Managing Tree Species Diversity for Forest Resilience and Adaptability

Will MacKenzie and MFML Forest Ecologists
Prince George BC

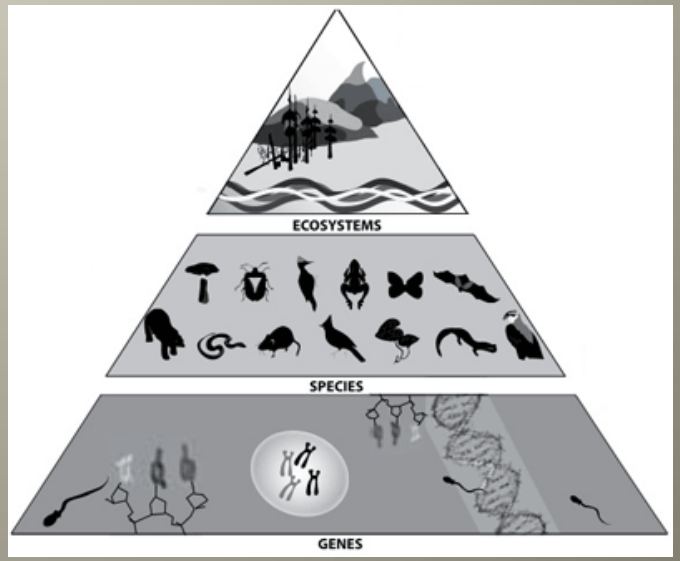
June 21, 2011

What IS diversity?

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

Landscapes!

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



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

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

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

- 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 r**eorganization** 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

2010 SISCO Winter Workshop

Searching for Sustainability in Forest Management: Is Good Silviculture the Key?

Agenda

Day One: Tuesday, April 13, 2010

8:25 **Welcome & Opening Remarks** — Sue Huddart, Consulting Silviculturist, New Basics Forest Management

Climate Change – the Underlying Reality that Shapes Forest Planning and Management

The Trouble With Pine

Jean Heineman, Jean Mather, Don Sachs and Suzanne Simard, Alan Vyse

April, 2010

Mark Johnston
Saskatchewan Research Council
Saskatoon SK
13.04.2010

Tree Species Vulnerability to Climate Change: an overview of the CCFM Study

From: Jim Snetsinger, R.P.F.
Chief Forester

Re: Guidance on Tree Species Composition at the Stand and Landscape Level

Some science-based factors that could be considered when developing stocking standards:

- the existing species diversity by BEC unit in both managed and unmanaged stands
- climate change information that could influence species vulnerabilities
- the life cycle of forest health agents and their ability to affect young stands, now and into the future
- insect and disease hazard and risk rating systems by BEC unit
- species that complement each other, e.g., Coastal Douglas-fir and Western red cedar
- appropriate density ranges and variability
- maintenance of natural diversity at the forest level

Coastal Silviculture Committee Winter Workshop

Species Diversity

"What is it?.....Do we have it?.....How do we manage for it?"

February 22, 2011 – 8:35 am to 4:00 pm

Vancouver Island University – Nanaimo Campus

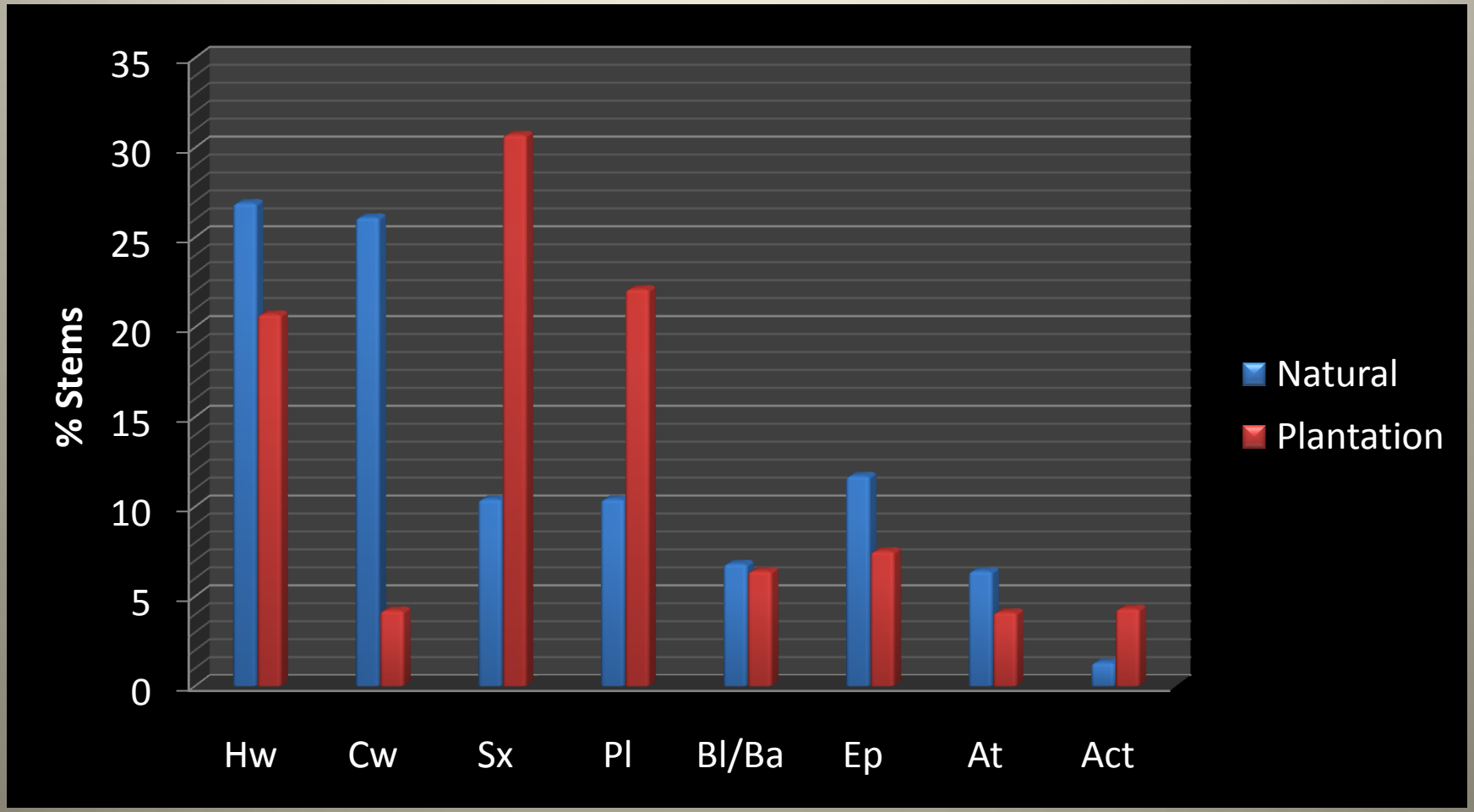
Is there a "diversity problem"?

- 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 to the forest landscape
  - 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%**	

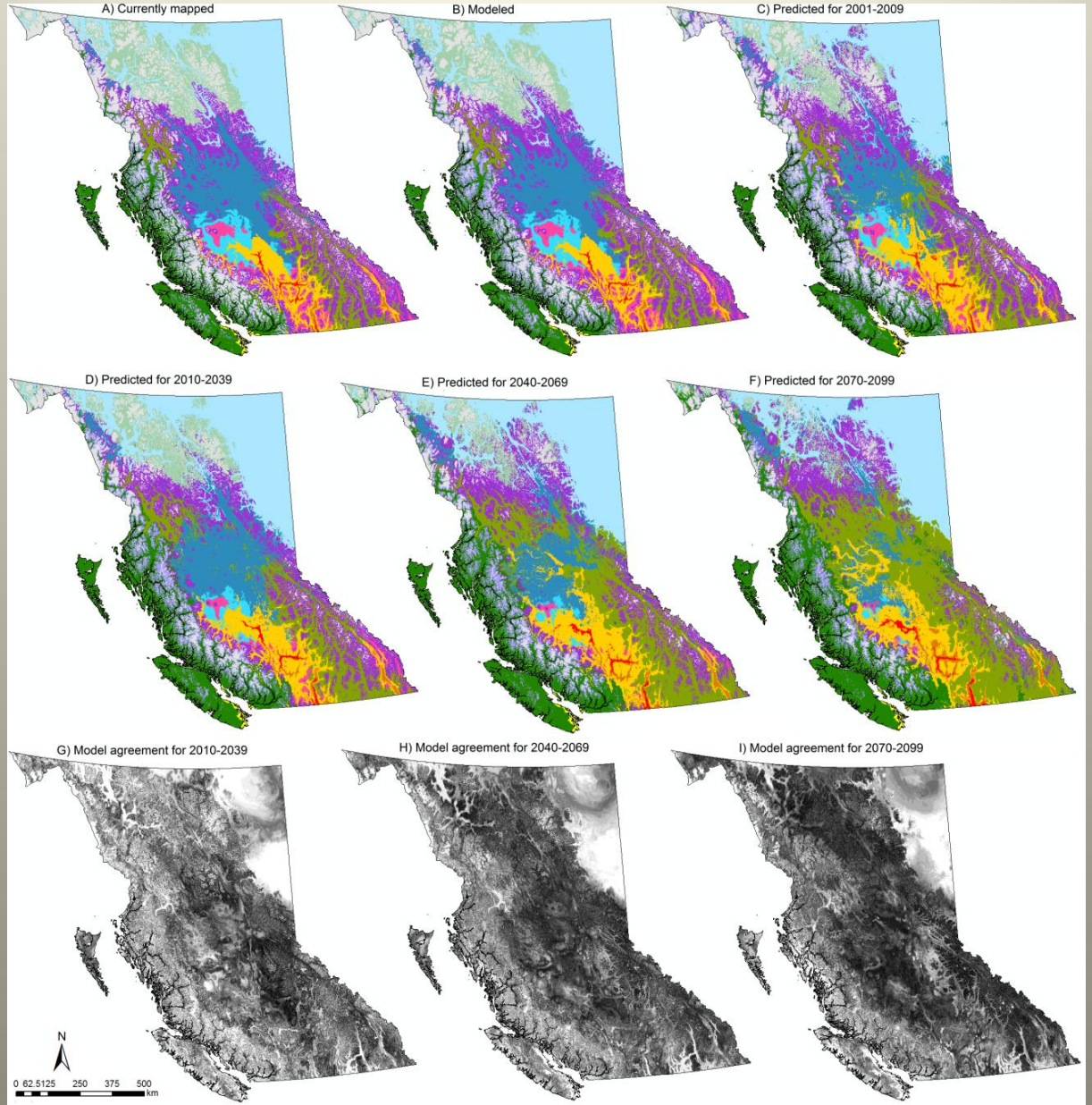
Landscape level species composition in ICHmc2 stands (<60yrs)



What ecology tools are available

- BEC
  - Landscape level ecological unit (subzone/variant)
  - Ecologically suitable species (by site and BGC)
- Climate change projections of BEC
- Tree Species Selection Tool
- Landscape level assessment methodology pilot

Modelling Future BECs



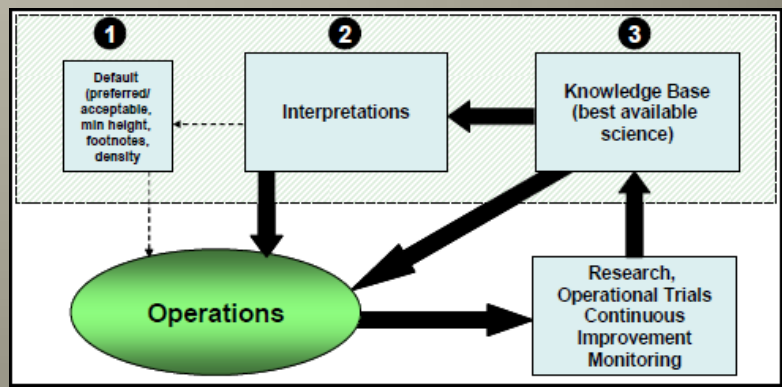
Wang et al. 2011 in prep.

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

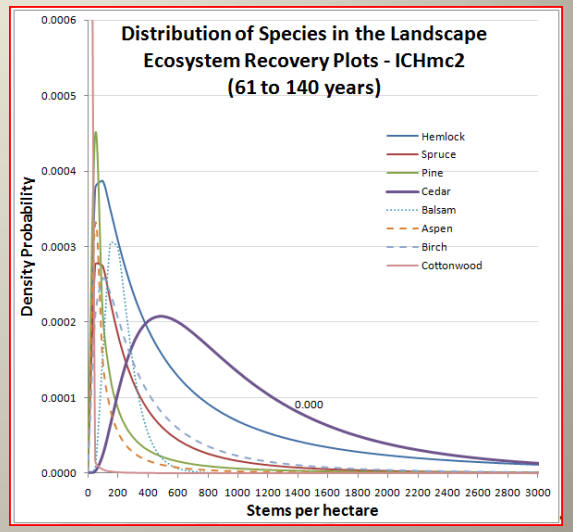
Expected release – 2011 for the Northern Interior BEC subzone/variants
http://www.for.gov.bc.ca/hfp/silviculture/TSS.htm

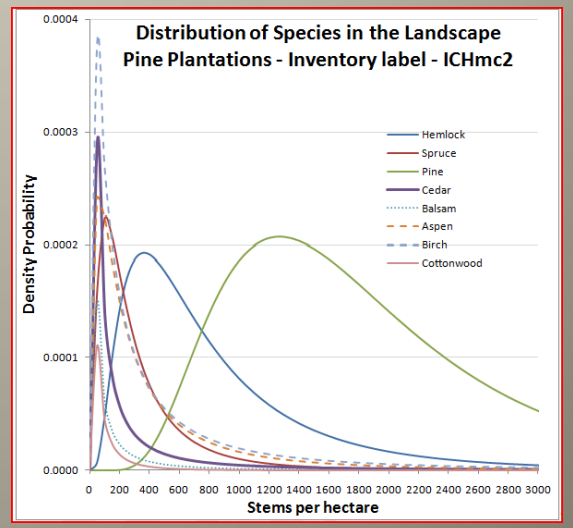


ICHmc2 Landscape-level Pilot Approach

Part of Species Selection Tool

- Database tool to compile and analyze available data
- Diversity analysis comparing natural vs managed stands
- Determining range of stand variation at the landscape scale (beyond averages)
- *Evaluate flexible management options at the stand scale (to meet objectives at the landscape scale)*



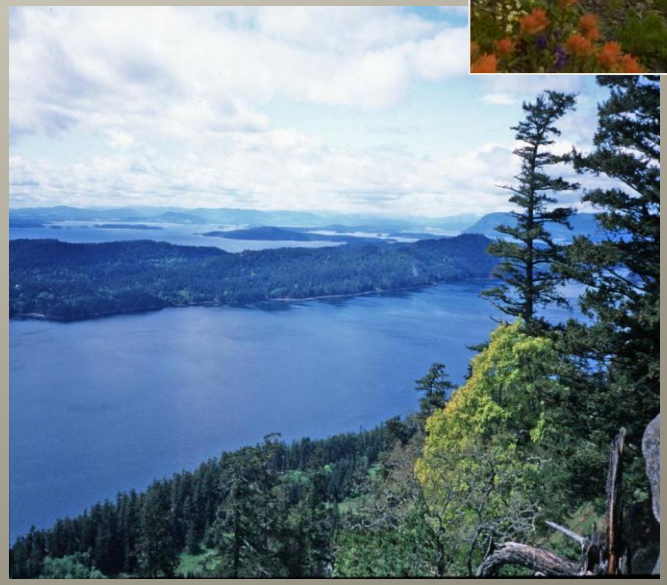


Banner et al. (2010)

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?

END