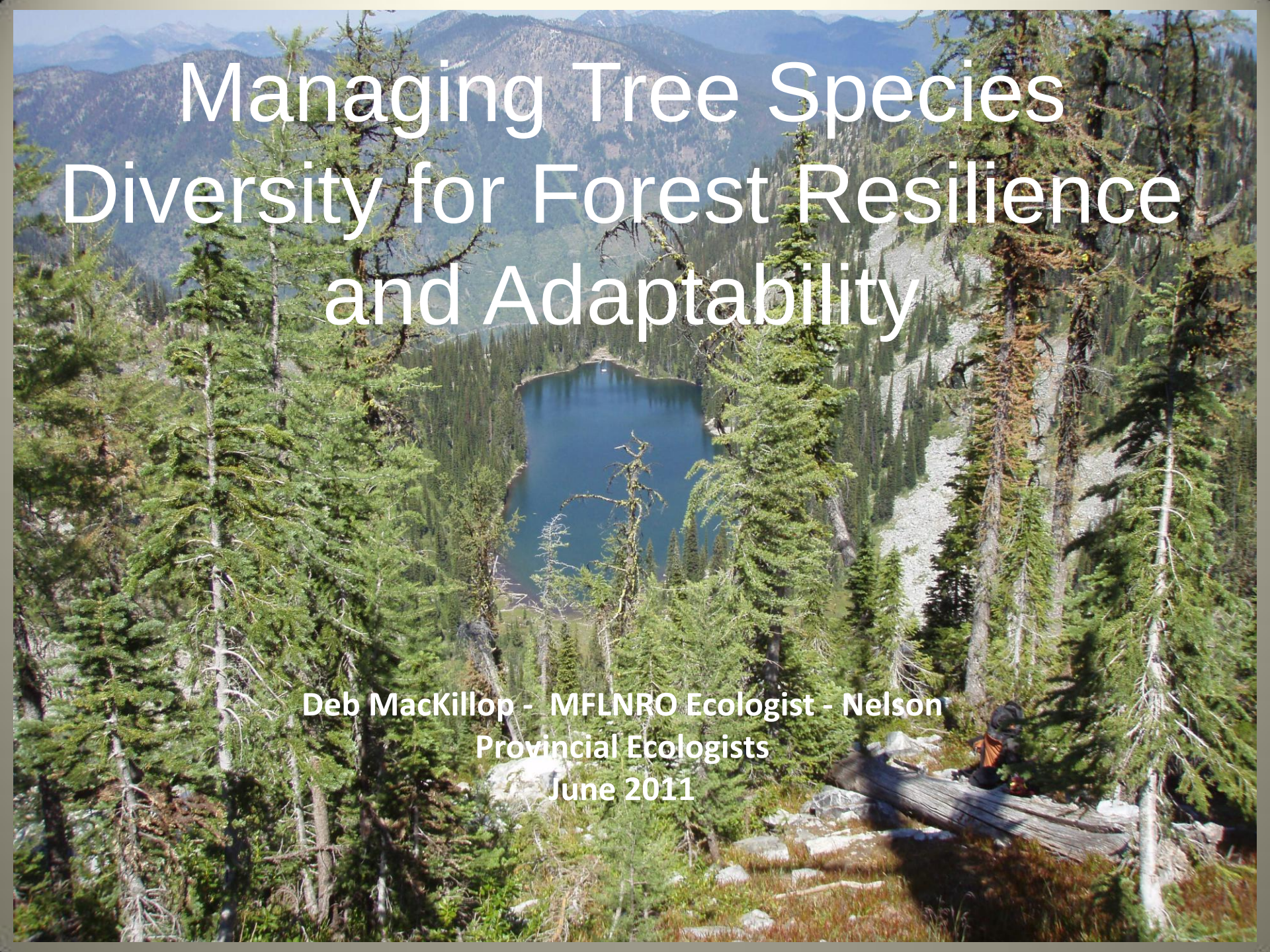




Managing Tree Species Diversity for Forest Resilience and Adaptability

Deb MacKillop - MFLNRO Ecologist - Nelson
Provincial Ecologists
June 2011

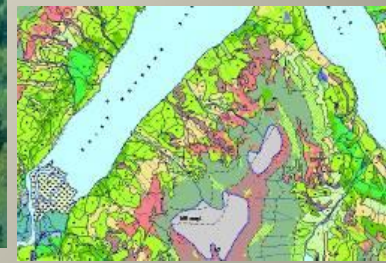
What IS diversity?

- Variety in structure, composition and function across levels of ecological organization

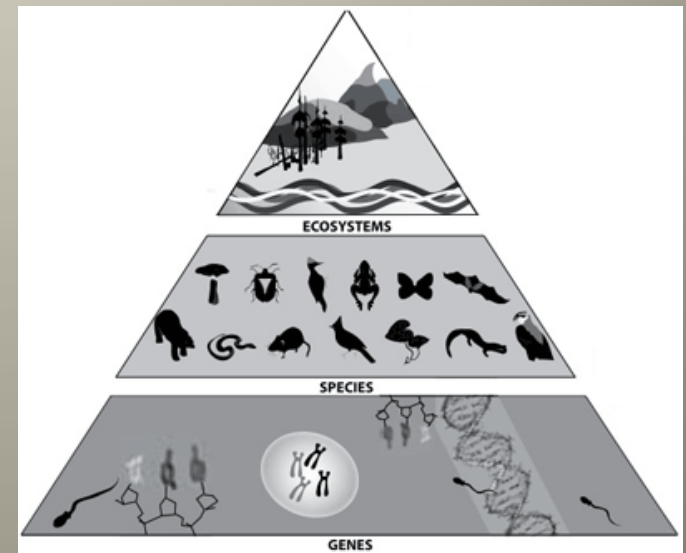
- genes (different seed sources)
- **species (Fd, Cw, Hw, Ba,...)**
- ecosystems (mature and seral)
- stand structure

- variety at any one of these levels across scales of **space** and time

- **stand (within-stand)**
- **landscape (among stands)**



Landscapes!



Species diversity is one aspect of Ecosystem Resilience

“the capacity of ecosystems to absorb disturbance without collapsing into a qualitatively different state that is controlled by a different set of ecological processes.”

- Interplay processes between species and with environment
- Adaptive cycles
- Processes working at different time/space scales
- **Diversity**
- Biological legacy and “memory”
- Connectivity

Species diversity is more than just number of species

- “Species Richness”
- Balance of species (evenness)
- Diversity of species traits (r , k)
- “natural” species composition
- “Key” species

Diversity Is Insurance Against Uncertainty

1. Maintains ecosystem **response diversity** to environmental change (including climate change)
2. Reduces ecosystem **vulnerability** to any single future disturbance event
3. Improves the potential for ecosystem **reorganization** following disturbance

“... complexity at a hierarchy of scales is a highly desirable attribute to maintain the capacity of ecosystems to gradually change in response to changing environmental conditions and provide benefits to future generations.”

E.A. Campbell et al. (2009)

Objective

We want our managed stands to adapt or self-organize after unexpected disturbances or changes and to continue to provide desired goods and services. (D. Coates NSC presentation 2011)

We want our forest landscapes to have sufficient diversity to limit the impacts of a single species-specific disturbances and improve adaptability to a changing environment

Stand Scale

Tree species diversity

Focus on the success of a single stand

- Reduces:
 - risk of complete stand failure
 - pest outbreak severity
- Enhances:
 - stand yield in a changing environment
 - structural attributes of habitat diversity
 - range of forest products



Landscape Scale

Tree species diversity

Focus on the overall success of the forest landscape (forest adaptability)

- Cumulative effects of individual stand-level decisions
 - Risk of widespread losses from species-specific pests
- Regional population of species for adaptability to future climatic conditions
- Variation in stand management while meeting broader targets



This is not new news...

We Know

- Tree species diversity is important
- Climate change introduces greater uncertainty

Home - Windows Internet Explorer
http://www.kootenayresilience.org/

Resilience and Climate Change:

Adaptation Potential for Ecological Systems and Forest Management in the West Kootenays

Exploring the Future of West Kootenay Forests

With climate change slowly building intensity around the globe, the future of West Kootenay forests, and how they're managed, is undergoing an assessment for resilience and vulnerability during 2010 and 2011. This website is the location to follow that assessment.

The website provides a description of the project and project team, contacts for further information and periodic progress reports. The website will also be a vehicle for distributing information regarding a series of workshops for technical specialists, forest managers and other stakeholders that will occur periodically as the project develops. The final reports for the project will be made available through the website in early 2012.

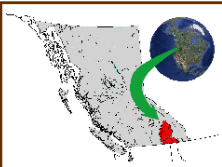
A local team of West Kootenay researchers have been awarded a two-year contract by the provincial government to carry out this work. The province has recognized that the impacts of climate change on our forests may demand new approaches to forest management. But the first step is to understand the changes.

The overall goal of this innovative project is to develop knowledge that will improve society's chances of maintaining the values currently provided by forests – from timber supply to clean water and wildlife habitat.

The team will begin by looking at global climate models and applying what they are predicting to the West Kootenay. Once the team understands the potential range of local climate changes, they will assess how forest ecosystems will be affected. Some ecosystems may be highly vulnerable to climate change, while others may be resilient, and more able to adapt.

Climate change is expected to bring changes in the frequency and severity of forest fires, storms and insect outbreaks, and in the amount of snow accumulated throughout the winter. All these factors affect the productivity, and even survival, of forest ecosystems.

The team will also hold a series of workshops with forest and land managers.



Global Temperature Relative to 1800-1900 (°C)

at the Stand and Landscape Level

When developing stocking standards:
both managed and unmanaged stands
species vulnerabilities
ability to affect young stands, now and

as by BEC unit
al Douglas-fir and Western red cedar

vel

Winter Workshop

ty
"do we manage for it?"
n to 4:00 pm
lanaimo Campus

2010 SISCO Winter

Searching for Sustainability in Forest Management

Agenda

Day One: Tuesday, April 13, 2010

8:25 Welcome & Opening Remarks

Climate Change – the Underlying Reality that S

The Trouble With Pine

Jean Heineman, Jean Mather, Don Sack
Suzanne Simard, Alan Vyse

April, 2010



Mark Johnston
Saskatchewan Research Council
Saskatoon SK
13.04.2010

Tree Species Vul
Climate Change:
of the CCFM study

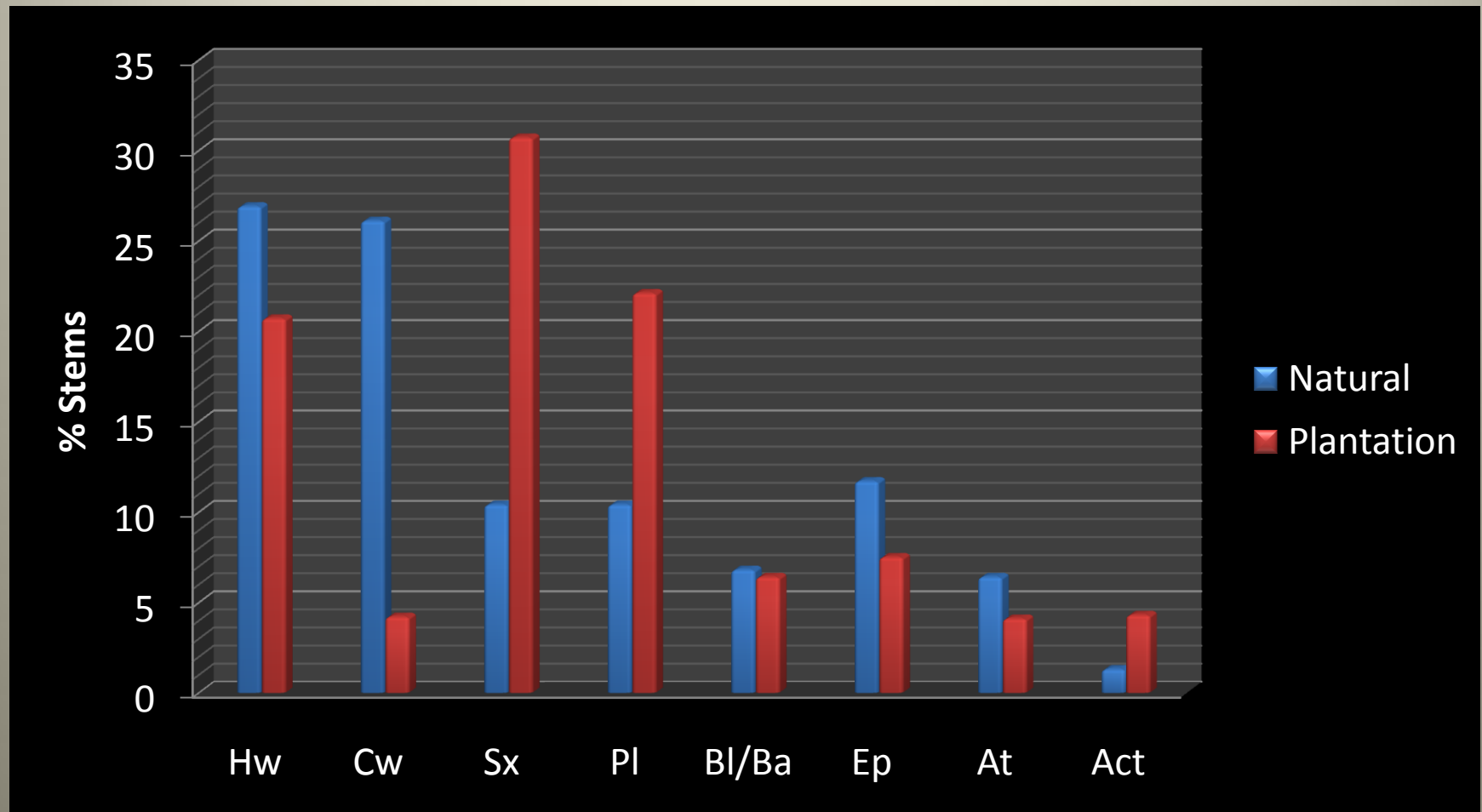
Is there a “diversity problem”?

- Landscape scale diversity assessment - **ICHmc2 pilot example**
- Using readily available data sources
- Findings:
 - Management intent is non-diverse; largely Pl and Sx
 - But natural ingress increases tree species diversity
 - Simple diversity measurements have not changed but obscure important changes
 - Divergence from natural stand composition
 - Cw is the big loser

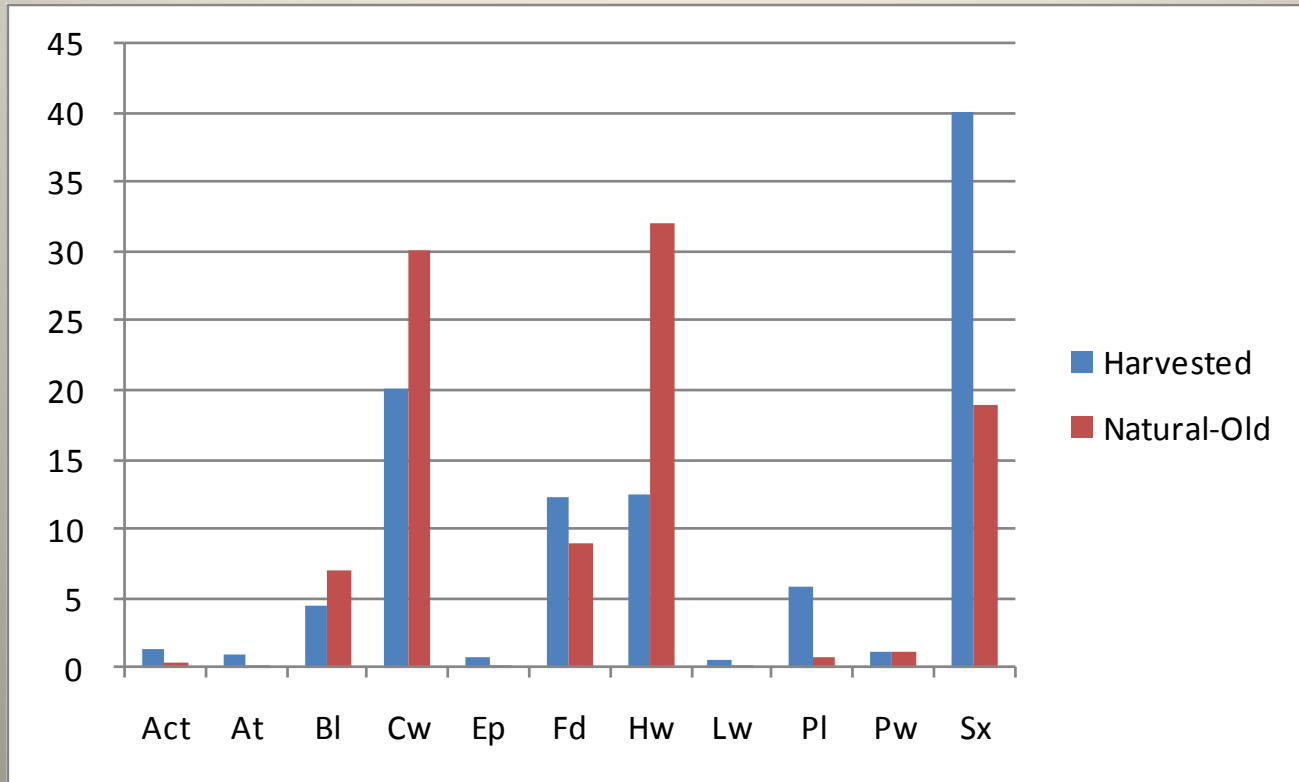
Comparative Statistics

	Young Natural Stands	Plantations
Richness (Number of Species)	8	8
Evenness	0.885	0.86
Diversity Index	1.84	1.79
Similarity Index	65%	

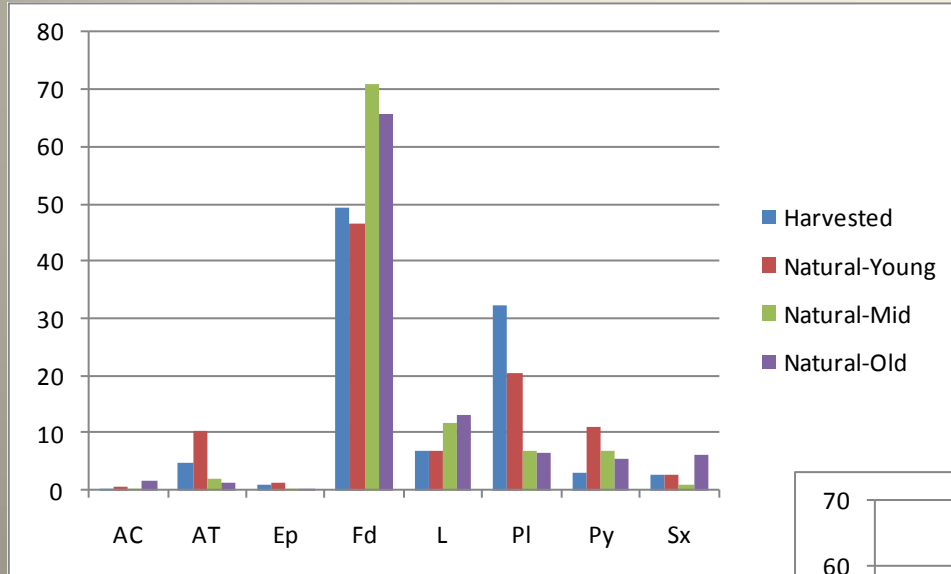
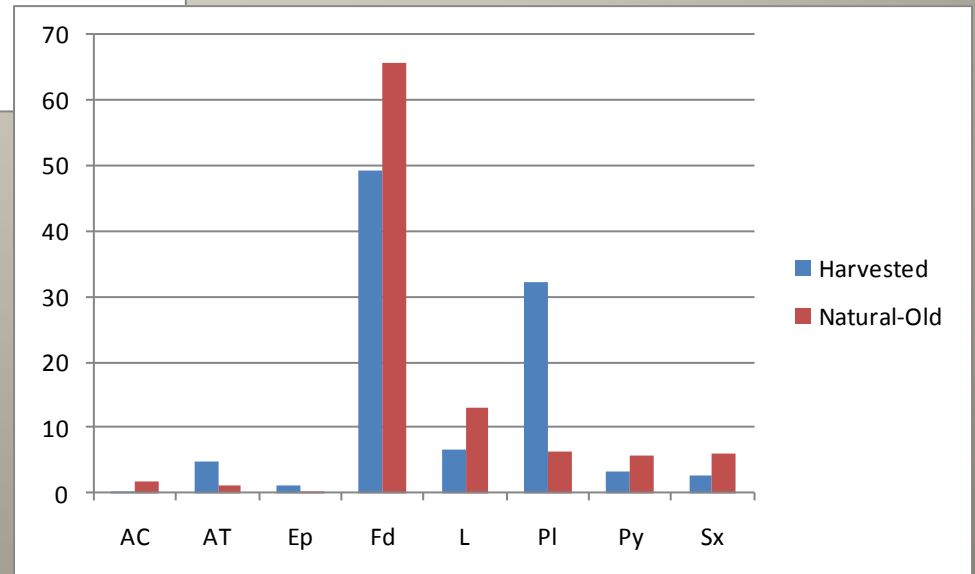
Landscape level species composition in ICHmc2 stands (<60yrs)



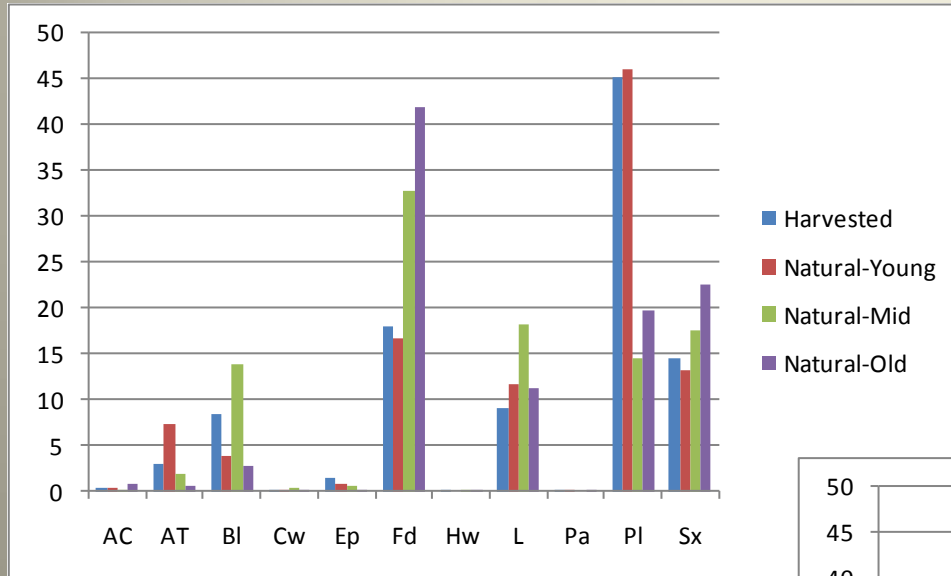
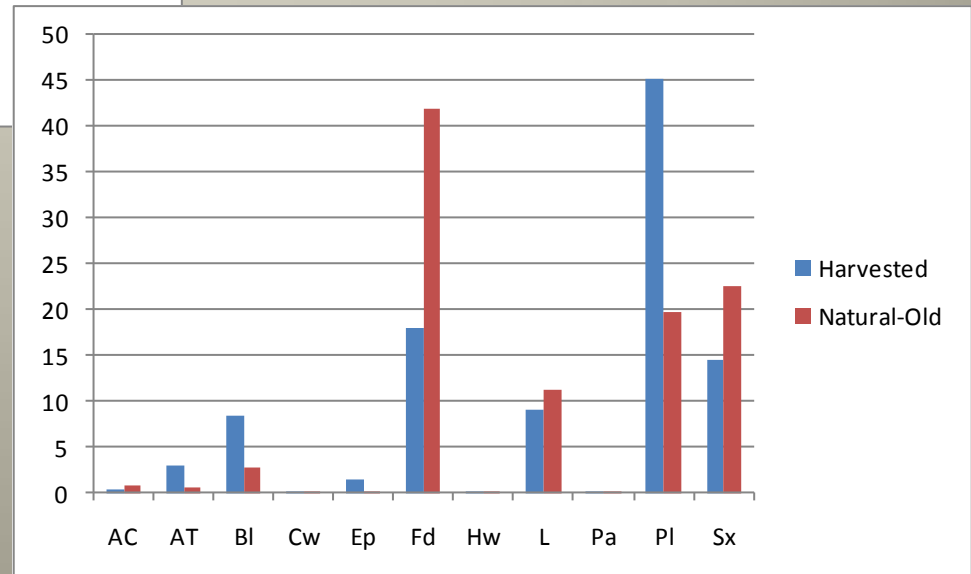
Species Composition – ICHwk1



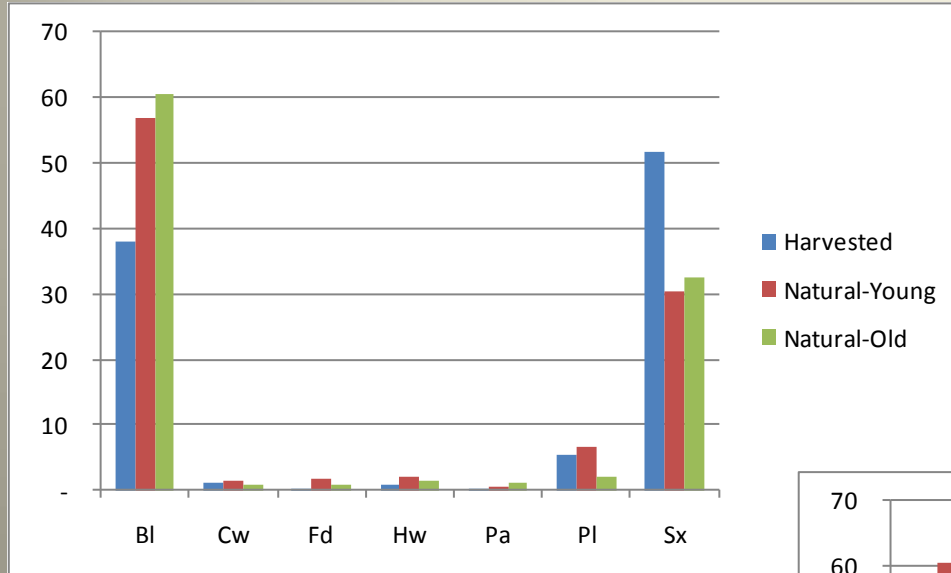
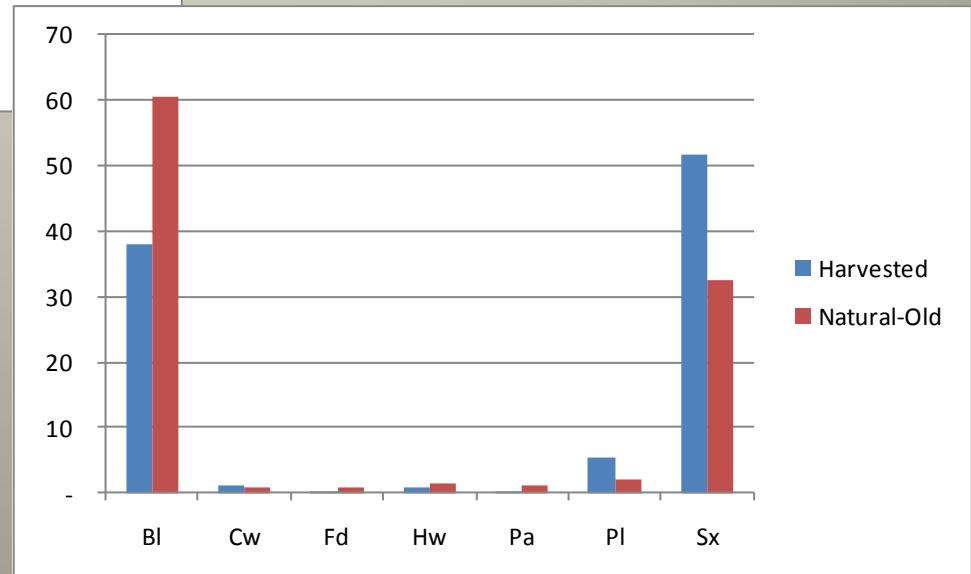
Species Composition – IDFdm2



Species Composition – MSdk



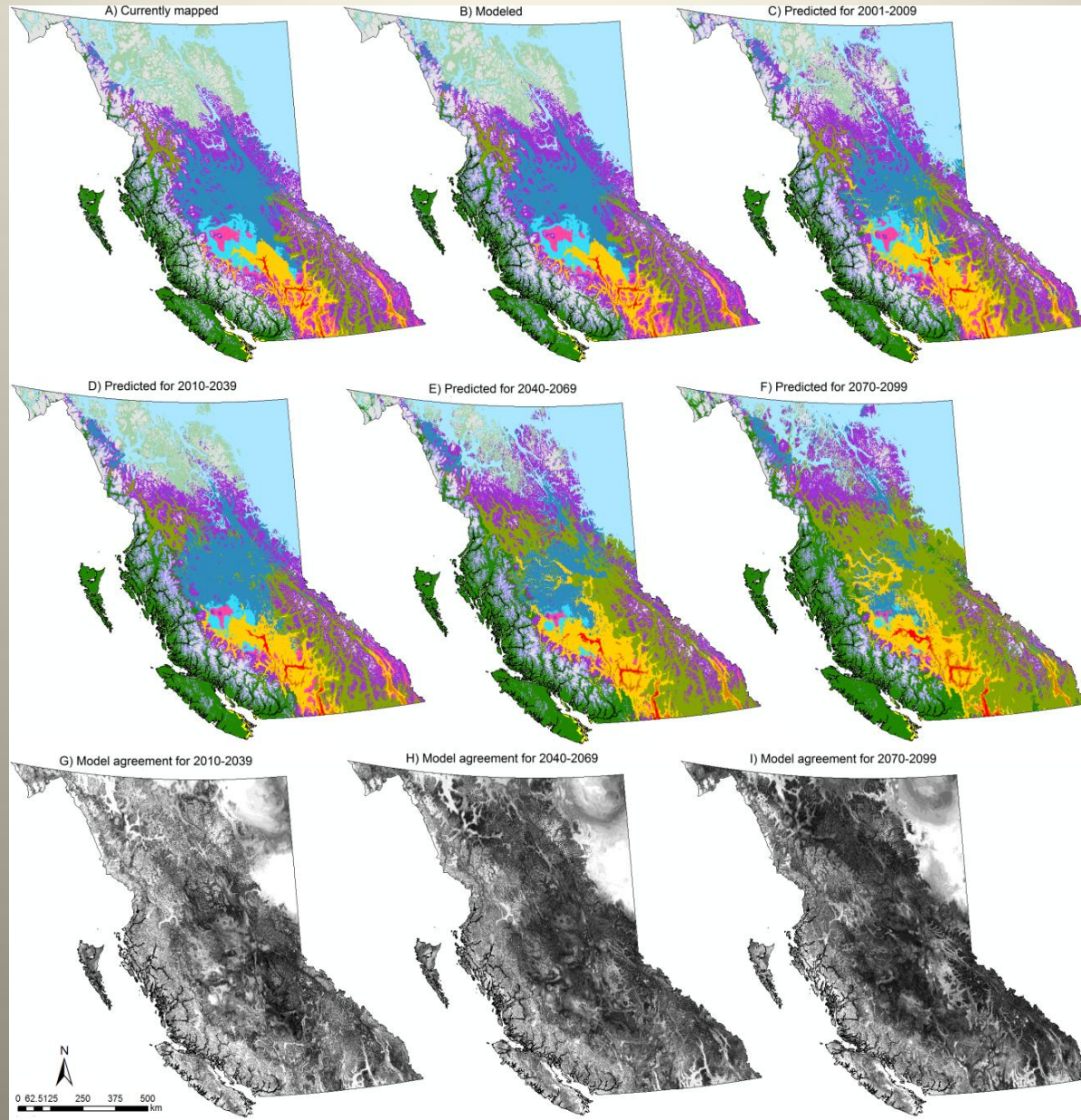
Species Composition – ESSFwc4



What ecology tools are available

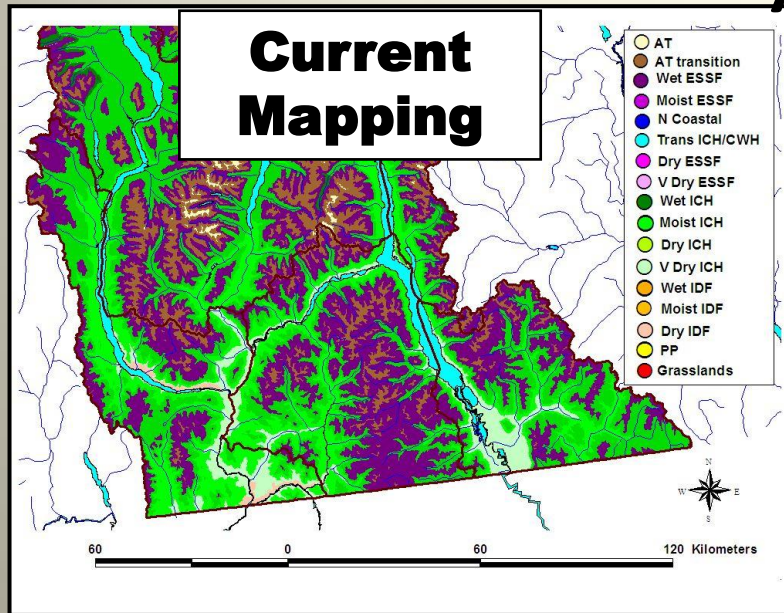
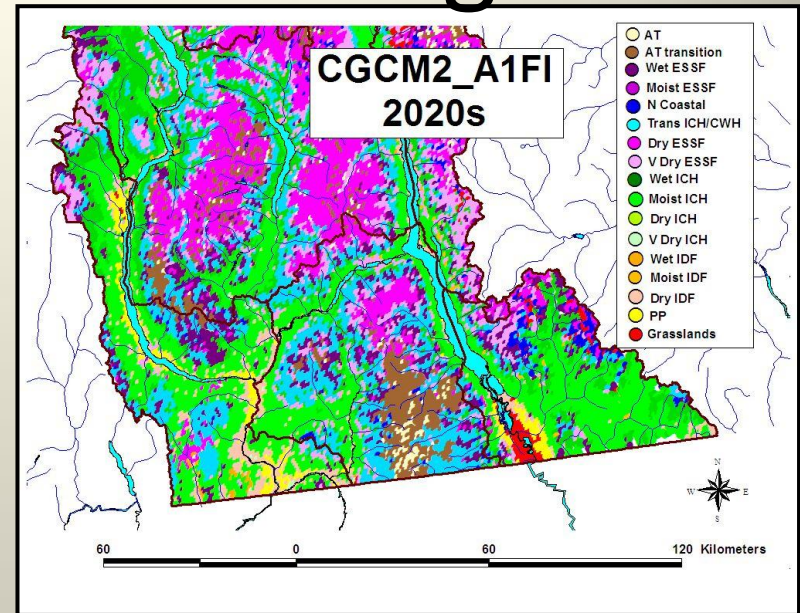
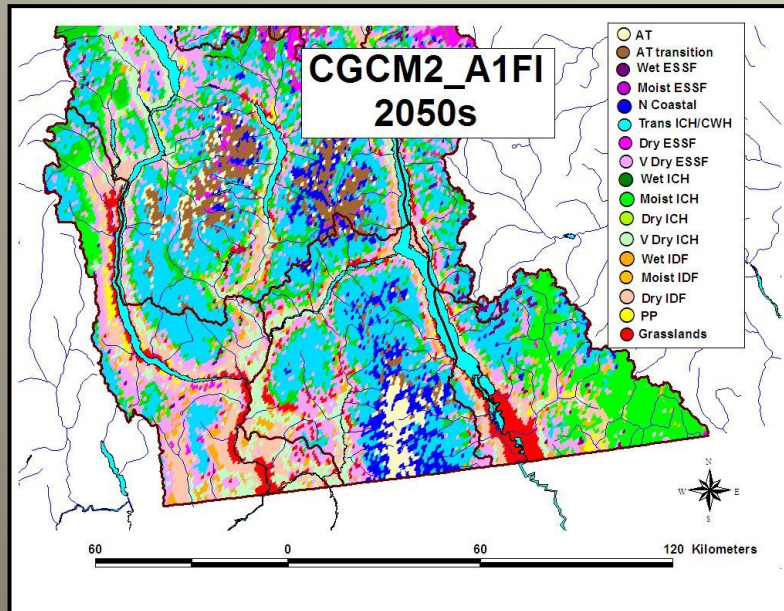
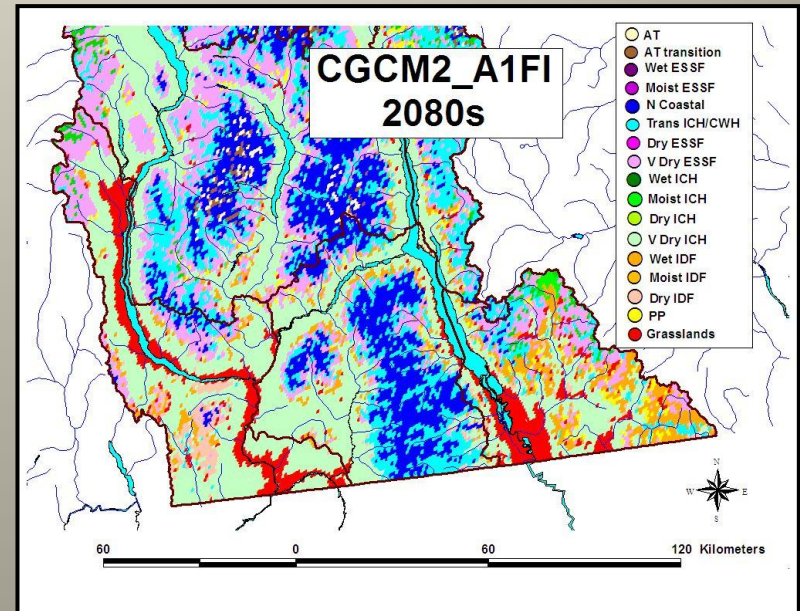
- BEC
 - Landscape level ecological unit (subzone/variant)
 - Ecologically suitable species (by site and BGC)
 - Major revisions to BEC in Kootenay-Boundary
 - Climate change projections of BEC
- Tree Species Selection Tool
- Future Forest Ecosystem Science Council (FFESC) Projects
 - Cranbrook: Using Actual Soil Moisture Regime to spatially predict tree vulnerability
 - Cranbrook: A landscape model for ecological complexity, resilience, climate change, and carbon management
 - South Selkirks Project (Innes, Klenner, Walton)
 - West Kootenay Resilience Project (Holt, Utzig, Pearce)

Modelling Future BECs



Wang et al.
2011 in prep.

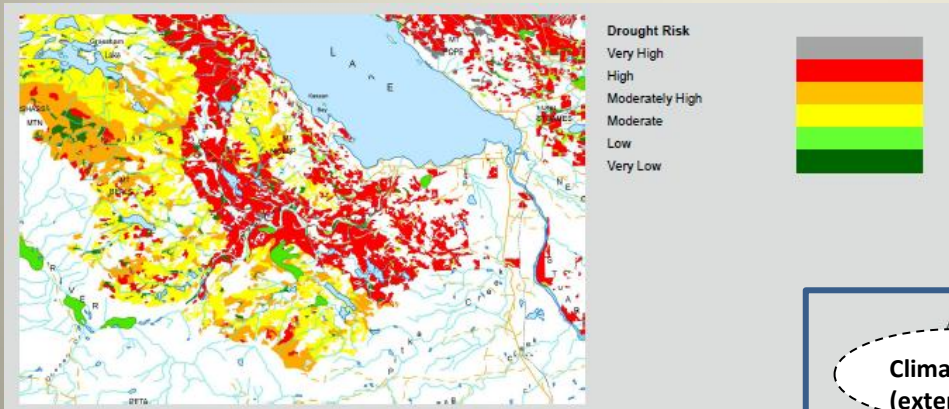
Potential Ecosystem Changes



Source: Utzig and Holt 2011, based on data from Hamman, Gray, and Roberts – UofA.

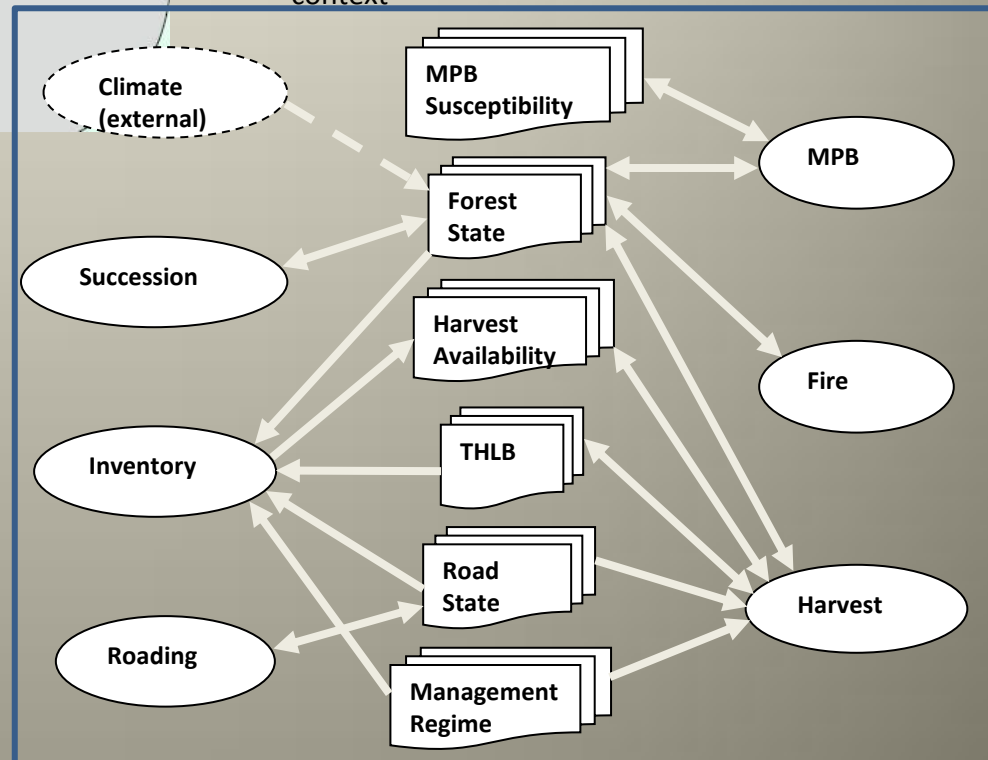
Available at: www.kootenayresilience.org

DRM Climate Change Projects



Delong et al. – Using Actual Soil Moisture Regime mapping to predict tree vulnerability

Fall et al. Modelling complexity, resilience, timber supply, wildlife habitat, and carbon in a climate change context



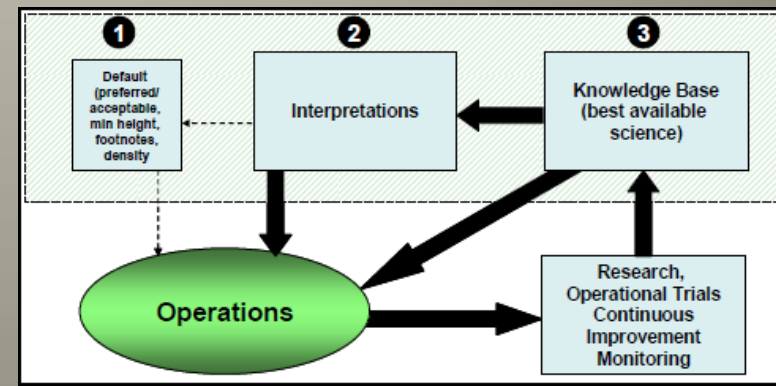
Tree Species Selection Tool

Compiled species information presented in the BEC framework for ecologically-suitable species and the ecological factors (environmental and forest health) limiting their performance.

- **Goal** : To provide easy access to current scientific information needed to support decision-making for
 - Stand and landscape levels
 - Short and long term objectives

Expected release – 2011 for the Northern Interior BEC subzone/variants

<http://www.for.gov.bc.ca/hfp/silviculture/TSS.htm>



Tree Species Selection Tool

Ecologically Suitable Species – Tree Species Selection Project definition:

“Coniferous or deciduous tree species that are adapted to a site’s environmental conditions, including the variability in these conditions that may occur over time.”

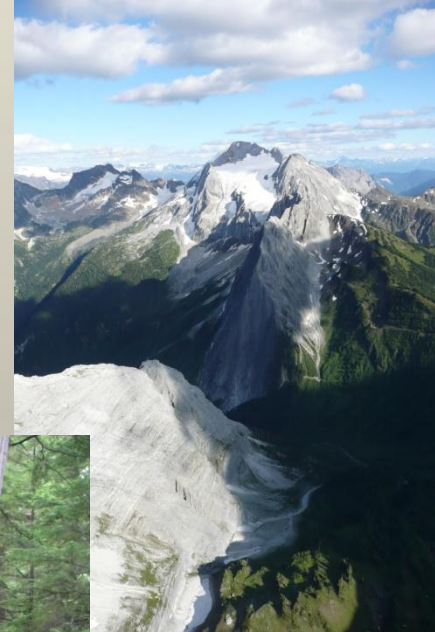


Climate Change = Increased Variability and Uncertainty

*If diversity improves adaptability to change,
then diversity management is becoming
more important*

- **Build Adaptive Capacity**

- Target higher levels of diversity than natural
- Encourage experimentation and adaptive management
- Evaluate success over longer time scales



A Diversity/Adaptability Approach Would...

- Promote and accept a wider range of management intents
- Encourage species mixes
- Reduce levels of species conversion in landscape
- Consider uncertainty and climate change in species selection
- Reduce efforts to bring all stands to a uniform standard
- Evaluate success at a landscape scale to allow variable management at the stand level

Decisions

1. Which scale is appropriate for diversity management?
2. What is the geographical unit we should evaluate diversity in?
3. What is the tree spp. diversity baseline?
4. What is our diversity objective?

