Forests and Climate What Next?

Jim Maclellan
NB Climate Change Research Collaborative
University of Maine, September 10, 2013

FORESTRY ENVIRONMENTAL MANAGEMENT

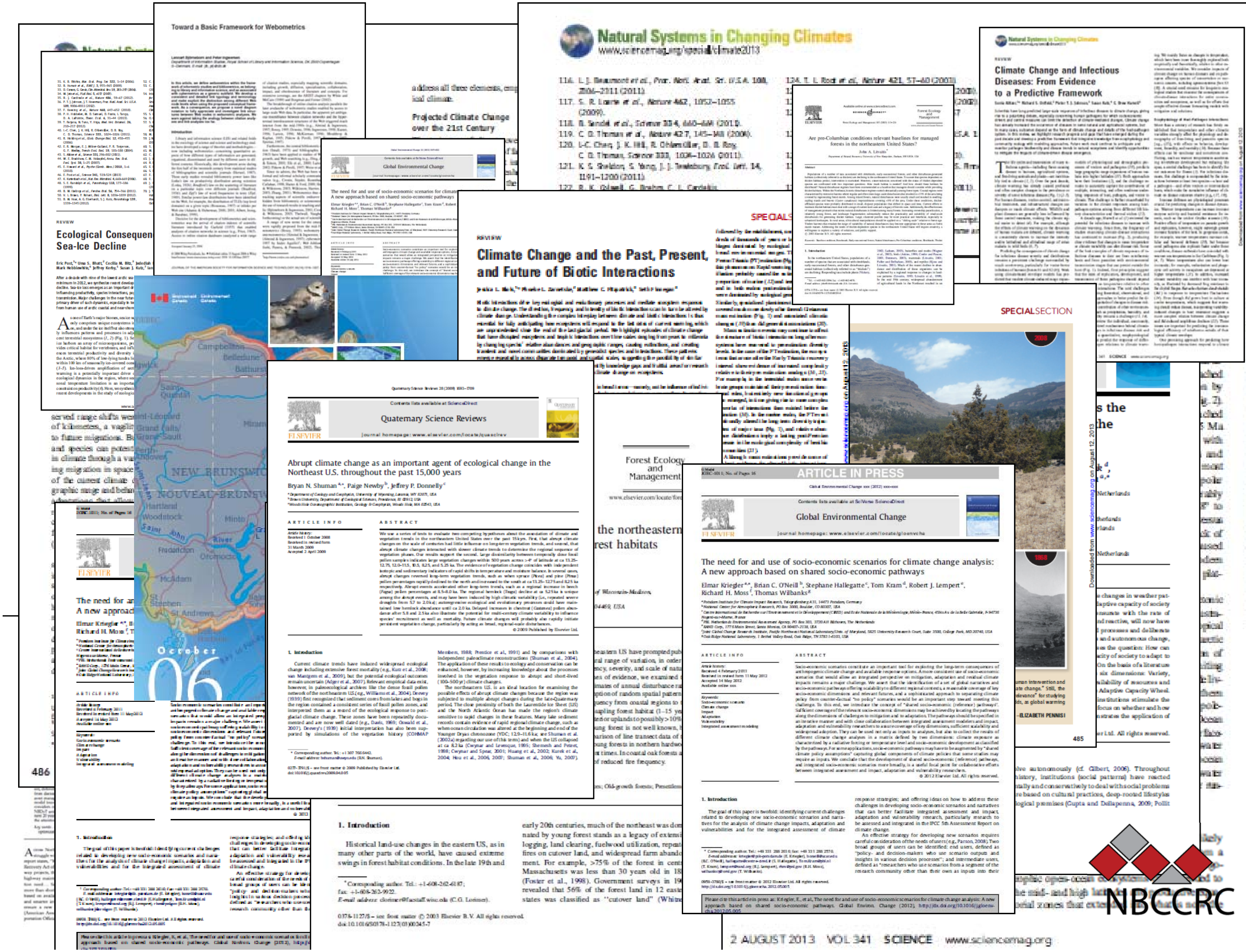
New Nouveau Brunswick
Your Environmental Trust Fund at Work
Votre Fonds en fiducie pour l'Environnement au travail

NBCCRC

OUTLINE

- Knowledge Perspectives
- Accounting for the Local
- Problem Framing …
- Structuring Decision Making …
  - Top Down
  - Bottom Up
- What's Next?

NBCCRC


Toward a Basic Framework for Webometrics
Natural Systems in Changing Climates
www.sciencemag.org/special/climate2013
Projected Climate Change over the 21st Century
Climate Change and Infectious Diseases: From Evidence to a Predictive Framework
Ecological Consequen
Sea-Ice Decline
Global Environmental Change
The need for and use of socio-economic scenarios for climate change analysis: A new approach based on shared socio-economic pathways
Are pre-Columbian conditions relevant baselines for managed forests in the northeastern United States?
Climate Change and the Past, Present, and Future of Biotic Interactions
SPECIAL SECTION
Quaternary Science Reviews
Abrupt climate change as an important agent of ecological change in the Northeast U.S. throughout the past 15,000 years
Bryan N. Shuman, Paige Newby, Jeffrey P. Donnelly
Forest Ecology and Management
ARTICLE IN PRESS
Elmar Kriegler, Brian C. O'Neill, Stephane Hallegatte, Tom Kram, Robert J. Lempert, Richard H. Moss, Thomas Wilbanks
1. Introduction
NEW BRUNSWICK
NOUVEAU-BRUNSWICK
October
06
2 AUGUST 2013 VOL 341 SCIENCE www.sciencemag.org
Downloaded from www.sciencemag.org on August 12, 2013

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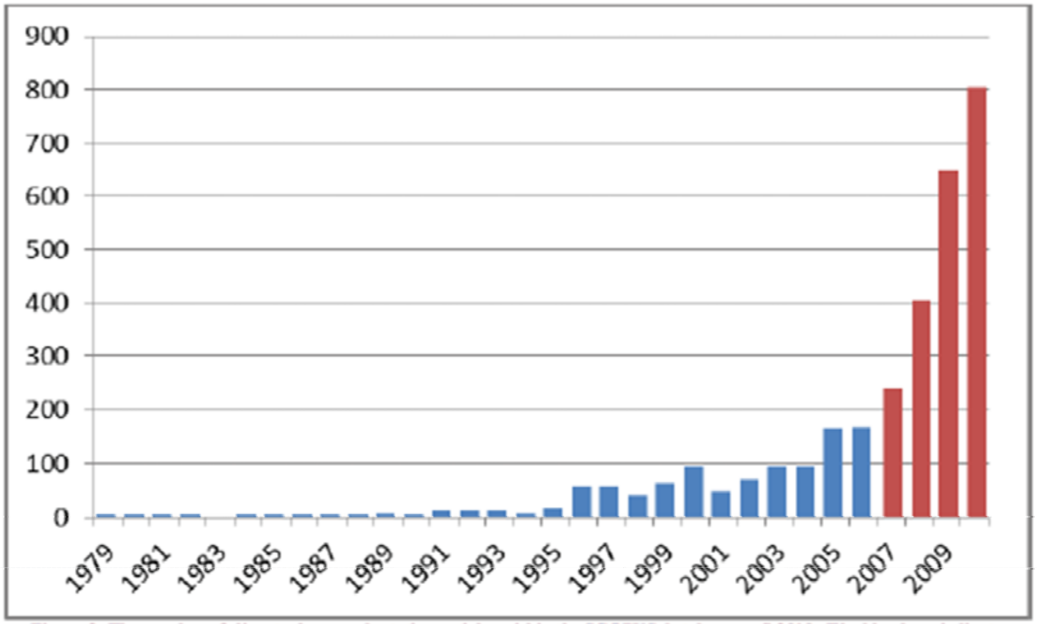

Figure 2: The number of climate change adaptation articles within the SCOPUS database until 2010. The blue bars indicate the previous study of Figure 1 ("Climate Change Adaptation for Neophytes" 2007-8). The red indicates a more recent search as reduced by an estimate of the number of non-related CCA articles (i.e. approximately 21%).

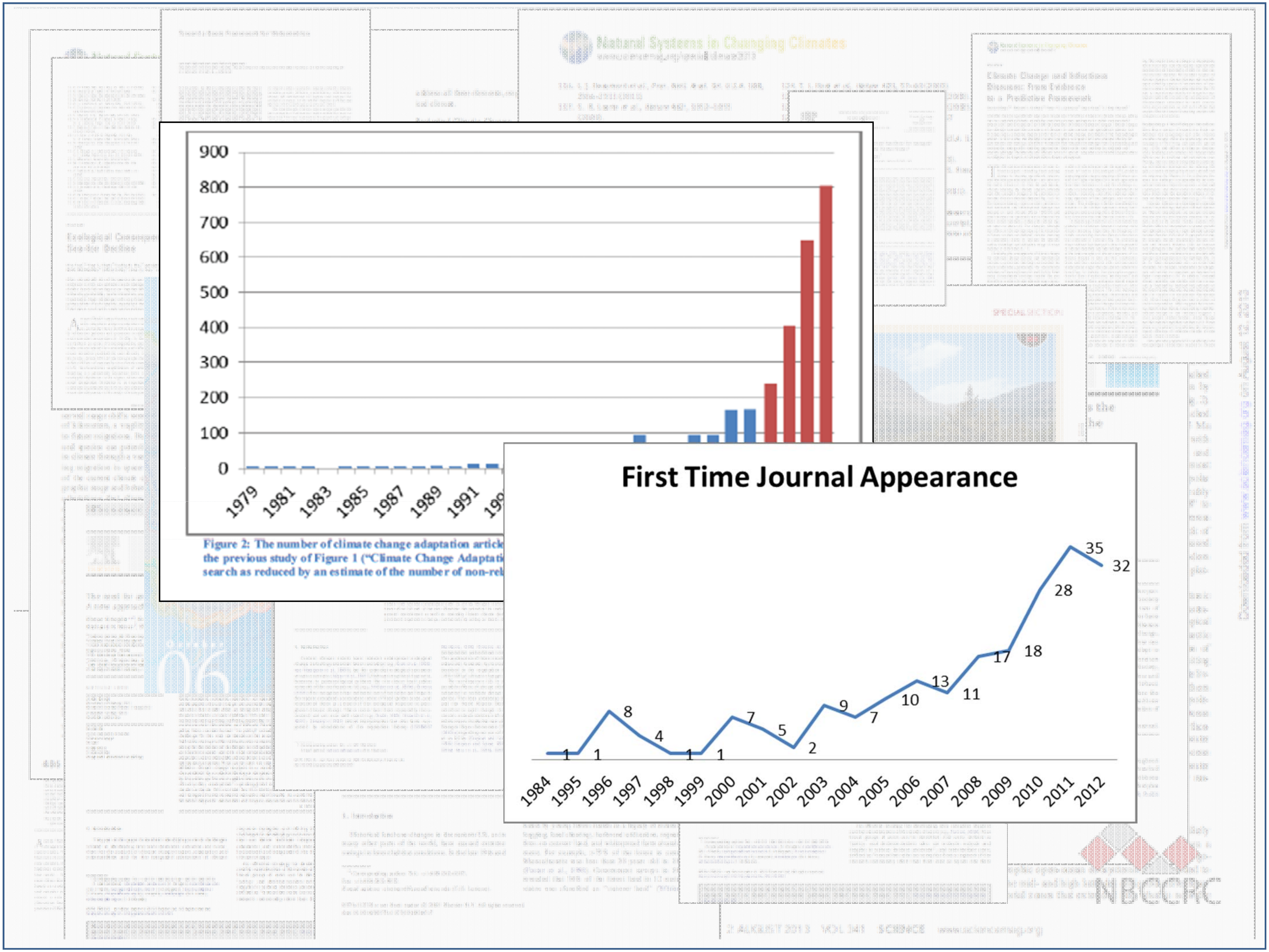
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Figure 2: The number of climate change adaptation
the previous study of Figure 1 ("Climate Change
search as reduced by an estimate of the number of
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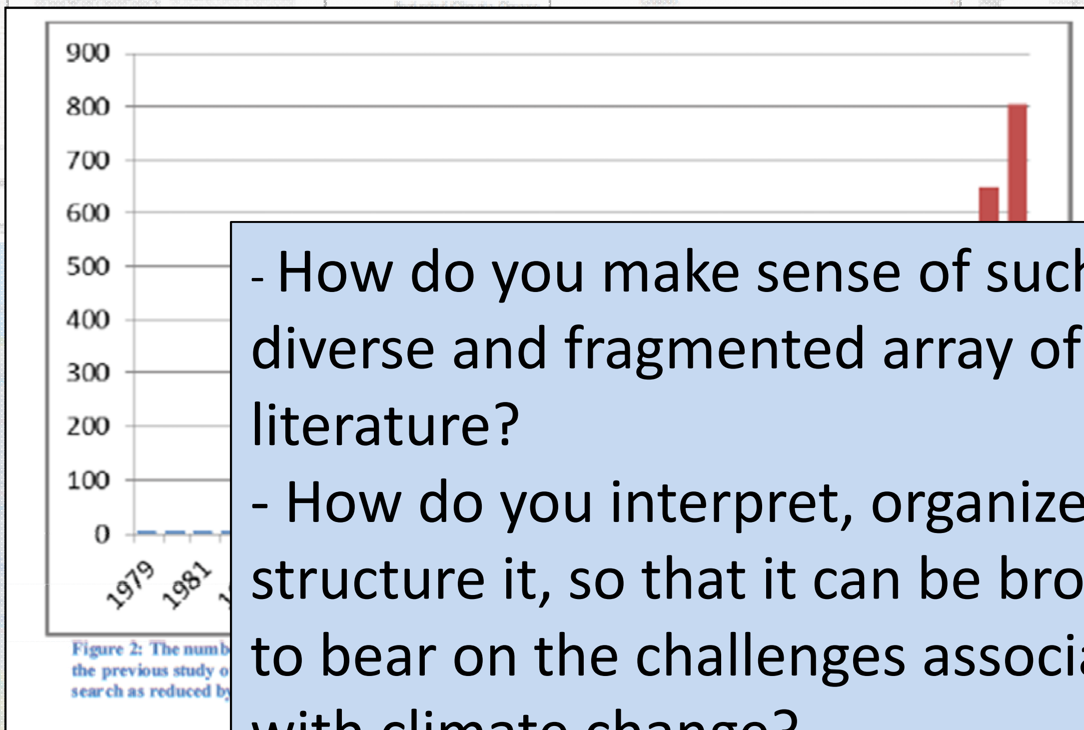
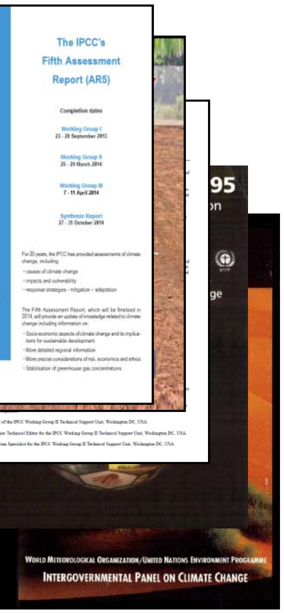
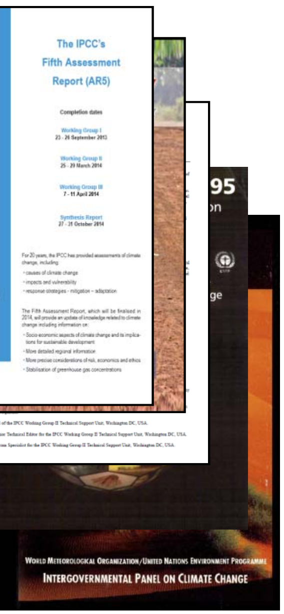


- How do you make sense of such a diverse and fragmented array of literature?
- How do you interpret, organize and structure it, so that it can be brought to bear on the challenges associated with climate change?

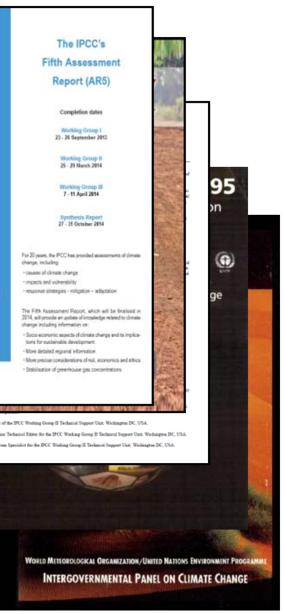
Knowledge Perspectives

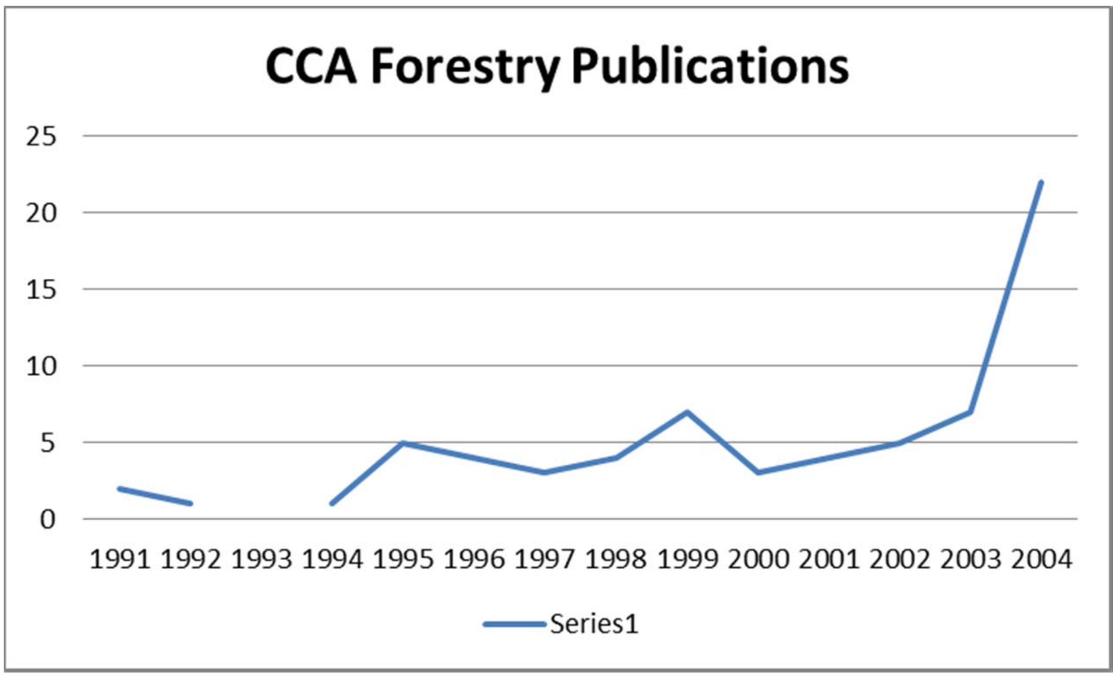


The IPCC was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) as a response to the problems accompanying global climate change. Its mandate is **to collect and assess scientific, technical and socio-economic information relevant for the understanding of climate change, and its potential impacts and options for adaptation and mitigation.** It does not carry out research itself, but bases its assessments on peer reviewed and published scientific/technical literature.



What about forests?


The IPCC's
Fifth Assessment
Report (AR5)
Completion dates
World Meteorological Organization/United Nations Environment Programme
Intergovernmental Panel on Climate Change


CCA Forestry Publications
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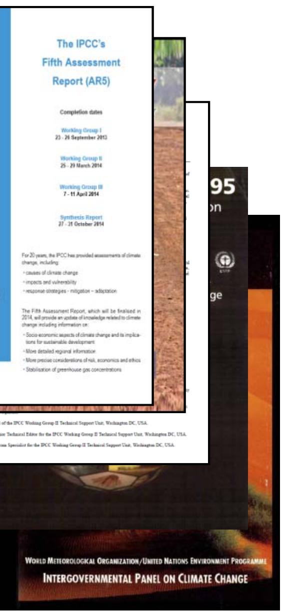
The IPCC's
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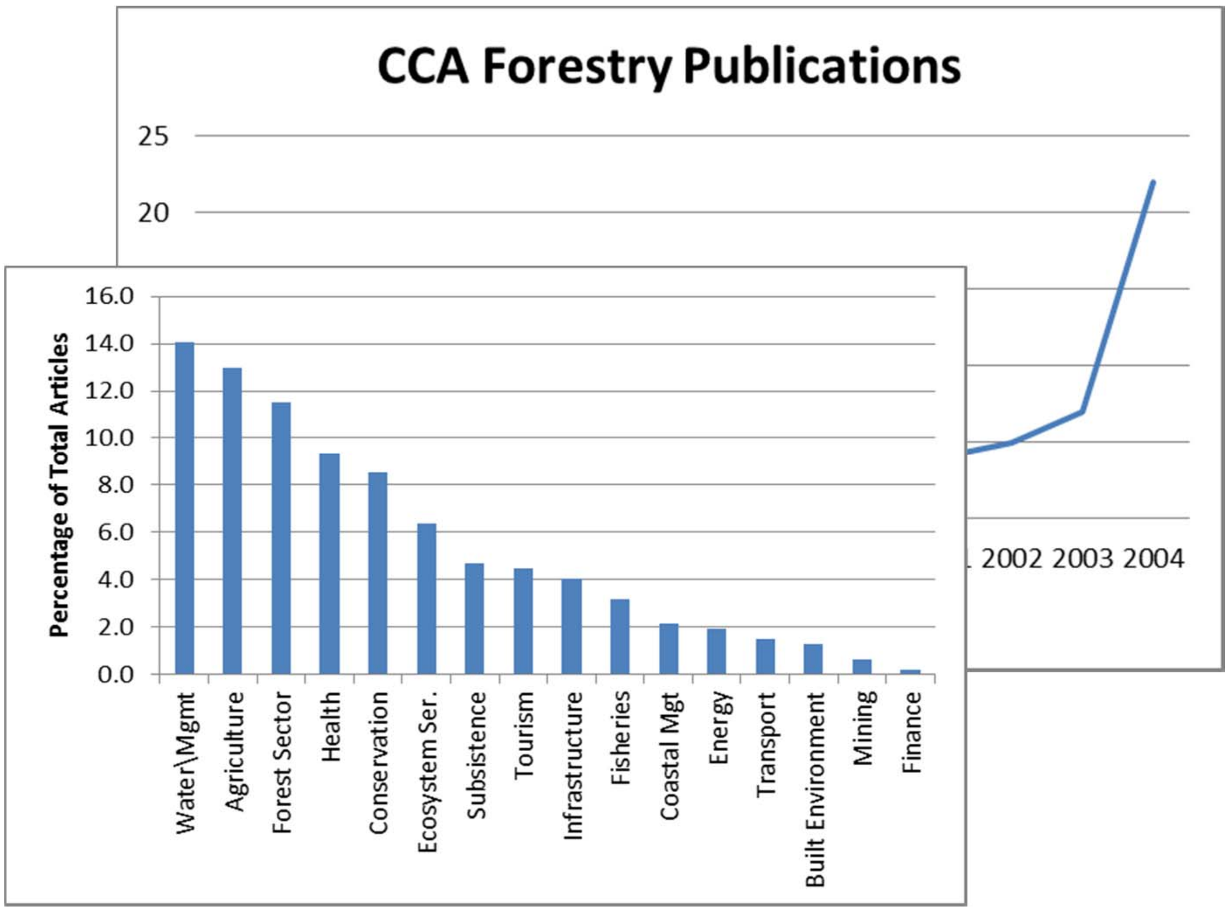
Completion dates
WORLD METEOROLOGICAL ORGANIZATION/UNITED NATIONS ENVIRONMENT PROGRAMME
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE


CCA Forestry Publications
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Subsistence
Tourism
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Fisheries
Coastal Mgt
Energy
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Built Environment
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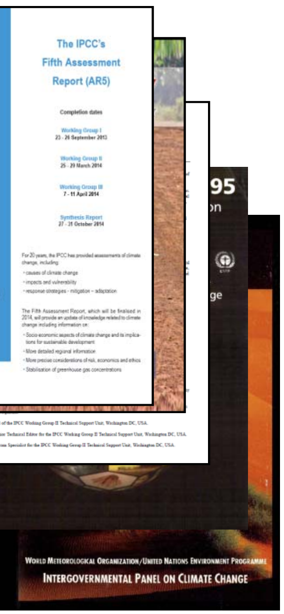
Finance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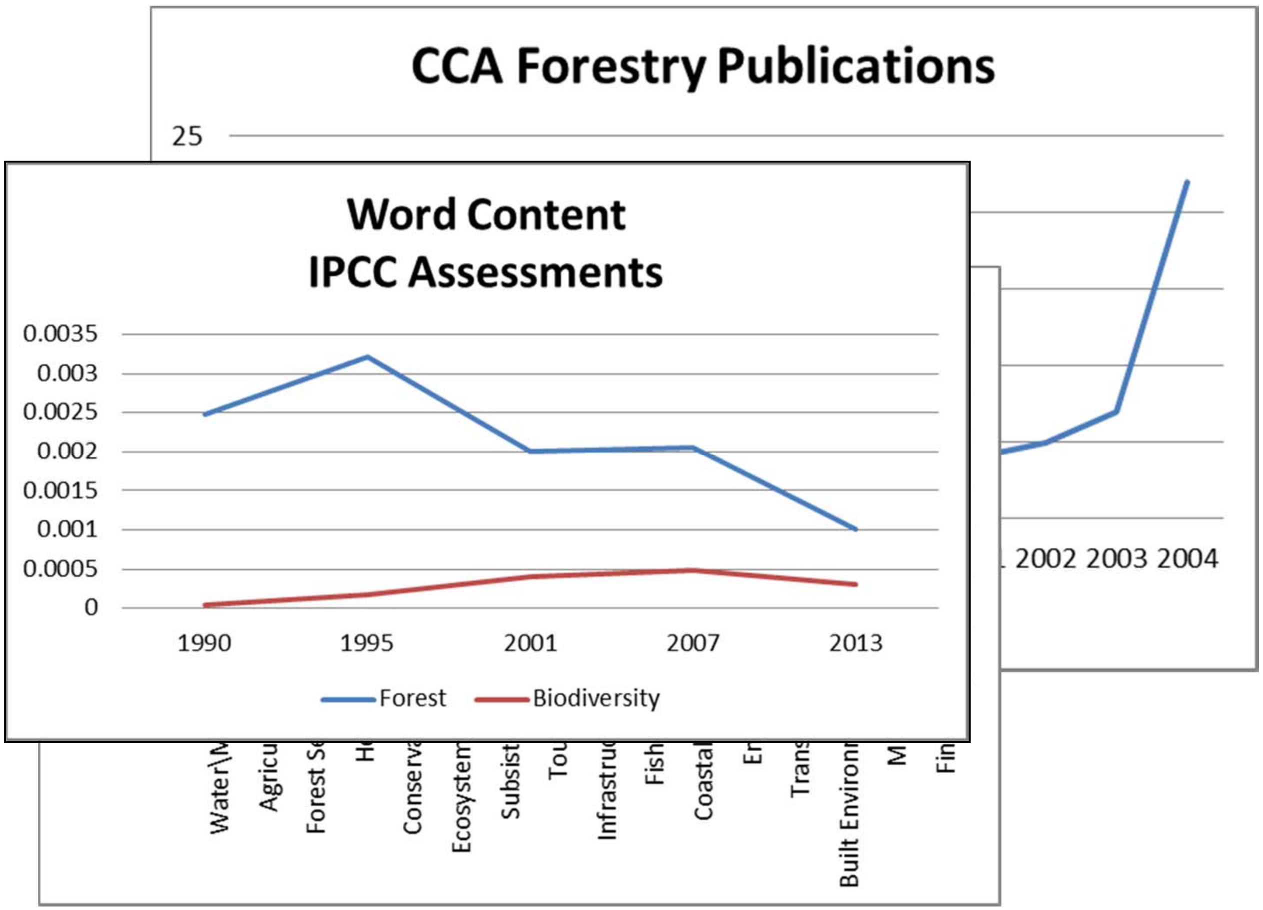
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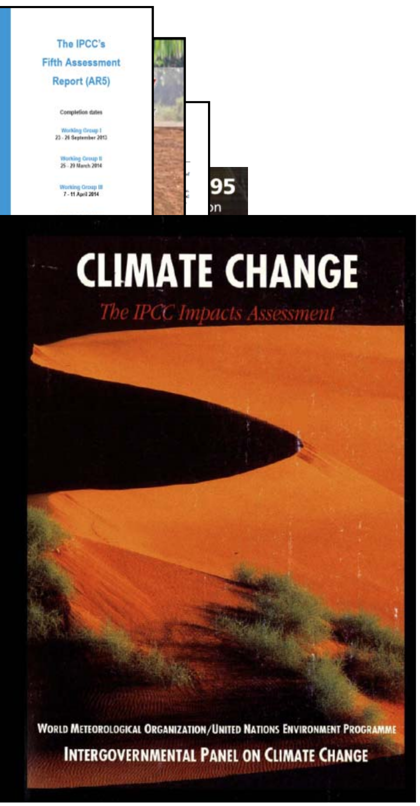
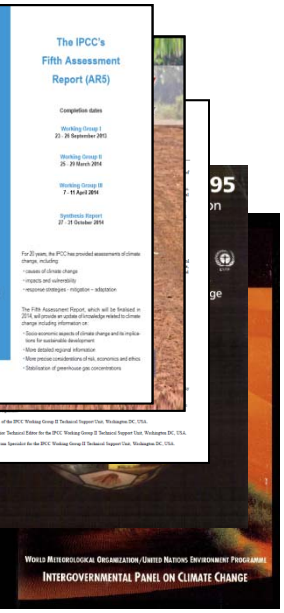


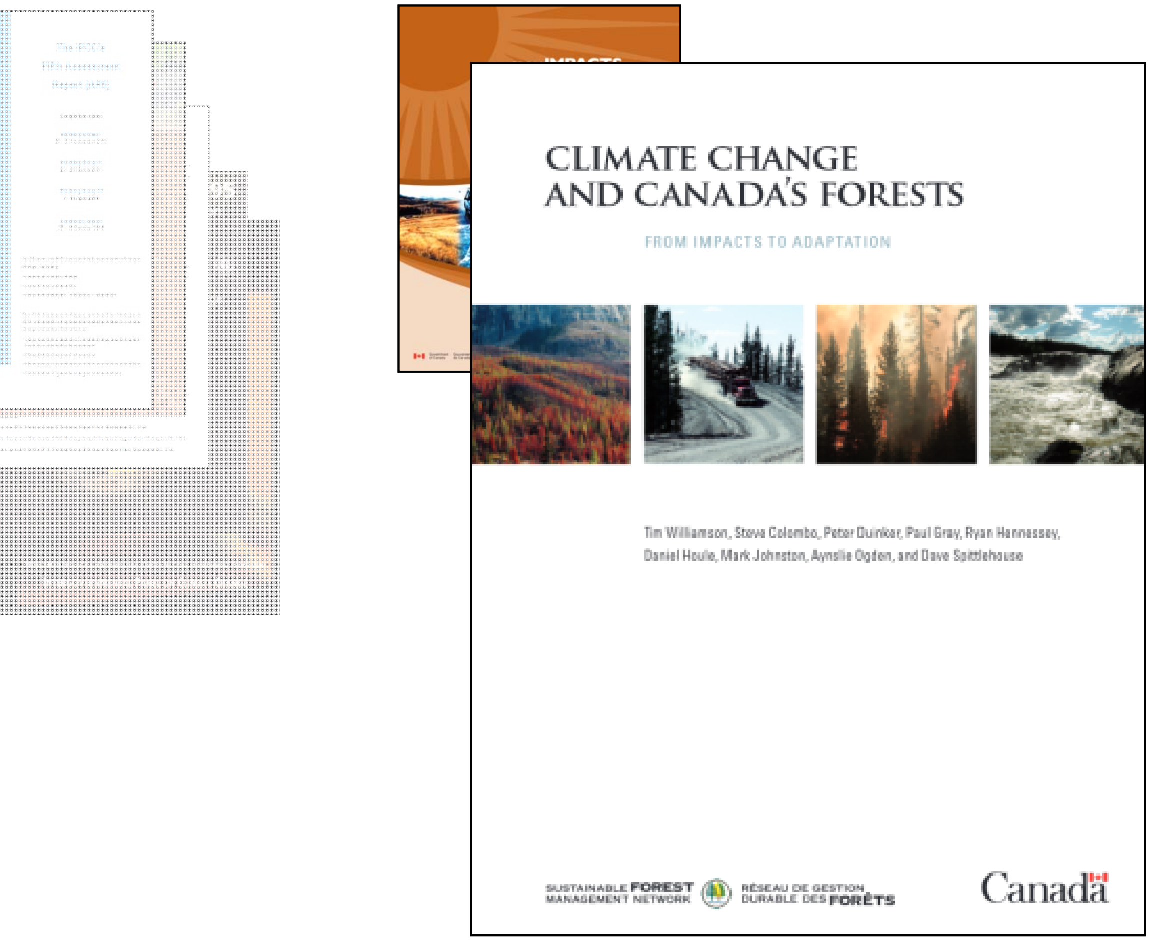
The rotation period of forests is long and current *forests will mature and decline during a climate in which they are increasingly more poorly adapted*. Actual impacts depend on the physiological adaptability of trees and the *host-parasite* relationship. Large losses from both factors in the form of *forest declines can occur*. Losses from *wild-fire* will be increasingly extensive. The climate zones which control species distribution will move *poleward and to higher elevations*. Managed forests require large inputs in terms of *choice of seedlot and spacing, thinning and protection*. … The most sensitive areas will be where species are close to their biological limits in terms of temperature and moisture. This is likely to be, for example, in semi-arid areas. *Social stresses* can be expected to increase and consequent anthropogenic damage to forests may occur. These increased and non-sustainable uses will place more pressure on *forest investments, forest conservation* and sound forest management.

(IPCC 1990)

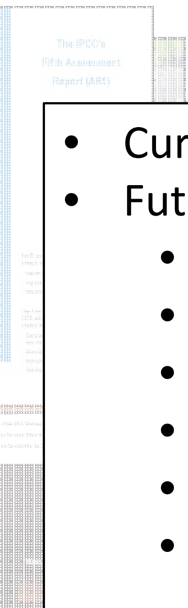


What about Canada?


The IPCC's Fifth Assessment Report (AR5)
FROM IMPACTS TO ADAPTATION:
Canada in a Changing Climate 2007
Canada
SUSTAINABLE FOREST MANAGEMENT NETWORK
RÉSEAU DE GESTION DURABLE DES FORÊTS
Canada



CLIMATE CHANGE AND CANADA'S FORESTS
FROM IMPACTS TO ADAPTATION
Tim Williamson, Steve Colombo, Peter Duinker, Paul Gray, Ryan Hennessey, Daniel Houle, Mark Johnston, Aynslie Ogden, and Dave Spittlehouse
SUSTAINABLE FOREST MANAGEMENT NETWORK
RÉSEAU DE GESTION DURABLE DES FORÊTS
Canada
The IPCC's Fifth Assessment Report (AR5)



- Current impacts on Canada's forests
- Future impacts on Canada's forests
    - Extreme weather and climatic variability
    - Forest fire
    - Insect and disease disturbance
    - Effects on physiological processes
    - Productivity
    - Composition, distribution, and structure of Canada's forested ecosystems
    - Climate-sensitive zones
- Regional forest vulnerabilities
- Impacts on the Forest sector
- Conclusion and recommendations

Regional Vulnerabilities: Atlantic Region

- Tree distribution of native species expected to shift
  - Some tree species may have difficulty persisting under a changing climate (e.g. balsam fir),
- Migration is such a slow process
  - influx of tree species common to Carolinian forest unlikely to occur during the 21st century unless assisted.
- Insects primary cause of disturbance to both Acadian and boreal forests of Atlantic Canada.
  - Spruce budworm is a significant source of forest disturbance. An opportunistic native species that takes advantage of windthrown
  - Other species include the spruce beetle
  - Hemlock woolly adelgid. Currently excluded from Atlantic Canada by winter temperatures, may capitalize on moderate winters
- Drought is considered a comparatively minor force of disturbance.
  - Less than 1% of the total forested area of the Atlantic Canadian provinces was burned in 2005.
  - Overall wetter conditions mean fire will not likely become a matter of increased concern.
- Acadian forests are subject to damage by wind damage which will likely increase in severity and frequency

Regional Vulnerabilities: Atlantic Region

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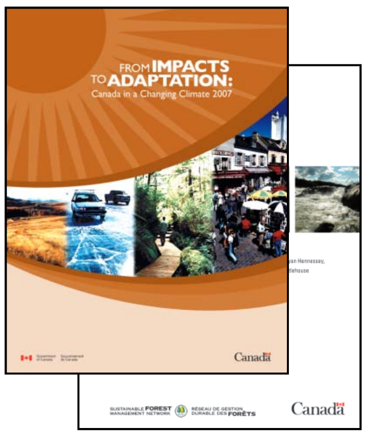
- Acadian forests
  increase in severity and frequency

1. Enhance the capacity to undertake integrated assessment of vulnerabilities to climate change at various scales
2. Increase resources for impacts and adaptation science and also increase resources to monitor the impacts of climate change.
3. Review forest policies, forest planning, forest management approaches, and institutions to assess our ability to achieve social objectives under climate change
4. Embed principles of risk management and adaptive management into forest management .
5. maintain or improve the capacity for communications, networking, and information sharing with the Canadian public and within the forest sector.


The IPCC's
Fifth Assessment
Report (AR5)


FROM IMPACTS
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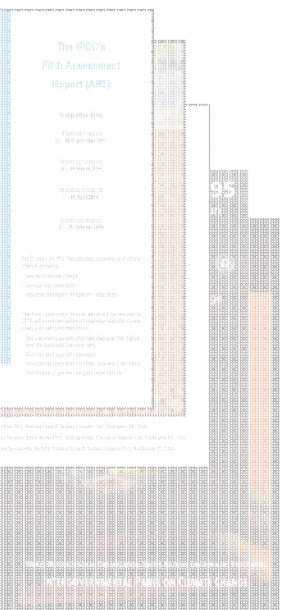
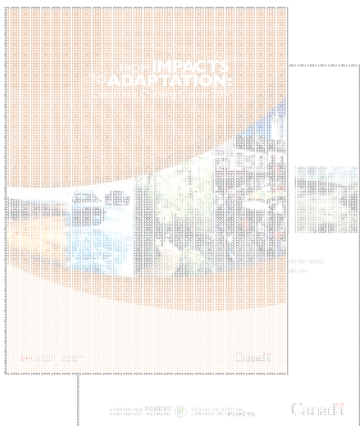
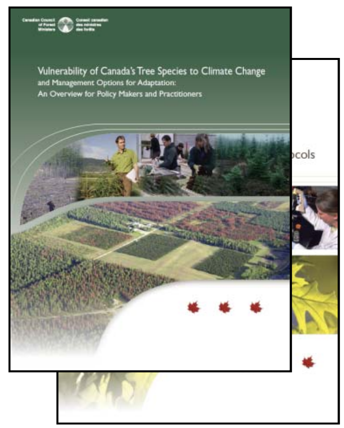
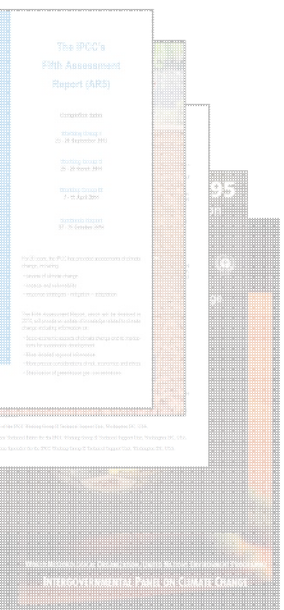
Canada

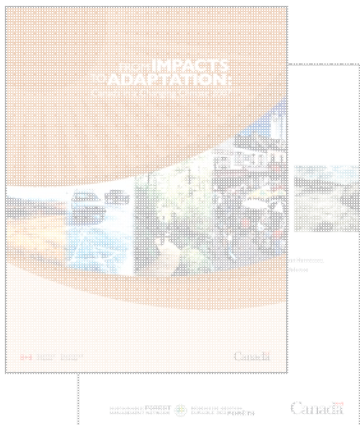


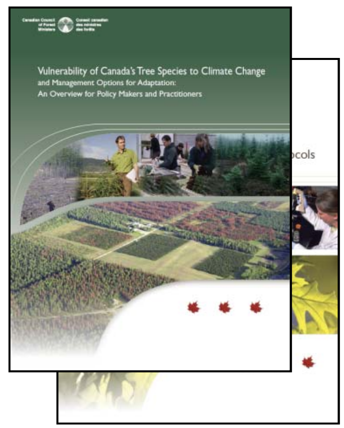



Canadian Council of Forest Ministers
Conseil canadien des ministres des forêts
Vulnerability of Canada's Tree Species to Climate Change
and Management Options for Adaptation:
An Overview for Policy Makers and Practitioners

PHASE I

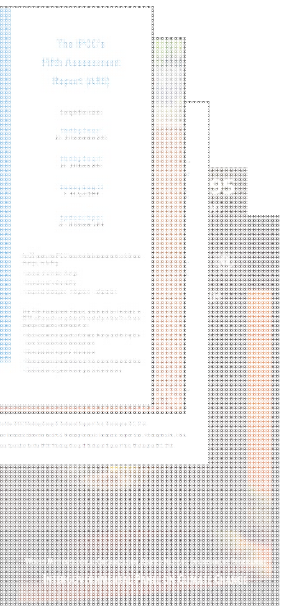


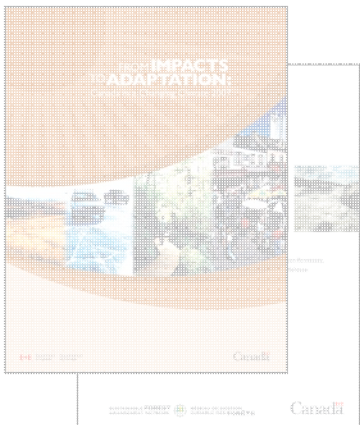


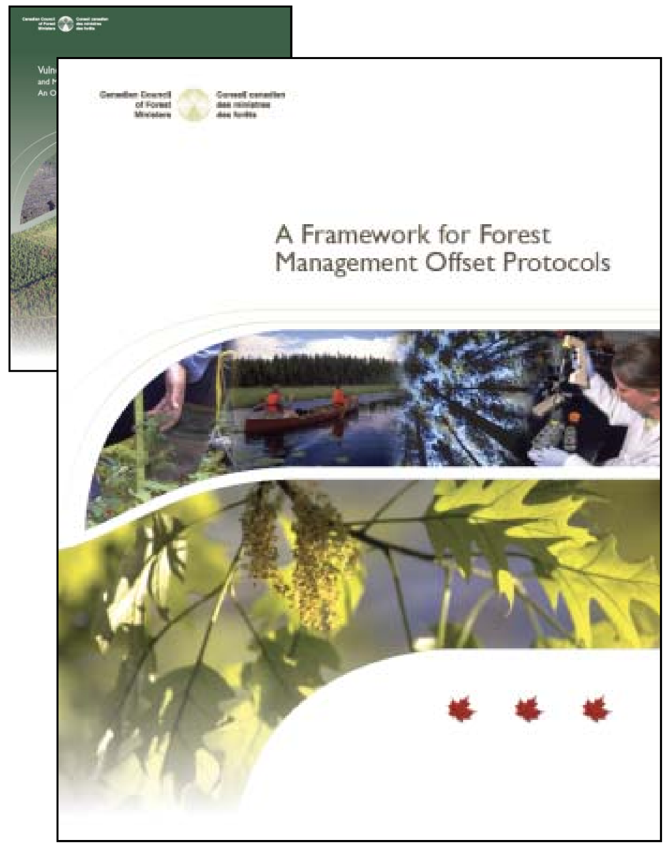

Vulnerability of Canada's Tree Species to Climate Change
and Management Options for Adaptation:
An Overview for Policy Makers and Practitioners

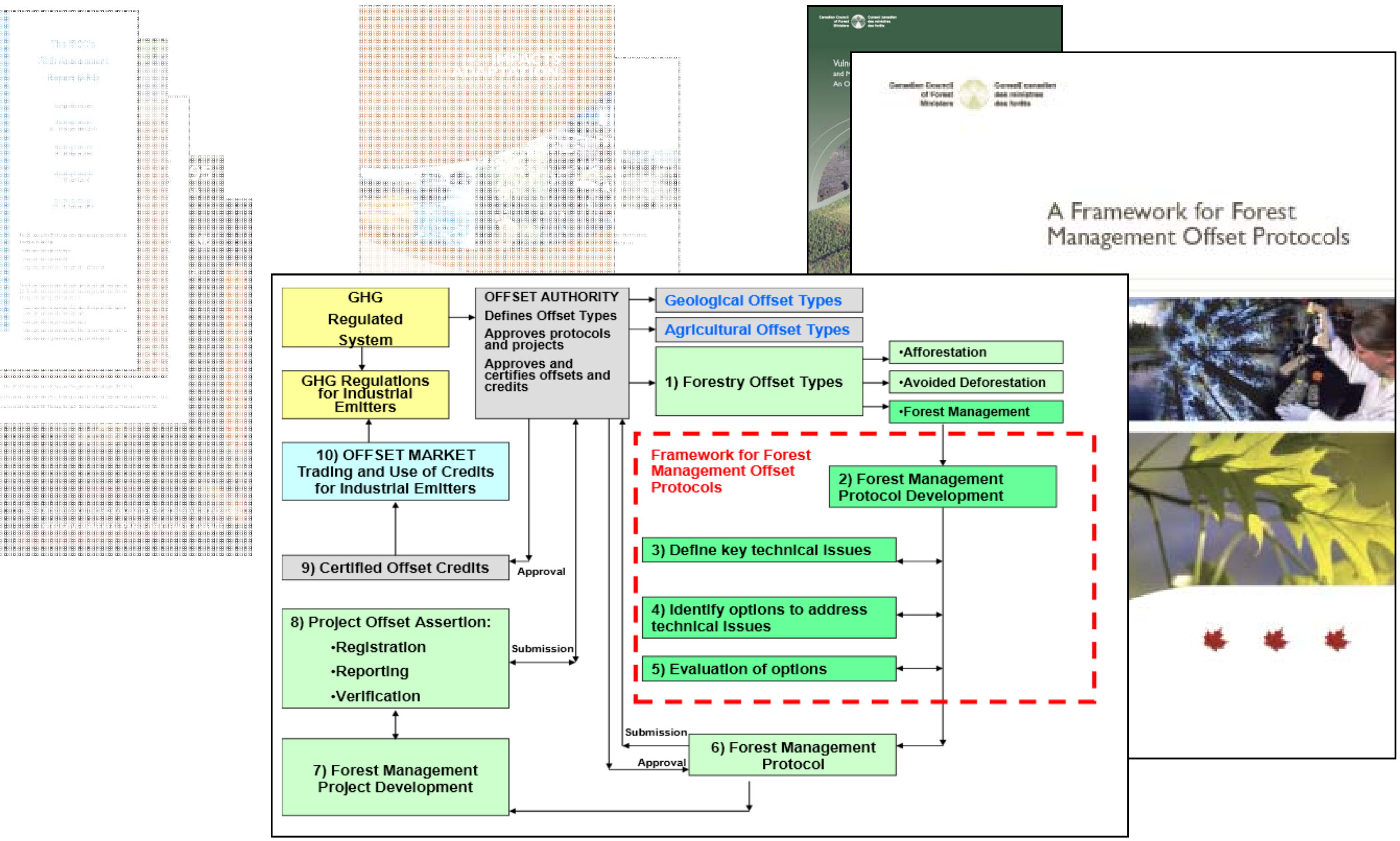
- FOREST CHANGE
- Adaptation program occurs over 13 departments: Health, Energy, Agriculture, etc
- 3rd year of a 5 year program

1. Develop a Set of Indicators,
    - climate signals, biophysical, etc.
2. Tool Kit
    - What kind of data is needed, etc for Forest management
    - Scientific data and protocols
    - Vulnerability Assessment Tools
3. Integration Assessment (internal)
    - S2 Climate Change Projects
    - S3 Disturbance and extreme weather
    - S4 Forest Composition and Productivity
    - S5 Timber Supply
    - S6 Forest Industry Competitiveness
    - S8 Policy Implications

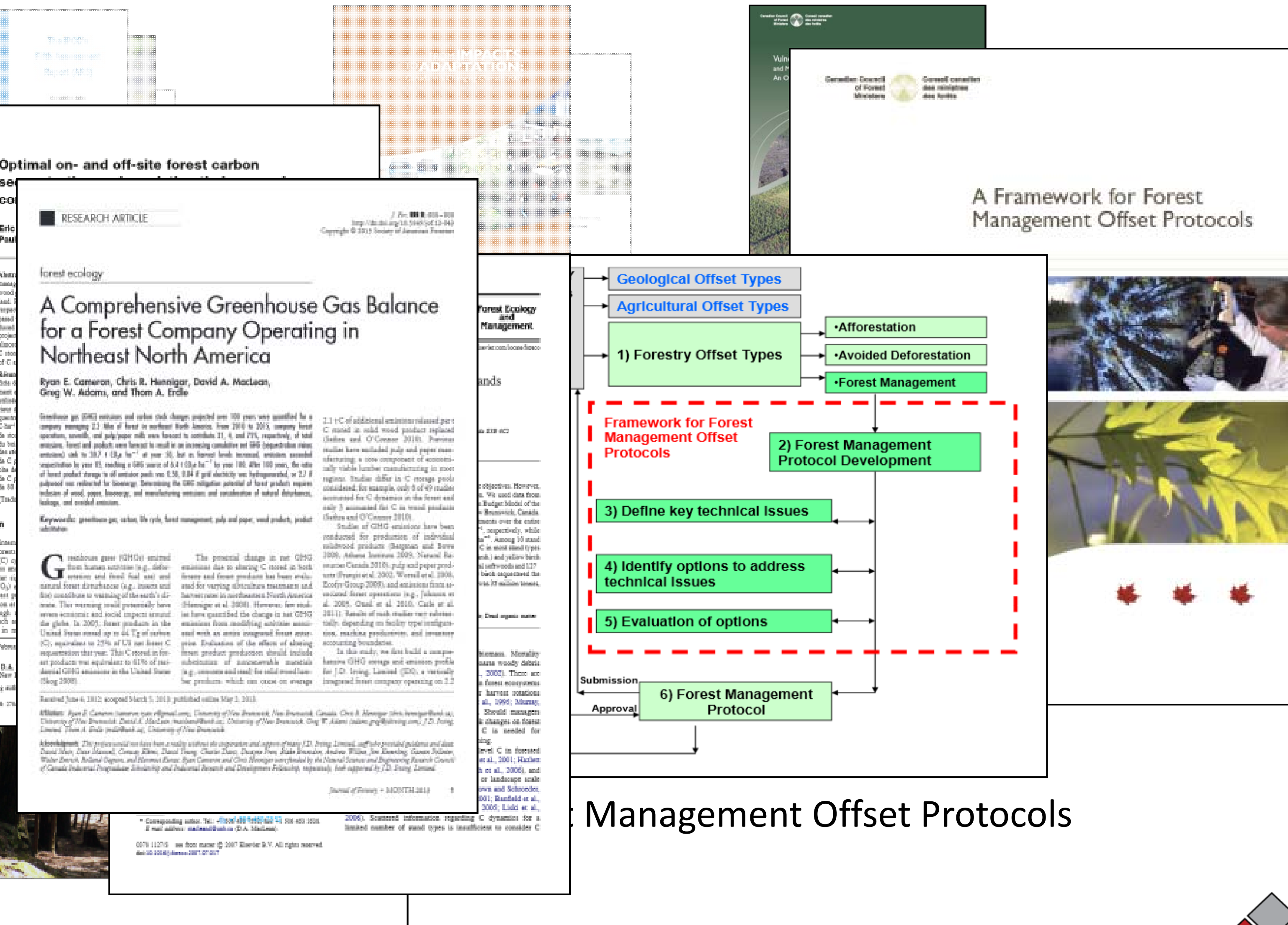




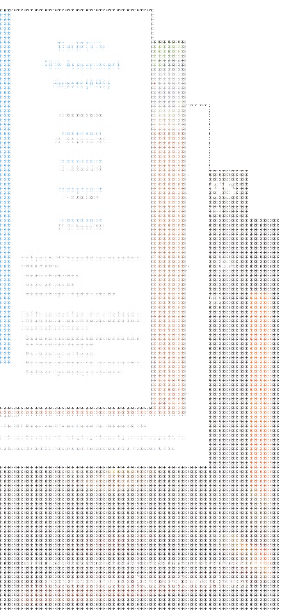

Canadian Council of Forest Ministers
Conseil canadien des ministres des forêts
A Framework for Forest Management Offset Protocols



Framework for Forest Management Offset Protocols



Management Offset Protocols


The IPCC's
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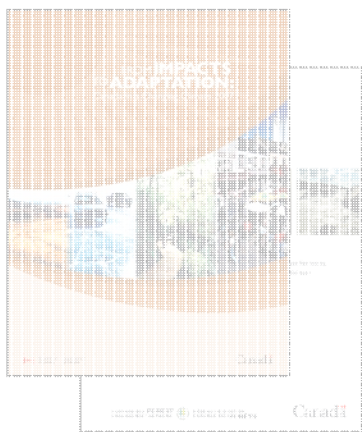
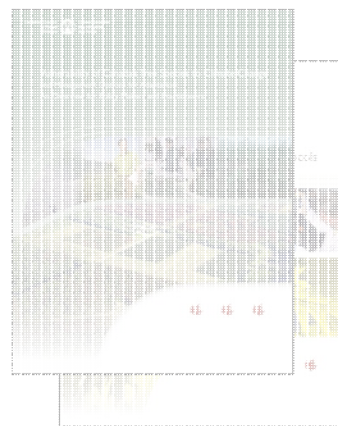
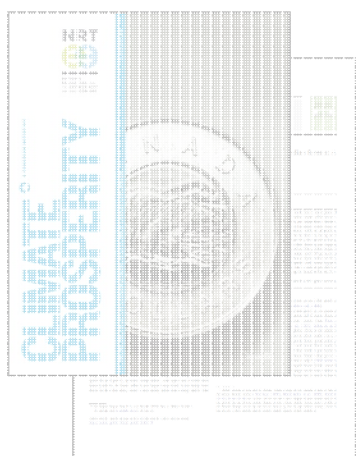

IMPACTS
ADAPTATION

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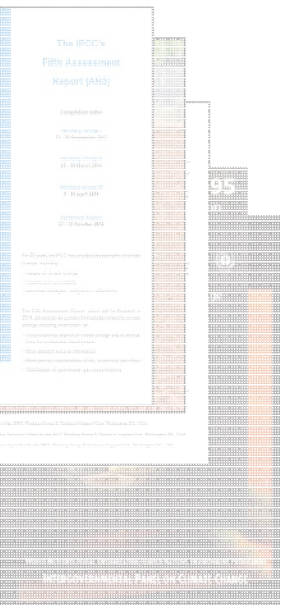
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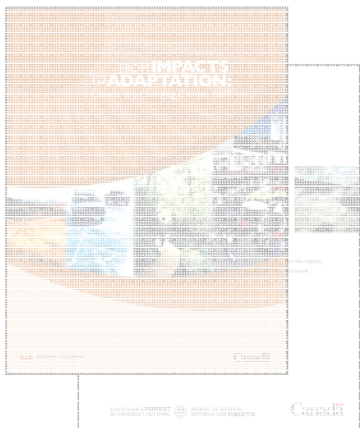
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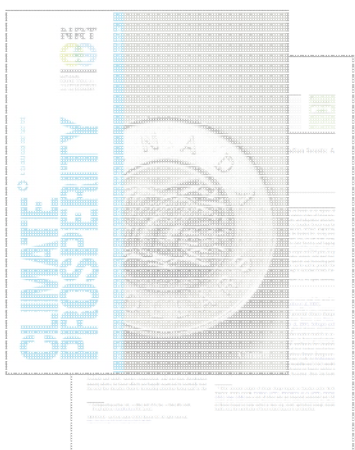
CLIMATE
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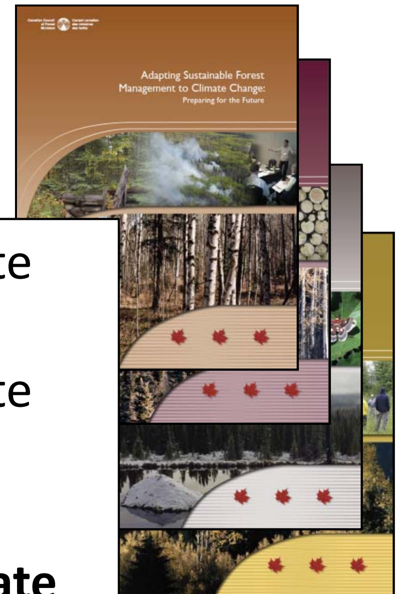
PHASE II


Adapting Sustainable Forest
Management to Climate Change:
Preparing for the Future



- Adapting sustainable forest management to climate change: preparing for the future
- Adapting sustainable forest management to climate change: a systematic approach for exploring organizational readiness
- **Adapting sustainable forest management to climate change: a framework for assessing vulnerability and mainstreaming adaptation into decision making**
- Adapting sustainable forest management to climate change: scenarios for vulnerability assessment

Adapting sustainable forest management to climate change: a framework for assessing vulnerability and mainstreaming adaptation into decision making

- This document presents a framework for assessing the vulnerability of sustainable forest management in Canada to climate change and linking the results of vulnerability assessment to an adaptation process that is integrated into forest management decision making.
- VULNERABILITY ASSESSMENT FRAMEWORK
  - Component 1: Provide Context
  - Component 2: Describe Current Climate and Forest Conditions
  - Component 3: Develop Scenarios of Future Climate and Forest Conditions
  - Component 4: Assess the Vulnerability of SFM to Current and Future Climate
  - Component 5: Develop and Refine Options for Adaptation
  - Component 6: Implement and Mainstream Options for Adaptation

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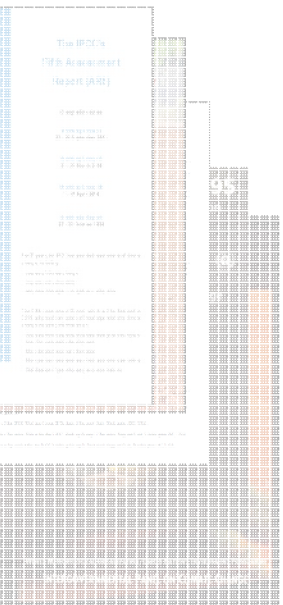

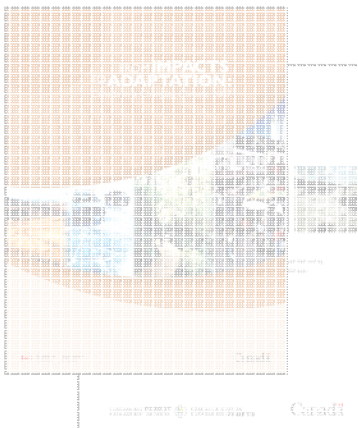

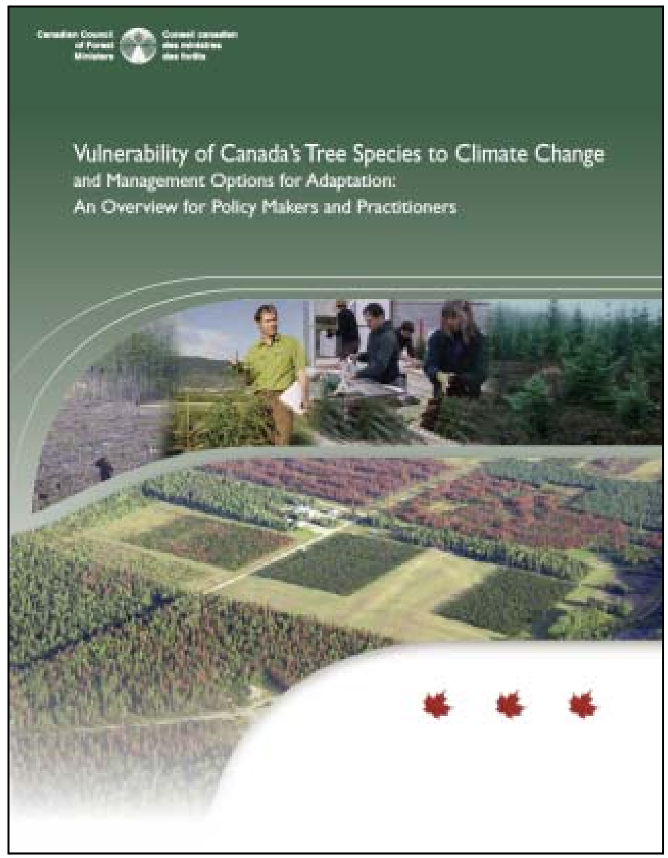
Canadian Council of Forest Ministers
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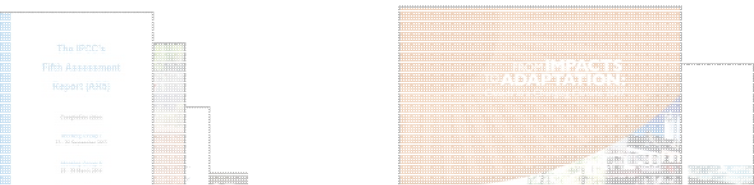

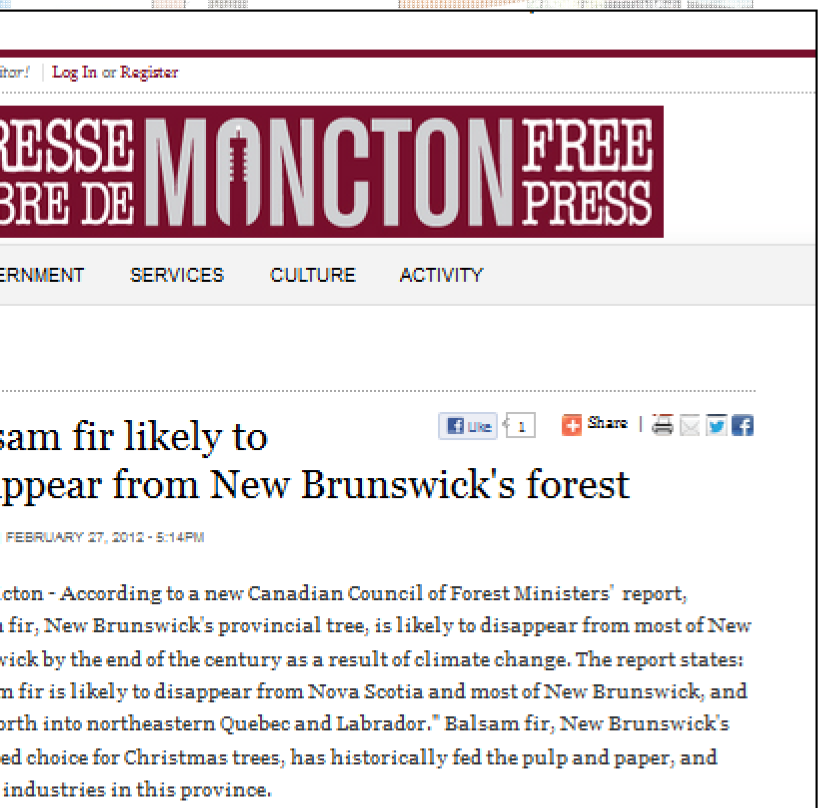

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ERNMENT SERVICES CULTURE ACTIVITY

sam fir likely to
ppear from New Brunswick's forest

FEBRUARY 27, 2012 - 5:14PM

cton - According to a new Canadian Council of Forest Ministers' report,
n fir, New Brunswick's provincial tree, is likely to disappear from most of New
wick by the end of the century as a result of climate change. The report states:
m fir is likely to disappear from Nova Scotia and most of New Brunswick, and
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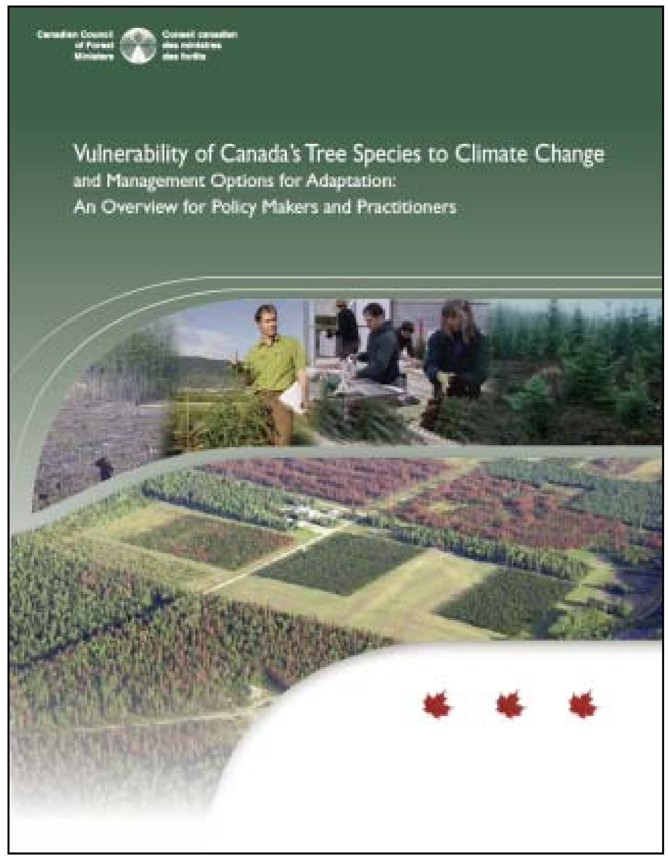
industries in this province.



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http://monctonfreepress.ca/article/balsam-fir-likely-disappear-new-brunswicks-forest

Simple Question

ill Bf disappear from New Brunswick forests?

Simple Question

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- The vulnerability assessment presumes a lot.
- What does it mean at the local level?

Simple Question

- ill Bf disappear from New Brunswick forests?
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o simple questions lead to simple answers?

oblem
aming ...

Problem Framing

he initial representation of the problem may
the most crucial single factor governing the
elihood of problem solution" (Posner 1973)

Problem Framing

he initial rep *roblem may*
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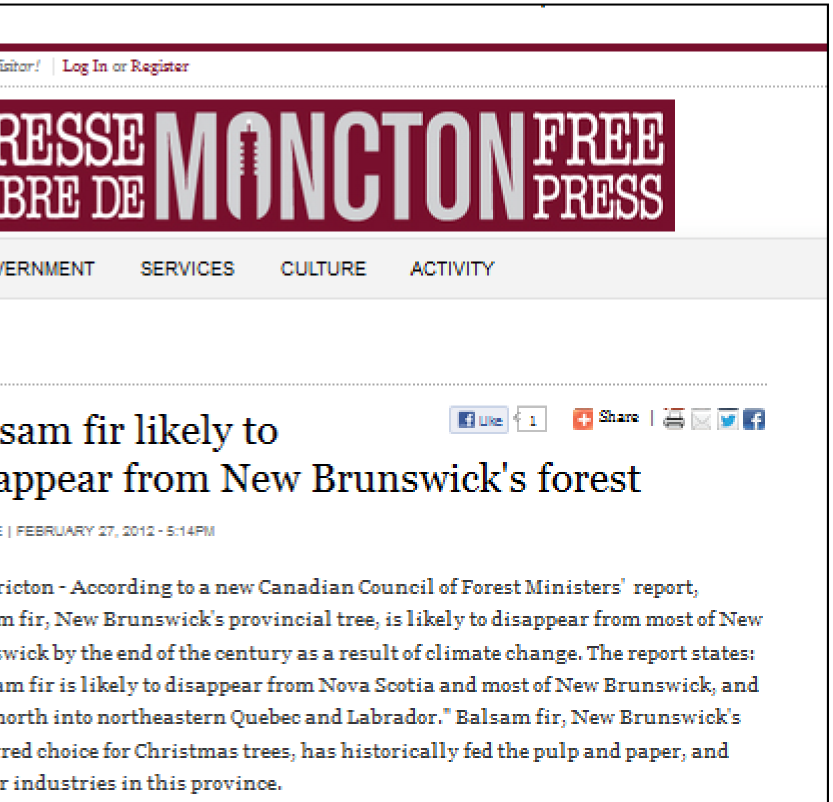

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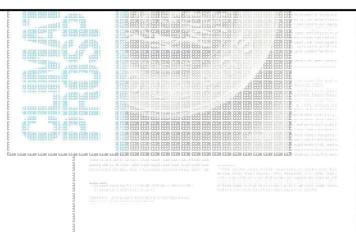
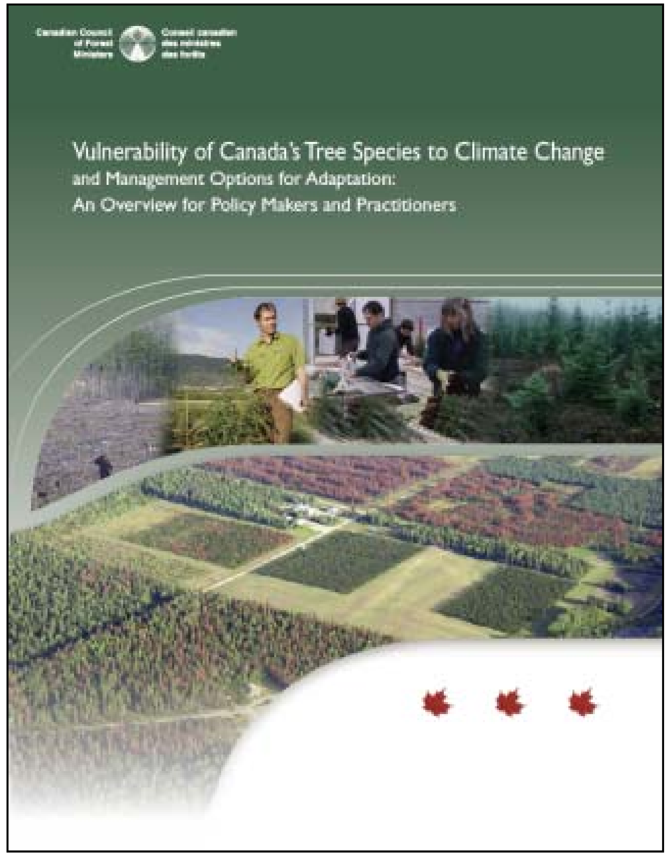
VERNMENT SERVICES CULTURE ACTIVITY

sam fir likely to
appear from New Brunswick's forest

E | FEBRUARY 27, 2012 - 5:14PM

ricton - According to a new Canadian Council of Forest Ministers' report,
m fir, New Brunswick's provincial tree, is likely to disappear from most of New
swick by the end of the century as a result of climate change. The report states:
am fir is likely to disappear from Nova Scotia and most of New Brunswick, and
north into northeastern Quebec and Labrador." Balsam fir, New Brunswick's
red choice for Christmas trees, has historically fed the pulp and paper, and
r industries in this province.





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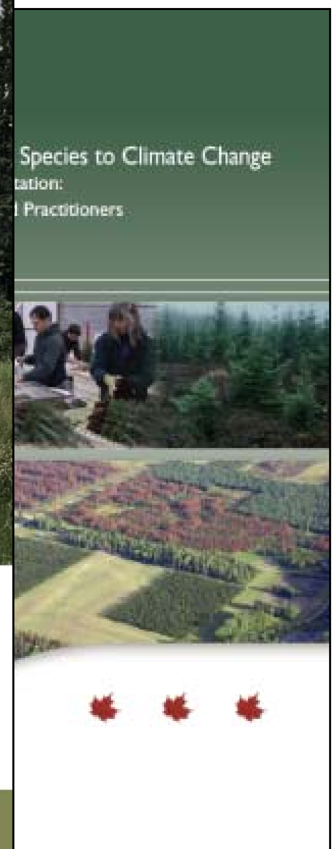


Modeling Ideal Species Distributions

Consistent weather patterns present common adaptive challenges, resulting in tightly related assemblages of species (Clements 1936).

VS

Species response to climatic change is based upon a set of individualistic life traits (Gleason 1926) cosystem movement"

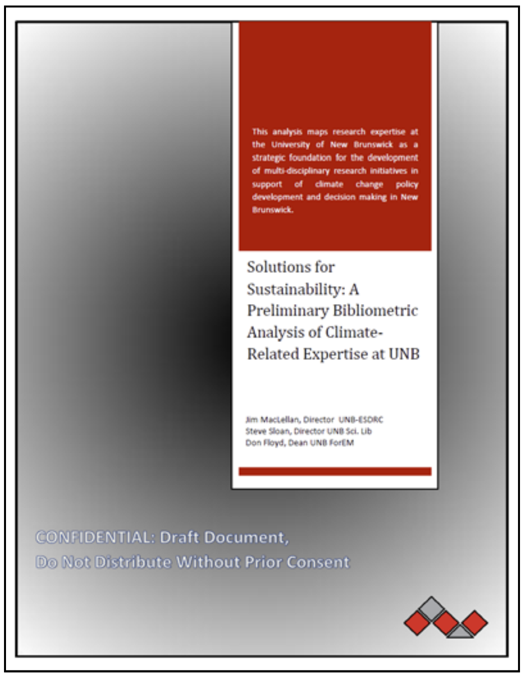
- gross simplification, has the advantage of being based upon a "well-demonstrated" relationship between climate and ecosystem range.

cosystem modification"

- assumes that regional responses will occur as a mix of species declines, and increases in abundance (Gitay et al 2002).

What factors do we consider?

What factors do we consider?

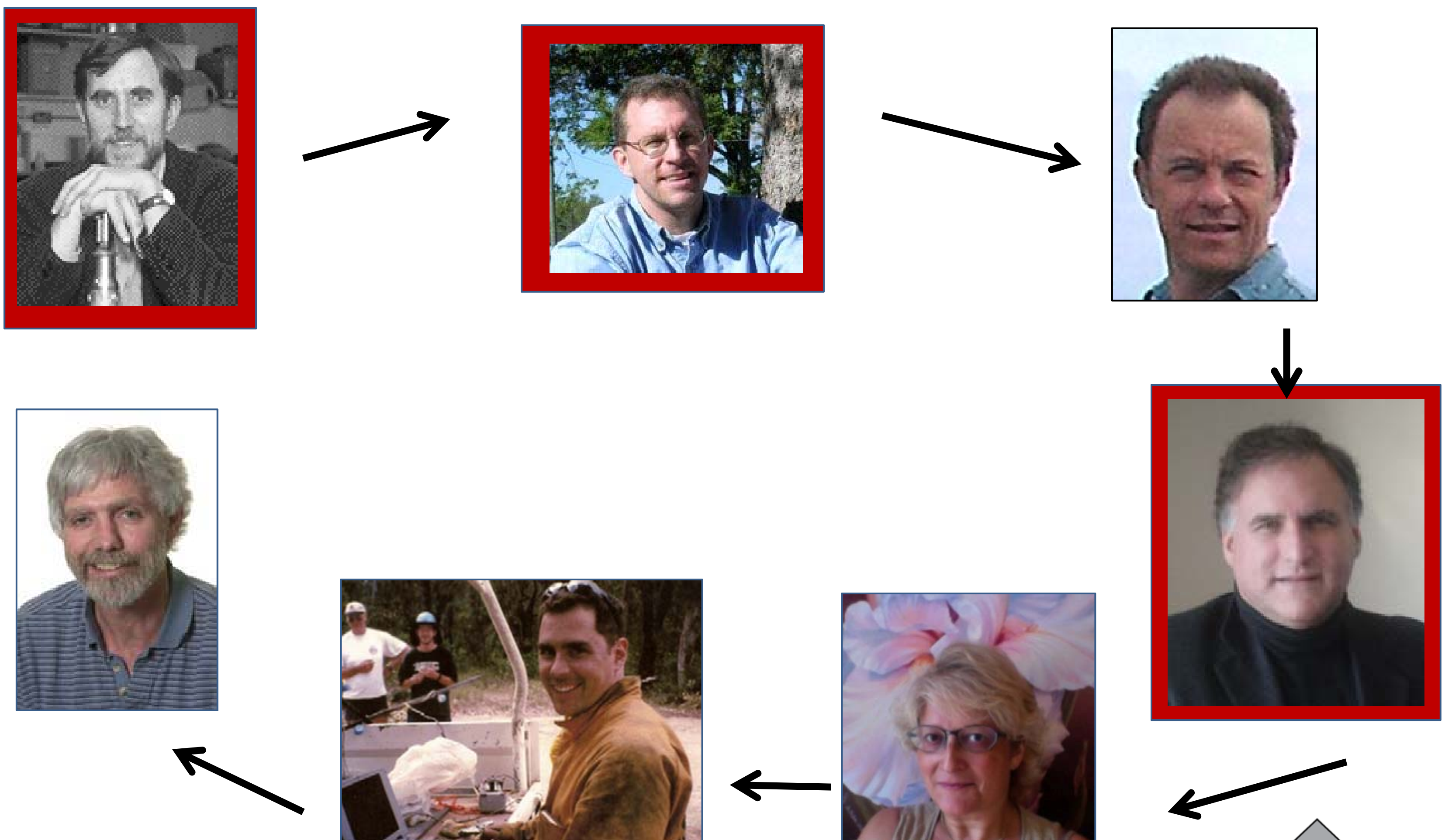

This analysis maps research expertise at the University of New Brunswick as a strategic foundation for the development of multi-disciplinary research initiatives in support of climate change policy development and decision making in New Brunswick.

Solutions for Sustainability: A Preliminary Bibliometric Analysis of Climate-Related Expertise at UNB

Jim MacLellan, Director UNB-ESDRC
Steve Sloan, Director UNB Sci. Lib
Don Floyd, Dean UNB ForEM

CONFIDENTIAL: Draft Document,
Do Not Distribute Without Prior Consent

What factors do we consider?



abitat as a multiplication of response
nction values of various attributes on the
ndscape. In this case:

I = $R(Q_s)$ x R(SWC) x R(GDD) x R(SF)

ere

= available sunlight
C = soil water content
D = growing degree days
= soil fertility

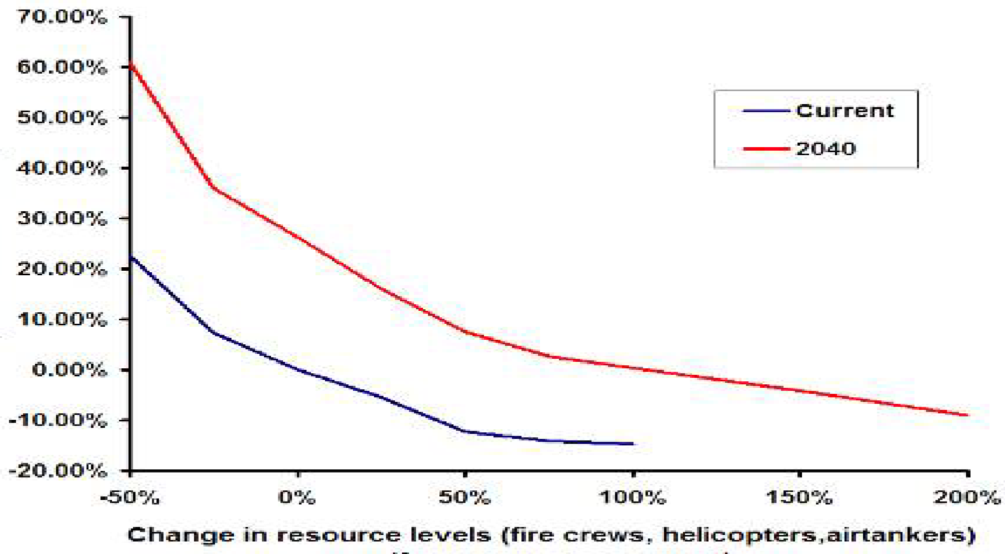
→ Bf Disappears

Increased temp generally leads to, increased fire occurrence

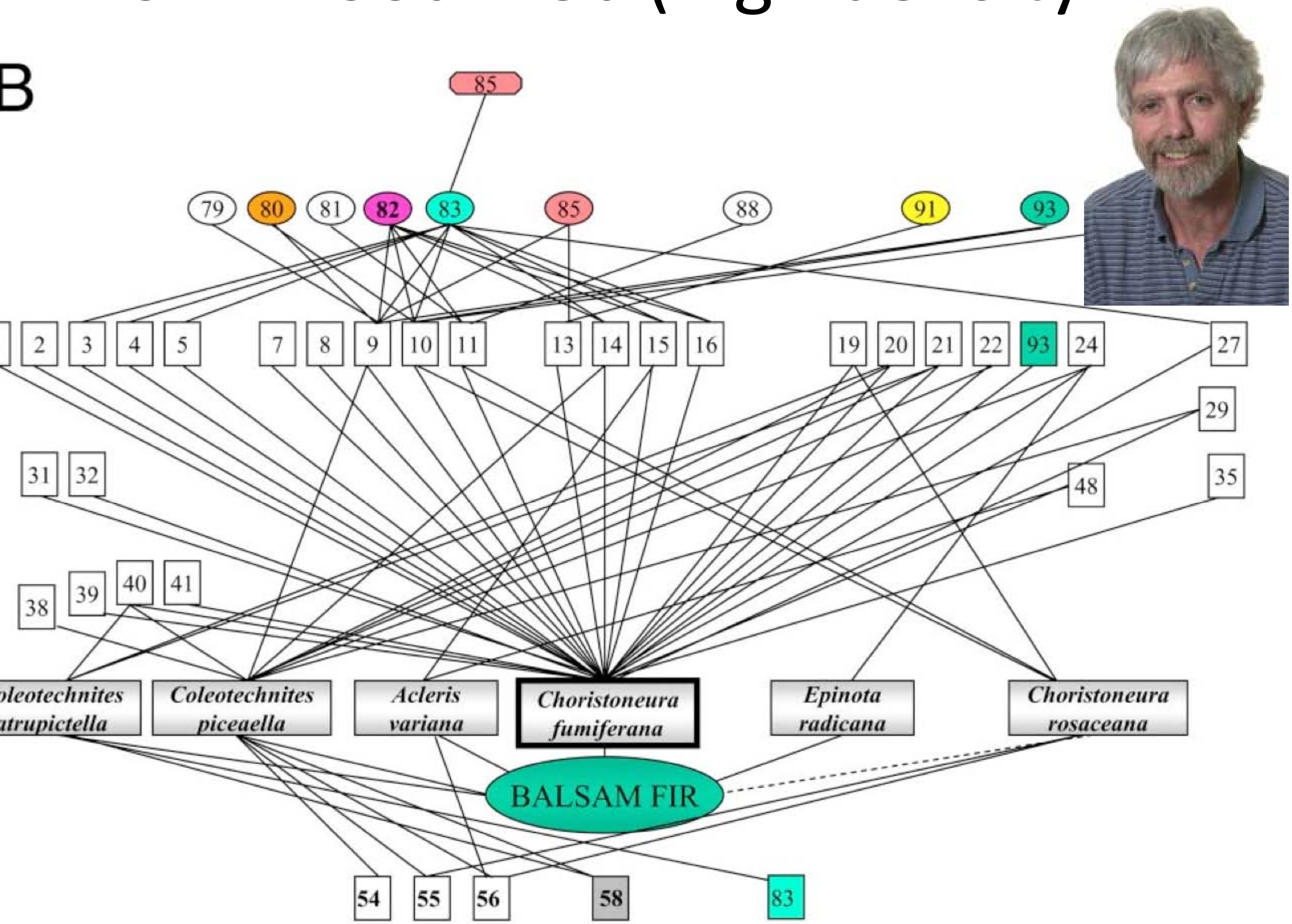
- increased fire escapes (a non-linear relationship)
- increased area burned

High levels of fire activity take place during extremes (both in terms of low humidity air masses AND wind events)

- In an intensively protected forest a situation of highly receptive fuels can lead to high number of daily ignitions which can overwhelm even a well-prepared fire management agency
- 15% increase in occurrence means you must double your resources to contain fires

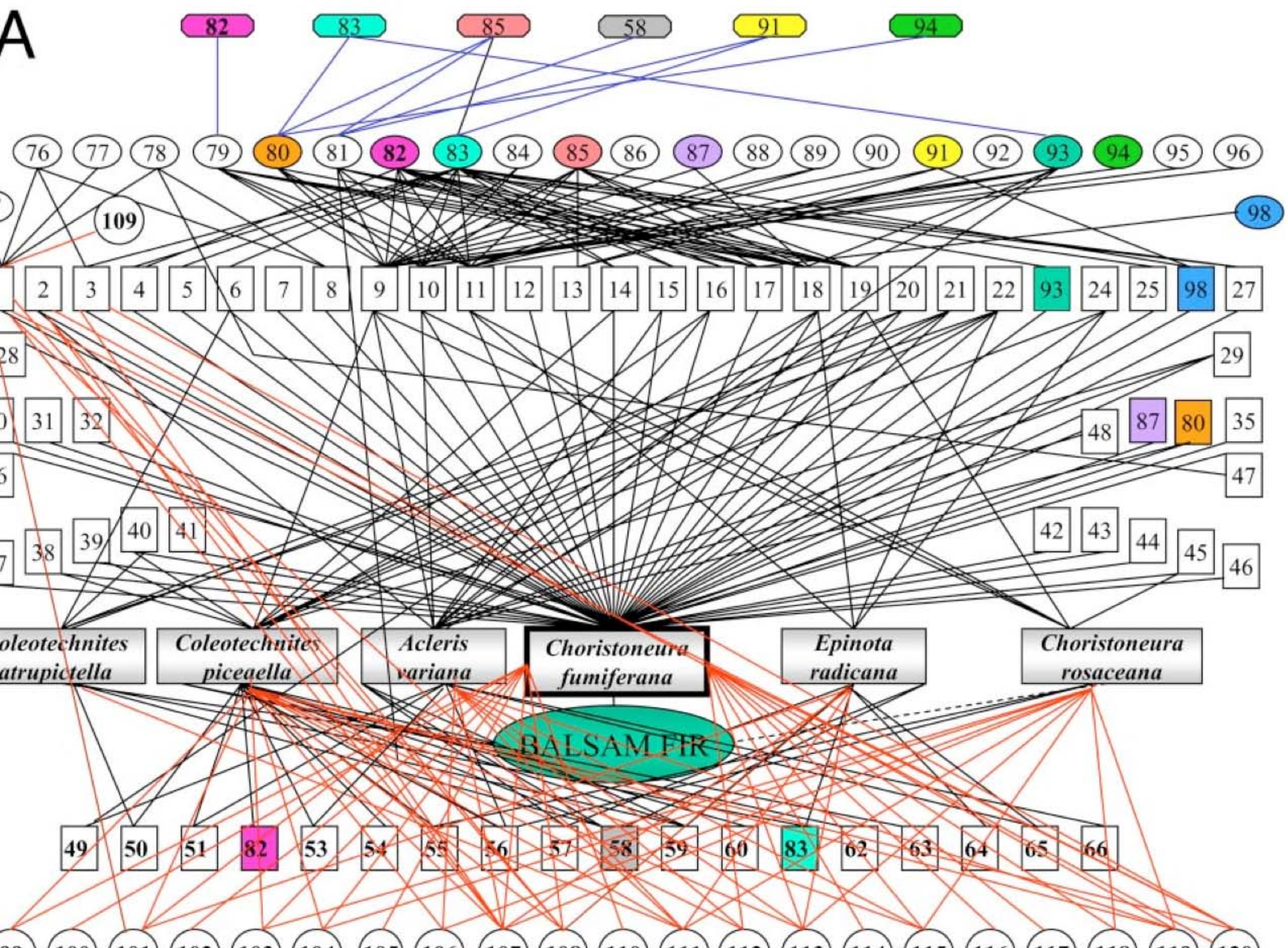


SBW food web (high density)



Eveleigh et al. 2007

SBW food web (low & high density)



2D1 Dilemma: What's Important?

Macro Scale modeling gets us in the door, but …

- Must be augmented by micro scale modeling exercises, and expert interpretation.
- Critical not only to project ideal species distributions, but to contextualize this information for conservation and management plans in New Brunswick.

Focus efforts:

- Discussion seemed to diverge along *analogue*, *zero analogue* conceptual interpretations.
- In conversations with key members of the audience, fire was clearly not considered as important an issue as insects pest for instance. But …
- Some factors were more quantified than others …

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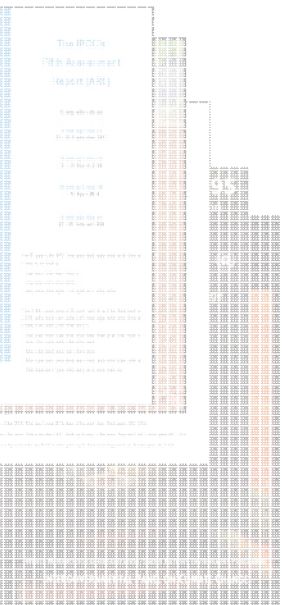
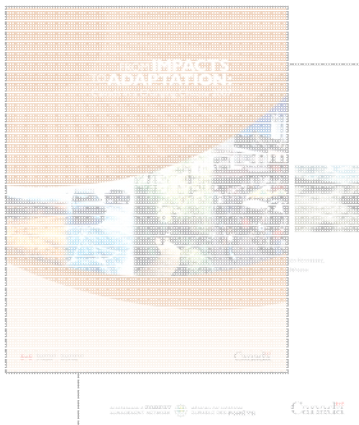
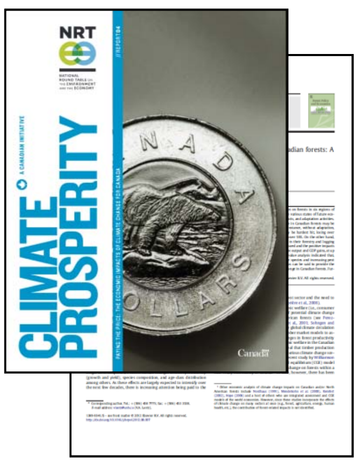
 Down


The IPCC's
Fifth Assessment
Report (AR5)


IMPACTS
ADAPTATION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CLIMATE
PROSPERITY
A CANADIAN INITIATIVE
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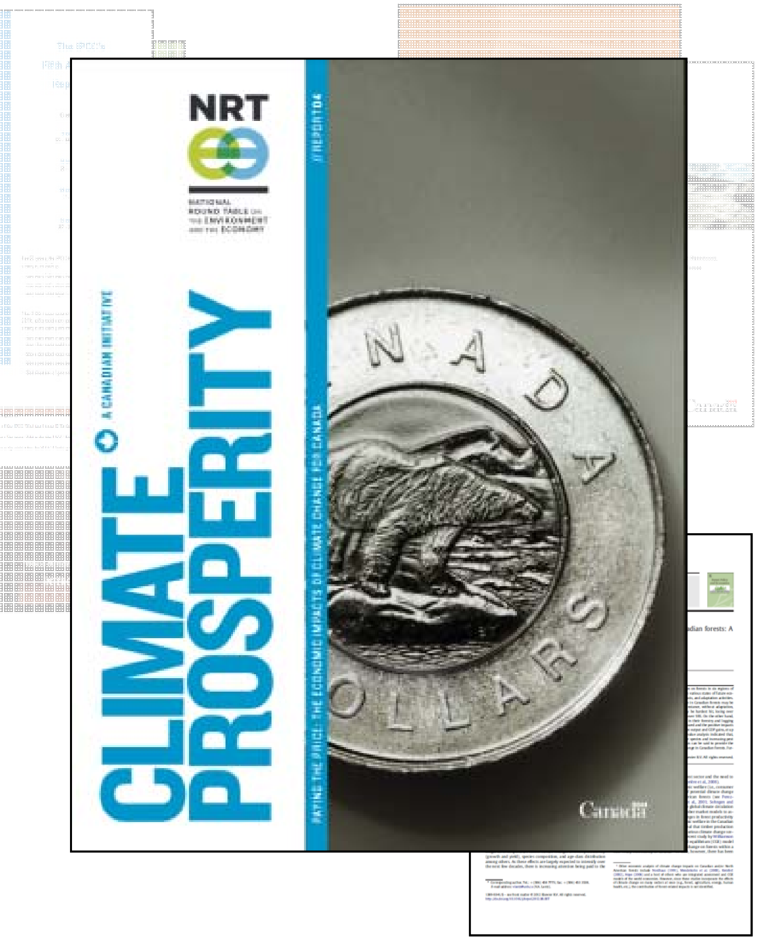
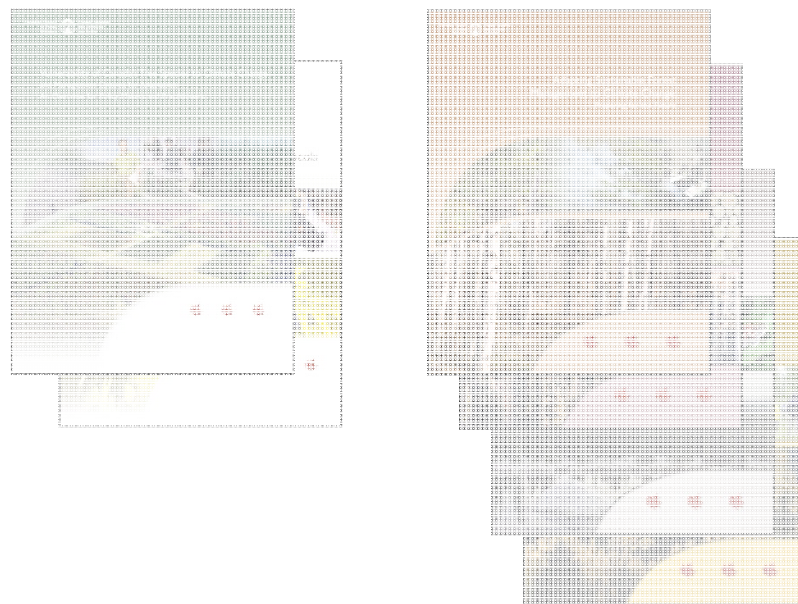
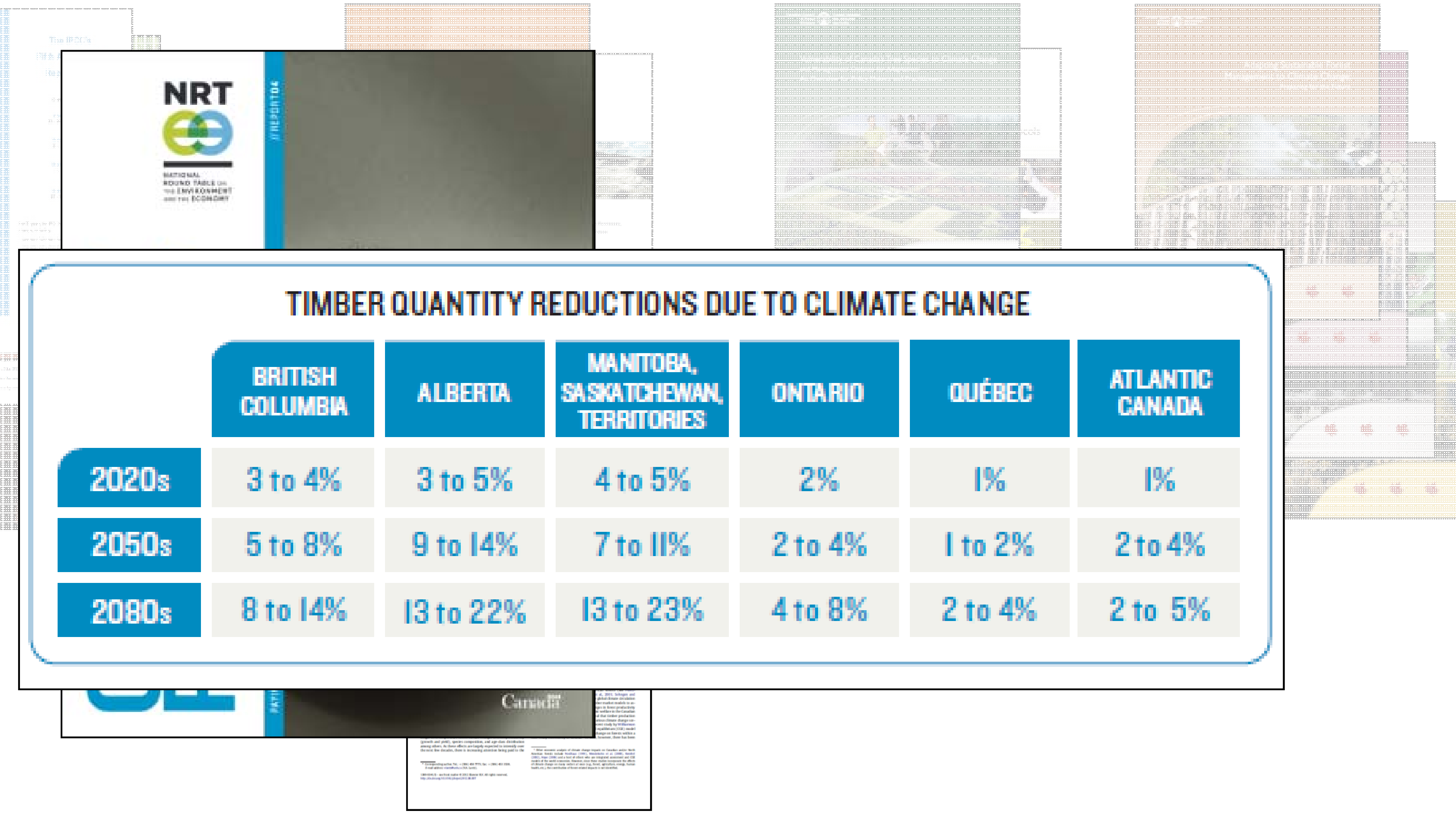

NRT
NATIONAL ROUND TABLE ON THE ENVIRONMENT AND THE ECONOMY
// REPORT 04
CLIMATE PROSPERITY
A CANADIAN INITIATIVE
PAYING THE PRICE: THE ECONOMIC IMPACTS OF CLIMATE CHANGE FOR CANADA
Canada





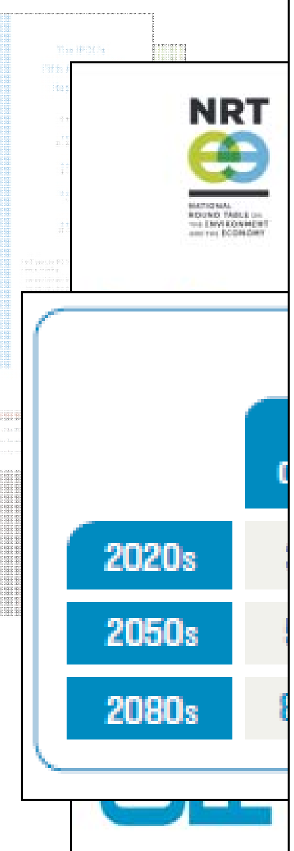
TIMBER QUANTITY REDUCTIONS DUE TO CLIMATE CHANGE

	BRITISH COLUMBIA	ALBERTA	MANITOBA, SASKATCHEWAN, TERRITORIES	ONTARIO	QUÉBEC	ATLANTIC CANADA
2020s	3 to 4%	3 to 5%	4 to 5%	2%	1%	1%
2050s	5 to 8%	9 to 14%	7 to 11%	2 to 4%	1 to 2%	2 to 4%
2080s	8 to 14%	13 to 22%	13 to 23%	4 to 8%	2 to 4%	2 to 5%

CUMULATIVE COSTS DUE TO CLIMATE CHANGE, 2010–2080

	– LOW CLIMATE CHANGE	+ HIGH CLIMATE CHANGE
REGION	SLOW GROWTH	RAPID GROWTH
BRITISH COLUMBIA	$5B	$32B
ALBERTA	$2B	$10B
MANITOBA, SASKATCHEWAN AND TERRITORIES	$5B	$33B
ONTARIO	$10B	$75B
QUÉBEC	$3B	$21B
ATLANTIC CANADA	$1B	$6B
CANADA	$25B	$176B

$ (2008), 3% DISCOUNT RATE



SUMMARY OF TIMBER ADAPTATION STRATEGY

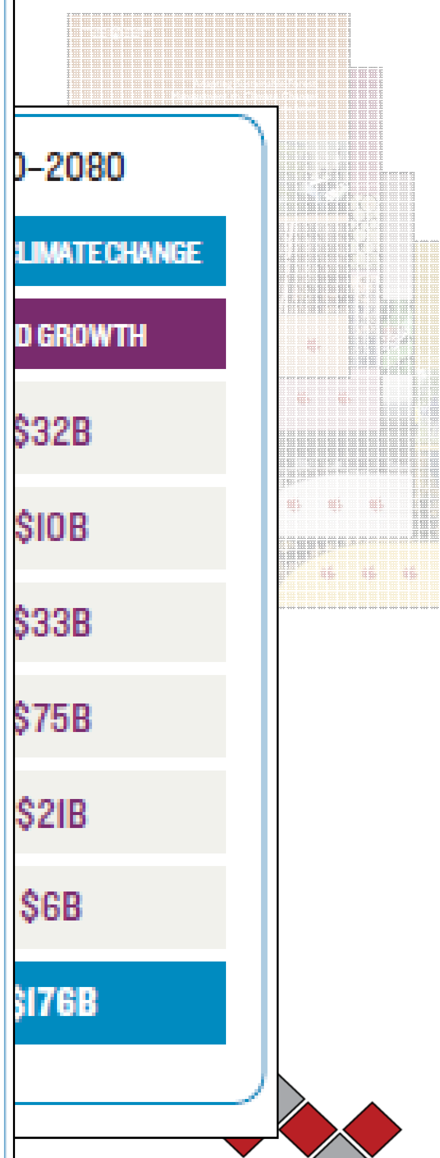
	ADAPTATION STRATEGY			
STRATEGY	• Enhance forest fire prevention, control, and suppression • Enhance pest control • Plant tree species suitable to future climate			
OBJECTIVE	Reduce the impacts of climate change on timber supply			
COSTS OF IMPLEMENTING STRATEGY (PRESENT VALUE, 2010-2080)	–		+	
	$2.3B		$3.6B	
BENEFITS OF IMPLEMENTING STRATEGY (PRESENT VALUE, 2010-2080)	–		+	
	SLOW	RAPID	SLOW	RAPID
	$19.9B	$77.2B	$34.4B	$137.9B
BENEFIT-COST RATIO	–		+	
	SLOW	RAPID	SLOW	RAPID
	9:1	34:1	10:1	38:1
REMAINING COSTS OF CLIMATE CHANGE AFTER ADAPTATION (PRESENT VALUE, 2010-2080)	–		+	
	SLOW	RAPID	SLOW	RAPID
	$4.6B	$24.4B	$8.1B	$37.1B
POTENTIAL CO-BENEFITS	• Enhanced greenhouse gas sequestration • Health benefits from reduced forest fires • Enhanced ability to achieve sustainable forest management objectives			
IMPLEMENTATION CHALLENGES	• Uncertainty on effectiveness • Ecological risks to planting alternative tree species			

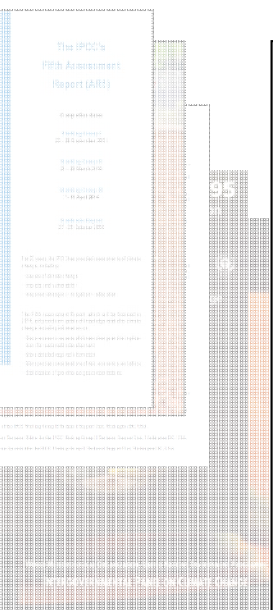
Slow Canadian economic and population growth

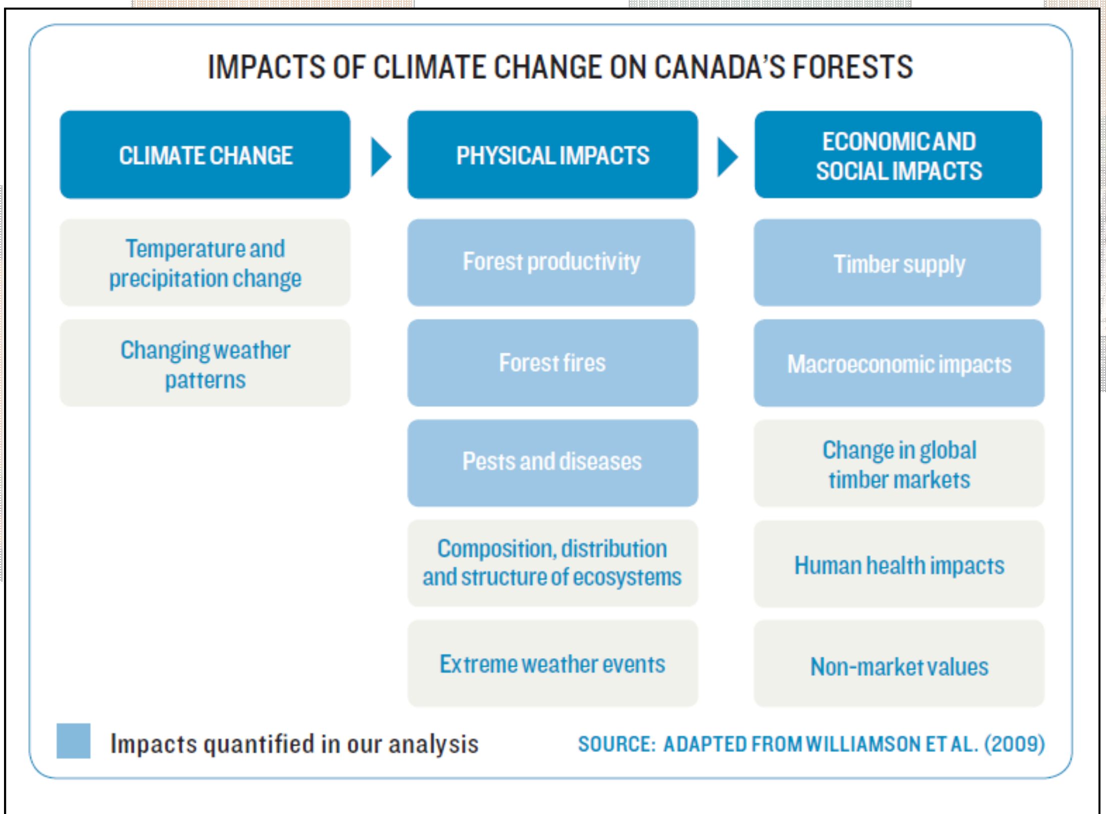
Rapid Canadian economic and population growth

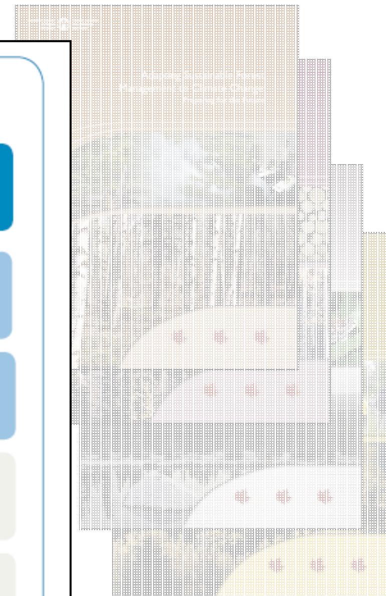
– Low climate change

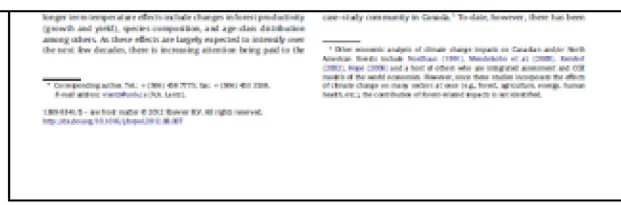
+ High climate change

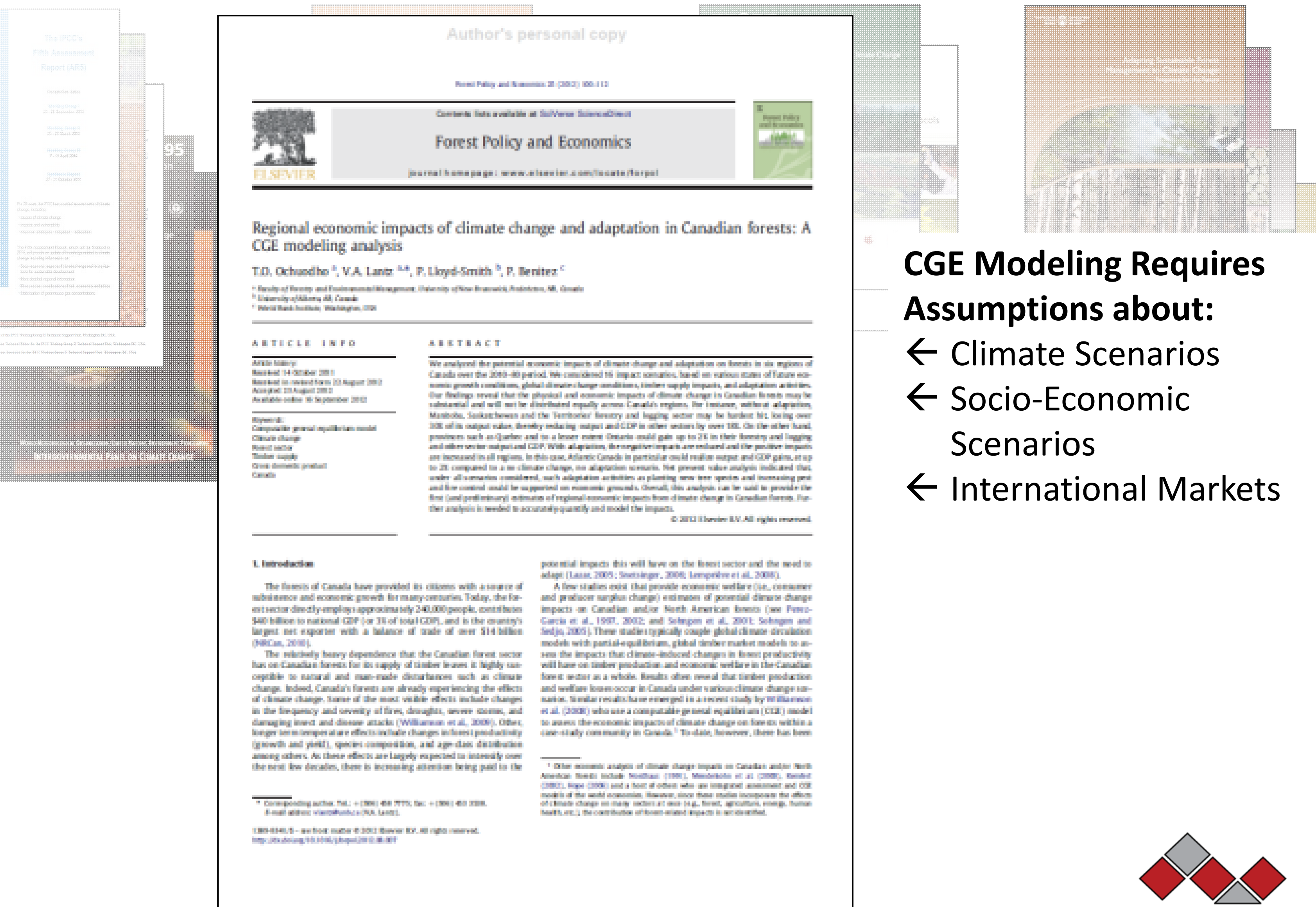





IMPACTS OF CLIMATE CHANGE ON CANADA'S FORESTS
CLIMATE CHANGE
PHYSICAL IMPACTS
ECONOMIC AND SOCIAL IMPACTS
Temperature and precipitation change
Changing weather patterns
Forest productivity
Forest fires
Pests and diseases
Composition, distribution and structure of ecosystems
Extreme weather events
Timber supply
Macroeconomic impacts
Change in global timber markets
Human health impacts
Non-market values
Impacts quantified in our analysis
SOURCE: ADAPTED FROM WILLIAMSON ET AL. (2009)



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Forest Policy and Economics

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Regional economic impacts of climate change and adaptation in Canadian forests: A CGE modeling analysis

T.O. Ochuodho, V.A. Lantz, P. Lloyd-Smith, P. Benitez

ARTICLE INFO

ABSTRACT

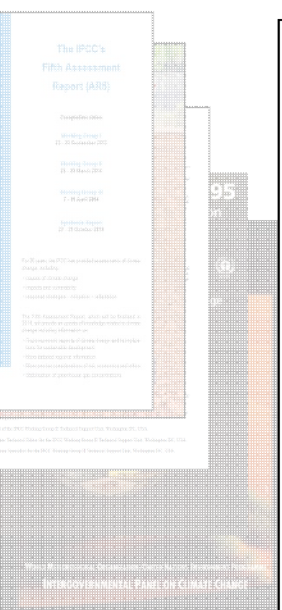
1. Introduction

CGE Modeling Requires Assumptions about:

← Climate Scenarios

← Socio-Economic Scenarios

← International Markets



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T.O. Ochuodho [a], V.A. Lantz [a,*], P. Lloyd-Smith [b], P. Benitez [c]

ARTICLE INFO

ABSTRACT

1. Introduction

CGE Modeling Requires Assumptions about:

- ← Climate Scenarios
- ← Socio-Economic Scenarios
- ← International Markets
- ← Pests
- ← Fire
- ← Growth
- ← Timber supply
- ← Species composition
- ← **Adaptation options**

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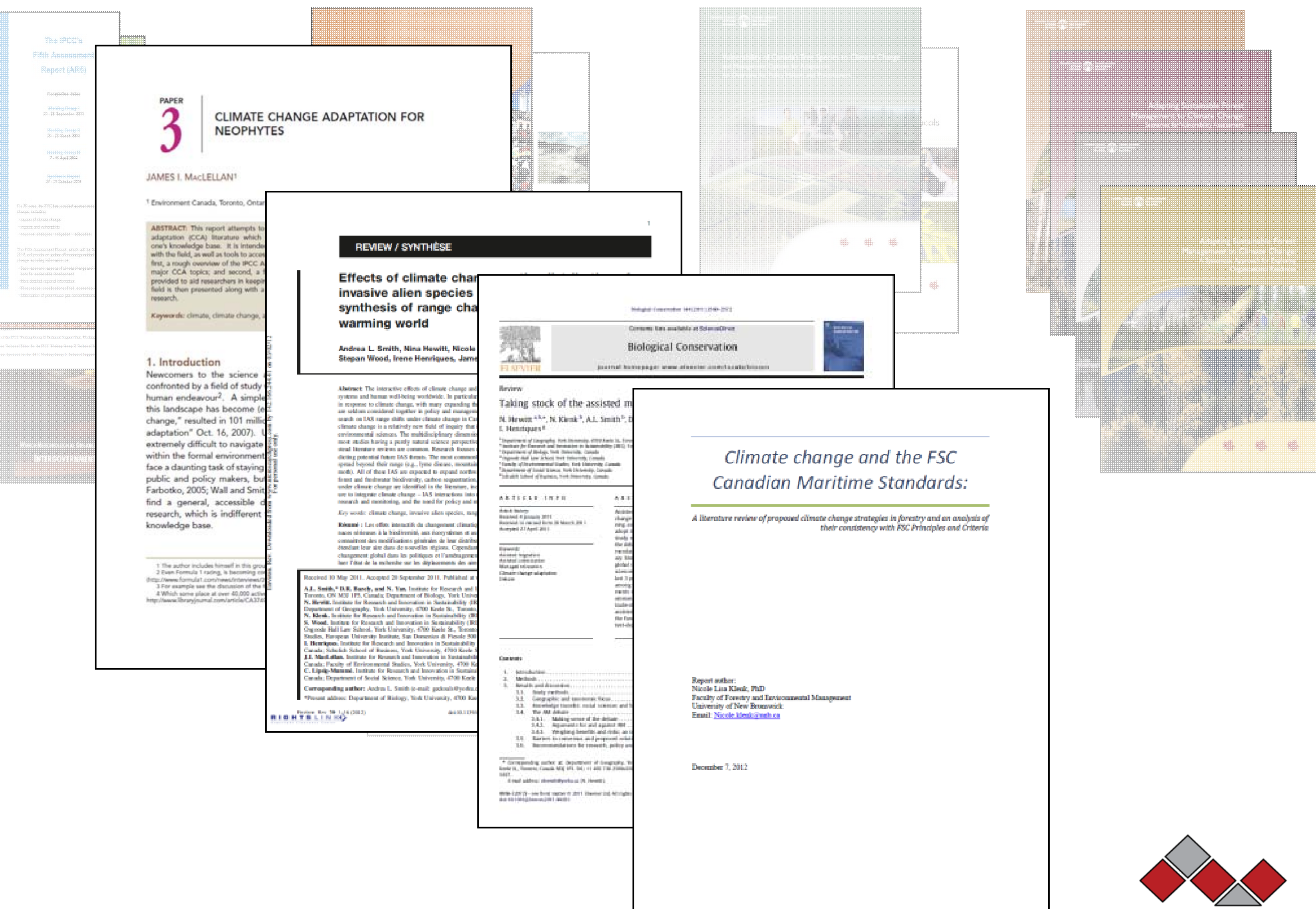

PAPER 3
CLIMATE CHANGE ADAPTATION FOR NEOPHYTES
JAMES I. MacLELLAN
1. Introduction
REVIEW / SYNTHÈSE
Effects of climate chan
invasive alien species
synthesis of range cha
warming world
Biological Conservation
Taking stock of the assisted m
Climate change and the FSC Canadian Maritime Standards:
A literature review of proposed climate change strategies in forestry and an analysis of their consistency with FSC Principles and Criteria
Report author:
Nicole Lisa Klenk, PhD
Faculty of Forestry and Environmental Management
University of New Brunswick
December 7, 2012

Resistance: protecting high-value resources

Resilience: maximize short term value and maintain diversity at landscape scale

Response: reduce rotation length and facilitate changing species diversity at landscape scale

Mitigation: enhance carbon storage, reduce emissions, forest product innovation using less desirable species

ecommendations: Climate change asures broadly related to forest landscape nagement	Strategy 1= Resist 2= Resilience 3= Response 4= Mitigation	Level 1= Strategic 2= Tactical 3= Operational
Maintain connectivity in a varied, dynamic landscape	2, 3	2
Realign management targets to recognize significantly pted conditions, rather than continuing to manage for ration to a reference condition that is no longer realistic given te change	3	1
Diversify risk by spreading habitats or plantations over a range vironments rather than strictly within the historic distribution	3	1
Use landscape-scale planning and partnerships to reduce entation and enhance connectivity	2, 3	1
Manage for refugia (e.g., identify and manage refugia for es that may otherwise be lost, try uneven-aged management to andscape heterogeneity and "lifeboat" residual species, protect tial refugial habitats, retain biological legacies	1	1
Avoid planting new forests in area likely to be subject to natural bance (e.g., flood)	2, 3	3
Minimize amount of edge created by human disturbances	2, 3	3

ecommendations: climate change asures broadly related to preparing disturbance in forest management	Strategy 1= Resist 2= Resilience 3= Response 4= Mitigation	Level 1= Strategic 2= Tactical 3= Operational
Monitor to determine when and what changes are ring	1, 2, 3	1
Adopt risk assessment and adaptive management ples	1, 2, 3	1
Agree on standardized climate scenarios for analysis	1, 2, 3	2
nclude climate variables in growth and yield models ncorporate climate change effects into long term er supply analysis and forest management plans	1, 2, 3	2
Anticipate surprises and threshold effects	2, 3	1
Anticipate variability and change and conduct rability assessment	2, 3	1
Foster learning and innovation	1, 2, 3	1
Prepare for changes in disturbance regimes (e.g., ased wildfire activity, higher-elevation insect eaks, species mortality events, altered fire regimes)	2, 3	2
Minimize or mitigate other threats or stresses (e.g., pread of insects and diseases, herbivory, alter forest ture or composition to reduce risk or severity of fire, lish fuelbreaks to slow the spread of catastrophic	1, 2, 3	2

commendations: climate change measures dly related to forest composition	Strategy 1= Resist 2= Resilience 3= Response 4= Mitigation	Level 1= Strategic 2= Tactical 3= Operational
djust species composition (e.g., plant alternative genotype or pecies in anticipation of future climate, planting less sensitive s, diversify species mix on lower quality sites, favor current nents that do not decrease under projections, but don't ninate against species projected to decrease, maintain nents across all sites, especially mesic sites, …)	3	3
ather than focusing only on historic distributions, spread s over a range of environments according to modeled future ons	3	1
nticipate and respond to species decline	3	2
xpand genetic diversity guidelines (e.g., move germplasm in the ated adaptive direction; expand seed zones in all directions; eed transfer guidelines to accommodate multiple habitat ; introduce long distance germplasm into seed mixes)	3	1
crease species and genetic diversity in plantations	3	1
laintain diverse gene pools	1, 2, 3	1
rioritize and protect existing populations on unique sites (may e active management for conifer species lowlands)	1	2
ontinue managing invasive species	1, 2, 3	1

What’s Next?

Vhy has the consideration of “forests” been going own in IPCC assessment reports?

Ny answer:

- We can easily pose simple questions re climate change, but solutions are complex.

Vhat then, constitutes an effective response?

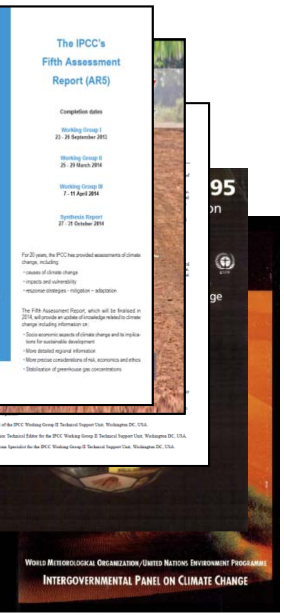
- Approach issue at multiple scales in an adaptive manner that questions assumptions and facilitates the development of new, locally oriented knowledge.
- Engage locally embedded researchers as well as local communities through a series of mechanisms …

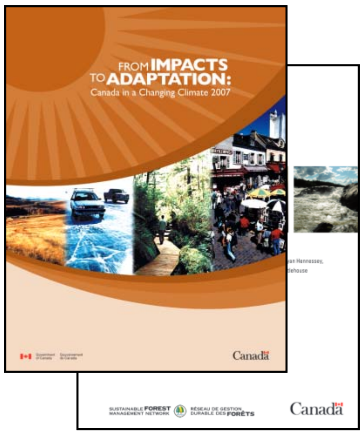
THAK YOU

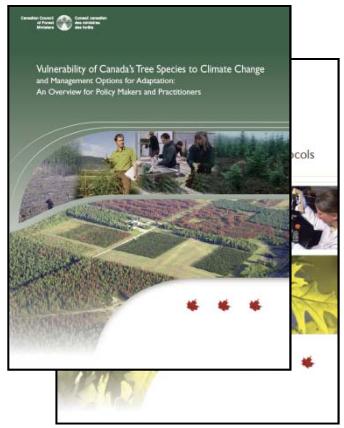
For more Information:

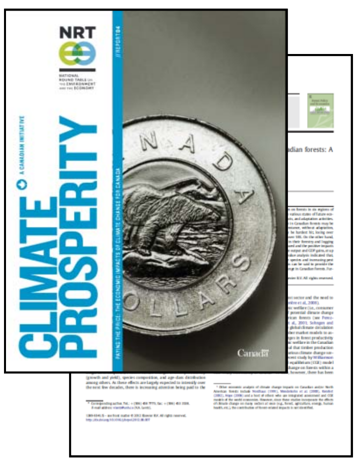
Jim MacLellan
jmaclell@unb.ca

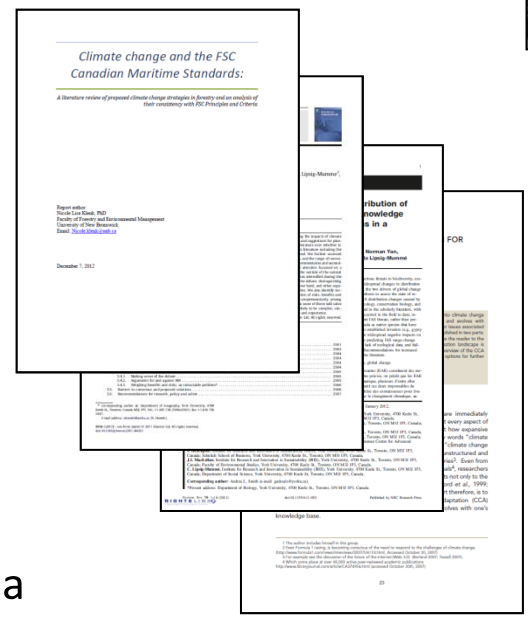
BCCRC











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