

Ministry of Forests Lands and Natural Resources Operations

Climate Change Adaptation Workshop:

Nelson October 30, 2013



Ministry of
Forests, Lands and
Natural Resource Operations

Managing for Resilient Forests and Ecosystems

Climate Change Adaptation Workshops

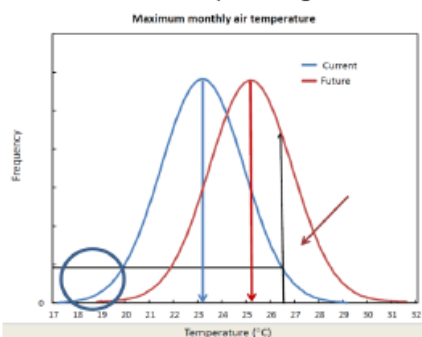
BC's climate is changing and extreme weather events are expected to increase in frequency.

What does this mean for BC's forests?
What can we do about it?

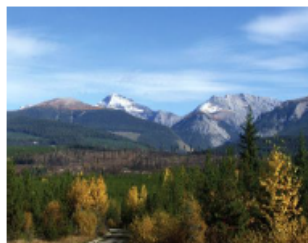
The Ministry of Forests, Lands and Natural Resource Operations (FLNRO) has organized a series of regional workshops to help incorporate our understanding of climate change into forest management practices.

Workshop Content

- **The Future Will Not Be The Same As The Past!**
What can we expect from climate change – what are the models and experts telling us?



- **Guiding Principles:** Fostering resilience and managing for complexity; uncertainty, and adaptation in a changing climate – what do these terms mean for BC forest and ecosystem management?
- **New Perspectives:** Exploring a range of plausible futures using a climate lens: prioritizing our most vulnerable forest stands and landscapes and managing risk, now and in the future.



- **Adaptation Tool Kit:** New tools that take into account both contemporary and future climates across multiple scales; and,
- **Adapting Practices:** Harvesting, silviculture, fire and ecosystem management practices that can be adapted today to foster resilient forests for a changing climate. What can we do to take action now?

Workshop Locations and Dates

- **Richmond:** October 17, 2013
- **Nelson:** October 30, 2013

Workshops are open to government, licensees, consultants and professionals.

Attend if you are:

- A Director of Resource Management, District Manager/ Resource Manager, Timber Sales Manager/ Woodlands Manager, Fire Centre Manager/ Deputy for FLNR; or,
- An industry or consulting decision maker, prescriber or practitioner.

Or responsible for...

- Designing and approving FSPs, woodlot licence plans, or community forest plans;
- Reforestation programs – in industry, government (FFT, LBIS), BCTS and consulting;
- Type 4 silviculture strategies now or in the future;
- Stewardship monitoring and evaluation (e.g. FREP district level delivery);
- Assessment of climate change impacts, risk and vulnerabilities, and in the creation of tools to assist management;
- Cumulative effects pilots;
- Risk mapping for wildfire management;
- Regional silviculture and habitat staff; or,
- Compliance and enforcement monitoring.

Others are welcome to attend as space permits to see how some of the concepts apply to other areas of natural resource management.

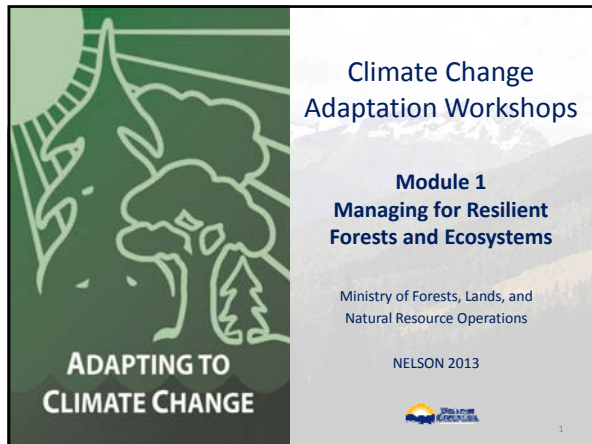
Registration

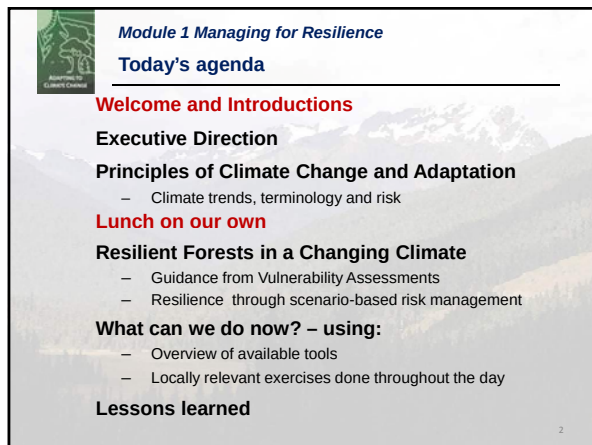
Send registrations to Miki Sakamoto msakamoto@forsite.ca
250.832.3366 ex. 228 except for
This workshop is no charge or a minimal charge (\$30) if attendance levels necessitate a non-government venue.
For more information, contact Kathy Hopkins Kathy.Hopkins@gov.bc.ca
or Katharine.McCallion@gov.bc.ca

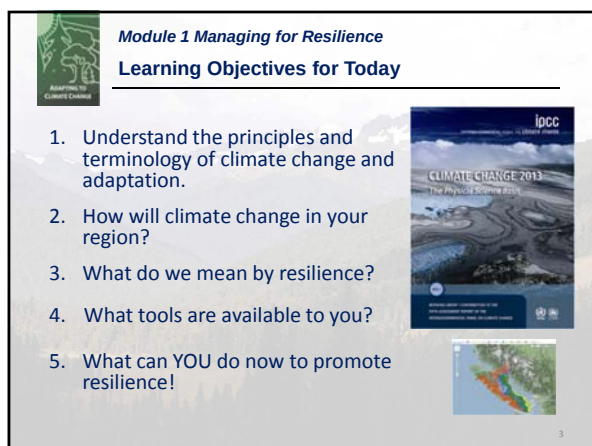
PARTICIPANT MATERIALS



Ministry of
Forests, Lands and
Natural Resource Operations









Module 1 Managing for Resilience
A message from our executive sponsors

Welcome from:

- Dave Peterson, ADM, Executive Sponsor
- Paul Rasmussen, Regional Sponsor
- APEG guidance
- Casey Macauley Association of BC Forest Professionals



Climate Change Adaptation Workshop
www.apeg.bc.ca

Thanks to Peter R. Mitchell, P.Eng. | Director, Professional Practice, Standards & Development
 Association of Professional Engineers & Geoscientists of BC



APEGBC has a Climate Change Adaptation Advisory Group (CCAAG) that advises the APEGBC Council on matters related to professional engineering and/or professional geoscience practice where the mitigation of the effects of climate change are relevant.



- APEGBC's CCAAG is currently finalizing a position paper on this which will be issued this fall.
- APEGBC is participating with other professional associations in the development of a statement of principles that could be jointly supported by the various professional associations involved (Foresters, Biologists, Agrologists, Planners). The focus is on how members of these professional associations can be equipped to deal with adapting their practice's to accommodate a changing climate.



- APEGBC acknowledges that guidance is limited on how to source and use appropriate climatic data related to a changing climate.
- APEGBC members are already being asked to consider the effects of climate change in their work.
- In response APEGBC has developed one guideline to date that responds to this need (APEGBC Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC)
http://www.apeg.bc.ca/ppractice/documents/Legislated_Flood_Assessments.pdf



- In addition Engineers Canada's Public Infrastructure Engineering Vulnerability Committee has developed a range of documents dealing with adopting infrastructure to climate change (Engineer's Canada is the national association of the constituent 12 provincial and territorial Engineering Associations across Canada having the legislated authority to regulate professional engineering)



— Climate Change and the Forest (Natural Resource) Professional

— Perspectives from the ABCFP



*Fostering Resilient Values and Ecosystems workshop series, October 2013
Casey Macaulay RPF, Resource Operations Specialist*



ABCFP 2008 Position Statement:

"There is a large body of scientific research showing that climate change will have a profound effect on BC forests (ecosystems.) Projections of climate change and assessment of carbon cycle dynamics should be derived from the most defensible scientific evidence available. The ABCFP supports a diverse range of approaches to managing BC's forest land adaptively..."



Why is the profession concerned?

Resource professionals have a critical role:

Learning: Knowledge, awareness and innovation

Professional Reliance: Independence, application of knowledge, reflection on decisions

Managing uncertainty and risk: 'Blind corner ahead'

Stewardship mandate: Long term focus



*Of course,
resource professionals are used to dealing
with some uncertainty..*





**To resource professionals, climate
change presents another example of a
non-statutory expectation..**

*"professionals are expected, by others, to achieve
(forest) resource outcomes in an environment that
does not always provide them the authority,
control or resources to produce these outcomes.."*

(Non-Statutory Expectations Series - A Description of Non-Statutory Expectations and
the Practice of Professional Forestry Sept. 2012)



What is the ABCFP doing?

**CEO established the Climate Change Task
Force:**

*That professionals will be guided in adapting
practices in a changing climate..*

Work to date:

- 1st Member survey: baseline of awareness (Feb '13)
- 2nd Member survey: barriers to adaptation (Oct '13)
- Collaborating with other professions
- Working with government and the research community to foster awareness
- Practical research summaries

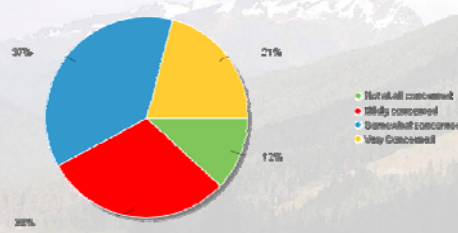


Ongoing projects

- Report on second survey of ABCFP members to determine barriers to adaptation and methods to overcome these barriers (Fall 2013)
- Website materials to engage members in current research in BC, and how it links to changes in practice
- Working with national and provincial organizations; e.g. workshops and training opportunities
- Information sharing and best practices



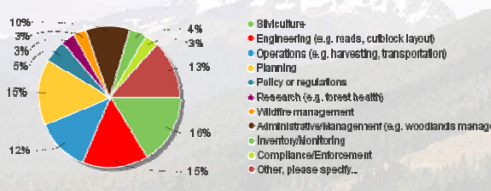
How concerned are you about adapting forest management to climate change?



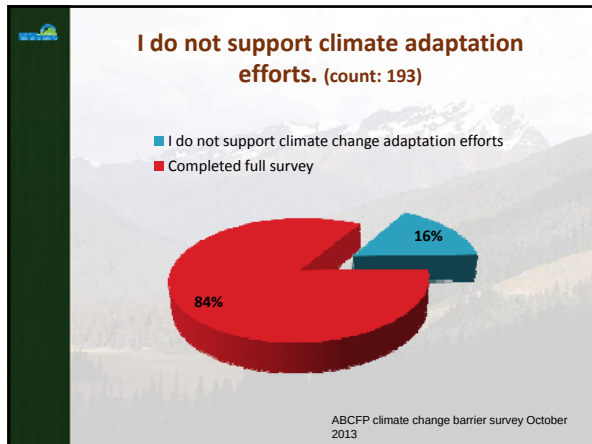
ABCFP climate change barrier survey October 2013

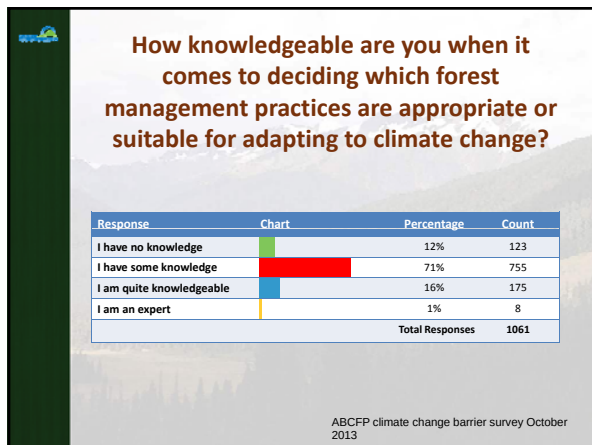


What is/was (if retired) your primary area of professional practice?



ABCFP climate change barrier survey October 2013





Please indicate to what degree the following aspects of legislation, government policy, or standards currently limit the development and implementation of adaptation strategies in BC forestry?

	Not at all limiting	Not very limiting	Somewhat limiting	Very limiting	Don't know/Not applicable
Stocking standards	5%	13%	39%	24%	19%
Harvesting levels/AAC	12%	21%	31%	18%	18%
Chief Forester's seed use	5%	14%	37%	15%	29%
Free growing policy	6%	19%	32%	20%	22%
Timber pricing policies	18%	20%	17%	12%	33%
TSR processes	10%	18%	31%	14%	26%
BEC zones	12%	24%	36%	11%	18%
Fire mgt standards/policies	11%	23%	27%	14%	26%
Organizational focus	6%	14%	30%	20%	29%
Existing higher level plans	7%	19%	37%	15%	23%
Unrealistic expectations from growth and yield models	6%	15%	30%	21%	27%
Reliance on models that are dependent on historic data	4%	12%	33%	29%	22%

ABCFP climate change barrier survey October 2013

 Please indicate the degree to which the following cost items limit your progress towards developing or implementing adaptation strategies in the forestry profession.

	Not at all limiting	Not very limiting	Somewhat limiting	Very limiting	Don't know/Not applicable
Human resources are insufficient	9%	15%	26%	25%	25%
Training expenses	7%	17%	29%	29%	18%
There is no perceived economic benefit to my employer/client	11%	16%	26%	23%	24%
Cost of public engagement for strategic planning..	6%	17%	31%	19%	27%
Costs of balancing multiple priorities (trade-offs)	4%	13%	37%	25%	21%
Costs of landscape level planning	5%	16%	30%	25%	24%
No incentive for increased investment in adaptation strategies	4%	10%	27%	40%	20%

ABCFFP climate change barrier survey October 2013

 Thinking about the way you do business, please indicate the degree to which the following standard practices and procedures limit developing/implementing adaptation.

	Not at all limiting	Not very limiting	Somewhat limiting	Very limiting	N/A
SOPs not updated	10%	19%	37%	17%	17%
Practices do not reflect current science	6%	19%	35%	25%	16%
Adaptation would complicate decisions	12%	28%	31%	12%	17%
Desire for stability and predictability	8%	22%	35%	16%	18%
Inability to engage policy makers	6%	16%	30%	26%	22%
Forest health strategies don't incorporate C/C	5%	16%	37%	22%	20%
Lack of knowledge	5%	14%	31%	37%	13%
Contradictory science	7%	15%	33%	31%	14%
Adaptation is inconsistent with political/business mandate	8%	13%	28%	31%	20%
Lack of concern in organization	19%	23%	27%	13%	18%
Lack of capacity	8%	14%	30%	31%	16%
Inventory/monitoring inadequate	4%	11%	26%	39%	20%

ABCFFP climate change barrier survey October 2013

 What are your suggestions for removing the barriers?

- Incorporate climate change performance measurements into corporate strategic plans to encourage innovative policy development.
- Take approach similar to AAC determinations. Every 5 yrs the CF should review the latest data on climate change, and adjust forest policy.
- Add appraisal incentives for enhanced strategies (avoid minimums) CF should allow 5-10% risk mgt allowance.
- Gov't needs to sponsor/work with the scientific community to clarify/quantify adaptation data, concerns, and resolutions.

What are your suggestions for removing the barriers? cont..

- Allocate staff time for group discussions about implications of CC.
- Legislative fix will be necessary so Licensees can use legal framework to justify actions instead of having to fight over professional interpretations.
- Stop driving up AAC calculations by assuming high conifer regeneration densities and high conifer growth rates based on an idealized past.
- Institute a legislated requirement for implementation of a long term climate management policy covering all users of the Provincial Land base.

What are your suggestions for removing the barriers? cont..

- Need to recruit more forest professionals so that everyone has the time to consider changes like this.
- Make inventory labels reflect current state and composition of forest.
- The issue boils down to who pays and who accepts the risks if things do not work out. Figure this out and we all can move on.
- Identifying the economic consequences of doing nothing. Will provide incentive for gov't to find resources

What activities have you been involved with that demonstrate climate change adaptation and long-term forest stewardship?

Response	Chart	Percentage
Planting strategies (e.g. new species or mixes)		30%
Stand-level treatments (e.g. application of a variety of silviculture systems)		20%
Landscape-level treatments (e.g. fuel management for interface zones)		17%
Planning strategies (e.g. re-assessing minimum culvert sizing)		18%
Development of corporate climate change policy or strategy		8%
Research trials		13%
None		46%
Other, please specify...		11%

ABCFP climate change barrier survey October 2013



What activities have you been involved with that demonstrate climate change adaptation and long-term forest stewardship?

- inter-agency work on climate change and forest carbon
- promoting higher establishment densities
- building fail safe roads
- built into AAC determination
- contribution to research regarding potential ecological impacts resulting from climate change
- support of sustainable, renewable, natural resources (clean energy)
- development of seed transfer standards that consider adaptation to future climates
- climate adaptation trials set up
- Synthesis of research results
- ER burns
- acceptability of existing understory stocking even if it does not match current stocking standards
- vulnerability assessment
- hydrology models for operations
- professional conversation (workgroup)

ABC FP climate change barrier survey October 2013



General comments about the survey.

Very leading questions. Climates never stop changing and it is impossible to predict how a climate will change with any degree of certainty. Planning for climate change is nothing new - all professionals should have planned for climatic variation when performing their various functions.

We need to start taking some definite actions now, not several years from now, or we will not be able to keep up with the rapidly changing climate and the associated forest health impacts.

I'm concerned that the range of possible outcomes of climate change is extremely wide, and that any changes to forestry practices need to recognize the high level of uncertainty around the eventual outcome.

ABC FP climate change barrier survey October 2013



Messages that we are working on..

- Resource professionals must develop an ongoing awareness.
- There is enough scientific data available for professionals to begin pursuing adaptation.
- Policy makers and practitioners must manage for uncertain future conditions.
- The ABCFP will advocate for and support policies that lead to improved climate adaptation.
- The ABCFP supports collaboration between governments, industry, researchers and practitioners.



For more information, contact the Professional Practice and Forest Stewardship Team

- www.abcfp.ca

Principles of Climate Change and Adaptation
Climate Trends

Looking for Solutions

Turn to your Neighbour Discussion

- Choose one or more of the barriers presented and provide possible solutions
- Debrief as a group



32

Module 1 Managing for Resilience

Work to date – building as we go

Ministry of Forests, Lands and Natural Resource Operations

Tools

This page provides links to tools useful for:

- understanding changes underway in your area and
- adapting forest management so that BC forests remain resilient to climate change, variability and other stressors.

Credit for each of the tools belongs with each developer noted on the linked web pages.

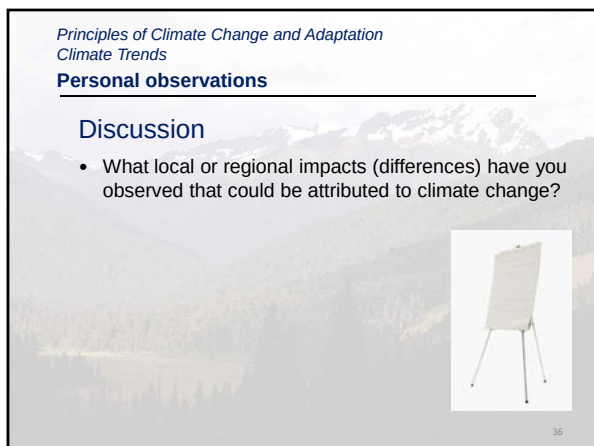
- **New link!** (June 2013) **Stand Establishment Decision Aids (SEDAs)**: These **SEDAs** show current forest health risk and point to silvicultural tools and practices to deal with environmentally limiting factors within the context of BEC.
- **New link!** (June 2013) **Forest health change detection risk (hazard/severity) maps** in two formats:
 - **Mapped incidence of pests by TSA and cutblock from the RESOLTS database** and,
 - **Regional maps of pest distribution** using the SEDA information.
- February 2013, FORREX **Checklist for adapting BC's landscapes to a changing environment**. This checklist summarizes the key considerations for buffering your managed forests against the impact of climate change during planning, harvesting, and reforestation. (3 pages).

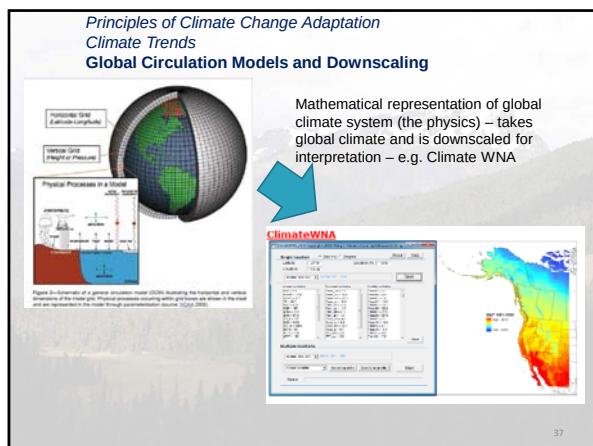
This website is constantly being updated – note New! links

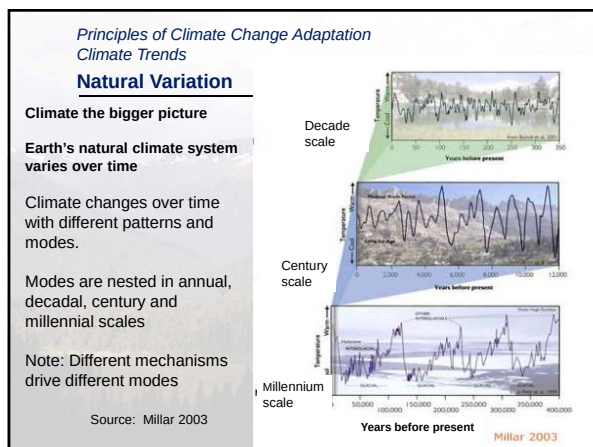
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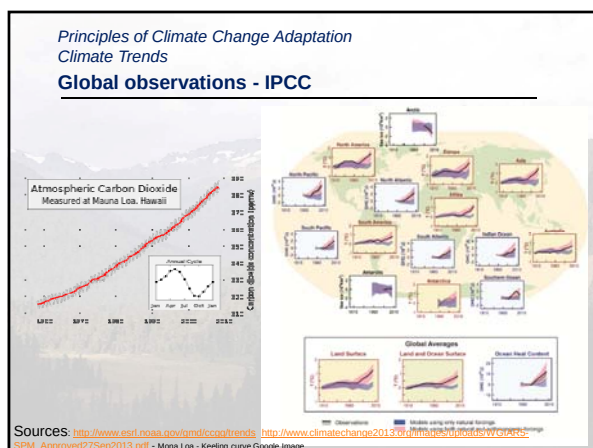












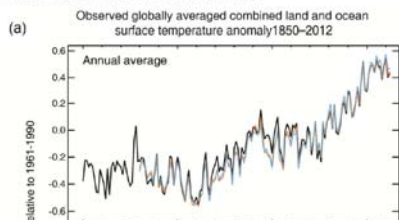
Principles of Climate Change Adaptation

Climate Trends

Global observations - IPCC

Twelfth Session of Working Group I Approved Summary for Policymakers

Figure SPM.1 (FIGURE SUBJECT TO FINAL COPYEDIT)



Source: http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf

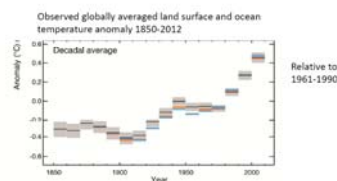
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Climate Trends

Global observations - IPCC

Global temperature – decadal average



IPCC AR5 Summary for policy makers 2013

Source: http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf

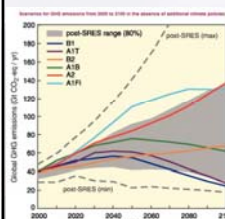
41

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Climate Trends

Scenarios – IPCC

From the Fourth Analysis Report



Note: SRES is the Special Report on Emission Scenarios.

http://en.wikipedia.org/wiki/Special_Report_on_Emission_Scenarios

The four SRES scenario families¹⁹⁹⁹ of the Fourth Assessment Report vs. projected global average surface warming until 2100

A1A (Summary PDF)	More economic focus	More environmental focus
Globalisation (homogeneous world)	A1 rapid economic growth (groups A1T, A1B, A1FI) 1.4 - 6.4 °C	B1 global environmental sustainability 1.1 - 2.9 °C
Regionalisation (heterogeneous world)	A2 regionally oriented economic development 2.0 - 6.4 °C	B2 local environmental sustainability 1.4 - 3.8 °C

Sources: IPCC http://www.ipcc.ch/publications_and_data/ar4/eyr/figure-3-1.html http://www.ipcc.ch/publications_and_data/ar4/eyr/figure-1-1.html

42

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Climate Trends

IPCC Representative Concentration Pathways

Twelfth Session of Working Group I

Approved Summary for Policymakers

Table SPM.2 [TABLE SUBJECT TO FINAL COPYEDIT]

Variable	Scenario	2046–2065		2081–2100	
		mean	likely range ^a	mean	likely range ^a
Global Mean Surface Temperature Change (°C) ^b	RCP2.6	1.0	0.4 to 1.6	1.0	0.3 to 1.7
	RCP4.5	1.4	0.9 to 2.0	1.8	1.1 to 2.6
	RCP6.0	1.3	0.8 to 1.8	2.2	1.4 to 3.1
	RCP8.5	2.0	1.4 to 2.6	3.7	2.6 to 4.8

From the Fifth Assessment Report

These scenarios provide a range of concentrations over time

The RCP2.6 is a mitigation strategy – where CO₂ peaks then declines by 2100

RCP4.5 and 6 are stabilization scenarios, while RCP8.5 is a scenario with increasing greenhouse gas emissions.

The RCPs can thus represent a range of 21st century climate policies, as compared with the no-climate-policy of the Special Report on Emissions Scenarios (SRES) used in the Third and Fourth Assessment Report..

Sources: http://www.ipcc.ch/report/ar5/wg1/WG1AR5_T2JRG

43

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Climate Trends

Global observations and impacts



For each ~1 degree C increase expected impacts include:

- 5 to 15% reductions in crops as currently grown
- 3 to 10% increases in the amount of rain during heaviest events
- 5 to 10% decreases in some rivers
- 200 to 400% increases in wildfire in parts of Western North America

Sources: <http://epa.gov/climatechange/basics/facts.html>

44

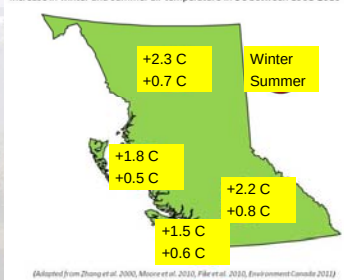
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What has been observed in BC

Change in Average Temperature 1901 - 2010

- North and interior warming faster
- Winter warming faster
- Spring coming earlier
- Summer warmer but not as much change as winter

Increase in winter and summer air temperature in BC between 1901-2010



45

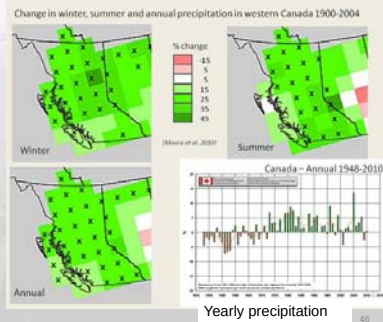
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What has been observed in BC

Change in Average Precipitation 1900-2004

- Overall, BC has been getting wetter.
- Note the prairies are getting drier.
- Canada is overall getting wetter

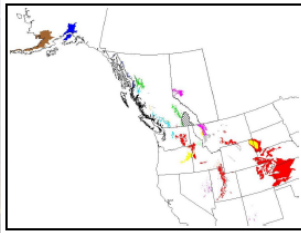
(Moore et al 2010)



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Climate Trends

Shifts of climate envelopes

West Kootenay 2080 output - possible climate from outside BC

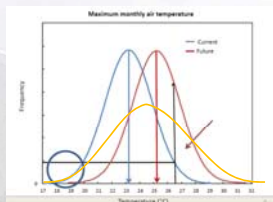


Source: http://www.kootenayresilience.org/Report5_BioClimateShift_Final.pdf

47

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Climate Trends

Regional plausible futures



E.g., Shift of the mean and extremes

(Spittlehouse 2012)

It is *virtually certain* that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales as global mean temperatures increase. It is *very likely* that heat waves will occur with a higher frequency and duration. Occasional cold winter extremes will continue to occur (see Table SPM.1). (12.4) <http://www.ipcc.ch/report/ar5/wg1/#.UkXFTzJrbGg>

48

Principles of Climate Change Adaptation
Climate Change Terminology

Local Vulnerability Assessment – Rachel Holt



Location of the 11 Reports – Rachel suggests as a minimum reading
 Report 1 - Summary
<http://www.kootenayresilience.org/page04.html>

49

Principles of Climate Change Adaptation
Climate Change Terminology

Research Notes

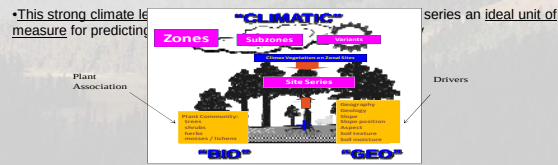
Kristine Weese provided an update on FFESC research report updates that are being prepared.

Those willing to review the DRAFTS can contact Kristine at Kristine.Weese@gov.bc.ca

50

BEC as a Framework for Climate Change Adaptation

- BEC subzone/variants are climate envelopes, defined by the distribution of plant communities
- BEC site series are a classification of site level units or ecosystems that reflect soil moisture and nutrient regimes and site factors such as slope position, aspect, cold air drainage
- Macro climate drives the distribution of zones; meso climate drives the subzone/variant level; and within the subzone/variant, micro climate and site/soil factors define plant associations
- This strong climate is a measure for predicting



Predicting the Future: BEC + Climate Change

Commission projections

Based on projected changes in temperature and precipitation, 20 climate change scenarios were selected to represent the range and distribution of the projected changes for over 140 climate change scenarios from the IPCC Fourth Assessment. Shifts in bioclimatic envelopes for 30 ecosystem zones were projected based on each of the 20 climate change scenarios. A consensus projection for a 40-year period was generated based on the most frequently projected ecosystem zone for each pixel among the 20 individual projections.

2080's

2011-2040 2041-2070 2071-2100

Zone

- 1. Tundra
- 2. Boreal forest
- 3. Subarctic forest
- 4. Temperate forest
- 5. Subtropical forest
- 6. Desert shrubland
- 7. Desert grassland
- 8. Desert scrub
- 9. Desert
- 10. Steppe
- 11. Grassland
- 12. Savanna
- 13. Shrubland
- 14. Forest
- 15. Wetland
- 16. Wetland
- 17. Wetland
- 18. Wetland
- 19. Wetland
- 20. Wetland
- 21. Wetland
- 22. Wetland
- 23. Wetland
- 24. Wetland
- 25. Wetland
- 26. Wetland
- 27. Wetland
- 28. Wetland
- 29. Wetland
- 30. Wetland

0 100 200 miles

They used the level of the model agreement among the 20 individual projections to represent the level of uncertainty of the ecosystem classification under climate change.

2011-2040 2041-2070 2071-2100

Model agree:
High: 100
Low: 50

Source: Hamman and Wang 2006

Source: Wang et al. 2012

Climate Envelopes are NOT Ecosystems

Do not address plant community shifts

Wang et al only uses BC BEC envelopes
American and Albertan ecosystem climate envelopes are not included

Novel ecosystems, non-analogues, and new ecosystems are not accounted for

Climate extremes are hard to incorporate, but can drive plant survival

Continuum projections

Based on projected changes in temperature and precipitation, 20 climate change scenarios were selected to represent the range and distribution of the projected changes. 10 real and 10 virtual scenarios from the 20 climate change scenarios of bioclimatic analogues for BC ecosystem zones were projected based on each of the 20 climate change scenarios. A consensus projection for a 5-year period was generated based on the most frequently projected ecosystem zone for each period among the 20 individual projections.

Time
Zone
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

100 km

2011-2040 2041-2070 2071-2100

We used the level of the model agreement among the 20 individual projections to represent the level of uncertainty of the respective climate model under climate change.

Model agree.
No
High - 100
Low - 30

100 km

2011-2040 2041-2070 2071-2100

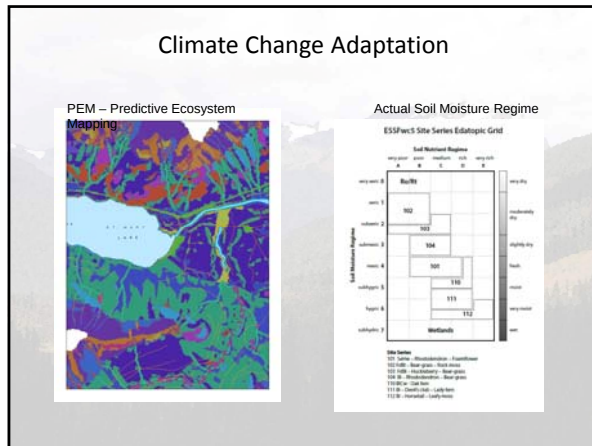
Lw Distribution and Seed Planning

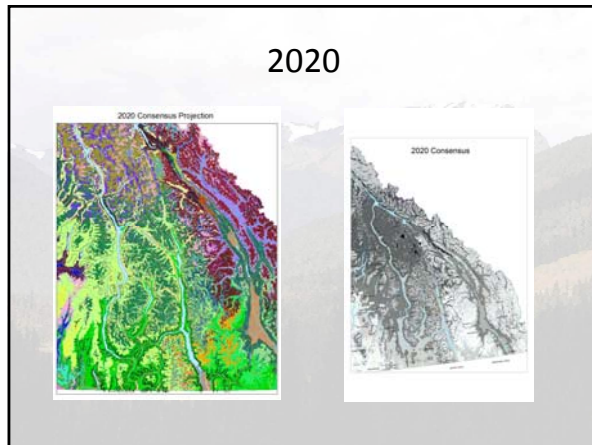
- Based on climate envelope modelling
- Does not factor site level differences
- In the IDfam2 (Cranbrook District), Lw grows on mesic to submesic sites
- In the ESSFcw5 (South Selkirks), Lw grows on suberic sites
- Using BEC to understand the distribution of trees within a climate envelope can be very helpful
- Using BEC to understand the deployment of trees at a site level can be very helpful

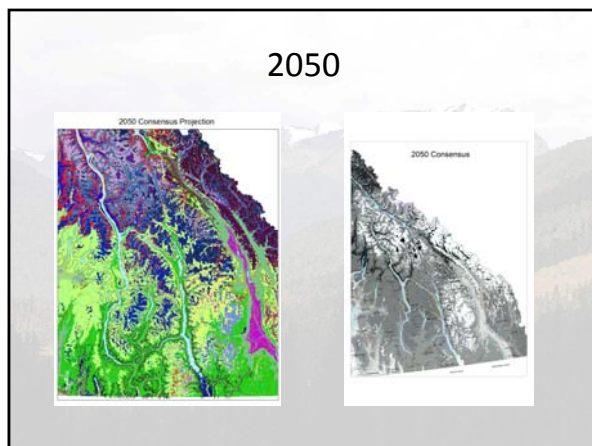
Figure 4 consists of nine maps arranged in a 3x3 grid. The rows represent the years 2050, 2080, and 2100. The columns represent different climate envelope models: IDfam2, ESSFcw5, and a third unlabeled column. Each map shows the distribution of Larix laricina (yellow) and its projected range (orange/red) under different climate scenarios. The maps show the progression of L. laricina distribution from its current range (yellow) to its projected range (orange/red) under different climate scenarios. The background is a grayscale map of the region.

Figure 4: Projected distribution of Larix laricina under different climate scenarios. The figure shows the distribution of Larix laricina (yellow) and its projected range (orange/red) under different climate scenarios. The maps are arranged in a 3x3 grid, showing the distribution of Larix laricina (yellow) and its projected range (orange/red) under different climate scenarios. The maps are arranged in a 3x3 grid, showing the distribution of Larix laricina (yellow) and its projected range (orange/red) under different climate scenarios.

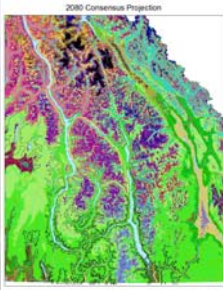
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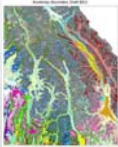
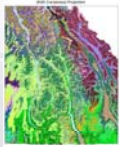
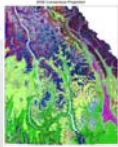
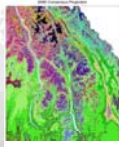




2080



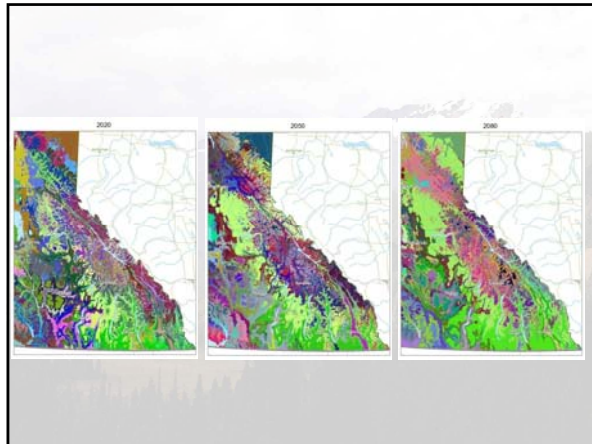
Comparison

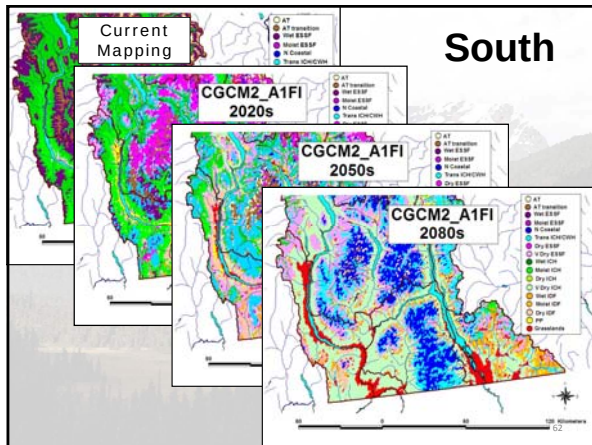


ICHmw2

- ICHdm in the South Purcells
- ICHmw4 in the South Selkirks
- ICHmw5 in the South Monashees
- ICHmw2 in the Central Selkirks, Purcells, Monashees
- ICHmw3 Crawford to Akokolex







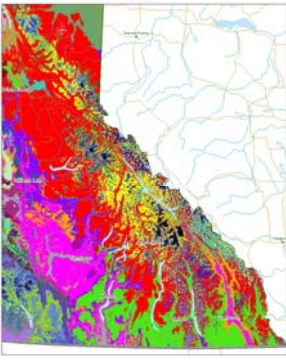
BEC as a Framework for Climate Change Adaptation

- BEC subzone/variants are climate envelopes, defined by the distribution of plant communities
- BEC site series are a classification of site level units or ecosystems that reflect soil moisture and nutrient regimes and site factors such as slope position, aspect, cold air drainage
- Macro climate drives the distribution of zones; meso climate drives the subzone/variant level; and within the subzone/variant, micro climate and site/soil factors define plant associations
- This strong climate le measure for predicting

series an ideal unit of

Logical BEC Groupings

- Yellow = wet ICH
- Red = ICHmw
- Green = ICHdw
- Purple = ICH/IDF transition
- Pink = PP / v dry IDF
- Orange = IDFdm
- Black = coastal alpine



IPCC Confidence and Likelihood Terminology

The confidence and likelihood terminology is used to communicate the level of confidence and likelihood in the assessment of the impacts of climate change and for producing quantitative projections of future climate scenarios. These are presented in the following table.

The probability distribution is given by the 10th, 50th and 90th percentiles. The 10th percentile is the lower bound of confidence or likelihood in specific understanding for the balancing of specific factors. The 50th percentile is the median estimate. The 90th percentile is the upper bound of confidence or likelihood in specific understanding for the balancing of specific factors. Confidence and likelihood are used to describe the level of confidence or likelihood in the assessment of the impacts of climate change and for producing quantitative projections of future climate scenarios.

The standard terms used to define levels of confidence in the report are given in the IPCC terminology box below.

Confidence level	Standard terms used to define levels of confidence
Very high confidence	At least 1 out of 10 chance
High confidence	About 2 out of 10 chance
Medium confidence	About 7 out of 10 chance
Low confidence	About 9 out of 10 chance
Very low confidence	Less than 1 out of 10 chance

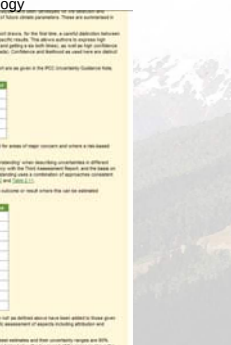
Note: That for confidence and very low confidence are only used for areas of major concern and where the lowest confidence is called.

Likelihood: The report uses a variety of levels of scientific understanding where describing confidence is affected by the level of confidence in the data. The standard is to use the 10th, 50th and 90th percentiles. The 10th percentile is the lower bound of confidence or likelihood in specific understanding for the balancing of specific factors. The 50th percentile is the median estimate. The 90th percentile is the upper bound of confidence or likelihood in specific understanding for the balancing of specific factors. The standard terms used to define levels of likelihood in the report are given in the IPCC terminology box below.

Likelihood level	Standard terms used to define levels of likelihood
Very likely	> 90% probability
Extremely likely	> 95% probability
Very high	> 90% probability
High	> 66% probability
Medium	> 50% probability
Low	> 33% probability
Very low	> 10% probability
Extremely unlikely	< 5% probability
Very unlikely	< 10% probability
Low	< 33% probability
Medium	< 50% probability
High	< 66% probability
Very high	< 90% probability
Extremely high	< 95% probability

The very unlikely, unlikely, medium, high and very high levels that are not defined above but are defined in the IPCC terminology box below are used to provide a more specific assessment of impacts including likelihood and confidence levels.

Lower level of confidence, low, medium, high and very high are used to describe the level of confidence and where confidence levels are 10%, 33%, 50%, 66%, 90%, 95% and 100%. There is a standard 10th, 50th and 90th percentile for the 10th, 50th and 90th percentiles. The 10th percentile is the lower bound of confidence or likelihood in specific understanding for the balancing of specific factors. The 50th percentile is the median estimate. The 90th percentile is the upper bound of confidence or likelihood in specific understanding for the balancing of specific factors. The standard terms used to define levels of confidence in the report are given in the IPCC terminology box below.



http://www.ipcc.ch/publications_and_data/4wgl1/en/ch1-1

Tools for Tree Species Selection

- The Reference Guide for Stocking Standards uses Biogeoclimatic Ecosystem Classification (BEC) site series as the foundation for tree species selection
- Ecosystem/climate niches were linked to stocking standards and then linked to the tables in the Reference Guide to produce a "% area change for existing BGC units" for 2020, 2050 and 2080 along with the corresponding new suggested species selection TreeGuideClimateChange.mdb tool

Green = stays the same, Purple = was added, Blue = was promoted, Yellow = was demoted, Red = was removed

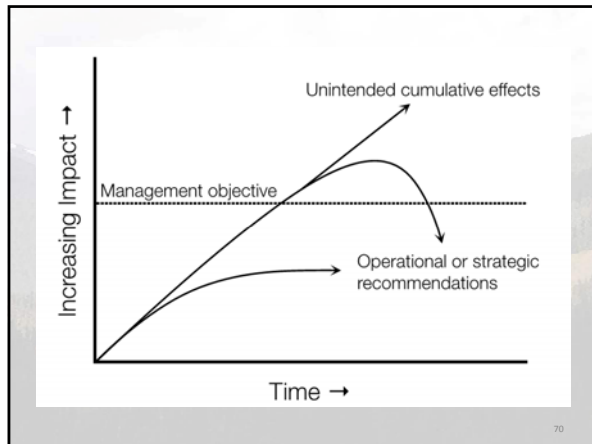
	Current Reference Guide Status
	Direction up or down
	New Status

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	Current Reference Guide Status	Direction up or down	New Status



Some things to think about...

- Although we don't know what the extent of ecosystem migration (flying BEC etc.) versus novel ecosystem development will be, the main site and soil drivers associated with each of these existing BEC site series still form a platform on which to project change
- **There are a variety of tools and more becoming available all the time so use everything available to base your decisions on – understand all assumptions, strengths and weaknesses, as they are only tools - “no smoking guns”
- **Climate projections used here are based on scenarios. We don't know what scenarios the future will hold.

What can be done now?
Exercise

GROUP EXERCISE – Tree Species Options

To explore species options for a changing climate on some high risk local sites – incorporation into FSPs

Local situation where species changes are warranted – provided or agreed upon by participants.

How do you determine where there may be a desire for different species – either due to risk or opportunity? What information is available?

Describe who you think should be involved in the process for making the case for the changes?

What information would you suggest you would use to help make the decision? – e.g., what tools and/or information sources?



Exercise to take 30 minutes for discussion and group summaries
an additional 30 minutes to debrief

72

Principles of Climate Change Adaptation
Climate Trends

Regional plausible futures

See also PCIC summaries – tmurdock@uvic.ca

Virtually Certain

Very Likely

Likely

- Temperatures will increase.
- Growing seasons will get longer.
- Nature and timing of precipitation will change.
- Pests and diseases will increase or become more severe.
- Frequency and size of natural disturbances will change across the landscape.
- Drier soils later in the growing season.

From: Generalities in USDA GTR NRS-87 2012 p2

76

Module 1 Managing for Resilience
Principles of Climate Change

Climate change terminology

- Vulnerability, risk and resilience – at relevant scales

77

Principles of Climate Change Adaptation
Climate Change Terminology

Vulnerability Definition (IPCC 2001)

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change.

– including climate variability and extremes.



NOTE:
Vulnerability relates to VALUES

Vulnerability $V = f(E, S, A)$

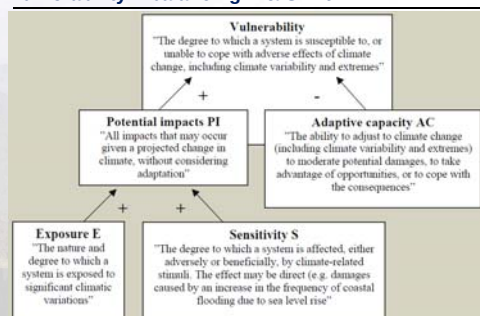
- Exposure (E), (i.e., the magnitude of climate change)
- Sensitivity (S), (sensitivity to change)
- Adaptive capacity (A) (ability to adapt the system to the change)

Sources: From Morgan - Turner et al. 2003, Smit and Pilifosova 2003, Ford and Smit 2004, IPCC 2007

78

Principles of Climate Change Adaptation
Climate Change Terminology

Vulnerability – balancing E & S with A



Sources: Locatelli et al. 2010. Forests and adaptation to climate change: challenges and opportunities (Ch 2). In Forests and Society—Responding to Global Drivers of Change (Morgan and Daust 2012)

79

Principles of Climate Change Adaptation
Climate Change Terminology

Vulnerability—balancing Exposure & Sensitivity with AC



Exposure – depends on which side of the fence you are on.

Sensitivity – your fear of heights, is it windy, wet...)

Adaptive Capacity – staying inside the fence, not going out when wet or windy – keeping your eyes shut?

How does this relate to resource values?



80

Principles of Climate Change Adaptation
Climate Change Terminology

Assessing Vulnerability - EXERCISE

Vulnerability $V = f(E, S, A)$

TURN TO YOUR NEIGHBOUR (TIME = 15 minutes)

1. Provide a local resource value that will become more vulnerable with climate change?
 - Where and why?



81



Principles of Climate Change Adaptation
Climate Change Terminology

Adaptation and Mitigation

- **ADAPTATION – WHAT WE CAN DO...**
 - Actions to moderate the vulnerability of forests and ecosystems
 - Manage forests to become more healthy, resistant, & resilient
 - Facilitate ecosystem responses to climate change when appropriate
- **MITIGATION AS IT RELATED TO FOREST MANAGEMENT**
 - Use of forests to sequester carbon, provide renewable energy from biomass, & avoid carbon emissions from fossil fuels, fire, mortality, and conversion in a thoughtful manner



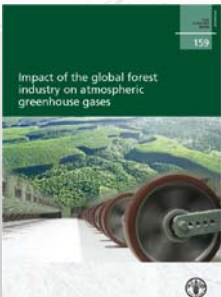
83

Principles of Climate Change Adaptation
Climate Change Terminology

Adaptation and Mitigation

The role of forest management:

"In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit."



<http://www.fao.org/docrep/012/i1580e/i1580e00.pdf>

84

Principles of Climate Change Adaptation
Climate Change Terminology

Ecological Resilience – Thoughts from BC Ecologists:

The Long-term goal of managing for ecological resilience is:

Use forest management practices that minimize the risk of:

- the risk of rapid, unexpected ecosystem changes
- that could in turn generate negative socio-economic pressures".

E.g., MPB – impact on timber, visuals, water, wildlife habitat, carbon sequestration...

Ecological Resilience and Complexity:
 A Theoretical Framework for Understanding and Managing British Columbia's Forest Ecosystems in a Changing Climate



From: Campbell, E.M., S.C. Saunders, K.D. Coates, D.V. Meidinger, A. MacKinnon, G.A. O'Neill, D.J. MacKillop, S.C. DeLong, and D.G. Morgan. 2009. Ecological resilience and complexity: a theoretical framework for understanding and managing British Columbia's forest ecosystems in a changing climate. B.C. Min. For. Range, For. Sci. Prog., Victoria, B.C. Tech. Rep. 055. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr055.htm

85

Principles of Climate Change Adaptation
Climate Change Terminology

Resilience – it is about values



"Resilience is - the long-term capacity of a system to deal with change and continue to develop."

For a forest ecosystem...it is the capacity to deal with:

- storms, fires and pollution,

For a society ... it is the capacity to deal with:

- political uncertainty or natural disasters.
- in a way that is sustainable in the long-term.

From <http://www.stockholmresilience.org/21/research/what-is-resilience.html>

86

Principles of Climate Change Adaptation
Climate Change Terminology

Resilience - Discussion

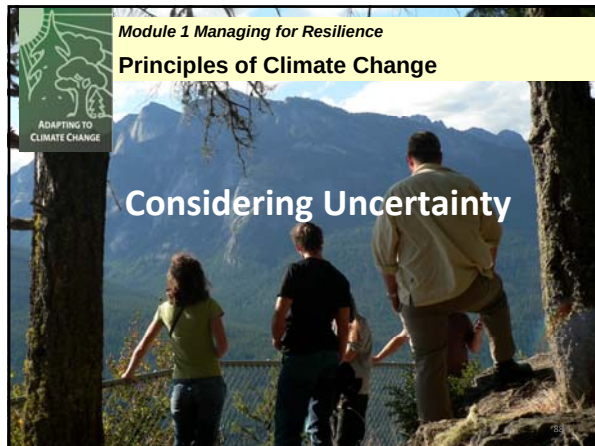
Characteristics of Resilient Ecosystems

1. Complex – at multiple scales – tree to watershed
2. Diverse in structure and function – spp, ages and patterns. Diverse interactions and responses to disturbance
3. Rich biological legacies
4. Seed & pollen dispersal
5. Vigorous vegetation with ample growing space – not stressed
6. Multiple representation of values – e.g., old forest, habitat...
7. Connectivity across scales
8. Reduced exposure and sensitivity to large scale disturbance such as fire, insects and disease.



E. Campbell et al (2009) (as summarized by Don Morgan, MFLNRO)

87



Principles of Climate Change Adaptation
Considering Uncertainty
Risk and Uncertainty



- Risk** is commonly defined as the product of the **probability or likelihood** of occurrence of a **consequence**...
- That is: what is the likelihood of something bad happening?
- Uncertainty** describes the **quality of our knowledge** concerning risk. Uncertainty may affect both the probability and consequence of the risk.
- Uncertainty is not the same as unknown, e.g., with CC there are numerous future scenarios, each can be described, we simply don't know which will occur.

<http://www.ukcip.org.uk/wp-content/PDFs/Risk.pdf>
Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report May 2003

Principles of Climate Change Adaptation
Considering Uncertainty
Risk, Resilience and Uncertainty

- Some sources of uncertainty are quantifiable,
 - particularly as climate observation networks improve.
- Nonetheless, uncertainty is not the same as incorrect information, nor does it mean we know too little to act".



Likelihood	Consequences				
	Minor	Minor	Minor	Major	Severe
Almost certain	M	M	M	R	R
Likely	M	M	M	R	R
Possible	L	M	M	R	R
Unlikely	L	M	M	M	M
Rare	L	L	M	M	M

<http://www.ukcip.org.uk/wp-content/PDFs/Risk.pdf>
Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report May 2003
http://andrewmedia.dyndns.org/Dartnell/images/risk_matrix.gif

Principles of Climate Change Adaptation
Considering Uncertainty

Decisions made in the face of uncertainty

"Decisions are routinely made in the context of military operations, monetary policy or financial investments—to name a few examples—where levels of uncertainty often exceed those of climate projections" (Mabey and others 2011).

An example of taking into account potential impacts of climate change:

Because some climate change impacts are inevitable, planning adaptation strategies now is essential. One example of adaptation is the Confederation Bridge between New Brunswick and Prince Edward Island, which was built a metre higher than currently required to accommodate sea level rise over its one hundred year lifespan.

<http://www.elements.nb.ca/theme/climate03/cclearn/adapting.htm>

<http://www.ukcip.org.uk/wordpress/wp-content/PDFs/Risk.pdf>
Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report May 2003

91

Module 1 Managing for Resilience
Principles of Climate Change

ADAPTING TO CLIMATE CHANGE

APPROACHES TO ADAPTATION
— Introducing the Five R's.

Principles of Climate Change Adaptation
Approaches to Adaptation

The 5 R's - Adaptation Approaches

Resistance
Resilience
Response
Realignment
Reduce

Management Opportunities

Millar et al 2007, 2008 as used by Nagel et al 2012

93

Principles of Climate Change Adaptation
Approaches to Adaptation

The 6th step – not an R

6. Set Priorities

Practice triage as appropriate

Confront What Can and Cannot be Done

* Sensitive & vulnerable vs resistant & resilient



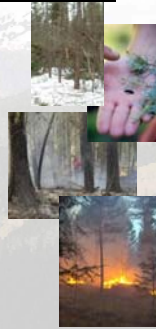
From Connie Millar Presentation: Climate Change at Multiple Scales Rethinking Management Paradigms to Address Uncertainty

94

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

A Management Approach – Suggested Steps

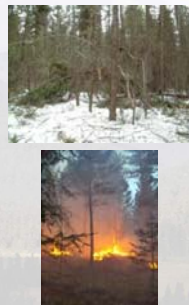
1. Anticipate the effects of climate change.
2. Explore approaches to promote more resilient forests with the anticipated effects.
3. Choose the preferred options to manage risk.
4. Empower their use.
5. Monitor and adapt accordingly



95

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

1. Anticipating Effects of Climate Change



A REAL LIFE EXAMPLE of PROMOTING RESILIENCE by ADDRESSING RISK

Alex Fraser Research Forest - observations

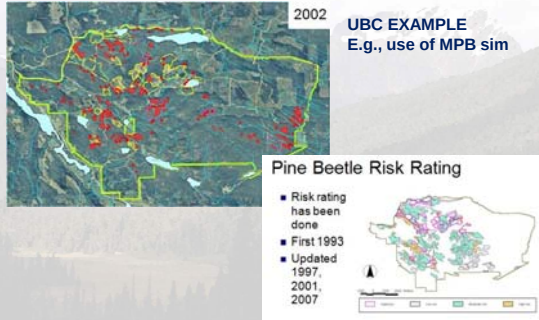
Weather seems unpredictable

- Drought (2010)
- Record snowpack (2011)
- Winter rainfall (2003)
- Warmer winter minimum temperatures
- Hotter summer maximum temperatures
- More humidity
- Return periods for extremes appear closer and more varied

96

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

2. Explore Approaches – Scenarios and Risk Assessment



Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

3. Manage Risk with Preferred Options – UBC example

Example: Set Sensible Harvest Priorities

a) Consider the risk of loss stand by stand

- Establish a harvest queue
- Harvest most likely to be lost first
- Revisit the priorities periodically



b) Management Plan #3 (2007)
Harvest Priority

1. Imminent loss
2. Dead and dying
3. Regeneration cuts in partial-cut systems
4. At risk of infestation
5. Declining vigour
6. Affected by disease
7. Healthy vigorous timber

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

4. Empower the Use of Preferred Options

KEY LESSON - Mountain pine beetle has confirmed: many of the lessons of the old textbooks remain sound

Empowering Preferred Management Options:

- Manage for vigorous stands
- Cut stands with greatest risk of loss
- Be aggressive when markets are favorable
- Be careful with investments
- Incorporate risk in operational decision-making – use climate change adaptation tools.



Remain vigilant, MONITOR, watch for new risks, ensure plans are forward looking!

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

5. Monitor to ID issues as they emerge

What is being done?

FH monitoring initiatives include:

- 100% survey of FG blocks,
- Stand Development Monitoring,
- Provincial aerial overview survey
- Provincial FH report, annually updated TSA Forest Health strategies.

Remember Your best source of info is your Regional Forest Health specialist!



These data sources should show what the current status of FH in your area.
 What other sources of information are there? - E.g., Link to RESULTS output

100

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

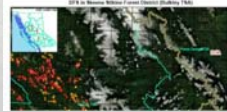
5. Monitor to ID issues as they emerge



In your area will this situation worsen with CC, remain the same or decrease?

How will you know?

What could we do better?



E.g., DFS
 Dothistroma Needle Blight (*Dothistroma septosporum*)

101

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

Dealing with Risk and Uncertainty

Be an adaptive thinker...

- Instead of fighting change work with it.
- Accept uncertainty, and use the best available information - revise as we learn more.
- The past is not the future – new ways of thinking may be needed.
- Focus on how forests grow and change instead of what they look like.
- Recognize we live with risk, and need to manage our behaviour and risk tolerance.



¹Adapted from Natural Inquirer, Climate Change Edition Number 14
<http://www.naturalinquirer.org>

102

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

Dealing with Uncertainty

Need a Planning Framework to...

- Monitor and collect more data to help clarify key uncertainties
- Collaborate with researchers
 - Explore uncertainties
 - Test assumptions
- Revisit mgmt options with the latest science and data.



If this is in place – you will not be paralysed by uncertainty

103

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

What about climate effects on species use?

What is being done?

Type 4 Silviculture Strategies have species direction at the Subzone level as desired trends and or targets, e.g., for SBSdw in the Quesnel TSA

SBSdw

PI			Sx			Fd		
Current	Trend	Target	Current	Trend	Target	Current	Trend	Target
68 / 80	◊	20 - 30	25 / 11	◊	15 - 20	5 / 5	↑	30 - 40

Promote Fd where possible; maintain reduced dependence on PI; increased use of Sx over harvest.

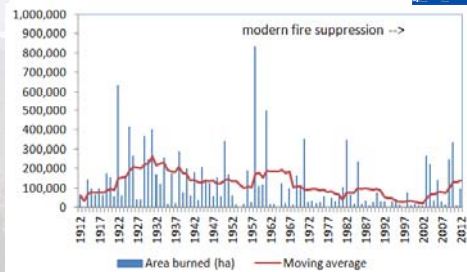
- Current – proportions planted / logged
- Trend – whether it is desired to
 - ◊ increase
 - ◊ decrease or
 - ◊ maintain the proportion planted / logged
- Target – a biological target for the unit to trend towards where feasible

104

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management

Anticipating effects from climate change

Fire trends



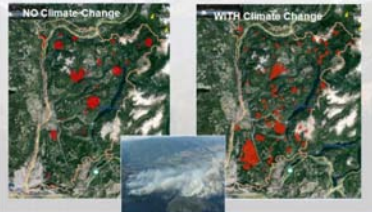
BC Wildfire Management New Reality

105

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management
Anticipating effects from climate change

TRENDS
Area burned (wildfires) projected to DOUBLE

Spatial simulation – at 2060-2070
 • 10 year area burned by stand replacing fires.



BC Wildfire Management Future Reality

106

Resilient Forests in a Changing Landscape
Resilience through scenario-based risk management
Managing Risk and Exploring Options

LOTS OF THOUGHT ON THIS ONE
The BC Wildland Fire Management Strategy 2010
 Framework for achieving fire resilient landscapes.

Forest Sector Strategy for BC 2012
 ...Province will implement landscape fire management planning...

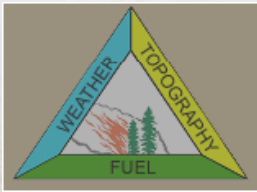
The BC Forest Stewardship Action Plan for Climate Change
 ...Manage risks and capture opportunities for fire resilience

- **Need to bring this into some thoughtful operational strategic planning**



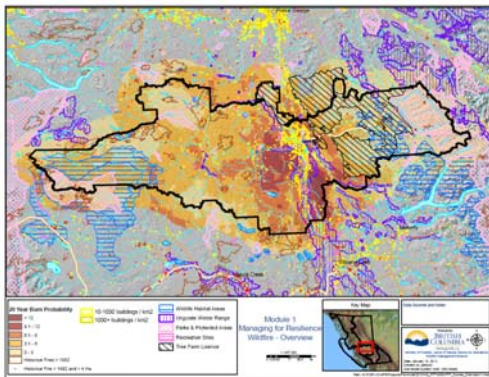
107

Fire and Climate Change
What can and should we be doing?

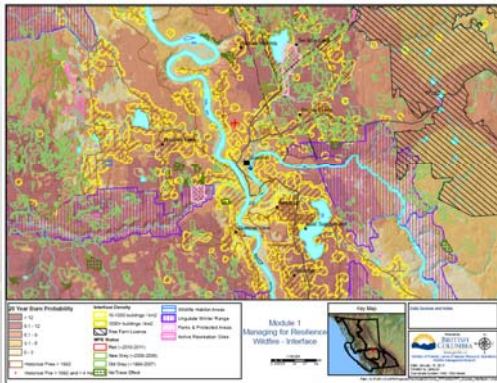


108

Landscape Analysis – Burn P3 Output



Landscape Analysis – Burn P3 Output



Discussion points

- Is your private property fire smart?
- Is your community at risk?
- Are other local values at risk?
- **How does climate change impact the current situation?**
- Is there a fire management plan in place?
- What treatments are suited to your area?
- What treatments are you presently doing?
- Are you doing enough?
- If not what more should be done?



Lessons Learned

GROUP DISCUSSION – What are you going to do differently based on what you learned today?



Lessons Learned

What is on the horizon to help?

FLNRO Climate Change Strategy

- BC's climate is changing
- BC natural resources are important to climate solutions & sensitive to change
- BC and MFLNRO have taken action
- The FLNRO strategy goes further

Tom Ethier: Sept 19, 2013

116



Module 1 Managing for Resilience

Climate Change Adaptation Workshops Overview

Long range view for Adaptation Workshops

Modules to be created by subject area, e.g.,

Forest Health

Hydrology

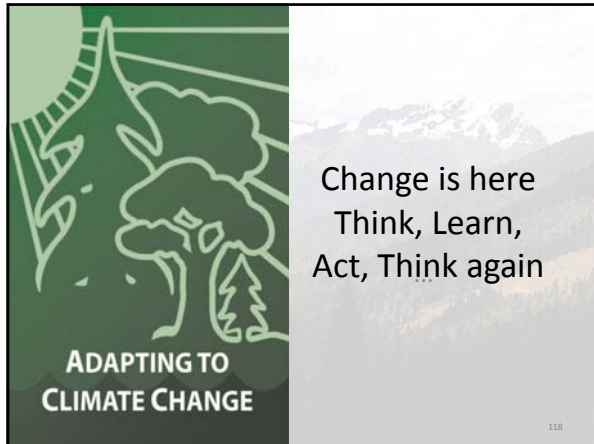
Habitat

...

Possible multi day field based workshop

Other modules to follow based on information availability and need – your feedback is welcome

117



Links to various tools available for practitioners



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 ☐ Ministry Only
 ☒ Competitiveness

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[B.C. Home](#)

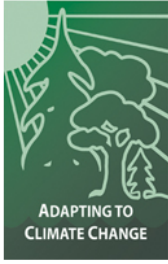
[B.C. Home](#) » [Ministry Home](#) » [Competitiveness and Innovation Branch](#) » [Climate Change](#) » Home



Ministry of Forests, Lands and Natural Resource Operations

Adapting BC's Natural Resource Management to Climate Change

- The Context:** British Columbia's overarching [Climate Change Adaptation Strategy](#) as articulated by the Climate Action Secretariat envisions that "British Columbia is prepared for and resilient to the impacts of climate change". Adapting B.C. forests to climate change is an important part of the adaptation work being undertaken in B.C.
- B.C.'s Forest Stewardship Action Plan for Climate Change Adaptation** outlines a new vision and signals an important new policy direction for climate change adaptation for forest management in British Columbia. Released in February 2012, it outlines goals, objectives and actions the Ministry will take over the next five years to adapt forest stewardship to a changing climate.
- Adaptation Knowledge and Tools for Adapting B.C.'s Forest Management** points to B.C. forest policies for adapting to climate change, and provides links to a suite of knowledge and tools to assist forest managers adapt their practices so that forests will remain resilient in the face of climate change, variability and other stressors.
- Future Forest Ecosystems Scientific Council** The FFESC funded 27 research projects to inform adaptation of BC forest and range policies and practices to climate change. This web site includes information on FFESC, and its many new project reports. A synthesis of research outcomes and the results of the June 2012 closing conference will soon be available.



B.C. Home

Ministry Home

▼ Competitiveness and Innovation Branch

- Bio-Economy Development
- Context for Adapting to Climate Change
 - Forest Stewardship Action Plan for Climate Change Action
 - Adaptation Knowledge and Tools for Forest Stewardship
 - Forest and Land Carbon
 - Other Links
 - Publications
- Log Export Policy and Administration
- Natural Resource & Industry Economics

Site Map

KEY INDEXES

- ➔ News
- ➔ Offices and Programs
- ➔ Statutes and Regulations
- ➔ Reports and Publications
- ➔ Applications and Services
- ➔ Forms Index
- ➔ Subject Index
- ➔ Telephone Directory

A companion document to Fostering Resilient Forests and Ecosystems – Climate Change Adaptation Workshops – winter 2013

The following links are meant to help integrate Climate Change into your day to day practice. They cover a range of topics, some provide computer adapted tools, and others provide guidance as text or examples. There is much to see, take your time, drill-in and enjoy.
The Climate Change Adaptation Team - October 2013

Contents

Links to various tools available for practitioners	1
Climate Change Policy link	3
Climate-Based Seed Transfer policy and guidance link	3
Knowledge link – a useful gateway.....	3
Species monitoring report	3
TSA Species summaries.....	3
Tree Species selection tool	4
Google map version of Climate BC	5
BioClimatic Envelope Modes - shows shifts the zone scale.....	5
Population response functions to climate change	5
Plan2Adapt.....	5
Potential Management Options for Adaptation, Link to pdf on FTP	5
FFESC Output	6
Stand Level Risk and Decision Tool, Link is to a FTP site.....	6
Changing tree species in the West Kootenays.....	6
K2 information.	6
Bulkley Valley project link.....	7
Quantifying risks and opportunities from climate change interim results from the Merritt TSA	7
USFS links	8
Links to short presentations –worth checking out, an example link below to a presentation by Connie Millar on adaptation:	9
Forest Health links	11
Review of Literature on Climate Change and Forest Diseases of Western North America.....	13
Predicting Forest Insect Disturbance under Climate Change (Allan Carroll)	14
Climate change and forest diseases – Sturrock et al 2011	15
Yellow-cedar decline and climate change.....	15
Advances in threat assessment and their application to Forest and Rangeland Management	16
Forest Health and Climate Change: A British Columbia perspective.	16
Is the health of British Columbia’s forest being influenced by climate change? If so, was this predictable? By Alex Woods, 2011	16
Forest health hazard ratings in BC: what is potentially an issue?	17
RESULTS data on incidence	17
Expected Effects of Climate Change on Forest Disturbance Regimes in British Columbia.....	18
Direction on fuel management in the Wildland Urban Interface.....	20
Useful link for managing habitat – Just add a climate change lens	20
Suggested links on specific subjects – some specific to the North regions:.....	21
Climate Change Guidelines for Forest Managers	21
Canadian Council of Forest Ministers – suite of four useful resource documents.....	22
Link to Regional summaries by PCIC.....	23
Future webinar to solicit feedback	23

Climate Change Policy link

<http://www.for.gov.bc.ca/het/climate/knowledge/index.htm>

Climate-Based Seed Transfer policy and guidance link

http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/index.htm



http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/2cbst_project.htm

- Ongoing project; see CBST project charter, 2012 to 2017

http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/3cbst_project.htm

- Provides links to upward elevation transfer limit changes (Nov. 2008)
- Provides links to the recent range expansion for Lw (June, 2010)

For further information on statutory seed use requirements, see the Chief Forester's Standards for Seed Use at:

<http://www.for.gov.bc.ca/code/cfstandards/>

Knowledge link - a useful gateway

<http://www.for.gov.bc.ca/het/climate/knowledge/knowledge.htm>

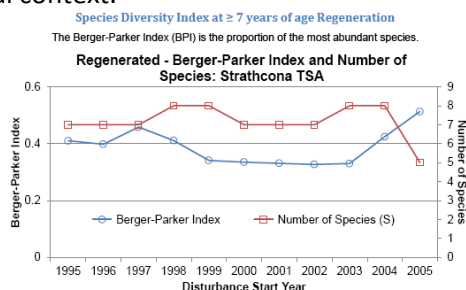
Species monitoring report

[http://www.for.gov.bc.ca/hfp/sof/species/Spp%20Monitoring%20Report%20-%20Province%20\(May%2010,%202012\).pdf](http://www.for.gov.bc.ca/hfp/sof/species/Spp%20Monitoring%20Report%20-%20Province%20(May%2010,%202012).pdf)

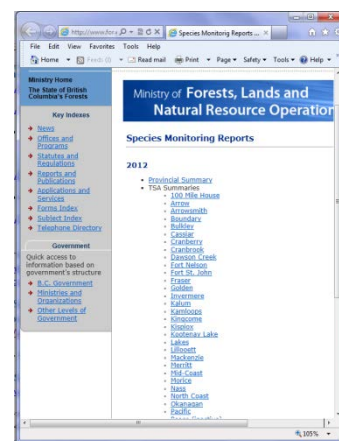
TSA Species summaries

<http://www.for.gov.bc.ca/hfp/sof/species%20monitoring%20reports.htm>

- Provides local context.



The index addresses the proportion of species present not simply presence or absence as richness describes.



Understanding the Berger-Parker Dominance Index

$$d = N_{\max} / N$$

$N_{\max}$ = Nmax is the volume in the most abundant species

N: Total volume of individuals

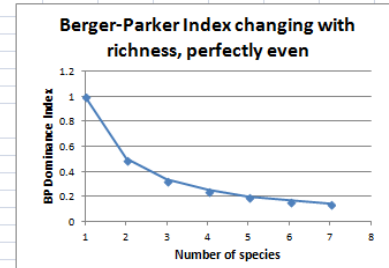
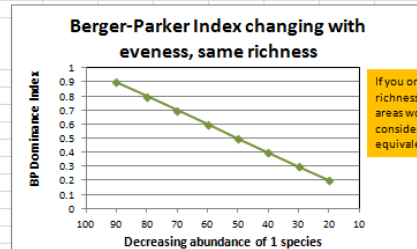
Note that the most abundant species is not constant

Perfectly even - all species have equal abundance

Number of species (richness)	Pine	Spruce	Fir	Hardwood	Larch	True fir	Cedar	Total	B-P Index
1	1000							1,000	1
2	500	500						1,000	0.5
3	333	333	333					1,000	0.33333
4	250	250	250	250				1,000	0.25
5	200	200	200	200	200			1,000	0.2
6	167	167	167	167	167	167		1,000	0.16667
7	143	143	143	143	143	143	143	1,000	0.14286

Constant richness - 5 species in all cases

Decreasing abundance of primary species (increasing evenness)	Pine Abundance	Spruce	Fir	Larch	True fir	Total	B-P Index
90	900	25	25	25	25	1,000	0.9
80	800	50	50	50	50	1,000	0.8
70	700	75	75	75	75	1,000	0.7
60	600	100	100	100	100	1,000	0.6
50	500	125	125	125	125	1,000	0.5
40	400	150	150	150	150	1,000	0.4
30	300	175	175	175	175	1,000	0.3
20	200	200	200	200	200	1,000	0.2



If you only considered richness all of these areas would be considered equivalent.

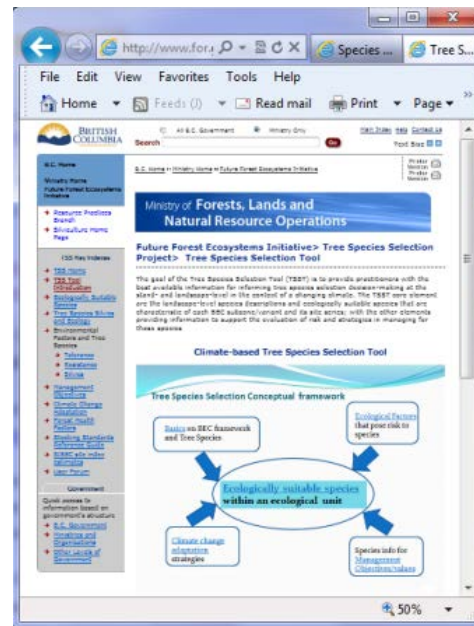
Tree Species selection tool

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

- This link provides a description of the Tree Species Selection Tool. Choose the green box and it takes you to the tool at right.

The following Link provides an example, using Lw on where information is found within the site to help make a decision on use.

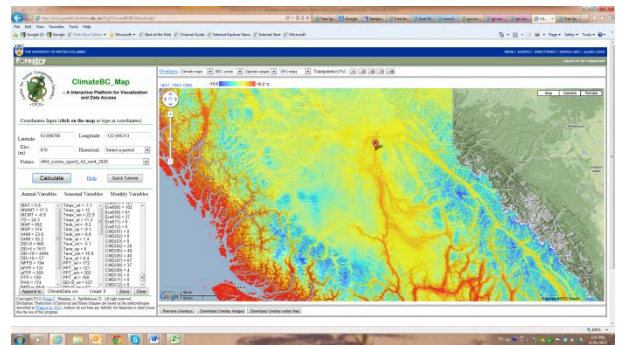
<http://www.for.gov.bc.ca/hfp/silviculture/TSS/example1.pdf>



Google map version of Climate BC

<http://www.genetics.forestry.ubc.ca/cfcg/ClimateBC40/Default.aspx>

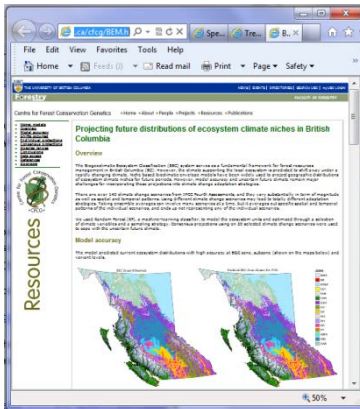
- Allows for easy exploration of scenarios.



BioClimatic Envelope Modes - shows shifts the zone scale

<http://www.genetics.forestry.ubc.ca/cfcg/BEM.html>

- Note: 20% shifted already from historic climate data. Consensus maps show greater consensus in 2020 diminishing with time as uncertainty increases. Presently this information has been summarized and is linked with species by BEC site series data for easy observation in shifts over time.

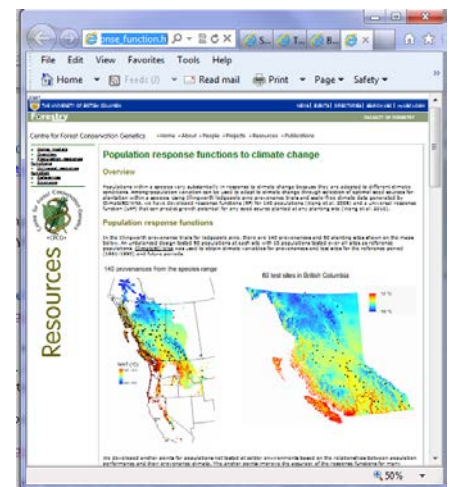


Population response functions to climate change

<http://www.genetics.forestry.ubc.ca/cfcg/response>

[function.html](#)

- Stress here the need to track seed source – may already be seed out there that has the propensity for maladaptation.



Plan2Adapt



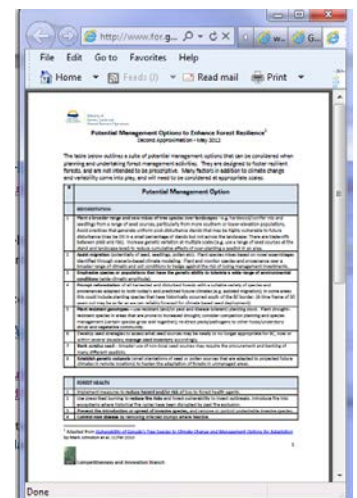
<http://pacificclimate.org/news/2012/pcic-updates-plan2adapt>

- This tool has been explored earlier.

Potential Management Options for Adaptation, Link to pdf on FTP.

http://www.for.gov.bc.ca/ftp/HFP/external!/publish/ClimateChange/Adaptation/Options/Management_Options_May9_2012.pdf

- This provides an overall list of general strategies. Where and how they are used will need local involvement, planning, implementation and monitoring. Worthwhile perusing the list.





FFESC Output

<http://www.for.gov.bc.ca/het/climate/knowledge/knowledge.htm>
http://www.for.gov.bc.ca/hfp/future_forests/council/

- Links to program description and research project websites and reports.
- Not presently on the Tools webpage – should be linked

Stand Level Risk and Decision Tool, Link is to a FTP site

http://www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Seminar_Series/2012/DeLong/

- We will go to the tool link and describe what is being provided. Note it is not presently available for the Coast. This information may be used in some area specific guidance.
- Need to obtain the newer version with wider scope.

Changing tree species in the West Kootenays

http://www.kootenayresilience.org/WK-CC-Tree-spp-shifts_6-30-11.pdf

- Presentation that shows different plausible futures and possible impacts for species choice.
- <http://www.kootenayresilience.org/> for full list of publications

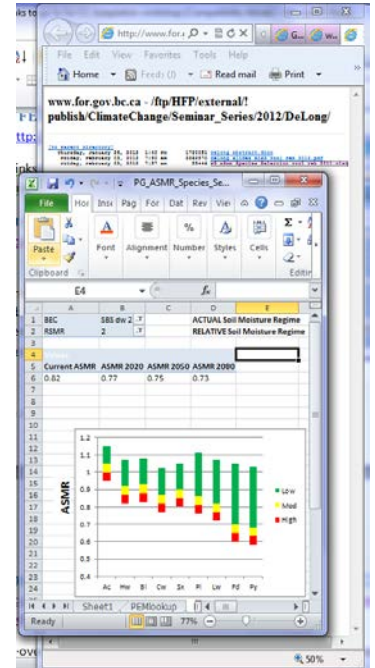
K2 information.

<http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/NelsonrevisedK2adaptationguidanceoverview120607.pdf>

- This is the guidance overview

<http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/NelsonrevisedK2adaptationguidance120607.pdf>

- A more detailed guidance piece with discussion of similarities and differences from K1.



Guidance	Details	Comments
1. Assess the current forest management practices and their potential impacts on forest health and resilience.	Assess the current forest management practices and their potential impacts on forest health and resilience.	
2. Identify the key forest management practices that are most vulnerable to climate change.	Identify the key forest management practices that are most vulnerable to climate change.	
3. Develop a plan of action to address the identified vulnerabilities.	Develop a plan of action to address the identified vulnerabilities.	
4. Implement the plan of action and monitor the results.	Implement the plan of action and monitor the results.	
5. Review the plan of action and update it as needed.	Review the plan of action and update it as needed.	

Bulkley Valley project link

http://bvcentre.ca/research/project/a_multi-scale_trans-disciplinary_vulnerability_assessment/

- Nadina Vulnerability Assessment.
- Lots to see here.

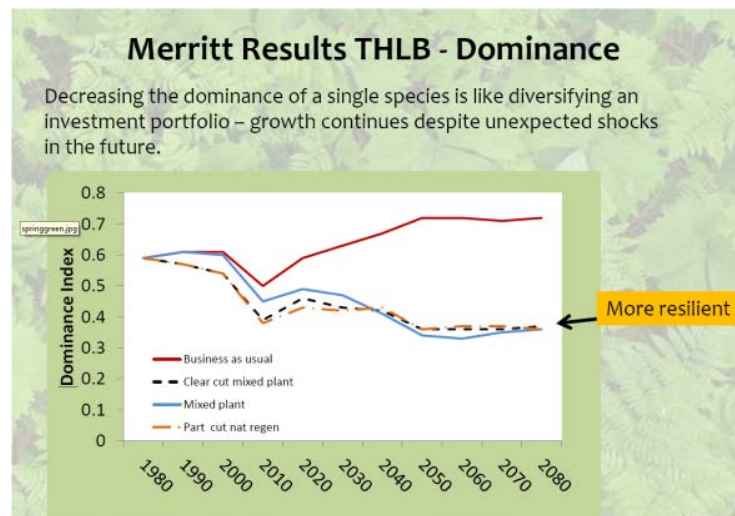


Quantifying risks and opportunities from climate change interim results from the Merritt TSA

- ftp://ftp.for.gov.bc.ca/HFP/external/!publish/ClimateChange/Seminar_Series/2012/Dymond/Dymond_slides_Socio-econ%20risk%20and%20opps-Merritt%20v3.pdf
- Not presently on the FLNRO site but can be found through FLNRO FTP site.

The socio economic portion is not yet complete but preliminary information shows that species mixes can provide for greater long term net revenue than business as usual.

Contact: Caren Dymond Caren.Dymond@gov.bc.ca



USFS links

The USFS has embraced climate change as reality and has created a range of resources that are useful for understanding the impacts, provide tools to screen projects for applicability and assess options. The following provide an entry point into their system.

<http://www.fs.fed.us/climatechange/>



<http://www.fs.fed.us/climatechange/advisor/>

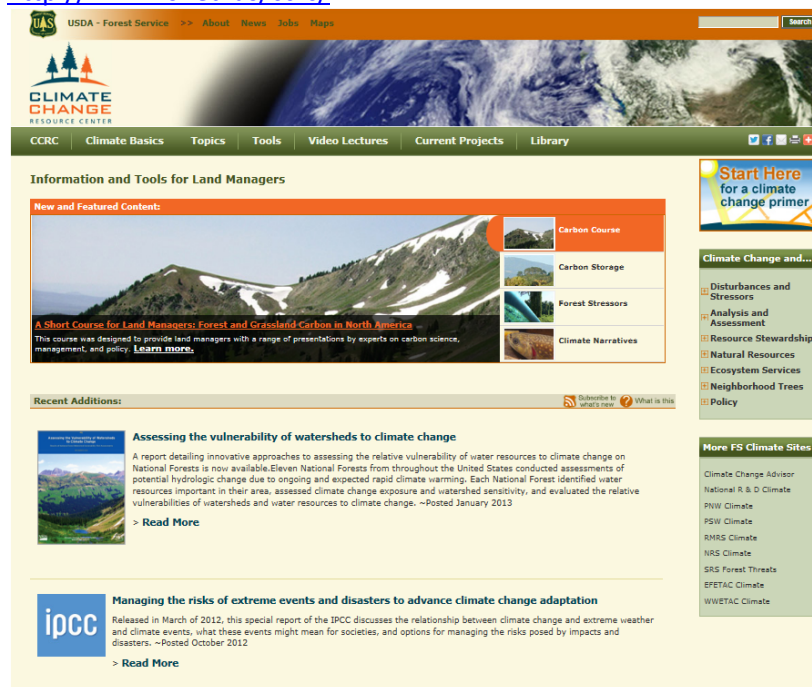
<http://www.fs.fed.us/ccrc/>

- This provides a portal to some of the work being done south of the border.

For a thorough overview of adaptation and mitigation see:

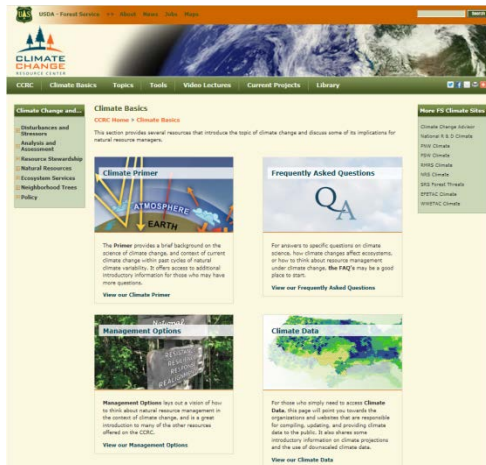
http://www.fs.fed.us/psw/publications/millar/MillarSwanson_inpress.pdf in Millar, C.I. and C. Swanston. In press. [Adaptation and Mitigation](#). Chapter 4 in National Climate Assessment. US Global Change Research Program.

<http://www.fs.fed.us/ccrc/>



Links to climate background information

<http://www.fs.fed.us/ccrc/climate-basics/>



Useful site for understanding climate in an easy to follow approach.

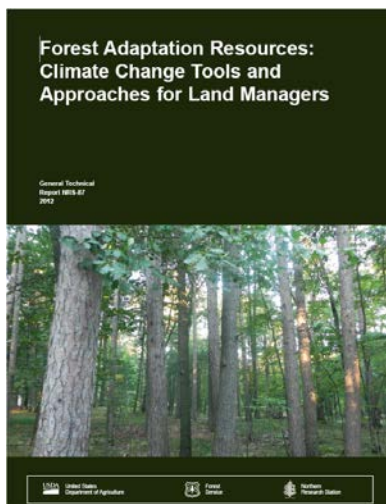
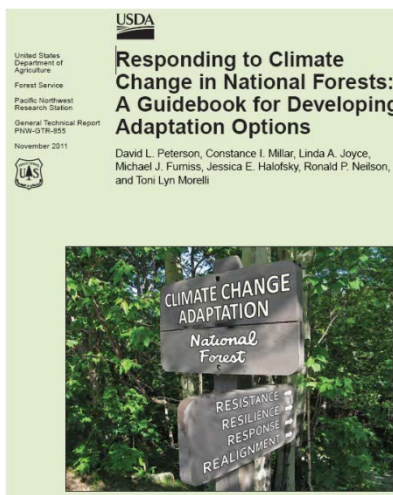
Links to short presentations –worth checking out, an example link below to a presentation by Connie Millar on adaptation:

http://www.fs.fed.us/ccrc/hjar/management_strategies.html **Good overview of**

collaboration: [http://www.fs.fed.us/psw/publications/millar/psw_2011_millar004\(littell\).pdf](http://www.fs.fed.us/psw/publications/millar/psw_2011_millar004(littell).pdf)

Adaptation resources: http://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs87.pdf

http://www.fs.fed.us/pnw/pubs/pnw_gtr855.pdf



This publication provides a clearly laid out approach to address climate change, with examples. The appendix provides a series of worksheets that aid in identifying vulnerable conditions, options and steps to address the issue.

Link to climate change options: http://www.fs.fed.us/ccrc/mgmt_options/

CCRC

Climate Basics

Topics

Tools

Video Lectures

Current Projects

Library

Climate Basics

Back Home

Climate Change Primer

Management Options

Frequently Asked Questions

Climate Data

Climate Change and...

Disturbances and Stressors

Analysis and Assessment

Resource Stewardship

Natural Resources

Ecosystem Services

Neighborhood Trees

Policy

Re-Framing Forest and Resource Management Strategies for a Climate Change Context

CCRC Home > Management Options

Among the surprising developments during the 2007 year-of-climate-dawning was an abrupt change in the nature of dialog between scientists and natural-resource managers. In previous years the primary communication involved researchers talking with managers about climate change and its impacts on ecosystems. By early 2007 the significance of climate became widely embraced, and the conversation did an about-face. From national agency headquarters to local field offices, the collective voice of decision-makers echoed resoundingly back to science: "OK, we get that climate is important. Now, what do we do about it?"

That question initially silenced many in the research community, although serious efforts have been investigating resource management implications for some years (e.g., Dale et al. 2001, Spittlehouse and Stewart 2003, Willows and Connell 2003, Joyce et al. 2007). While field-proven conceptual frameworks and desktop manuals will be developed only through collaborative efforts of scientists and managers, we offer the following as an overarching framework of options for addressing climate change issues in resource contexts such as encountered in western mountain environments (Millar et al. 2007, Joyce et al., in press).

Defining Assumptions

- Embrace and work with change.

While this may seem obvious, many existing resource-management practices rest on assumptions that ecological backgrounds are stable over time even though they acknowledge short-term successional dynamics. Likewise, engrained institutional traditions commonly rest implicitly on assumptions of persistent and stable behavior. Make friends with change, while still working to mitigate it.
- Accept uncertainty as a premise for decision-making.

While opportunities for prediction and forecasting will be presented to managers, uncertainty will always lurk close at our shoulders -- at least at the scale relevant to most resource-management projects. Addressing uncertainty head-on will often be more effective than taking a course of action based on a narrowly defined future. For many situations, we will never have enough knowledge to predict future outcomes at scales that matter to managers. Evaluate the wisdom of "putting your eggs in one basket" (accepting a definite future) versus "hedging your bets" (accepting uncertainty) strategies.
- Recognize that some existing management paradigms have limited value.

This is because many traditional practices are based on assumptions that the future will be similar to the past -- that ecosystems are not changing over time. Climate change puts that notion finally to bed. Many ecosystem-management philosophies will still make sense, especially when practiced creatively. This is a good time to experiment with old techniques in new ways and pioneer altogether novel approaches.
- Manage for desired future processes rather than desired future conditions.

Composition and structure relate to static rather than dynamic goals; a focus on ecosystem services and ecological and physical functions as management targets fixes the aim on dynamic process.

NEW GUIDEBOOK: Responding to climate change in national forests: a guidebook for developing adaptation options

Contents

Intro

Strategy

Resistance

Resilience

Respond

Realign

Reduce

Priorities and Summation

References

Authors

PDF download

next >>

Note the tool bar along the top has links to many useful sites.

Taccimo (Template for Assessing Climate Change Impacts and Management Options) – science at your fingertips – web tool: <http://www.sgcp.ncsu.edu:8090/>

The Template for Assessing Climate Change Impacts and Management Options (TACCIMO) is a collaborative endeavor of the Eastern and Western Threat Centers and Regional Forest Planning units of the USDA Forest Service. The Threat Assessment Centers provide forest landowners, managers, and scientists with the latest research and expertise concerning environmental threats to forests.

US

WETAC

VERSION 2.2 IS HERE!

New reporting formats

Simplified literature explorer

Updated content and organization

Now supporting FS Regions 5, 8, & 9

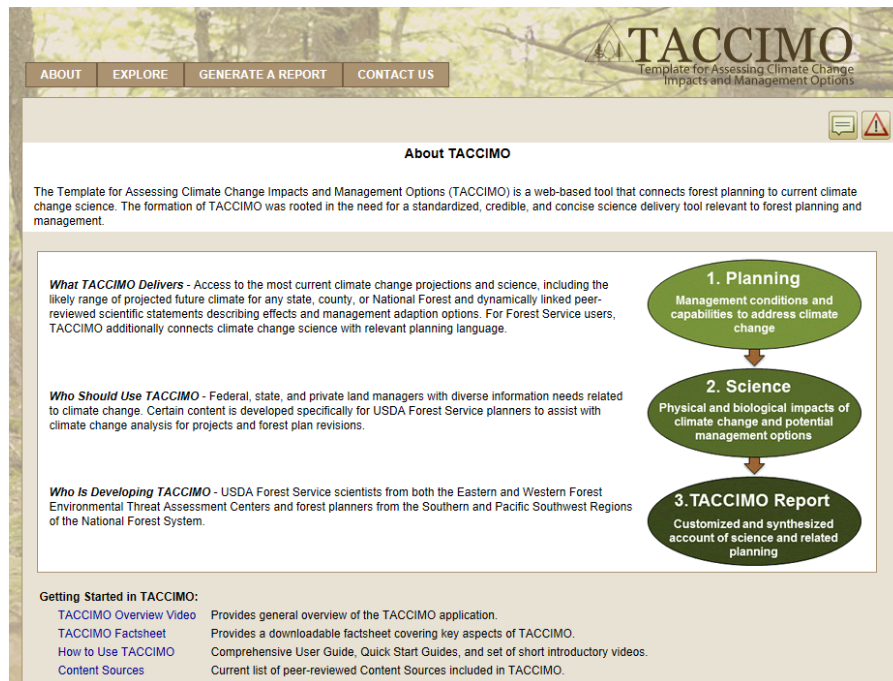
TACCIMO

Template for Assessing Climate Change Impacts and Management Options

Enter Site

10 | Page

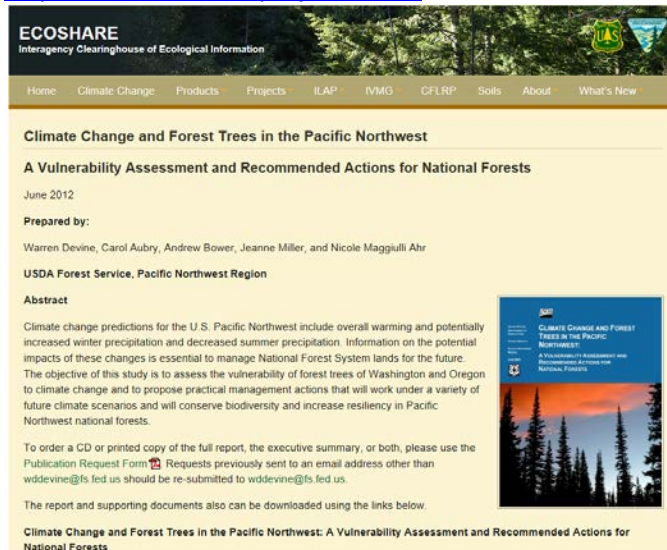
Links for CC Adaptation Workshop Updated Oct 05_2013



Taccimo is worth a look through, it is created to help USFS planners but has information useful to all planning with a Climate Change filter.

Climate change and forest trees in the Pacific Northwest: A vulnerability assessment and recommended actions for National Forests:

<http://ecoshare.info/projects/ccft/>

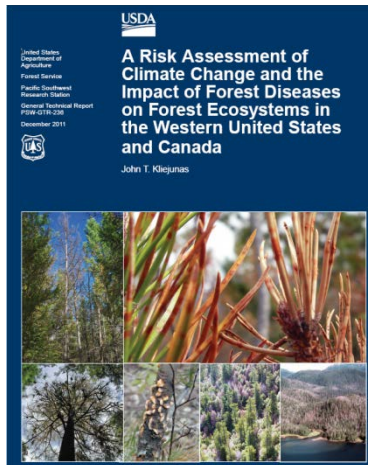


This document provides a list of vulnerabilities based on different characteristics. It clearly provides assumptions and is a useful reference to begin thinking about tree vulnerability.

Forest Health links

A Risk Assessment of Climate Change and the Impact of Forest Diseases on Forest Ecosystems in the Western United States and Canada

http://www.fs.fed.us/psw/publications/documents/psw_gtr236/psw_gtr236.pdf



Information is provided on Dothistroma, Swiss Needle Cast, Sudden Oak Death, Ramorum Blight, White Pine Blister Rust, Cytospora Canker of Alder, Dwarf Mistletoes, Armillaria Root Disease, Yellow Cedar Decline.

Armillaria example (page 2-4)

Likelihood and the consequences were each assigned a certainty category as described in Orr and others (1993). The certainty categories are a function of the information that is available and the confidence of the assessor in it. Certainty categories used in the risk assessment process are:

- *Very certain*
- *Reasonably certain*
- *Moderately certain*
- *Reasonably uncertain*
- *Very uncertain*

Likelihood of increased disease damage

Warmer, drier–High (very certain) (Applicable criteria: a, b, d, e).

Warmer, wetter–Moderate (moderately certain) (Applicable criteria: a, d, e).

The incidence of Armillaria root disease is likely to increase as temperatures increase and precipitation decreases (Shaw and Kile 1991, U.S. Office of Technology Assessment 1993), especially when hosts are stressed by moisture deficiency.

Five criteria were used to estimate likelihood (risk) of increased disease damage:

- a. Suitability of conditions for pathogen survival, reproduction, spread, or host infection will increase as climate changes.*
- b. Changes in climate will stress the host and increase its susceptibility to the pathogen.*
- c. Pathogen is capable of substantial increases in population size (has a high reproductive potential).*
- d. Pathogen has a broad host range.*
- e. Control techniques are unknown, not feasible, or ineffective.*

Consequences of increased disease damage (pages 40-41)

High (reasonably certain) (Applicable criteria: a, b, c). As precipitation decreases, increased growth reduction and mortality losses in British Columbia could increase. Increased growth loss and mortality would likely increase as sites become drier elsewhere as well.

Risk potential–

Warmer, drier–Very high (9) (Likelihood of increased disease damage = high; consequences of increased disease damage = high). Warmer, wetter–High (6) (Likelihood of increased disease damage = moderate; consequences of increased disease damage = high). A warmer climate will generally increase Armillaria incidence and impact as host stress increases. A drier climate would, in general, stress hosts more than a wetter climate, and thus increase host susceptibility.

Review of Literature on Climate Change and Forest Diseases of Western North America

http://www.fs.fed.us/psw/publications/documents/psw_gtr225/psw_gtr225.pdf



Provides good general guidance: e.g.: below

Key points:

“Although rusts can adapt to a wide range of environmental conditions, their tolerances are unknown. Under a changing climate, the incidence of rusts will be determined chiefly by host distribution. Rusts are likely to remain the cause of damaging and lethal diseases. Typically, rusts increase in intensity and distribution in “wave years” during which the weather is especially favorable for sporulation, dispersal, and infection. As climate changes, the frequency of such wave years is expected to change.” P 19

Predicting Forest Insect Disturbance under Climate Change (Allan Carroll)

<http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/Carrollfinalreport.pdf>

“ABSTRACT

This paper comprises a review of literature regarding climate change impacts to forest insect disturbances. Its primary objectives were three-fold. First, commonalities were sought among systems regarding the effects associated with altered temperature and/or precipitation patterns on forest insect herbivores, the proximate and ultimate form of the response by the insects, and the outcome in terms of forest disturbance. Second, a general framework within which to assess future disturbances to temperate and boreal forests by insect herbivores was constructed. Finally, uncertainty regarding predictions of the extent/severity of forest insect disturbances under climate change into the future was discussed.

Conclusions

The preceding analysis suggests that disturbance by bark beetles is more likely to be exacerbated by climate change than defoliators, mainly because of the former's positive response to host tree stress and lack of a requirement for strict phenological synchrony. Given that there is little doubt of climate change-aggravated disturbance by bark beetle populations occurring already, priority should be given to development of realistic predictive tools that will facilitate proactive strategies intended to minimize impacts. Vigilance toward native innocuous, native invasive and alien invasive species should also be stressed due to their potential to erupt unpredictably in space and time. For example, lesser known bark beetle species occurring in the southern regions of North America have the potential to move northward as temperatures increase (Gan 2004, Bentz et al. 2010). Although the response by defoliators may be less predictable compared to bark beetles, their potential to cause disturbances over vast areas of forest cannot be ignored. The predictive framework suggested in this study provides a suite of potential outcomes for an eruptive forest defoliator under climate change; however, research efforts should focus on the development of predictive models of defoliator dynamics in a warming environment.”

Climate change and forest diseases – Sturrock et al 2011

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3059.2010.02406.x/abstract>

Table 1 Predicted change in impact on forests of several examples of forest diseases as they respond to warmer and drier or warmer and wetter future climates (adapted from Dukes *et al.*, 2009)

Group	Forest disease (pathogen)	Climate change		Warmer/Wetter	
		Warmer/Drier	Level of uncertainty ^b	Predicted change in impact ^a	Level of uncertainty ^b
Diseases caused by group-1 pathogens (temperature and moisture directly affect pathogen reproduction, spread, infection and survival)	Phytophthora root rot (<i>Phytophthora cinnamomi</i>)	+/0	L	+	L
	Sudden oak death/ramorum blight (<i>Phytophthora ramorum</i>)	-	M	+	L
	Dothistroma needle blight (<i>Dothistroma septosporum</i> , <i>Dothistroma pini</i>)	0/-	M	+	L
	Swiss needle cast (<i>Phaeocryptopus gaeumannii</i>)	-	M	+	L
	White pine blister rust (<i>Cronartium ribicola</i>)	-	L	0	M
Diseases caused by group-2 pathogens (temperature and moisture more directly affect host susceptibility to pathogen)	Armillaria root disease (<i>Armillaria</i> spp.)	+	L	0	M
	Sphaeropsis shoot blight (<i>Sphaeropsis sapinea</i>)	+	L	0	M
	Charcoal canker (<i>Biscogniauxia mediterranea</i>)	+	L	0	M
	Botryosphaeria canker (<i>Botryosphaeria</i> spp.)	+	L	0	M
	Pitch canker (<i>Fusarium circinatum</i>)	+	M	+	H
Decline and abiotic diseases	Septoria canker (<i>Septoria musiva</i>)	+	M	0	M
	Yellow-cedar decline	+	L	+	M
	Sudden aspen decline	+	L	0/+	M
	Oak decline	+	M	0	M

^a+, increase in impact; -, decrease in impact; 0, no change in impact.

^bThe effects of climate change on pathogen/host interactions are complex and uncertain. Dukes *et al.* (2009) lists four types of uncertainties: those associated with (i) internal ecosystem processes, (ii) climate projections (general agreement that mean annual surface temperatures will increase but amount of warming and nature of precipitation change is less certain), (iii) future human actions, and (iv) a lack of data on the pathogens themselves. These four types of uncertainty were considered when estimating predicted changes in impact by the case study diseases; associated uncertainty levels were estimated to be low (L), moderate (M) or high (H).

R. N. Sturrock et al.

Plant Pathology (2011) 90, 133–149

Yellow-cedar decline and climate change

http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_hennon_001.pdf

Articles

Shifting Climate, Altered Niche, and a Dynamic Conservation Strategy for Yellow-Cedar in the North Pacific Coastal Rainforest

PAUL E. HENNON, DAVID V. D'AMORE, PAUL G. SCHABERG, DUSTIN T. WITTWER, AND COLIN S. SHANLEY

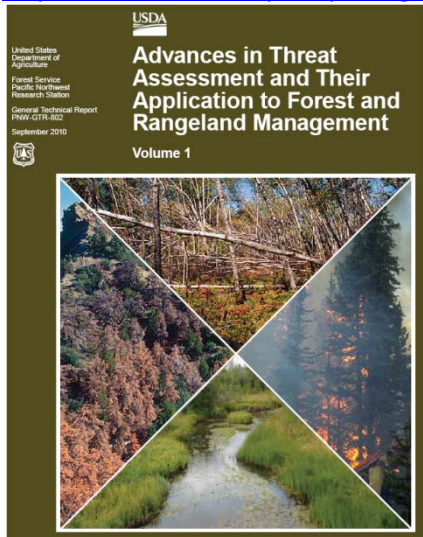
The extensive mortality of yellow-cedar along more than 1000 kilometers of the northern Pacific coast of North America serves as a leading example of climate effects on a forest tree species. In this article, we document our approaches to resolving the causes of tree death, which we explain as a cascade of interacting topographic, forest-structure, and microclimate factors that act on a unique vulnerability of yellow-cedar to fine-root freezing. The complex causes of tree mortality are reduced to two risk factors—snow depth and soil drainage—which are then used to model present and future cedar habitat suitability. We propose a dynamic, comprehensive conservation strategy for this valuable species on the basis of zones created by shifting climate, cedar's ecological niche, and observed risk factors. Research on yellow-cedar decline is offered as a template for understanding and adapting to climate change for other climate-forest issues.

Keywords: climate adaptation, forest decline, root cold tolerance, *Callitropsis nootkatensis*, *Chamaecyparis nootkatensis*

Provides compelling evidence of snow level impacts on yellow cedar – shows that the impacts of climate change may not be simple to identify.

Advances in threat assessment and their application to Forest and Rangeland Management

http://www.fs.fed.us/pnw/pubs/gtr802/Vol1/pnw_gtr802vol1.pdf



Interesting reference, may be of limited use in BC.

Forest Health and Climate Change: A British Columbia perspective.

http://bcwildfire.ca/ftp/HFP/external/!publish/ClimateChange/FRPA/Workshop/Forest_Health_CC.pdf

Forest health and climate change: A British Columbia perspective

by Alex J. Woods¹, Don Heppner², Harry H. Kope³, Jennifer Burleigh³ and Lorraine MacIsaac⁴

ABSTRACT

BC's forests have already faced two simultaneous, globally significant, epidemics linked to climate change; the Dothistroma needle blight epidemic in NW BC and the massive mountain pine beetle epidemic throughout the BC Interior. Building on these experiences, we have compiled our best estimates of how we believe other forest health agents may behave as climate change continues to influence our forests. We have drawn on literature from around the world but have focused on the situation in BC. We have made management recommendations based on what we have seen so far and what we expect to come.



Fig. 1. Landscape-level damage in central BC, dominated by current mountain pine beetle epidemic.



Fig. 2. Mature forest with significant pine beetle damage (left) and a young forest (right). Both examples of Dothistroma needle blight. Related mortality is 100%.

BC context.

Is the health of British Columbia's forest being influenced by climate change? If so, was this predictable? By Alex Woods, 2011

http://journals2.scholarsportal.info/details.xqy?uri=/07060661/v33i0002/117_ithobcciswtp.xml

An excerpt from the conclusion: “The current MPB epidemic in BC was arguably predictable given the strong link between the insect’s vulnerability to very cold winter temperatures and the recent marked increase in winter minimum temperatures. Increasing winter temperatures are one of the most confidently predicted trends in climate change projections. Forest pathogens are similarly following a pattern of increased incidence and impact but the greater role that precipitation plays in their collective life histories presents a far less predictable scenario. The DNB epidemic in northwest BC has been linked to an increase in summer precipitation but increasing precipitation should have been beneficial for the trees. Increasing precipitation and warmer temperatures should also have benefited lodgepole pine plantations in the central interior but instead hard pine rusts may be increasing due to these new environmental conditions. A shortage of winter precipitation combined with increasing temperatures is causing more severe drought in portions of the southern interior which may already be exacerbating root disease severity.”

Forest health hazard ratings in BC: what is potentially an issue?

http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/SEDA_maps/Individual%20Regional%20PDFs/

Example for Armillaria Root disease from the SEDA maps showing hazard rating – good starting point when looking forward in time. Note the high hazard area is for the entire BEC unit and may have areas within that have characteristics that are either greater or less than the identified hazard rating.

SEDA link from FORREX <http://www.forrex.org/stand-establishment-decision-aids-sedas>



RESULTS data on incidence

http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/RESULTS%20incidence%20maps/

This site houses incidence maps based on survey information found in RESULTS. This provides a description of severity in a local area from actual data and is not extrapolated.



Expected Effects of Climate Change on Forest Disturbance Regimes in British Columbia

<http://jem.forrex.org/index.php/jem/article/view/152>



Home > Vol 13, No 1 (2012) > Haughian

Expected Effects of Climate Change on Forest Disturbance Regimes in British Columbia

Sean R. Haughian, Philip J. Burton, Steve W. Taylor, Charles Curry

Abstract

Projections for forest disturbance and damage under a changing climate in British Columbia are summarized, with the objective of collating regionally specific expectations so that land managers can take pro-active steps to avoid or adapt to the changes expected. While some projections are based on extrapolations of recent multi-decadal trends, most are based on global climate models (GCMs) that must make assumptions about the range of CO₂ emissions and the status of atmospheric greenhouse gas emissions over the next century. Regardless of emission scenarios, it is universally expected that British Columbia will experience warmer air temperatures, coupled with more precipitation in some regions and less in others. Forest fires are expected to be more frequent and more intense in the southern half of the province and in the Taiga Plains, but less important in other portions of the province. Forest insects and fungal pathogens are expected to more fully occupy the current range of their host tree species and expand ranges northward and to higher elevations along with their hosts. More frequent and detrimental pest outbreaks are expected in some regions when several years of favourable weather align. Wind damage, floods, and landslides can be expected to increase on terrain where they are already a risk factor. For many agents of tree mortality, expected changes in disturbance regime amount to an expansion or shifting of the seasonal window of activity, sometimes with different trends projected for different seasons and different regions of the province. The prediction of future forest disturbance regimes is in its infancy, requiring a much more concerted effort in compiling both empirical and simulated data, but managers may wish to adjust plans accordingly where there is largely a consensus among current and projected trends.

Keywords

disturbance ecology, ecoprovinces, forest pathogens, insect outbreaks, tree mortality, wildfire, wind damage

Full Text: [PDF](#)

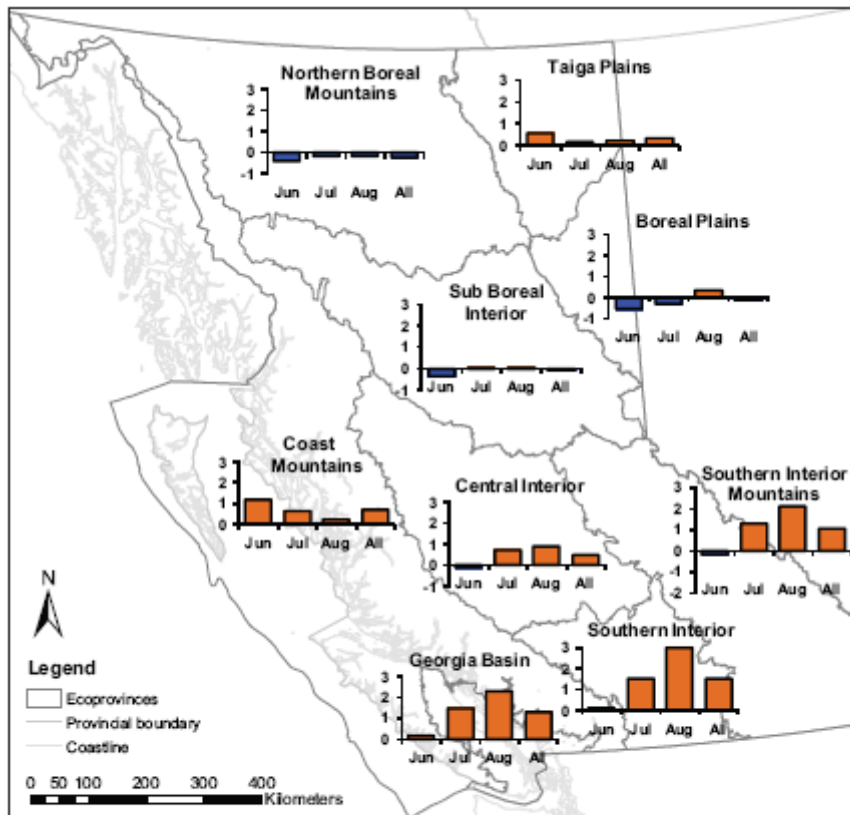


FIGURE 1. Projected changes (approximating the 2080s under the A2 scenario) for British Columbia from current monthly (MSR for June, July, August) and seasonal mean severity ratings (SSR, "all") by ecoprovince. Change is expressed as absolute change in MSR; baseline MSR values range from 0 to 12, with higher values in the south and lower values in northern and coastal areas. Data are summarized and extended from Taylor et al. (2010).

Example information on severity using the Canadian Fire Weather Information System – note regional variation.

Direction on fuel management in the Wildland Urban Interface

The attached link provides some guidance on integrating fuel management regimes into silvicultural treatments and high lights a prime opportunity for collaboration with fuel and fire management specialists throughout the province so that when planning and undertaking FFT treatments we can realize multiple benefits.

Thanks to all those who contributed comments in the development of this document and especially thanks to Ed Korpela and Bev Atkins for their very detailed contributions. (Al Powelson contact)

http://www.for.gov.bc.ca/ftp/HFP/external/!publish/LBIS_web/Guidance/FFT%20guidance%20-Silvicultural%20Regimes%20for%20Fuel%20Management%20in%20the%20WildLand%20Urban%20Interface_V2.3.pdf

RESOURCE PRACTICES BRANCH



Silvicultural Regimes for Fuel Management in the Wildland Urban Interface or Adjacent to High Landscape Values - Guidance

Scope

This guidance covers silviculture activities by Forests For Tomorrow (FFT) within the Wildland Urban Interface¹ or adjacent² to identified high landscape values.

The main focus of the FFT funded silviculture activities within these areas will be on future timber production, however, modification of treatment prescriptions will be employed to reduce current and future wildfire hazard where possible

1. Introduction

Silvicultural treatments can be used to influence stand structure which, in turn, can influence wildfire behaviour and severity. There is a potential to use stocking standards (including species choice), site preparation, thinning, and pruning (*not yet eligible under FFT*) as tools to reduce or modify surface, ladder, and canopy fuels.

2. Purpose and Objectives

The purpose of this Ministry of Forests, Lands, and Natural Resource Operations (FLNR) Silvicultural Regimes for Fuel Management in the Wildland Urban Interface guidance is to provide direction on modifying silviculture regimes when they occur within the wildland urban interface or adjacent to identified high landscape values to reduce wildfire impacts while still targeting the primary objective of future timber production.

The secondary objective is to direct that, where feasible and ecologically appropriate to do so, FFT silviculture activities undertaken within the wildland urban interface or adjacent to identified high landscape values will use regimes that minimize current and future wildfire hazard.

3. General Principle

Altering tree species composition and/or reduction in aerial and/or ground fuels coupled with adequate tree crown base height management generally results in fires, should they occur, of reduced intensity and reduced likelihood of crown fire. Resulting surface fires of reduced intensity are generally easier to control and may result in less damage to values at risk as well as the stand itself.

¹ The wildland urban interface is any area where combustible wildland fuels (vegetation) are found adjacent to homes, farm structures or other outbuildings. Typically, the wildland urban interface is defined as an area within 2 km of a community, however, for the purposes of modifying treatments to reduce wildfire risk and hazard the zone will encompass those FFT treatments within 10 km of a community

² In reference to wildfire planning adjacent means within 10 km a community (community zone) or an area identified as having a high landscape values
<https://www.firemartcanada.ca/images/uploads/resources/chapter1.pdf>

Useful link for managing habitat – Just add a climate change lens

http://www.env.gov.bc.ca/fia/documents/mca_silvbmp.pdf

Suggested links on specific subjects – some specific to the North regions:

Prescribed Fire In BC

<http://bcwildfire.ca/prevention/PrescribedFire/docs/BC%20Prescribed%20Fire%20Council%20Brochure.pdf>

Ecosystem Restoration in BC <http://www.for.gov.bc.ca/hra/Restoration/>, <http://www.trencher.com/library/search/search&keywords=wildfire/>

Best Management Practices for Invasive Plants in the Oil and Gas Industry:

http://prrd.bc.ca/services/environmental/weed_control/documents/OG-Guide.2013.FINAL.pdf

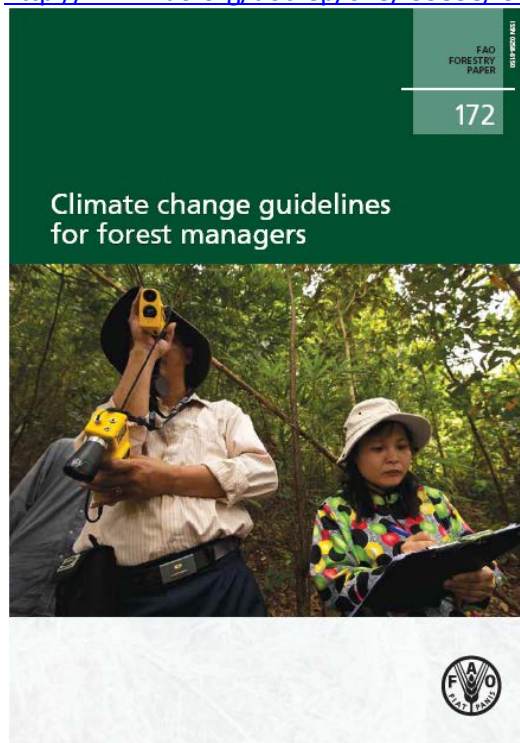
Seeding Manual for British Columbia http://www.for.gov.bc.ca/hra/Publications/practices/Seeding-Manual/MobileSeedManual/BC%20RL%20Seeding%20Manual_web_single_150dpi.09.04.pdf

Peace Liard Revegetation Manual

http://prrd.bc.ca/services/environmental/weed_control/documents/NEIPC_Reveg_manual_PeaceLiard_April2010_000.pdf

Climate Change Guidelines for Forest Managers

<http://www.fao.org/docrep/018/i3383e/i3383e.pdf>



The framework is on page 24:

- Yield & productivity p. 26
- Biodiversity p. 28
- Species p. 29
- Water p. 31
- Fire p. 34
- Pests p. 38
- Extreme events p. 41
- Sea level rise p. 44
- Social p. 46
- Economic p. 50
- Institutional p. 54
- Mitigation p. 55

Canadian Council of Forest Ministers – suite of four useful resource documents

<http://www.ccfm.org/english/coreproducts-cc.asp>

Canadian Council
of Forest
Ministers



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What's New



[HOME > CLIMATE CHANGE](#)

Climate Change

 A Vision for Canada's Forests: 2008 and Beyond

 Climate Change

 Wildland Fires

 Forest Pests

 Forests In Mind

As Canada's forest sector continues to evolve it is subject to the effects of many global forces. A changing climate is one factor that will provide opportunities for and present major threats to Canada's forests, their economic benefits, and the livelihoods of those who depend on them. Adapting to a changing climate is therefore essential for Canada's forest sector to remain resilient and vibrant and for our forest industries to remain competitive in the global marketplace.

In 2008, Canada's premiers, via the Council of the Federation, asked the Canadian Council of Forest Ministers (CCFM) to collaborate on adaptation in forestry. This work was undertaken by the CCFM's Climate Change Task Force (CCTF), which initiated a two-phase program in this area.

Phase 1 culminated in 2010 with the publication of two reports:

- [Vulnerability of Canada's Tree Species to Climate Change and Management Options for Adaptation](#)
- [A Framework for Forest Management Offset Protocols](#)

These reports have been widely distributed to forestry organizations and are being used to help inform policies and practices.

Phase 2 addresses adaptation at the forest ecosystem and forest sector levels, responding directly to a key CCFM objective that "consideration of climate change and future climatic variability is needed in all aspects of sustainable forest management" (as described in *A Vision for Canada's Forests: 2008 and Beyond*). The primary goal is to provide members of the forest sector with state-of-the-art tools and new knowledge that will allow them to assess the vulnerabilities, risks, and opportunities associated with climate change. The CCFM vulnerability assessment tools and techniques are described in a series of inter-related reports, specifically designed for forest management decision-makers. Several reports are now available, with the remaining reports targeted for release in early 2013:

- Adapting sustainable forest management to climate change: preparing for the future
([Abstract](#)) ([Full Report](#))
- Adapting sustainable forest management to climate change: a systematic approach for exploring organizational readiness
([Abstract](#)) ([Full Report](#))
- Adapting sustainable forest management to climate change: a framework for assessing vulnerability and mainstreaming adaptation into decision making
([Abstract](#)) ([Full Report](#))
- Adapting sustainable forest management to climate change: scenarios for vulnerability assessment
([Abstract](#)) ([Full Report](#))

The CCTF's work has been strongly supported by all members of the CCFM and is intended to catalyze and accelerate the transformation of sustainable forest management policies, planning, and practices in accordance with the needs of various forest management organizations across Canada. We hope that you find this work informative and beneficial.

Contact:

- Amélie Roberge (aroberge@NRCan-RNCan.gc.ca)

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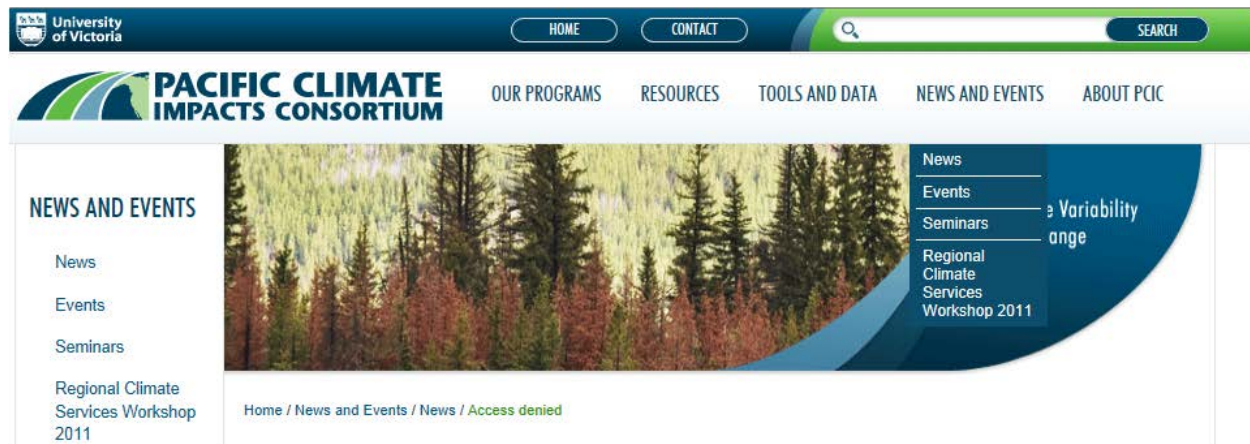
Canadian Council
of Forest
Ministers



Conseil canadien
des ministres
des forêts

Link to Regional summaries by PCIC

<http://www.pacificclimate.org/news-and-events/news/2013/bc-regional-climate-summaries-now-online>



Future webinar to solicit feedback

The Pacific Climate Impacts Consortium will be running a webinar in the coming months as part of a project to develop National Guidelines on the Use of Climate Scenarios for NRCAN, in collaboration with Ouranos <http://www.ouranos.ca/en>. As an attendee, you will be invited to attend. The purpose of the webinar is to obtain feedback and questions from people who have attended climate change workshops in regards to what information would be most valuable to include in a guidelines document on the use of climate information.