.............based on estimates of natural variation.

Applying the Guide in Forest Management Planning

- Measure the current forest condition using Landscape Guide prescriptive indicators

- Use the inter-quartile-range (IQR) of the SRNV as the forest management plan desirable levels for area based indicators and the mean SRNV of texture classes for pattern based indicators

- Develop targets for the Landscape Guide indicators that are consistent with movement within or towards the IQR over the short (0-10 years), medium (0-20 years) and long term (0-100 years).

- Identify large landscape patches (LLPs) when required to meet targets for landscape pattern or habitat indicators
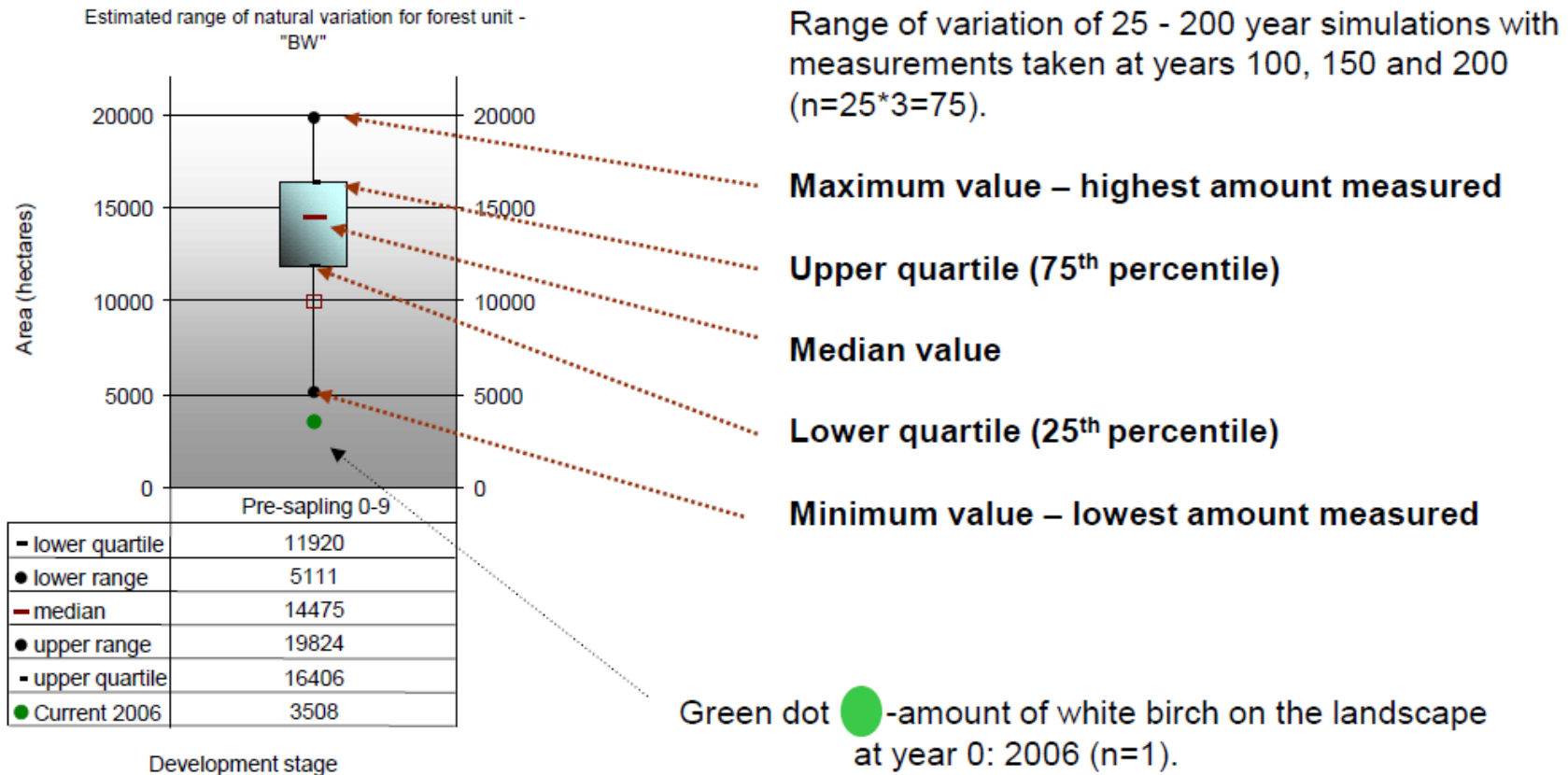
OLT - Linking Policy with Science
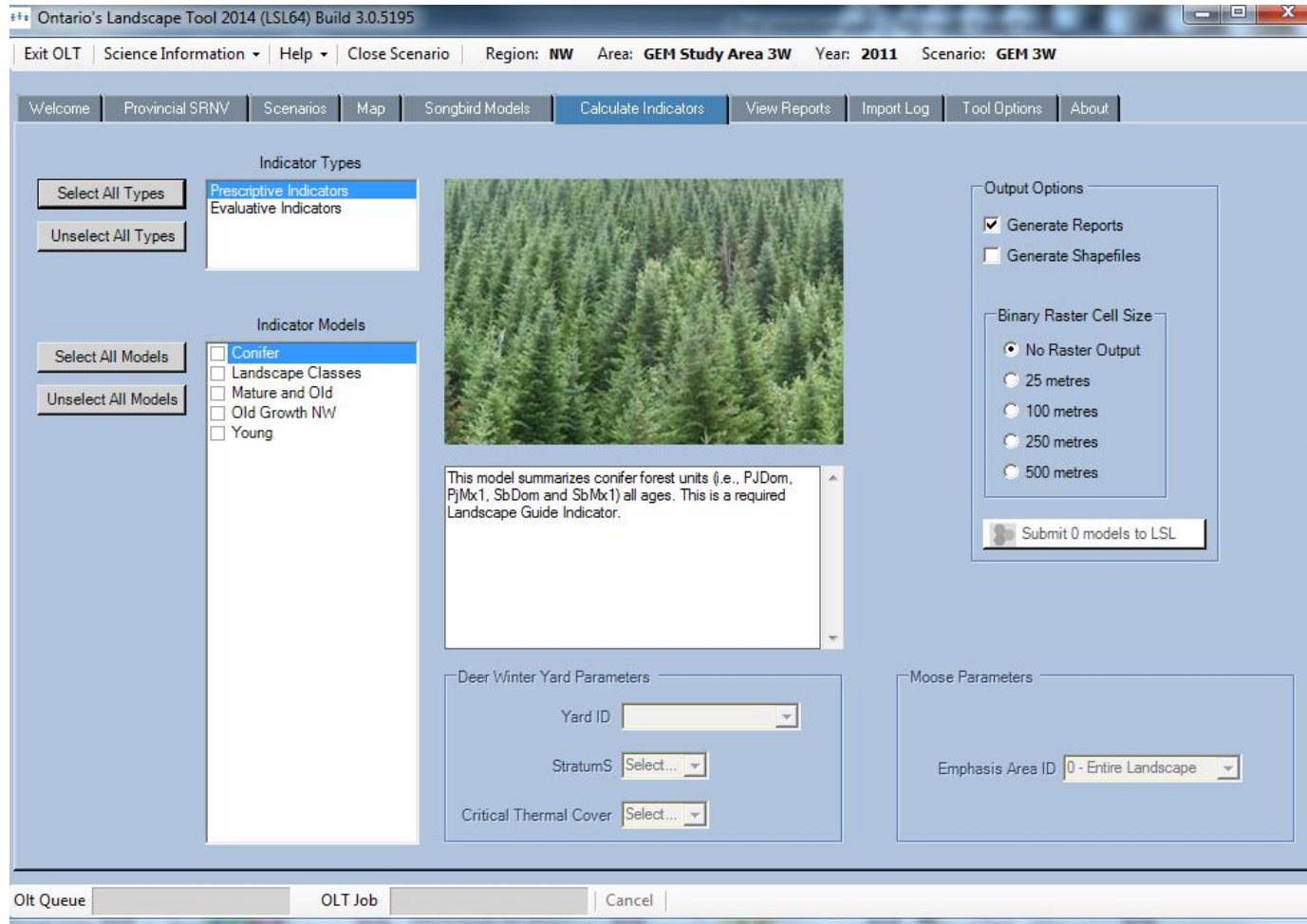
Elkie, P., A. Smiegielski, M. Gluck, J. Elliott, R. Rempel, R. Kushneriuk, B. Naylor, J. Bowman, B. Pond, Derek Hatfield and Sean Heringer. 2014. **Ontario's Landscape Tool**. Ontario Ministry of Natural Resources. Forest Policy Section. Sault Ste. Marie Ontario.
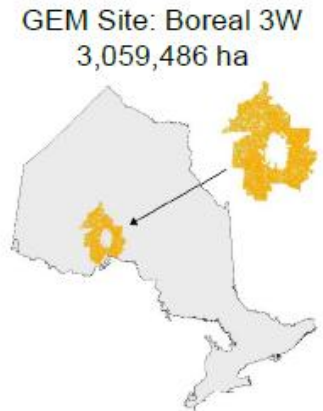
Example box and whisker diagram

This diagram shows the modelled variation, an estimate of natural variation, for the white birch (BW) forest unit in the pre-sapling development stage.

IQR – Interquartile Range

Estimated range of natural variation for forest unit - "BW"

Area (hectares)

	Pre-sapling 0-9
– lower quartile	11920
● lower range	5111
▬ median	14475
● upper range	19824
– upper quartile	16406
● Current 2006	3508

Development stage

Range of variation of 25 - 200 year simulations with measurements taken at years 100, 150 and 200 (n=25*3=75).

Maximum value – highest amount measured

Upper quartile (75th percentile)

Median value

Lower quartile (25th percentile)

Minimum value – lowest amount measured

Green dot ● -amount of white birch on the landscape at year 0: 2006 (n=1).

Simulation (Box & Whisker) Area: GEM Study Area 3W
Indicator: Landscape Classes

Prescriptive Indicator

GEM Site: Boreal 3W
3,059,486 ha
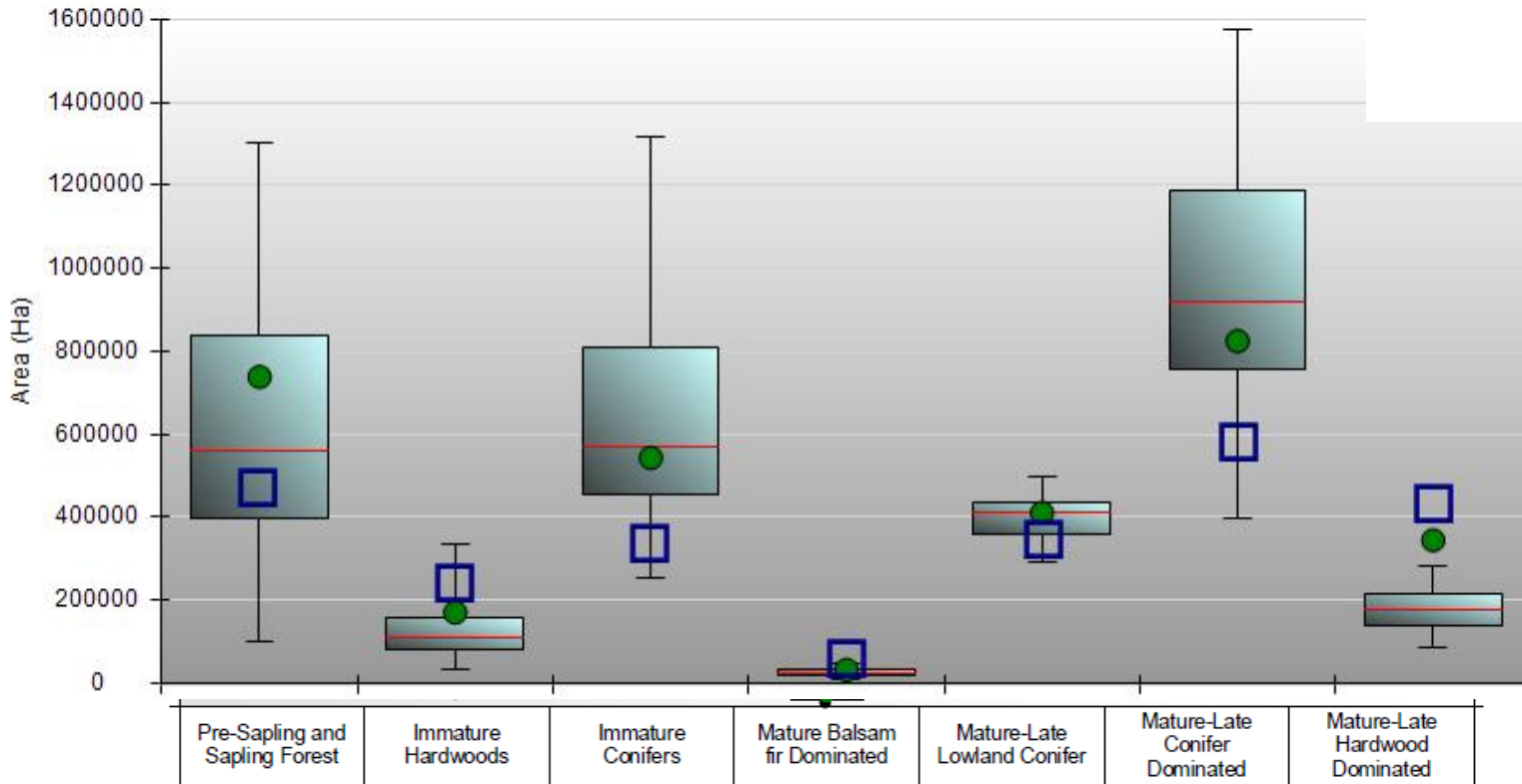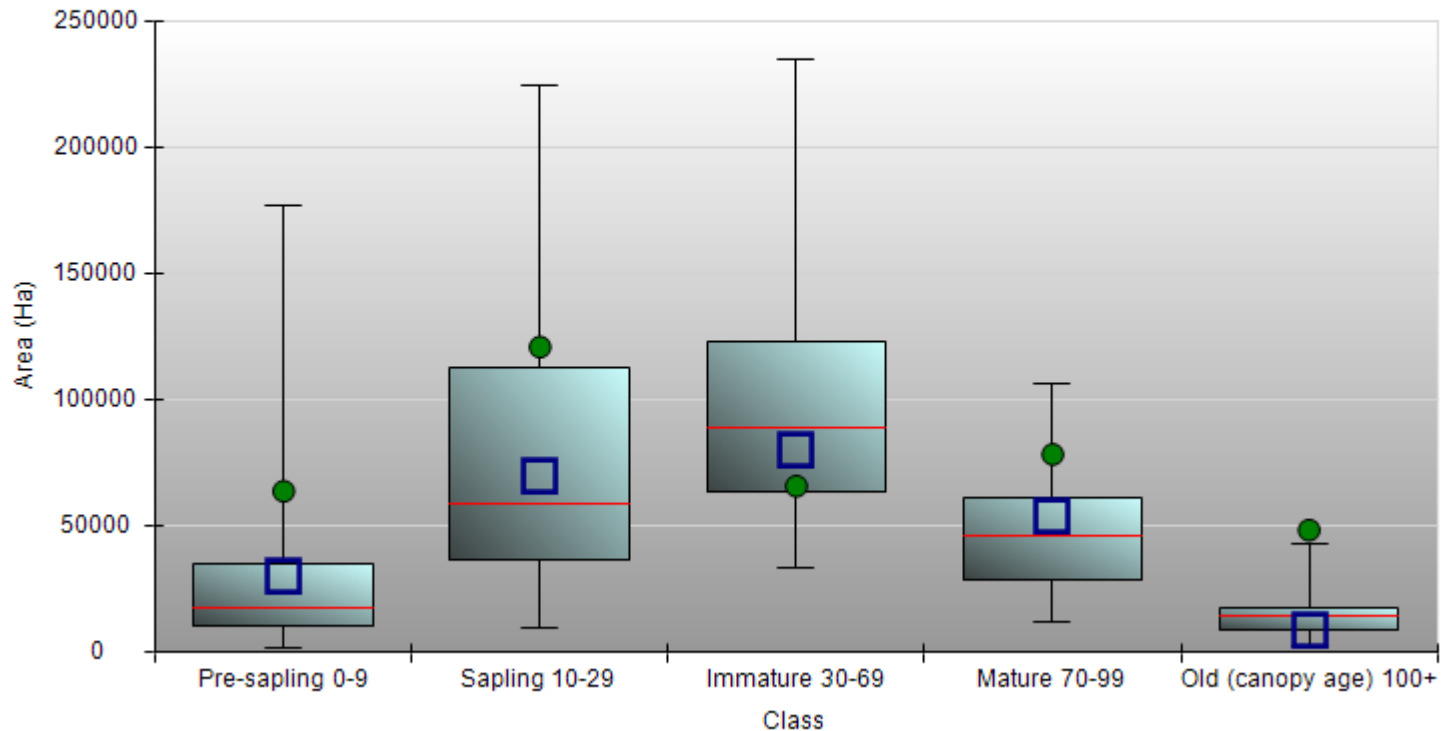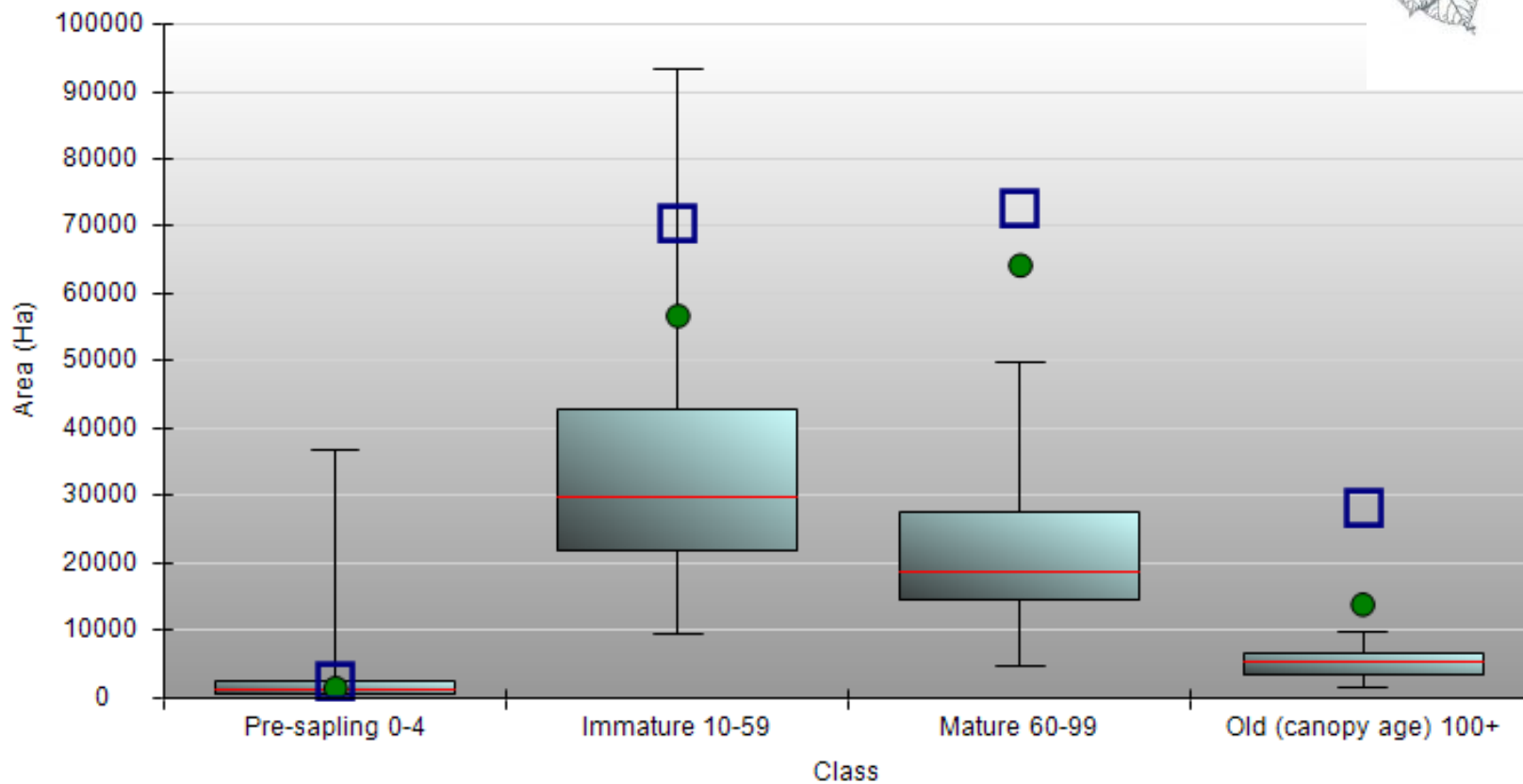
SRNV for Jackpine Dominant
Prescriptive Indicator

Simulation (Box & Whisker) Area: GEM Study Area 3W
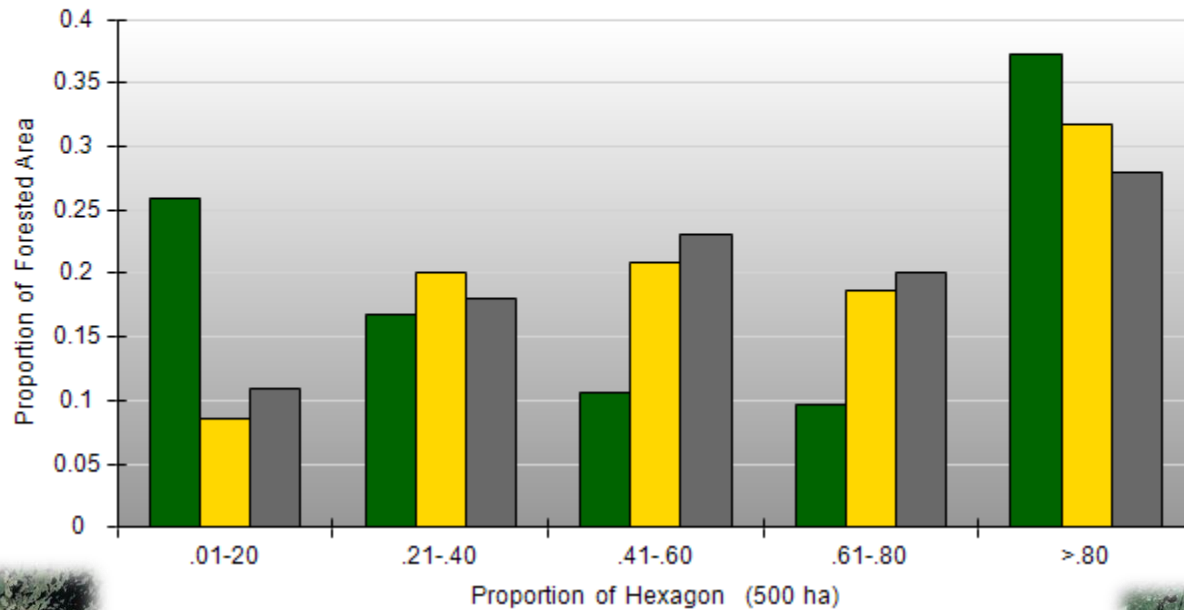Indicator: Forest Unit - PjDom

Simulation (Box & Whisker) Area: GEM Study Area 3W
Indicator: Forest Unit - HrDom

Mature and Old Forest – Pattern
Prescriptive Indicator

Simulation Area: GEM Study Area 3W
Indicator: Mature and Old

This pattern SRNV is estimated from entire Landscape Guide Region - 3W

Legend: SRNV Mean | Simulation Model Start - Year 0 | GEM 3W

SRNV for Focal Songbird Species (1 – 7)
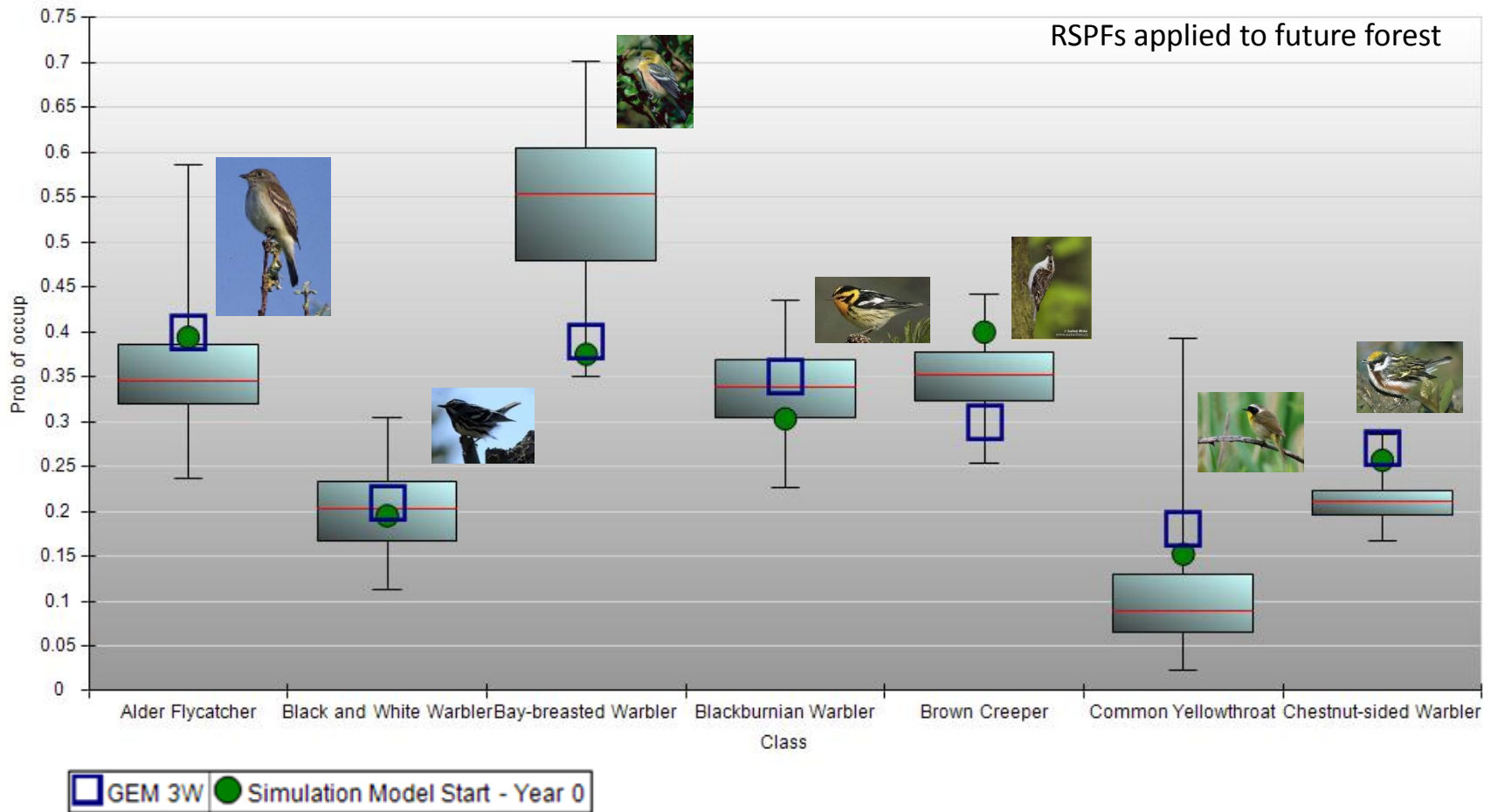## Evaluative Indicators (RSPFs)

**Table A16. Landscape Guide Region 3W – Milestones for the Lake Nipigon Forest.**

CFSA Objective Category	Landscape Guide Indicator Group	Landscape Guide Indicator	Measurement (units)	Milestones			
				Directional Statement	Short (10 years)	Medium (20 years)	Long (100 years)
Structure and Composition	Landscape classes	Mature and late balsam fir mixed	Area (ha)	Maintain within the inter-quartile range (IQR)	Maintain	Maintain	Maintain
		Mature and late lowland spruce and low other conifer	Area (ha)	Maintain within the IQR	Maintain	Maintain	Maintain
		Mature and late conifer and conifer mixedwood	Area (ha)	Maintain within the IQR	Maintain	Maintain	Maintain
		Mature and late hardwood and hardwood mixedwood	Area (ha)	Decrease and maintain within the IQR	Decrease	Decrease	Maintain
	Old growth forest	Old growth by Forest Management Plan forest unit or appropriate grouping	Area (ha)	Increase and maintain within the IQR	Increase	Maintain	Maintain
	Red and white pine forest	All ages red and white pine forest units	Area (ha)	Increase to pre-industrial condition estimate	Increase	Increase	Increase
	Upland pine and spruce forest	All ages Conifer	Area (ha)	Increase and maintain within the IQR	Increase	Increase	Maintain
	Young forest	Young forest	Area (ha)	Move towards and/or maintain within the IQR	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable

Is Emulation of Natural Disturbance working?
Guide Effectiveness Monitoring

1. Are landscape (prescriptive) indicators changing as a result of the Landscape Guide, and

2. Are focal species (evaluative) indicators responding to the change?
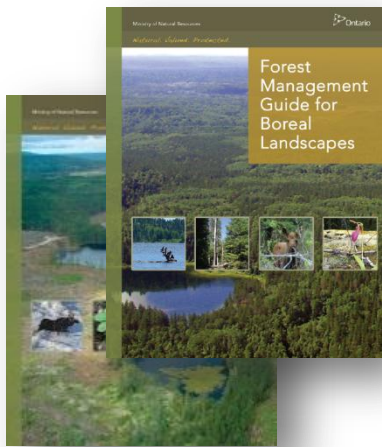
Guide Effectiveness Monitoring
Policy as Hypothesis

Management Expectation (hypothesis): Indicators of biodiversity and ecological processes (ecological integrity) will not differ between natural and managed sites

Managed

Natural

Ecological integrity: Integrity implies an unimpaired condition or the quality or state of being complete or undivided; it implies correspondence with some original condition (Karr 1996).

…refers to a condition in which biotic and abiotic components of ecosystems and the composition and abundance of native species and biological communities are characteristic of their natural regions and rates of change and ecosystem processes are unimpeded. PPCRA, 2006, c. 12, s. 5 (2).

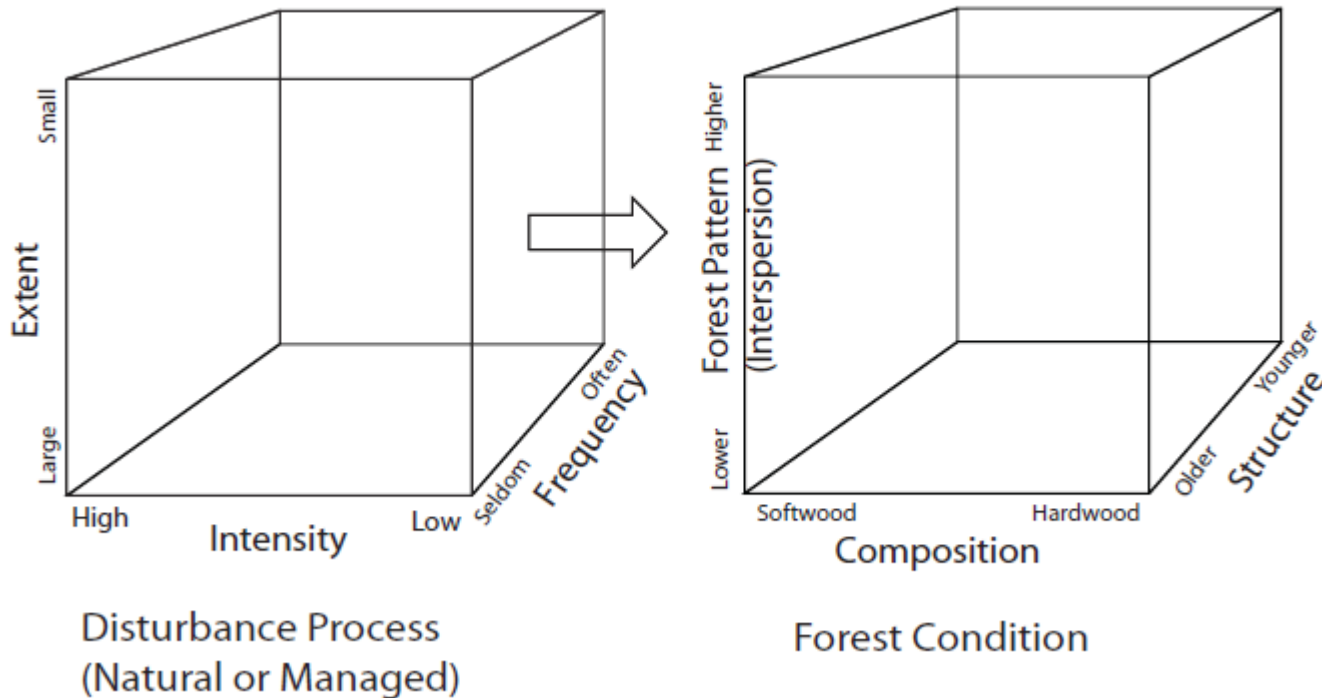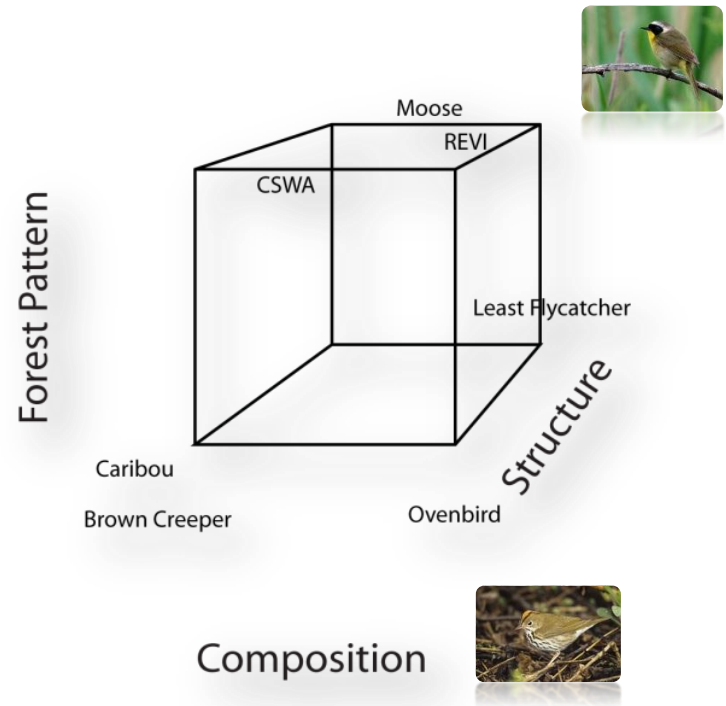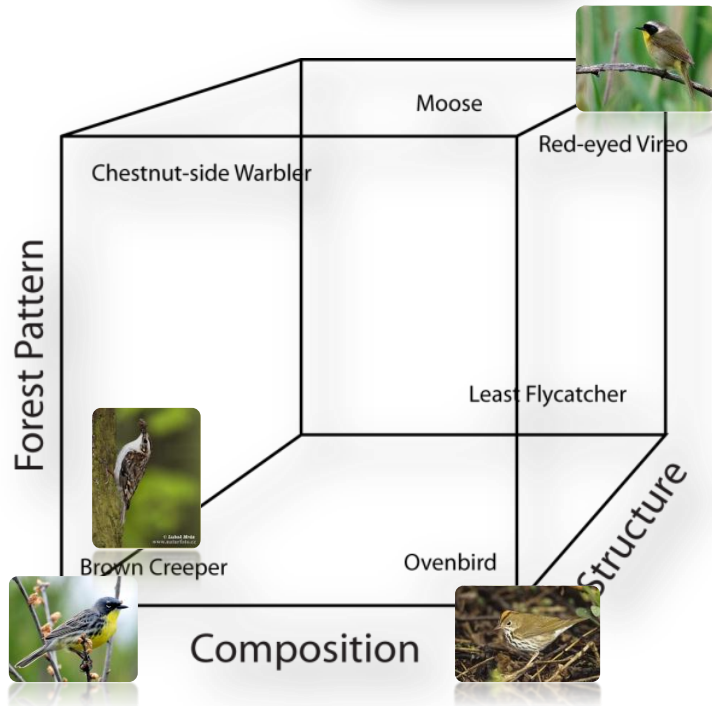# Natural Disturbance Process

α

K

r

Ω
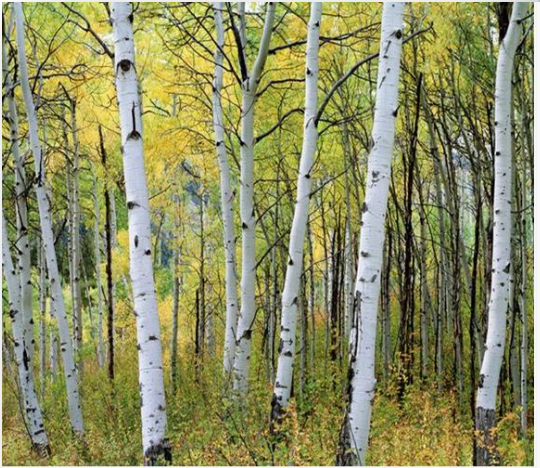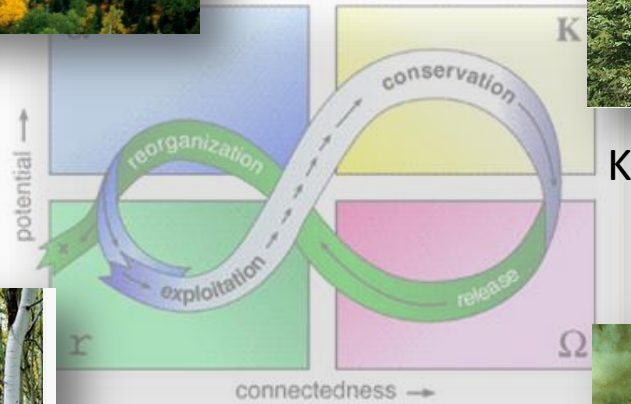
Habitat Variability

α

K

r

Ω

Disturbance Process → Forest Condition

Heuristic Model

Disturbance Process (Natural or Managed):
- Extent (Small – Large)
- Intensity (High – Low)
- Frequency (Seldom – Often)

Forest Condition:
- Forest Pattern (Interspersion) (Higher – Lower)
- Composition (Softwood – Hardwood)
- Structure (Older – Younger)

Forest Condition → Wildlife Habitat

Habitat Niche Space

Selection of Species Representing Range of Variability in Habitat Condition

Landscape Scale (~5,000 ha)
- Covertype edge
- AgeClass edge

Local Scale (~ 50 ha)
- Area by veg-type
- Seral stage
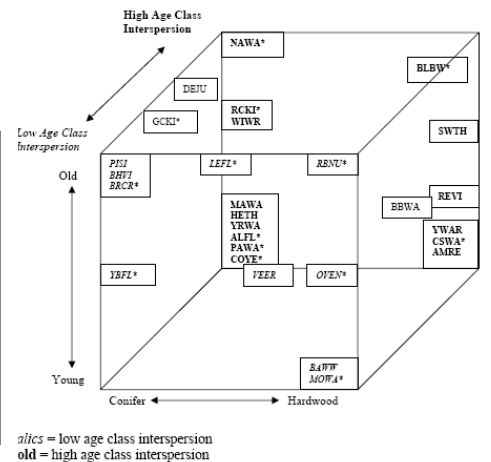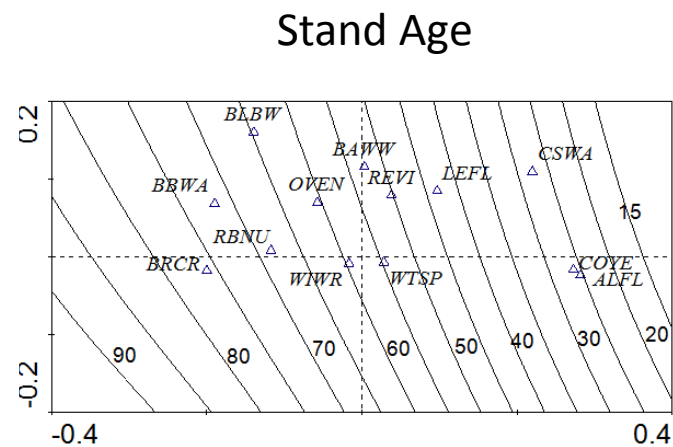- Height
- Canopy Closure
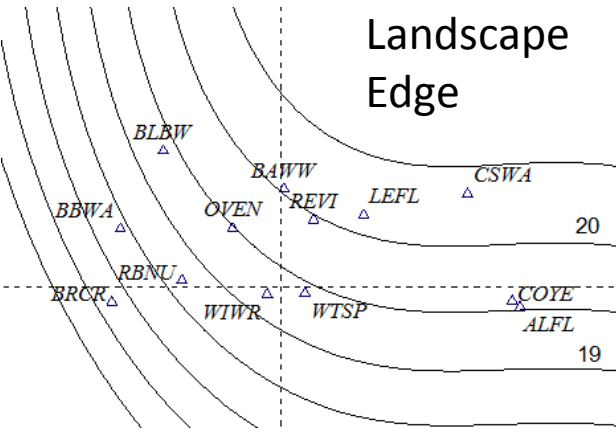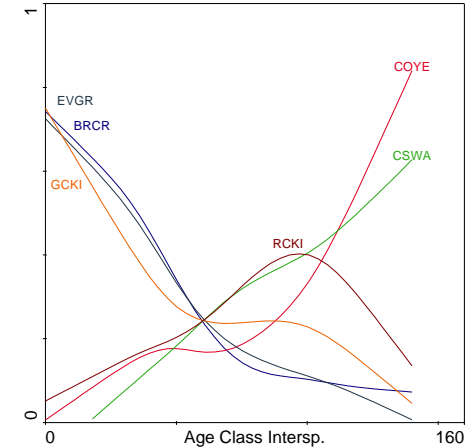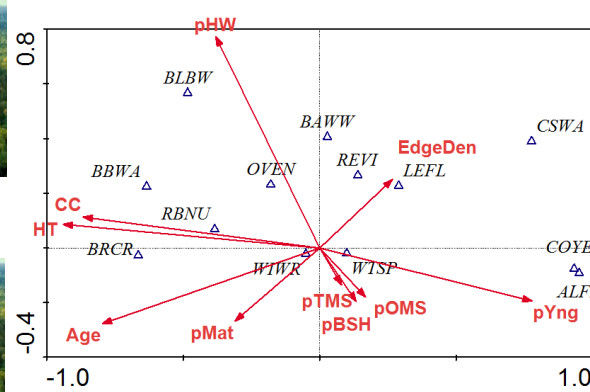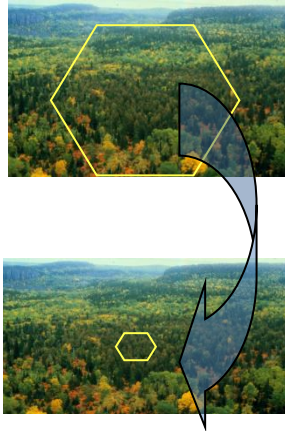- Snag density

Landscape Edge

Stand Age

Figure 16. Major habitat conditions influenced by forest management and the associated songbird distribution for selected species. * = selected for Landscape Guide evaluation.

italics = low age class interspersion
old = high age class interspersion

FOCAL SPECIES: SELECTED TO REPRESENT A BROAD RANGE OF NATURAL VARIABILITY IN FOREST CONDITION

• *Alder Flycatcher, Black & White Warbler, Chestnut-sided Warbler and Common Yellow Throat*: Younger, more open hardwood forest with high disturbance and edge levels

• *Bay-breasted warbler, Blackburnian Warbler, Brown Creeper, Red-breasted Nuthatch, Winter Wren*: Older softwood/mixedwood, intact matrix

•*White Throated Sparrow*: Older, open mixedwood

• *Red-eyed Vireo, Least Flycatcher*: Closed hardwood, less intact matrix

• *Ovenbird*: Closed Hardwood, less disturbance and edge

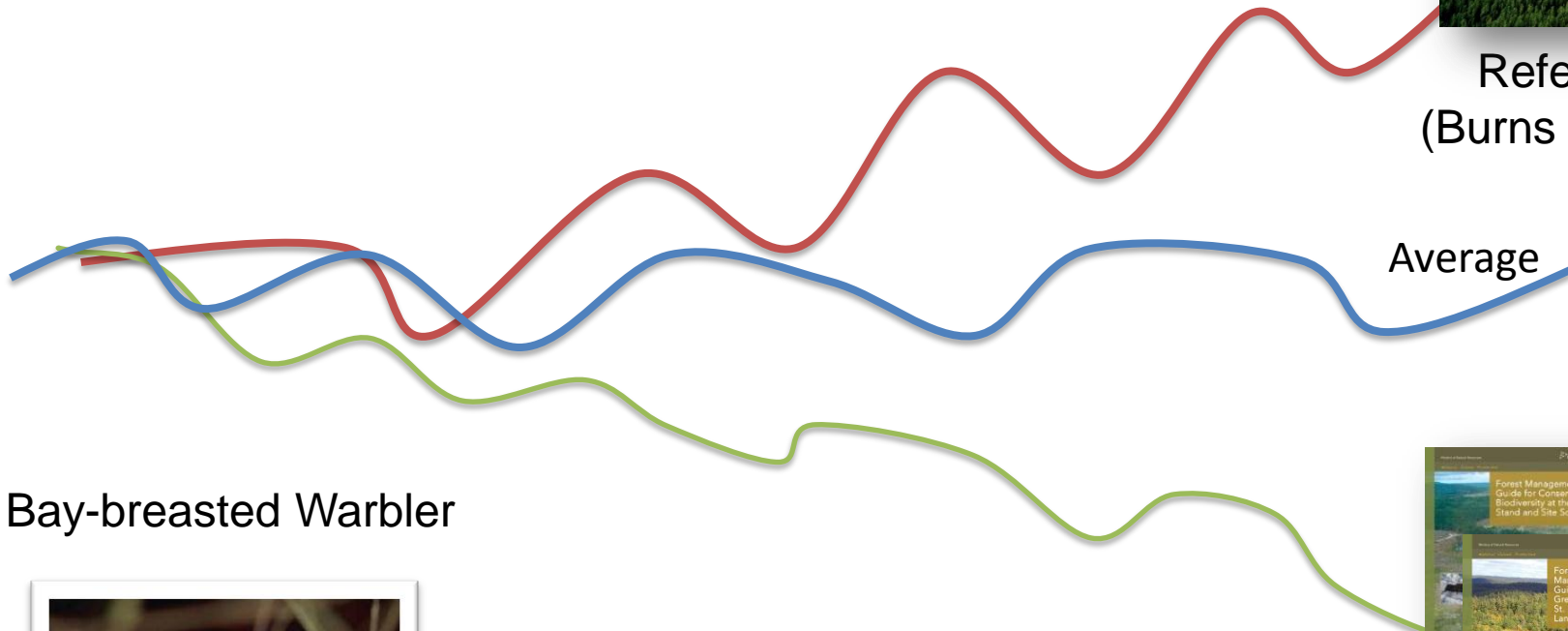# Effectiveness Monitoring Questions

- Is occupancy lower in reference sites compared to forest management sites?

- Is occupancy rate lower than simulated range of natural variation

- Is occupancy declining over time?
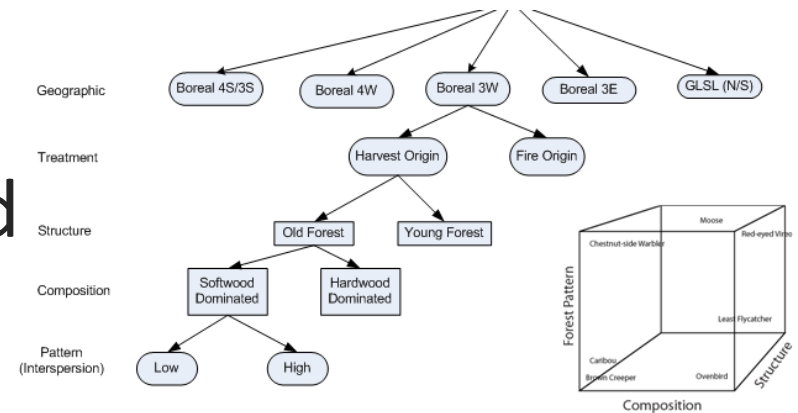
Policy as Hypothesis
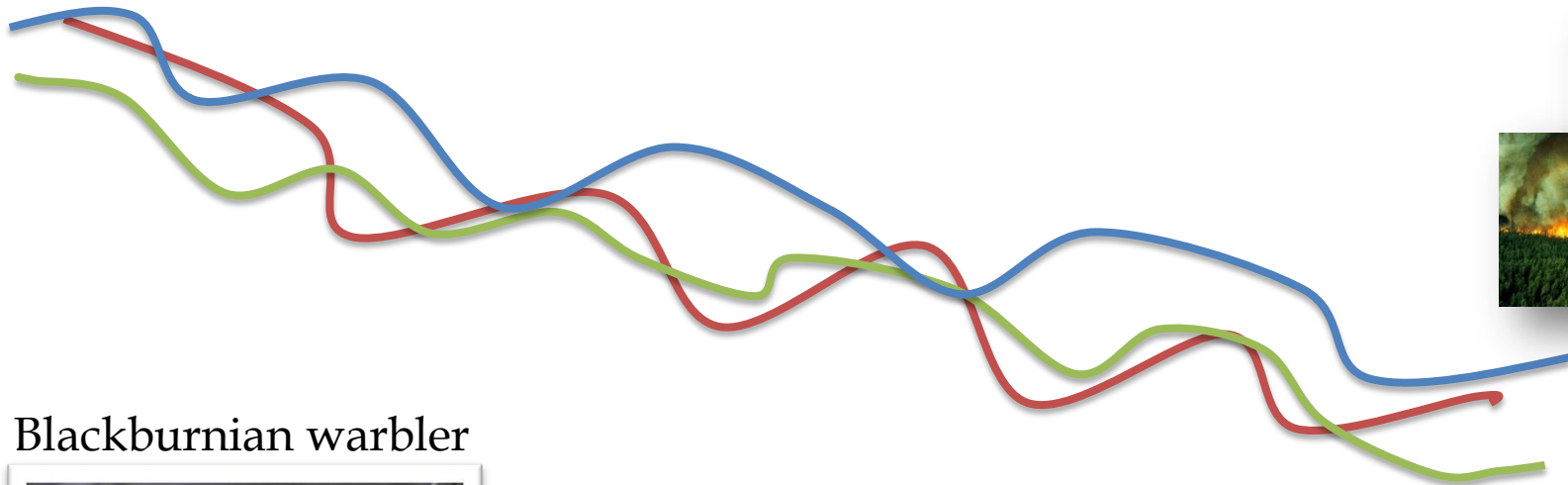## - Isolate Effects

Reference
(Burns & Parks)

Average

Bay-breasted Warbler

Treatment
(Harvest Areas)

Policy as Hypothesis
- Isolate Effects
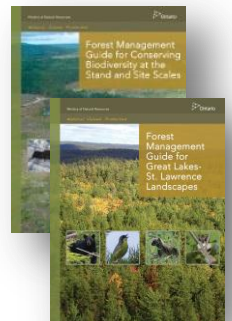

Reference

Blackburnian warbler

Treatment

Initial Results

Harvest versus Reference Occupancy Rates

Young Harvest

Old Harvest

Young Burn

Old Burn

Chart: Occupancy Rate (y-axis 0.0 to 1.0) versus species (ALFL, BAWW, BBWA, BLBW, BRCR, COYE, CSWA, LEFL, OVEN, RBNU, REVI, WIWR, WTSP). Legend: Harvest, Reference.

Natural Disturbance Model (SRNV) versus Field Survey Results
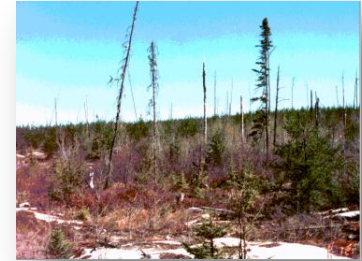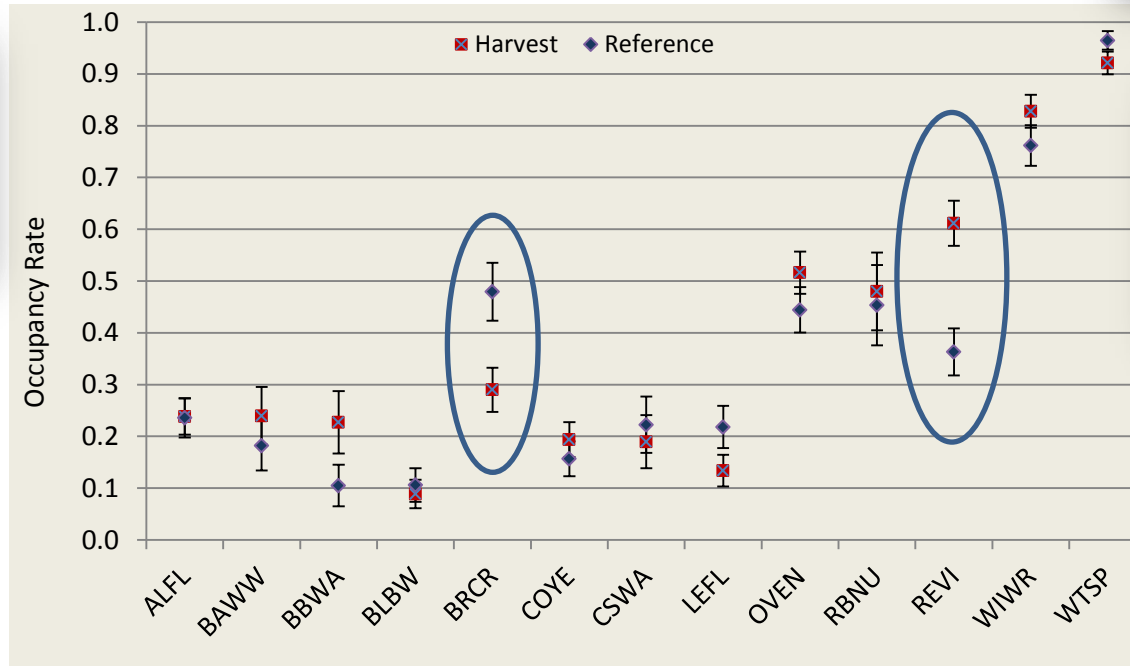
Conclusions

- Principals of natural disturbance ecology can be used to inform forest management and conservation policies to sustain ecological integrity and ecosystem services

- Fire science and simulation can be used to estimate desired ranges of natural variability

- Carefully selected wildlife species can be used to assess effectiveness of EMD based policies

- EMD should be viewed as a policy hypothesis, with effectiveness monitoring used to test assumptions and improve policy direction, in an adaptive management context.
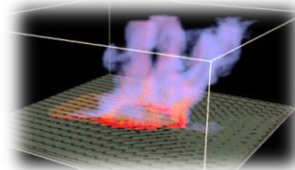
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Elkie, P., A. Smiegielski, M. Gluck, J. Elliott, R. Rempel, R. Kushneriuk, B. Naylor, J. Bowman, B. Pond, Derek Hatfield and Sean Heringer. 2014. Ontario's Landscape Tool. Ontario Ministry of Natural Resources. Forest Policy Section. Sault Ste. Marie Ontario. http://www.olt.tbayteldirectit.com/

ESSA Technologies Ltd. 2005. TELSA - Tool for Exploratory Landscape Scenario Analyses: User's Guide Version 3.3. Prepared by ESSA Technologies Ltd., Vancouver, BC. 236 pp.

Perera, A.H., M.R. Ouellette, W. Cui, M. Drescher and D. Boychuk. 2008. BFOLDS 1.0: A spatial simulation model for exploring large scale fire regimes and succession in boreal forest landscapes. Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, ON. Forest Research Report No. 152. 50 p.

Ontario Ministry of Natural Resources. 2014. Forest Management Guide for Boreal Landscapes: http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@forests/documents/document/stdprod_110507.pdf

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Rempel, R. S., J. Baker, P. C. Elkie, M. J. Gluck, J. Jackson, R. S. Kushneriuk, T. Moore, and A. H. Perera. 2007a. Forest policy scenario analysis: Sensitivity of songbird community to changes in forest cover amount and configuration. Avian Conservation and Ecology - Ecologie et Conservation des oiseaux 2:Article 5.

_____. 2007b. Forest Policy Scenario Analysis: Evaluating the Effectiveness of Coarse-Filter Policy Options on Conserving Forest Songbird Communities. Report CNFER TR-002. http://cnfer.on.ca/SEP/papers.htm

Yemshanov, D. and A.H. Perera. 2002. A spatially explicit stochastic model to simulate boreal forest cover transitions: general structure and properties. *Ecological Modelling* 150(2): 189-209.

That concludes the LSFSC 2013-2014 Webinar Series – Thank You for Participating

We will be setting up our 2014-2015 Webinar Series shortly

All 2014-2015 LSFSC Webinars are held on the third Thursday October through April at 2 PM EST/1 PM CST

The first one will be held October 16, 2014