Managing Woodlands in a Changing Climate

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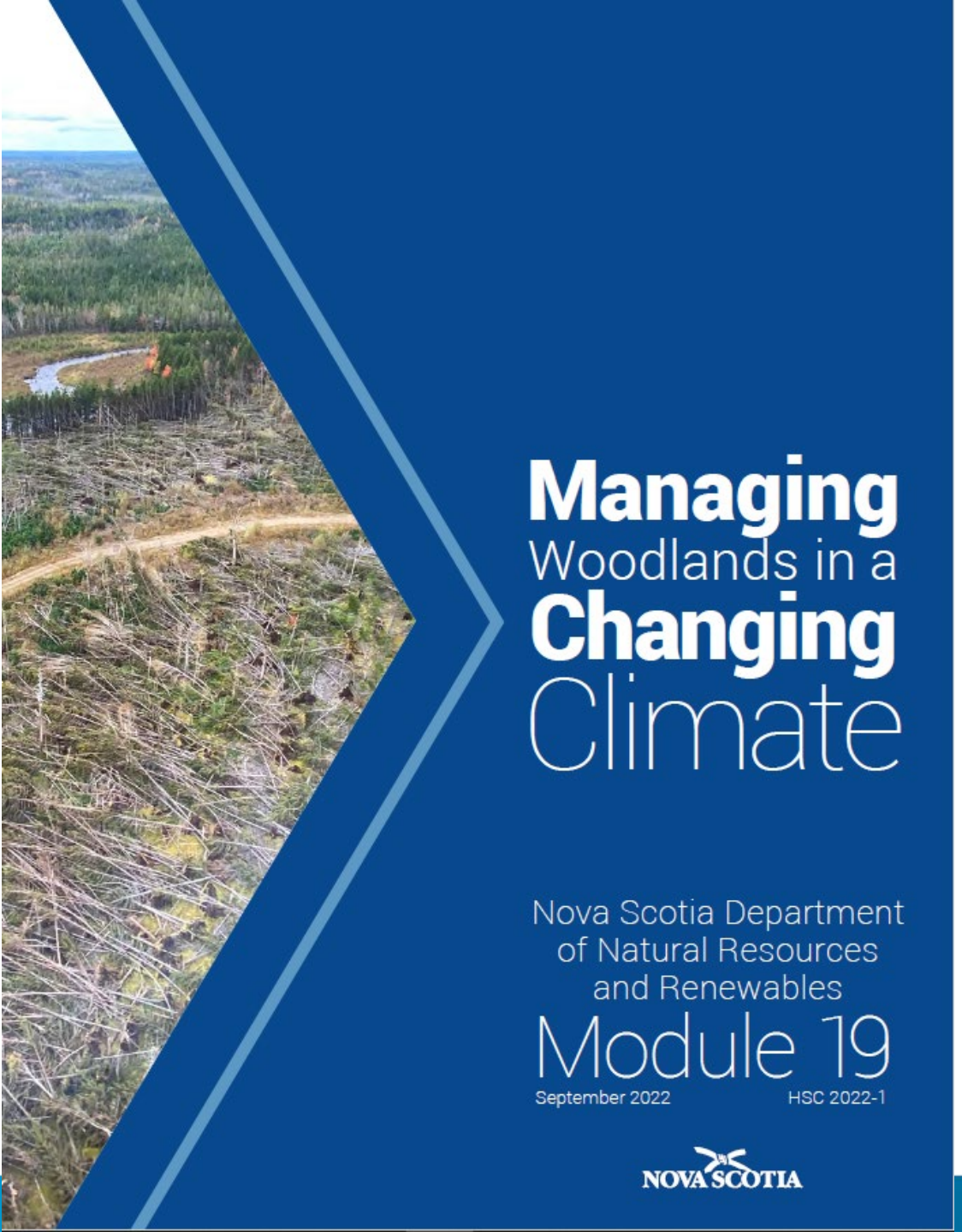

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Natural Resources and Renewables

Mitacs

Cole Vail

Peter Duinker

Jane Barker

Introduction

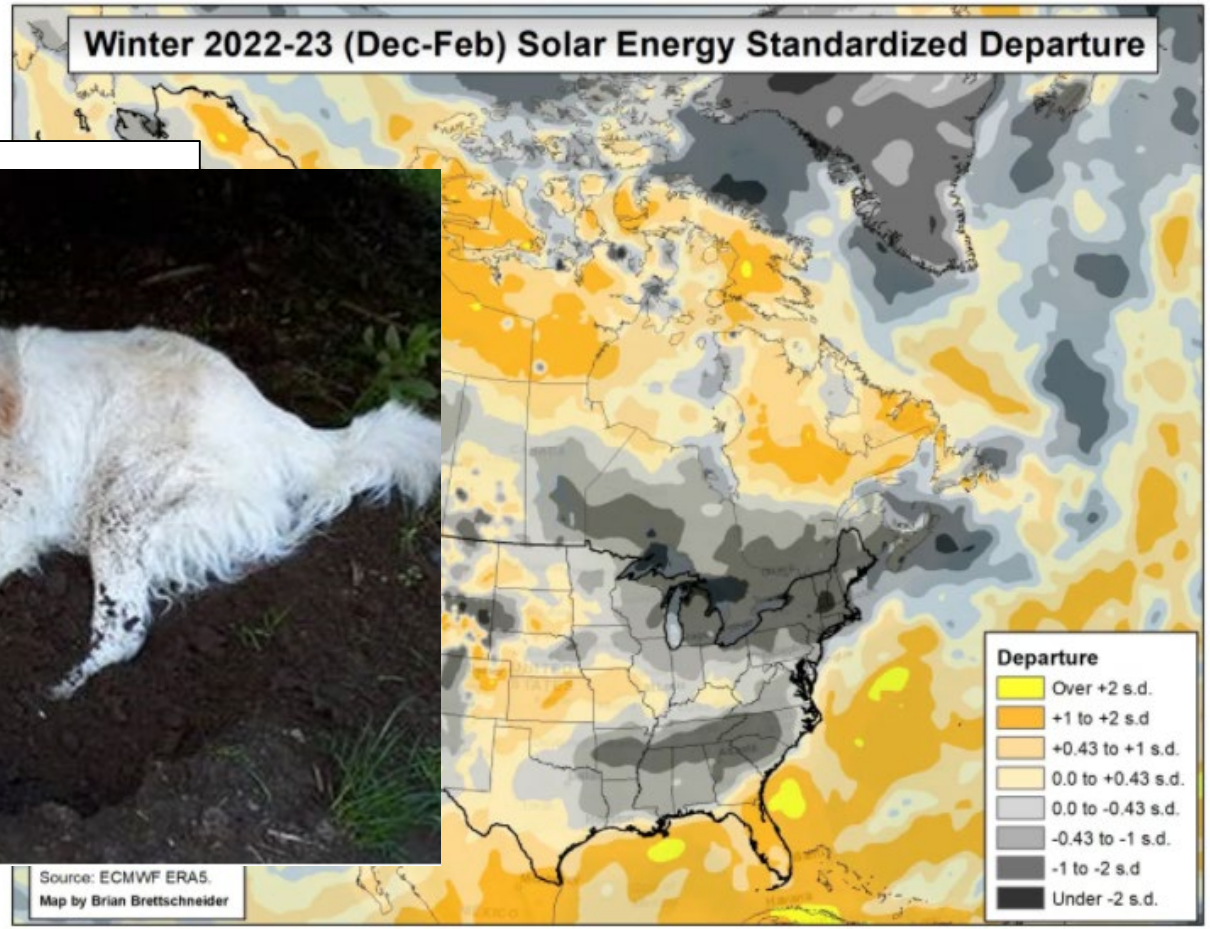
- Weather
- Climate
- Weather **VERSUS** climate
- Climate change

Nova Scotia · Weather

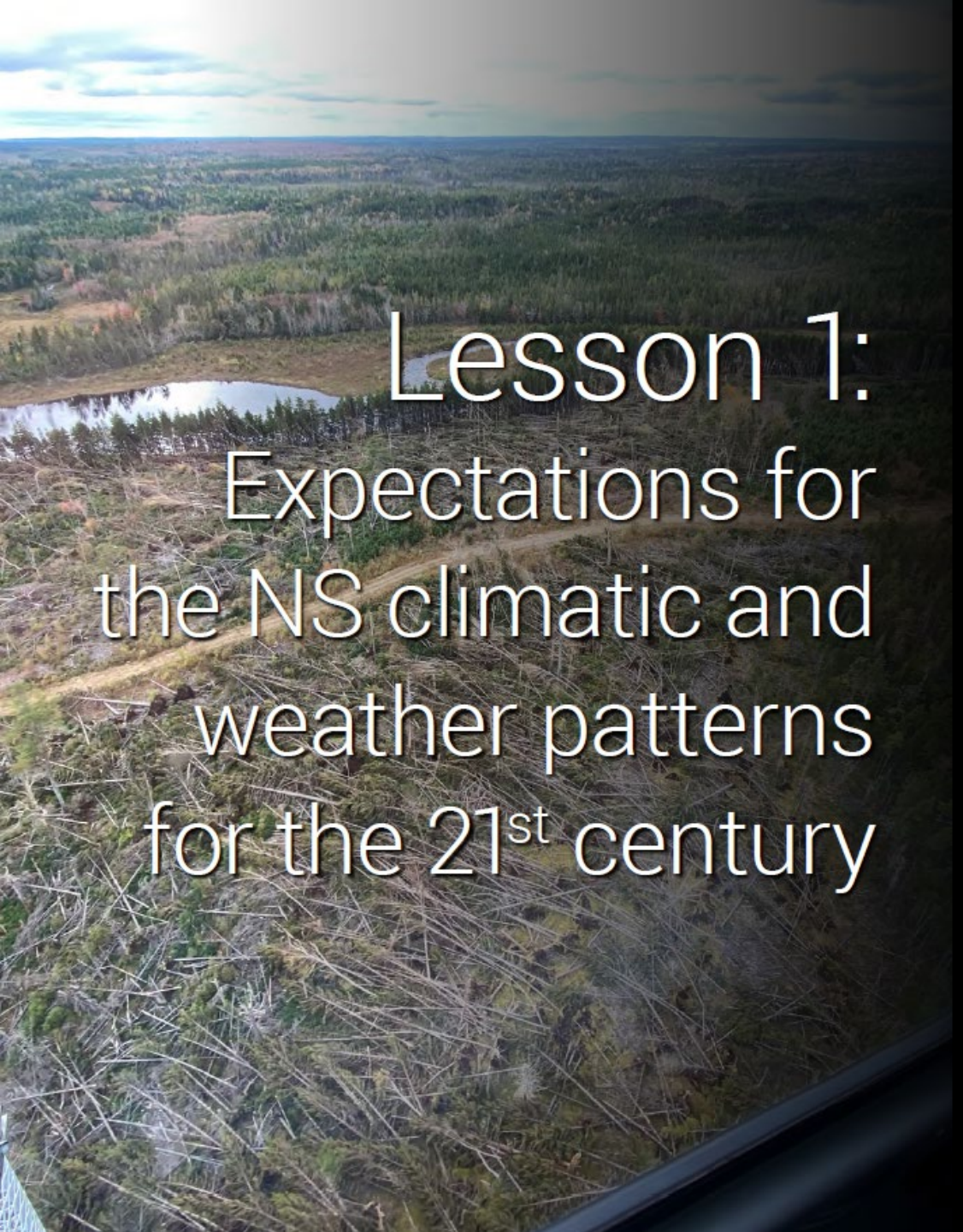
3 reasons to celebrate the forward this weekend

Springing forward has become key checkpo

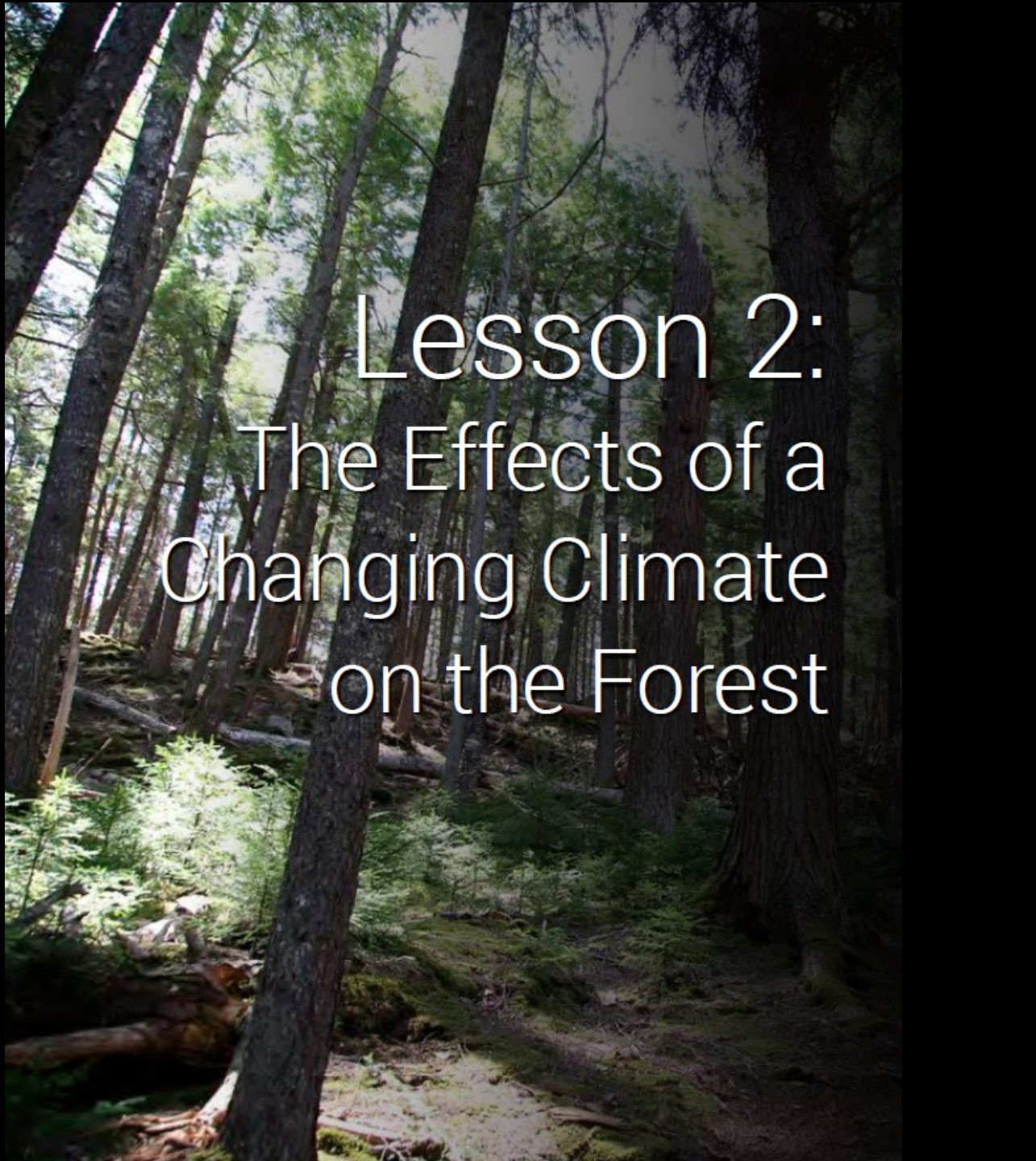
Ryan Snoddon · CBC News · Posted: Mar 11, 202



This solar energy departure-from-normal map shows the Maritimes were cloudier than average for December, January and February. (Brian Brettschneider)

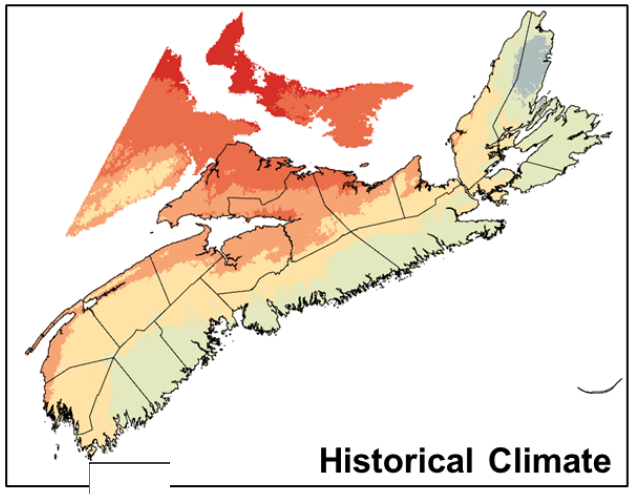


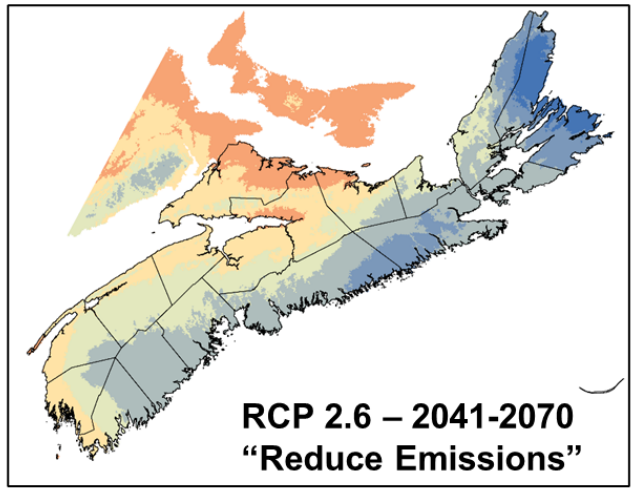
Lesson 1:
Expectations for the NS climatic and weather patterns for the 21st century

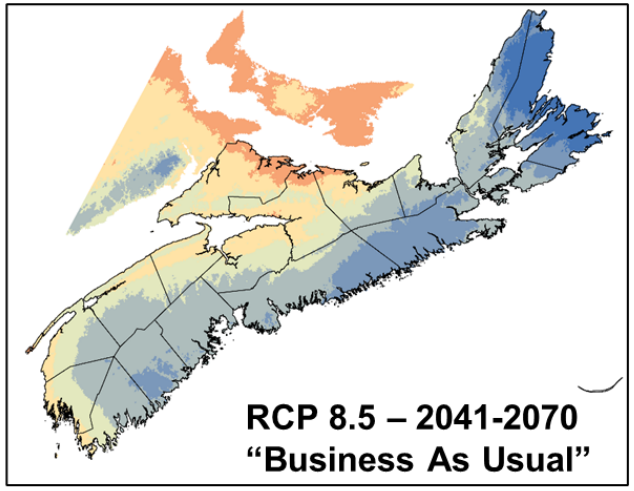


Lesson 2:
The Effects of a Changing Climate on the Forest

Precipitation



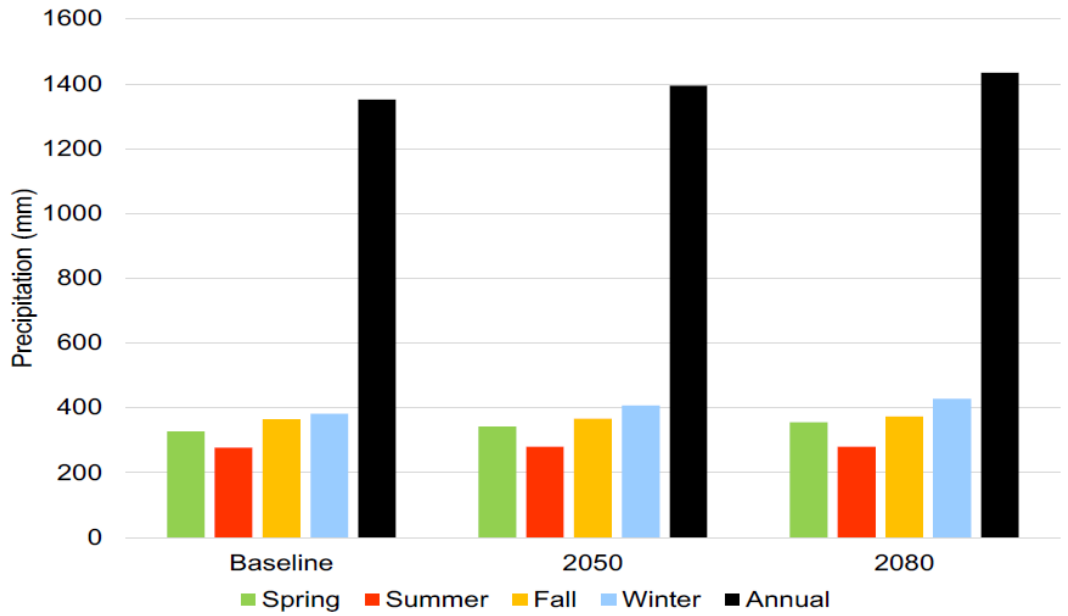




Annual Precipitation (mm)

1800

1000



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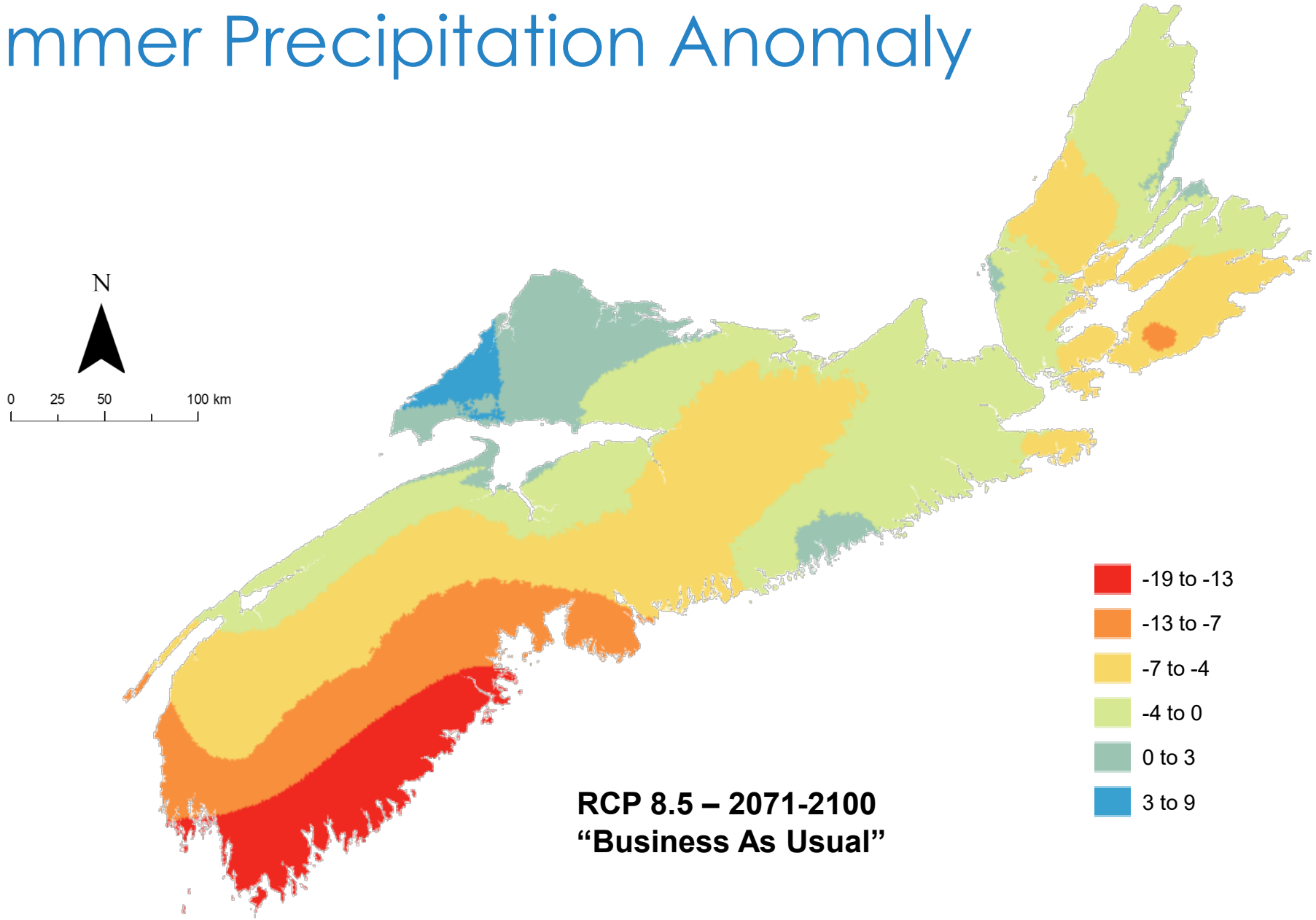
Summer Precipitation Anomaly



Source: Natural Resources Canada & Nova Scotia Department of Lands and Forestry

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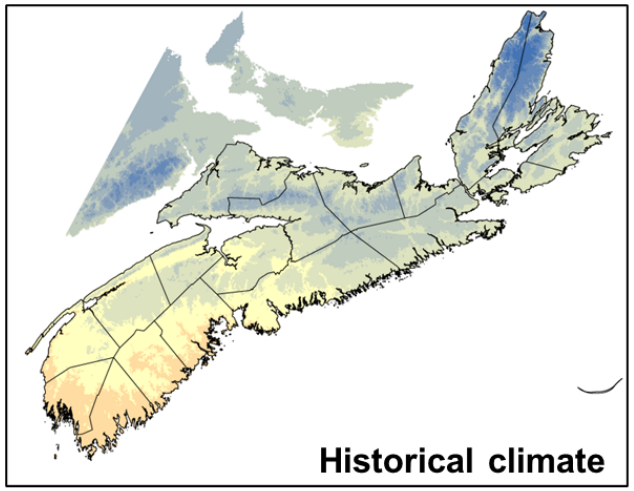
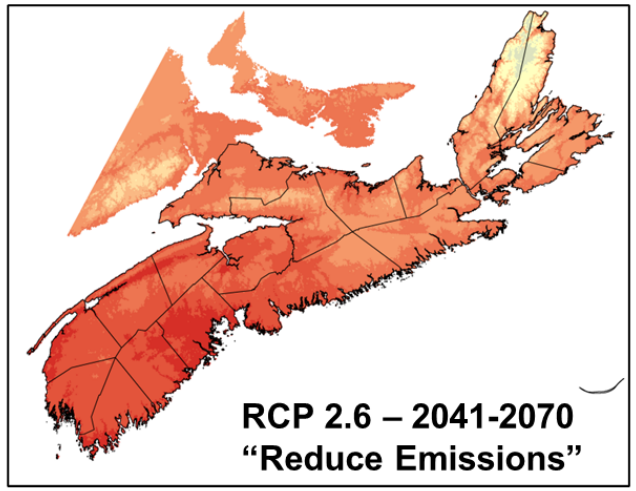
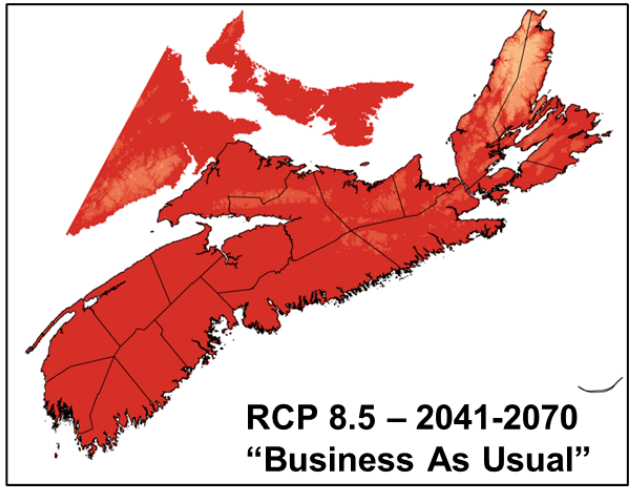
Temperature



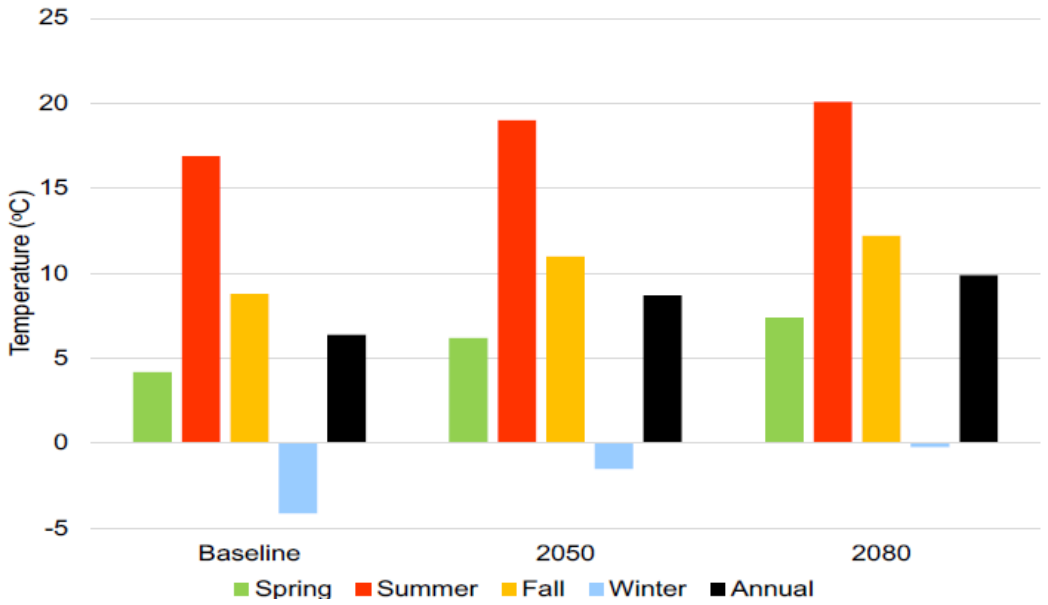




Mean annual temperature (°C)

10.0

3.5



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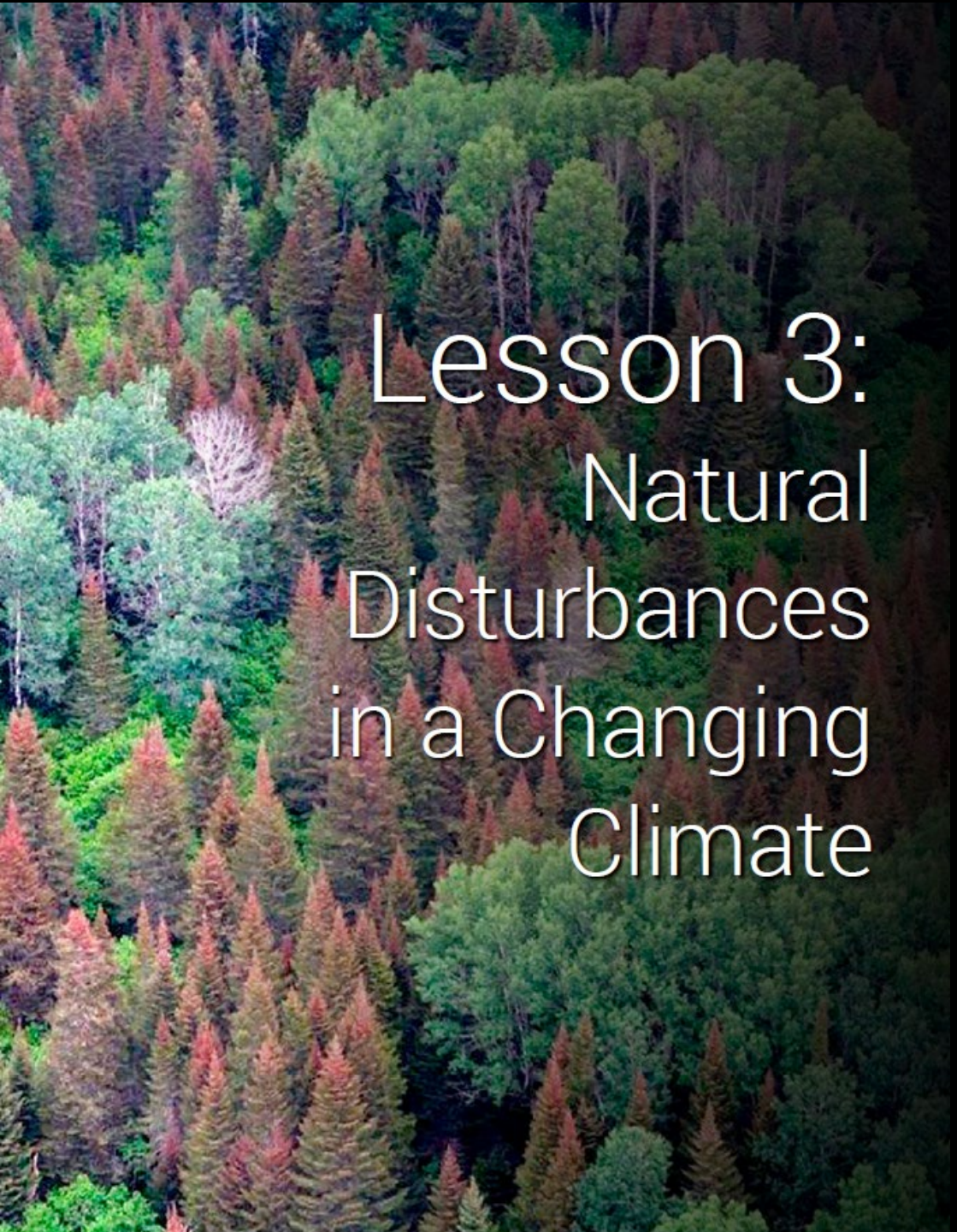


Lesson 3: Natural Disturbances in a Changing Climate

- Wind, spruce budworm, fire
- More Frequent
- More Severe
- More Unpredictable

Ecological Forestry in a Changing Climate

- The **F word…**
- What to do about partial harvests and uneven-aged management in forests dominated by wind disturbance
- Long-term resilience versus short-term vulnerability?
  - Integrate blowdown into management planning
  - Additional considerations of wind vulnerability

Natural Disturbance Research

UNB

NRC Research Press

REVIEW

A review of natural disturbances to inform implementation of ecological forestry in Nova Scotia, Canada

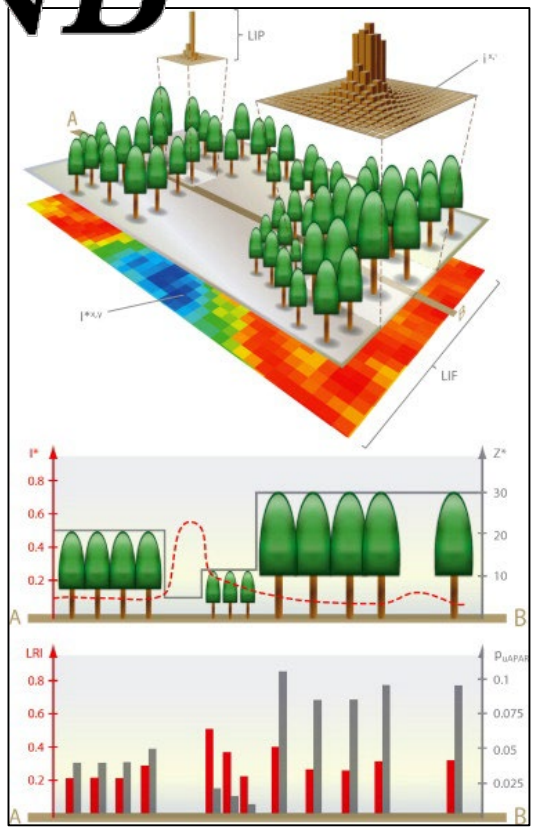
Anthony R. Taylor, David A. MacLean, Peter D. Neily, Bruce Stewart, Eugene Quigley, Sean P. Basquill, Celia K. Boone, Derek Gilby, and Mark Pulsifer

Canadian Science Publishing

REVIEW

Natural disturbance regimes for implementation of ecological forestry: a review and case study from Nova Scotia, Canada

David A. MacLean, Anthony R. Taylor, Peter D. Neily, James W.N. Steenberg, Sean P. Basquill, Eugene Quigley, Celia K. Boone, Morgan Oikle, Peter Bush, and Bruce Stewart



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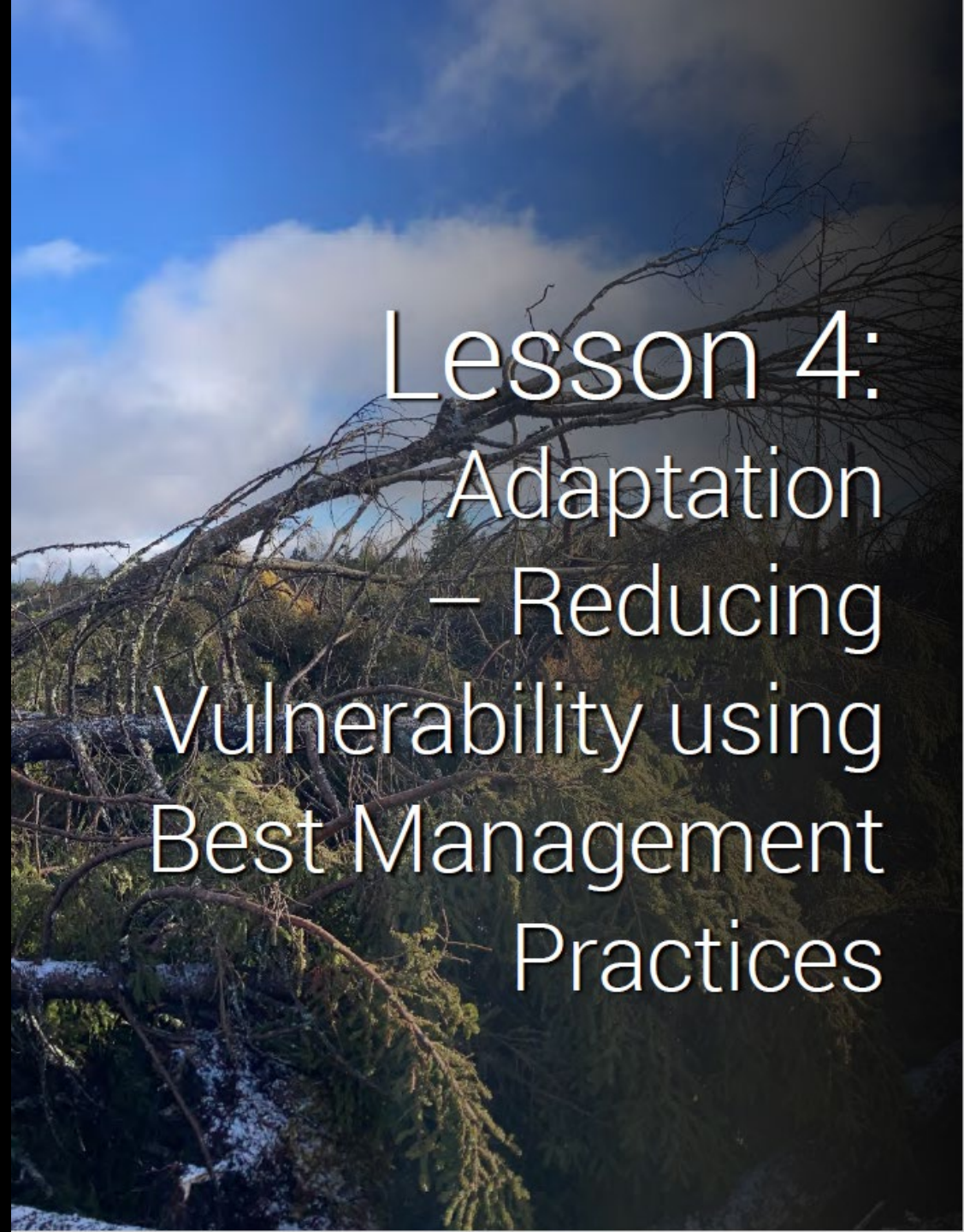
- Vulnerability
- Impacts
- Adaptation
- Silviculture



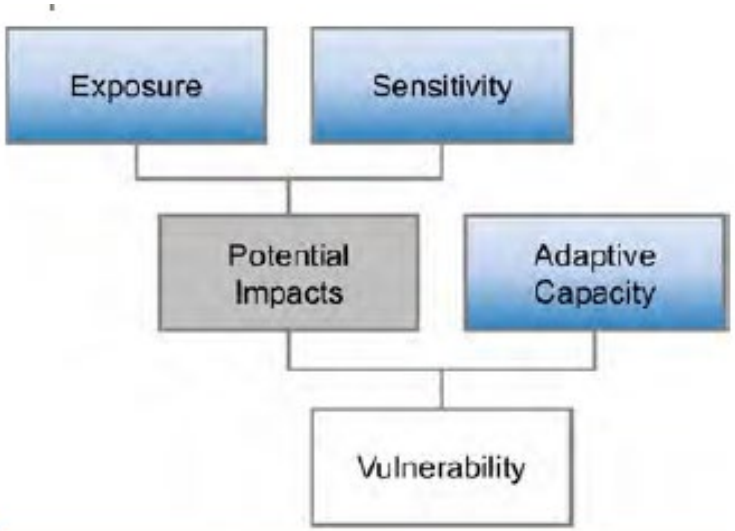
Lesson 4: Adaptation – Reducing Vulnerability using Best Management Practices

Relative vulnerability of Nova Scotia tree species to climate change

Species	Relative Vulnerability to Climate Change
Red spruce	Intermediate
Eastern hemlock	Low
White pine	Low
White spruce	High
Black spruce	High
Balsam fir	High
Red pine	Intermediate
Jack pine	High
Tamarack	High
Sugar maple	Intermediate
Yellow birch	Intermediate
White ash	Low
Red oak	Low
Red maple	Low
White birch	High
Trembling aspen	Intermediate
Large-tooth aspen	Intermediate

Climate Change Adaptation

- Reducing ecosystem sensitivity
- Building adaptive capacity in management



The components of vulnerability (figure credit: Marshall et al., 2009).

Drone imagery of gap and continuous cover irregular shelterwood harvests in Antigonish County (figure credit: James Steenberg).

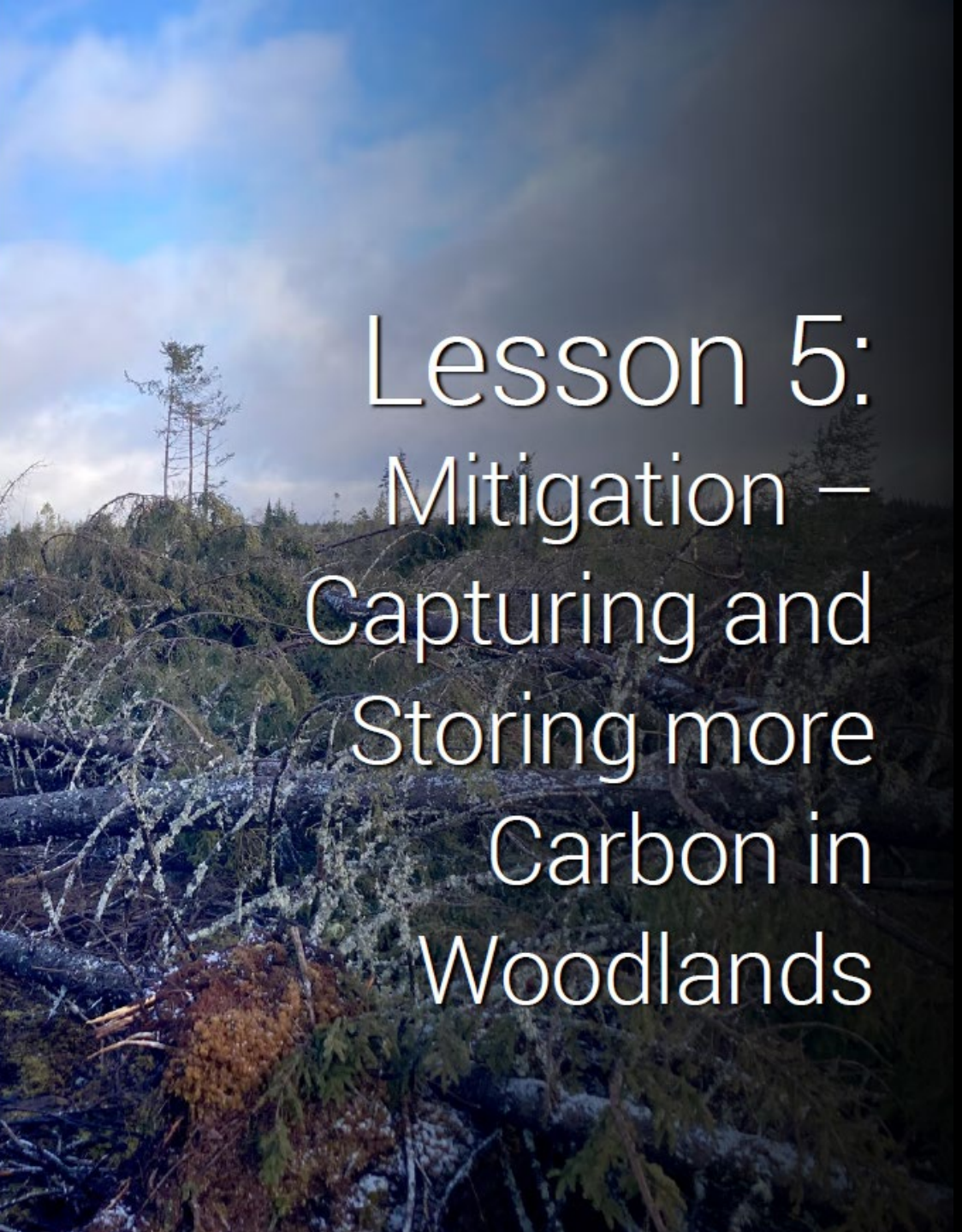
Spotlight on Pre-Commercial Thinning

Species selection to restore ecosystems and reduce vulnerability

Increased yields and carbon

Reduced windthrow hazard

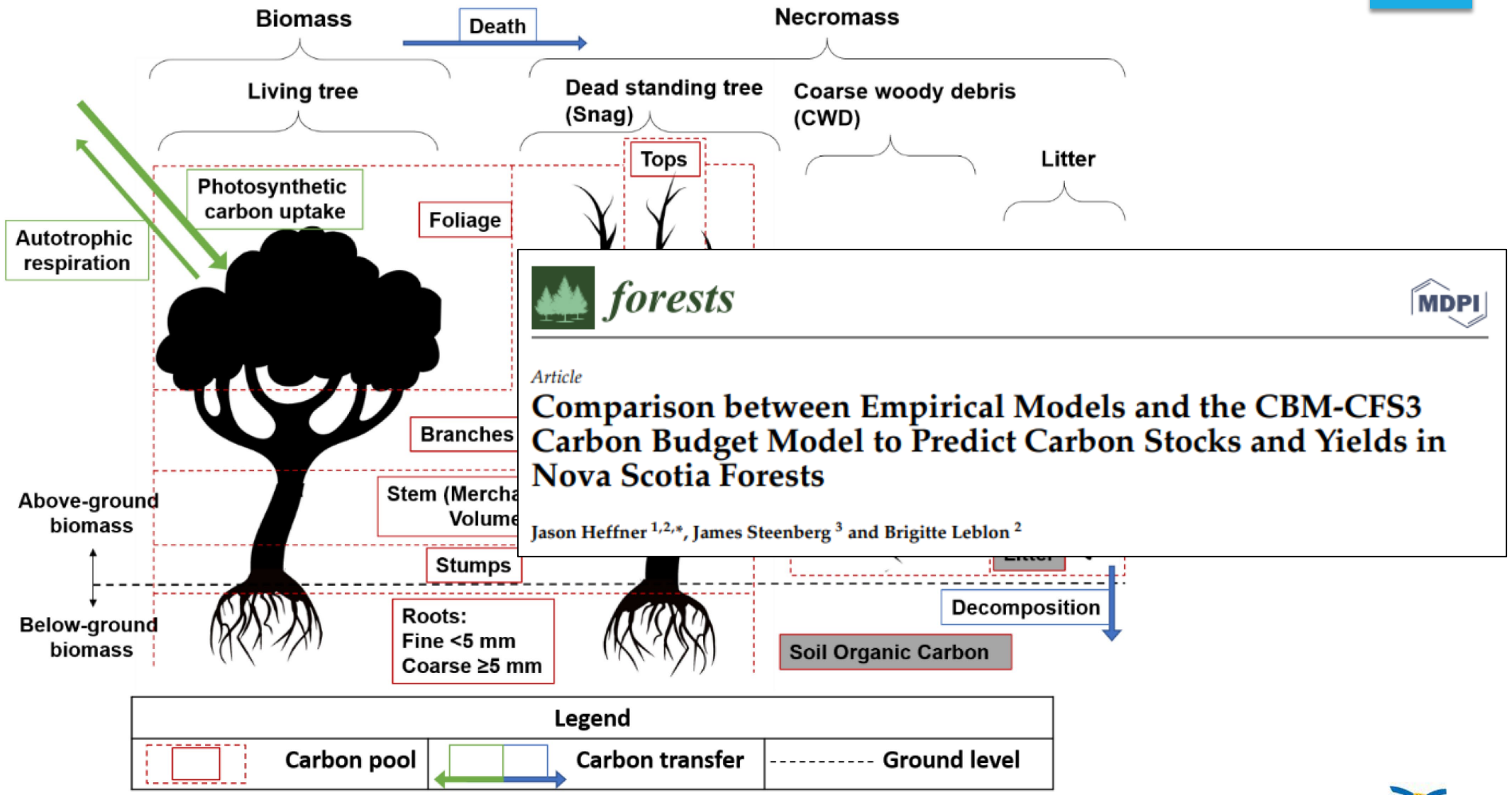
Reduced moisture stress on soils



Lesson 5: Mitigation – Capturing and Storing more Carbon in Woodlands

- Unpacking the forest carbon cycle
- Silviculture, ecological forestry, and the triad
- Forest carbon economics

Forest Carbon Dynamics



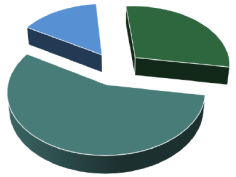
forests
MDPI
Article

Comparison between Empirical Models and the CBM-CFS3 Carbon Budget Model to Predict Carbon Stocks and Yields in Nova Scotia Forests

Jason Heffner [1,2,*], James Steenberg [3] and Brigitte Leblon [2]

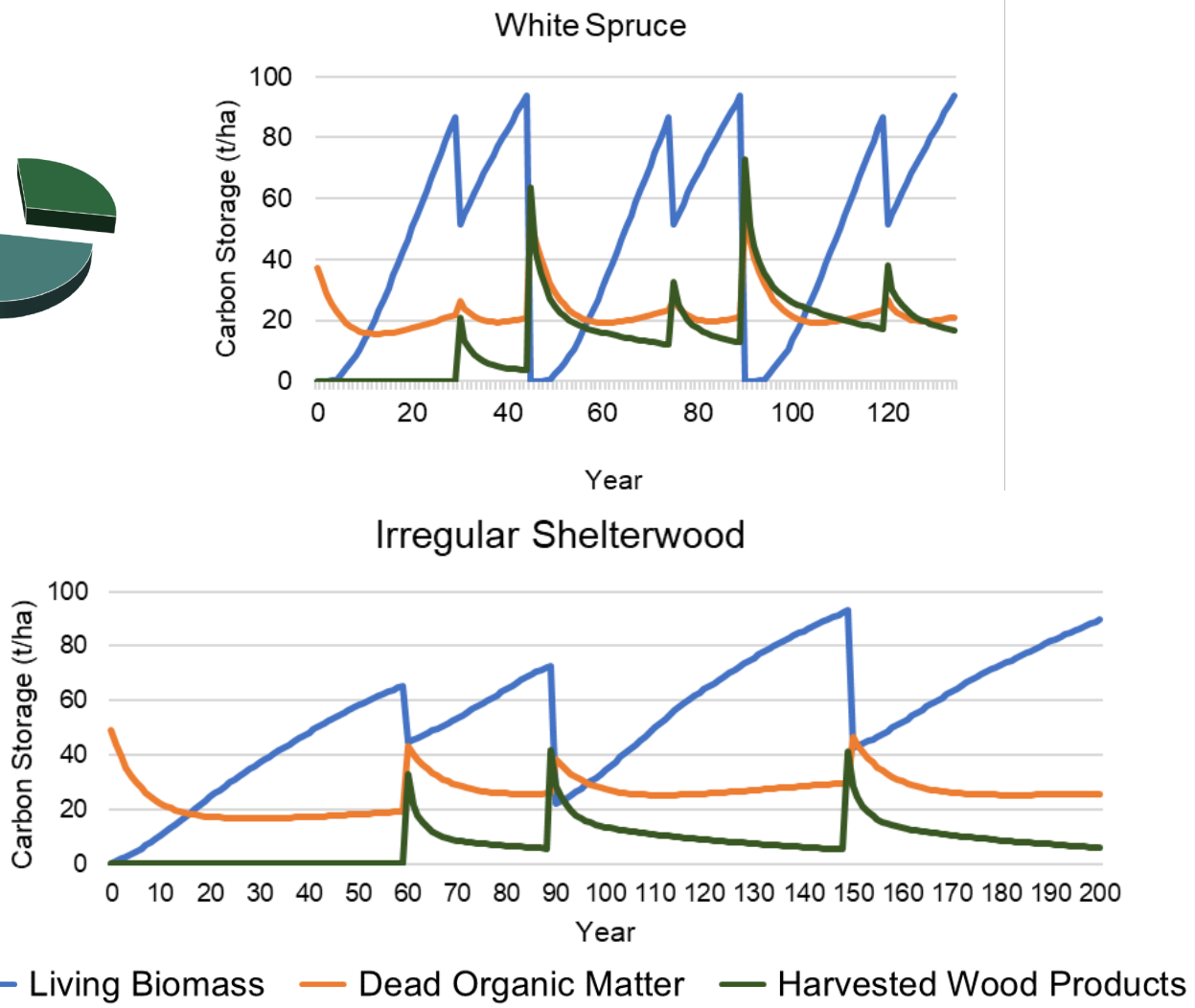
Ecological Forestry and the Triad

- Conservation`
- High production forestry
- Ecological matrix



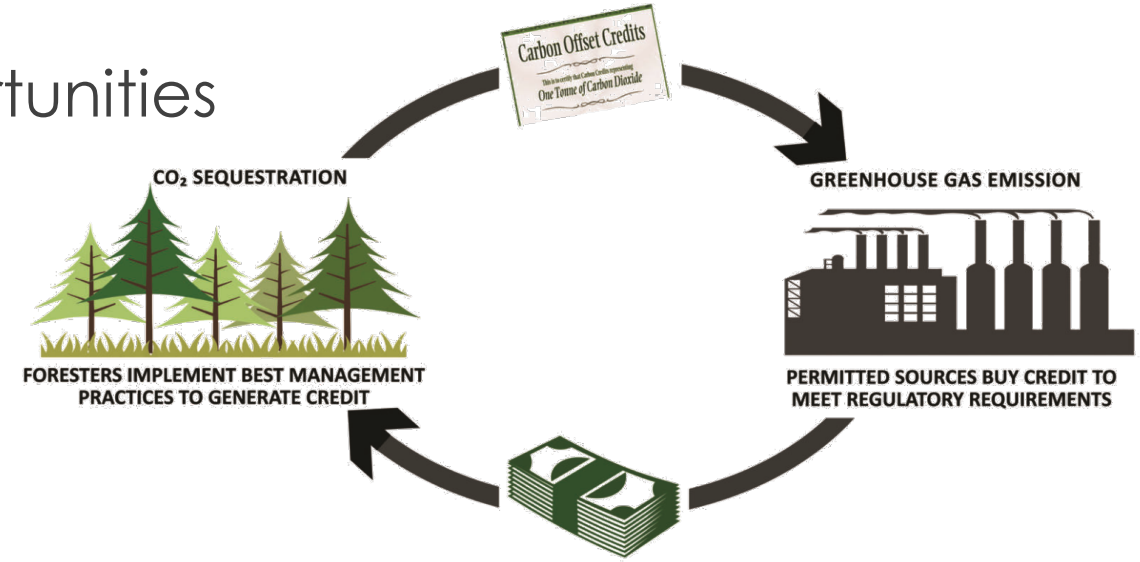
- It plays out at the landscape level and history matters

- Restoration, afforestation, and avoiding deforestation



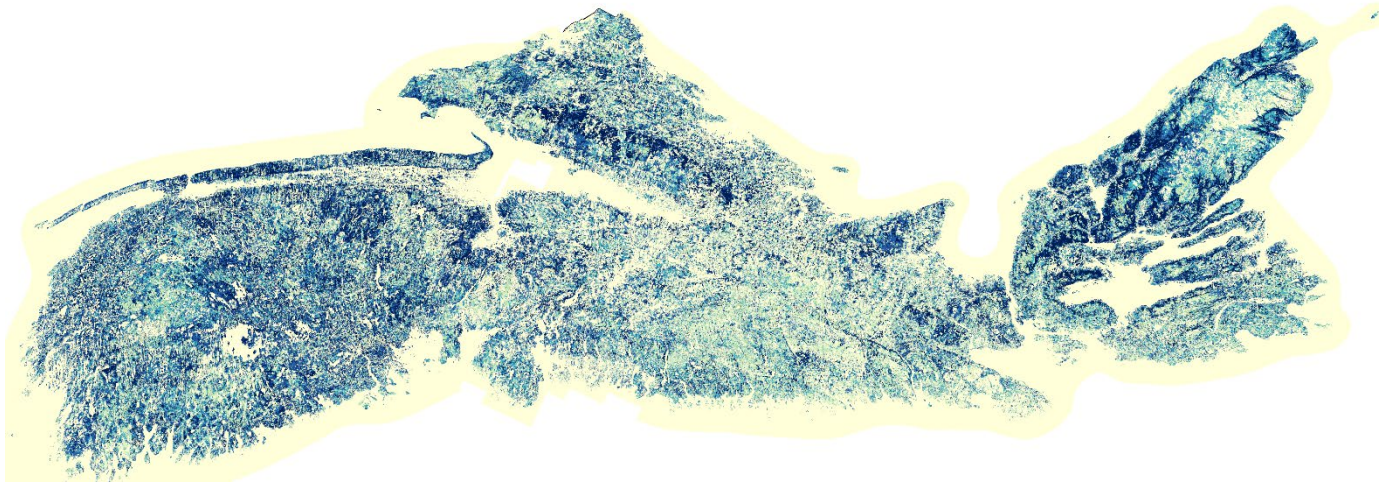
Carbon on the Market

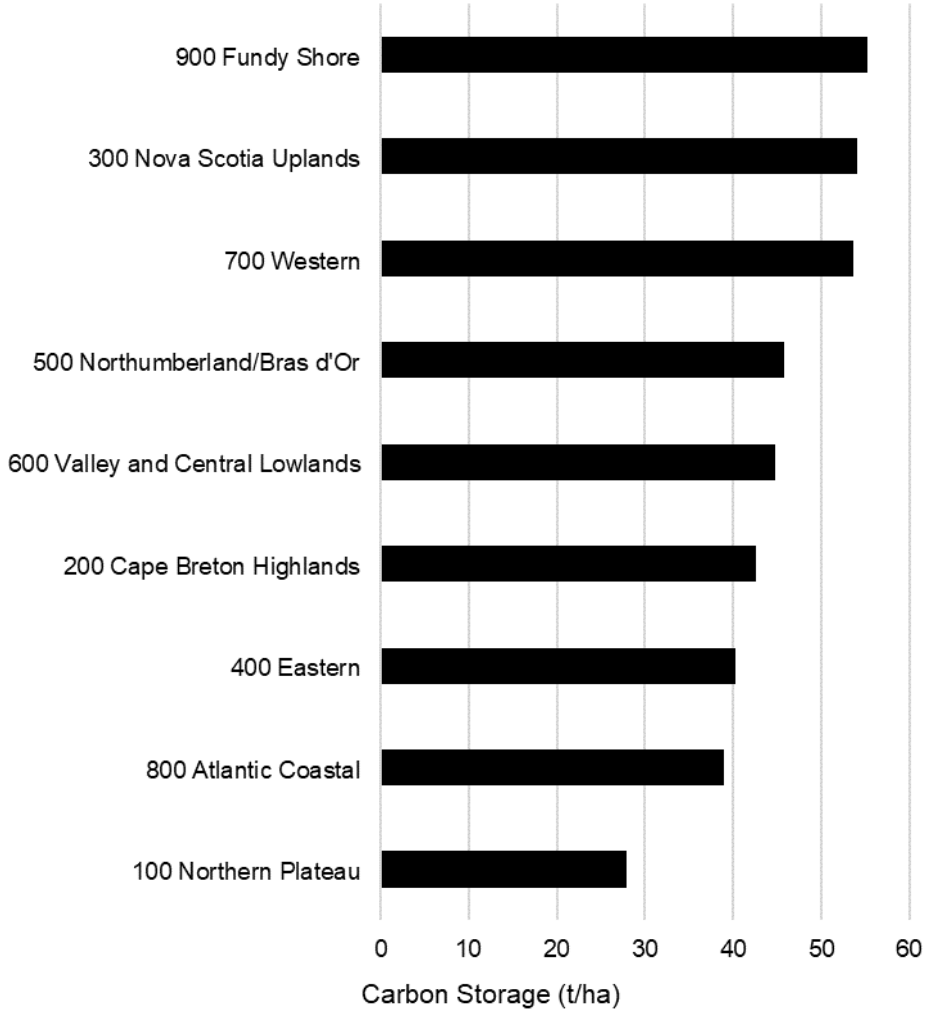
- What carbon markets and opportunities exist for woodland owners?
  - Voluntary markets
  - Provincial market?
  - Federal market – stay tuned…



- Thinking beyond carbon credits
  - Managing low-grade fibre

Carbon That's Alive





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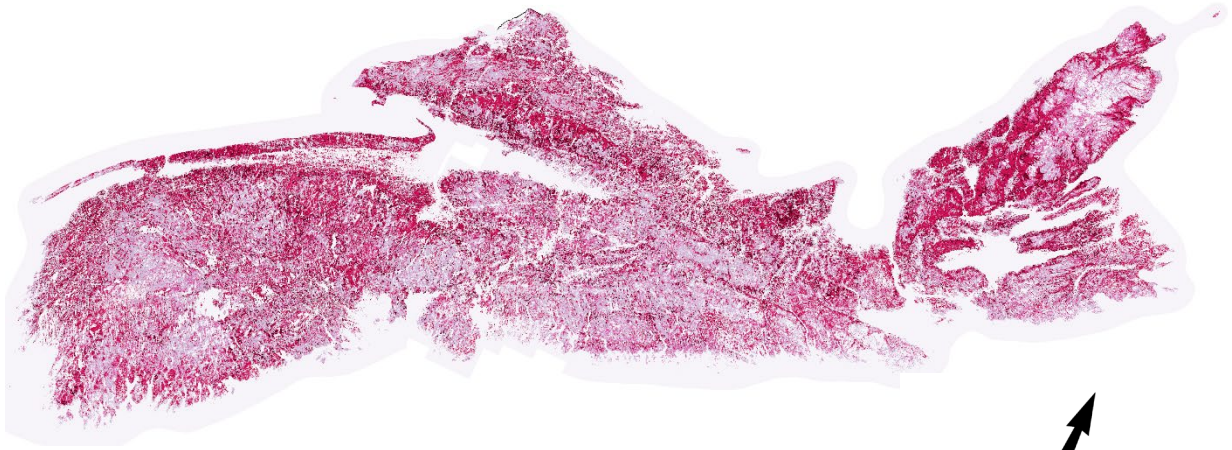
Carbon That's Dead



390 Mt of CO_2

2,042 Mt of CO_2

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Carbon That's Stuff

PRODUCT	Percent of Total Harvest	Hardwood m^3 solid	Softwood m^3 solid	Total m^3 solid
Firewood	2%	60,432	301	60,733
Fuelwood	2%	50,808	14,699	65,507
Energy Wood	5%	69,942	62,355	132,297
Posts/Rails, House Logs	<1%	-	1,165	1,165
Pulpwood	27%	247,872	455,727	703,599
Studwood/Sa				
OSB Wood/Ve				
TOTALS				

Forest Science, 2023, **XX**, 1–13
https://doi.org/10.1093/forsci/fxac060
Advance access publication 2 January 2023
Research Article

OXFORD

SAF

Forest Management

Life-Cycle Greenhouse Gas Emissions from Forest Bioenergy Production at Combined Heat and Power Projects in Nova Scotia, Canada

James W.N. Steenberg,[1,*] Jérôme Laganière,[2] Nathan W. Ayer,[3] and Peter N. Duinker[4]

Solid Wood Products:

376 kt of CO_2

Pulp and Paper Products:

917 kt of CO_2

Energy Products / Waste:

463 kt of CO_2

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Thank You
Comments & Questions?

Contact: james.steenberg@novascotia.ca

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