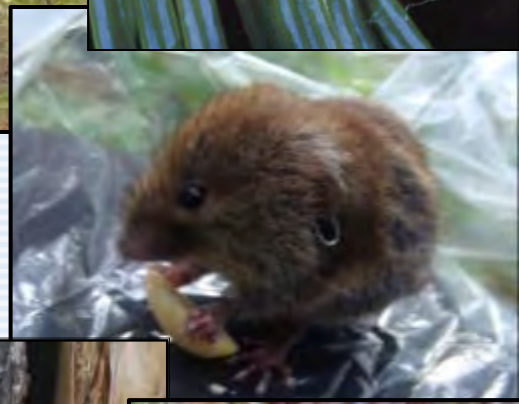
Ecological research to empower forest management: spruce budworm, carbon modeling, and conservation value of plantations



David MacLean

University of New Brunswick

UNB
UNIVERSITY OF NEW BRUNSWICK

NSERC CRSNG

IRVING

Outline

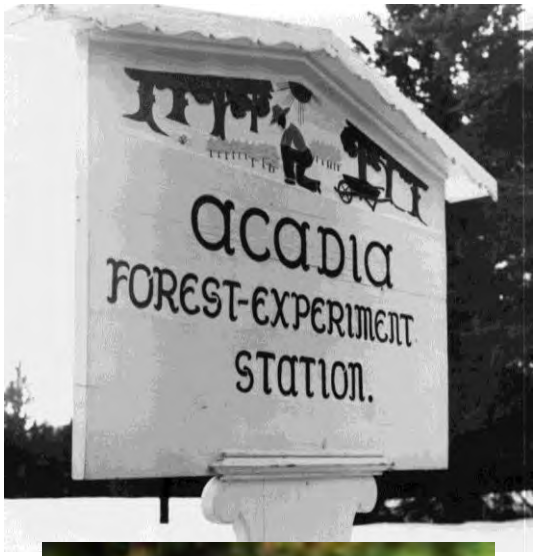
1. **My background & training…**
2. **New Brunswick forests & forestry**
3. **Three research topics/projects:**
   - Spruce budworm & early intervention project
   - Carbon in forests and forest products
   - Manipulating intensively managed spruce plantations to increase conservation value
4. **Effective university/industry collaboration**

Summer student – 1970 Green River


Gordon Baskerville

Summit Depot Research Station - Laboratories, offices, and living quarters for the Green River Project

Summer student – 1971-72
Acadia Forest Experiment Station




Don Fowler


Black spruce

Graduate student – PhD UNB 1973-78

Nutrient accumulation for postfire jack pine and hardwood succession patterns in New Brunswick

DAVID A. MACLEAN AND ROSS W. WEIN

Department of Biology, University of New Brunswick, P.O. Box 4400, Fredericton, N.B., Canada E3B 5A3

Can. J. For. Res. ***7:*** *562-578. (1977)*

SIMULATION OF WILDFIRE EFFECTS ON THE NITROGEN CYCLE OF A *PINUS BANKSIANA* ECOSYSTEM IN NEW BRUNSWICK, CANADA

DAVID A. MACLEAN * and ROSS W. WEIN

Department of Biology, University of New Brunswick, P.O. Box 4400, Fredericton, N.B. E3B 5A3 (Canada)

Ecological Modelling ***10:*** *167-192. (1980)*

Ecological modeling

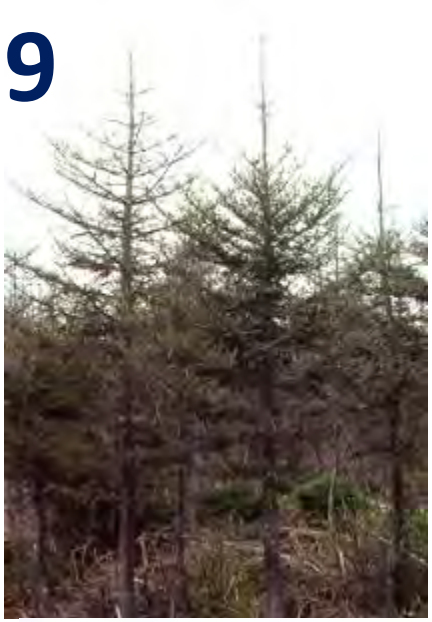
- Institute of Resource Ecology, UBC -- 1976-77
- Baskerville-Holling spruce budworm modeling
- Resilience, ecological economics, adaptive management…
- Post-doc UBC with Dr. J.P. Kimmins, FORCYTE model beginning


C.S. 'Buzz' Holling

A dynamic model of growth in defoliated fir stands

G. BASKERVILLE[1] AND S. KLEINSCHMIDT[2]
Faculty of Forestry, University of New Brunswick, Fredericton, N.B., Canada E3B 5A3

Research Scientist – CFS AFC 1978-99



Dean of Forestry, UNB 1999-2009

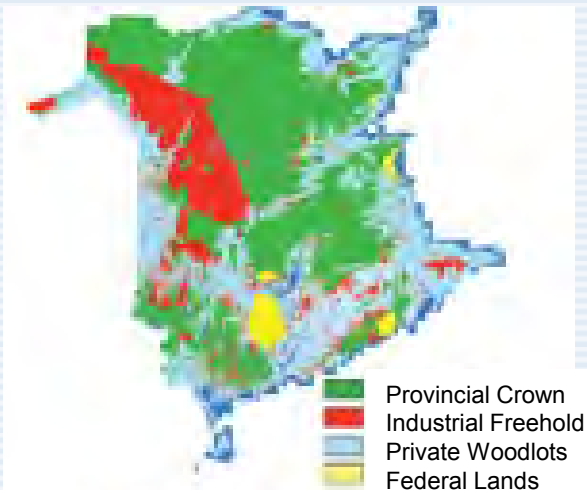
UNB
UNIVERSITY OF NEW BRUNSWICK

Graduate students mentoring


MacLean graduate students 2007

- **Advice?**
  - Be passionate about your project
  - Become the expert
  - Emulate good practices
  - Learn to be efficient
  - Present, publish
- **Thesis/manuscripts**
  - Objectives, questions
  - Write early; it's where things really come together
  - Focus on the 'keeper' Figs. & Tables
  - Point-form results

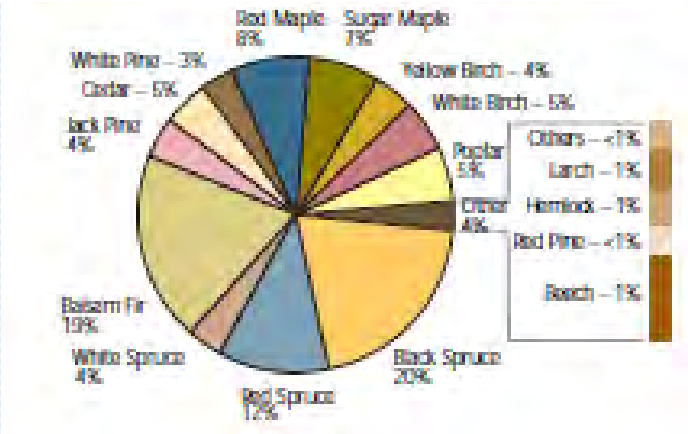
A snapshot of forests in NB



Forest ownership in New Brunswick

- **85% forested**
  - 50% Crown
  - 30% private woodlots
  - 20% industrial freehold
- **68% softwood (evergreen)**
  32% hardwood (deciduous)
- **Diverse tree species**
  - 36% spruce (white, red, black), 19% balsam fir (55% vs 54% 1938, 61% 1958)
  - ~5% each cedar, jack pine, white pine
  - 8% red maple, 7% sugar maple, ~5% ea white birch, poplar, 4% yellow birch
  - ~ 4% total: hemlock, red pine, beech, larch, oak, butternut, ash, elm

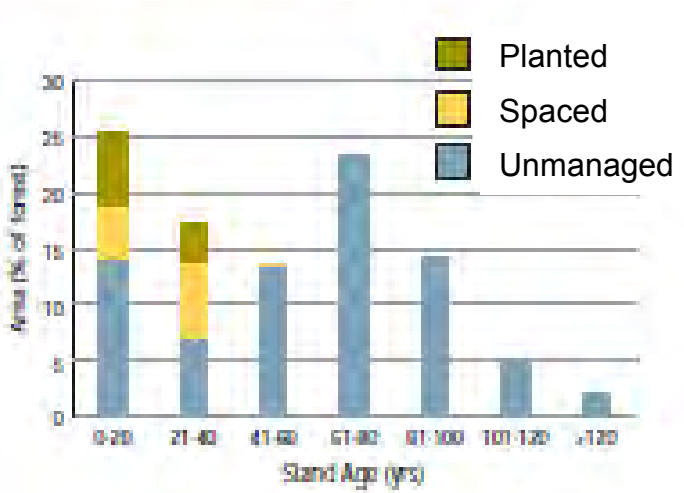
Species composition (% volume) of Crown forest



Erdle et al. 2008 NB Task Force on Forest Diversity & Wood Supply

New Brunswick forests

Age-class distribution (% area)

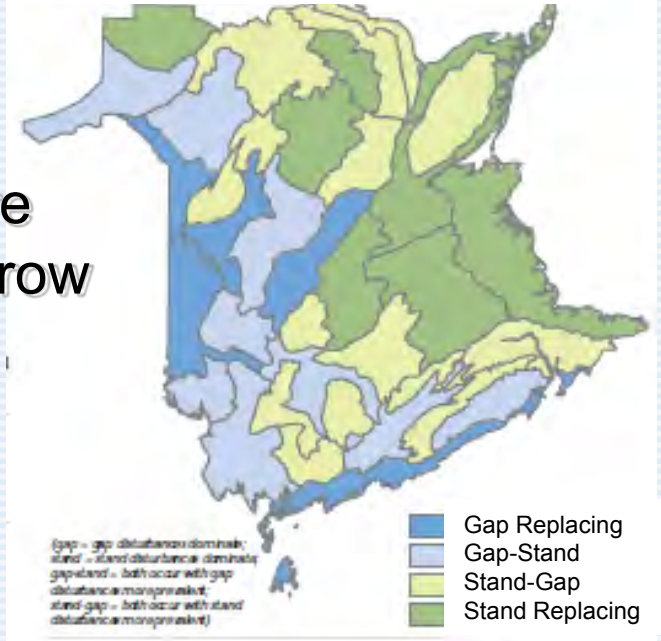


Age-class distribution

- Most Crown forest 0-20 or 61-80 yrs old
- ~40% < 40 yrs; >1/2 planted or spaced

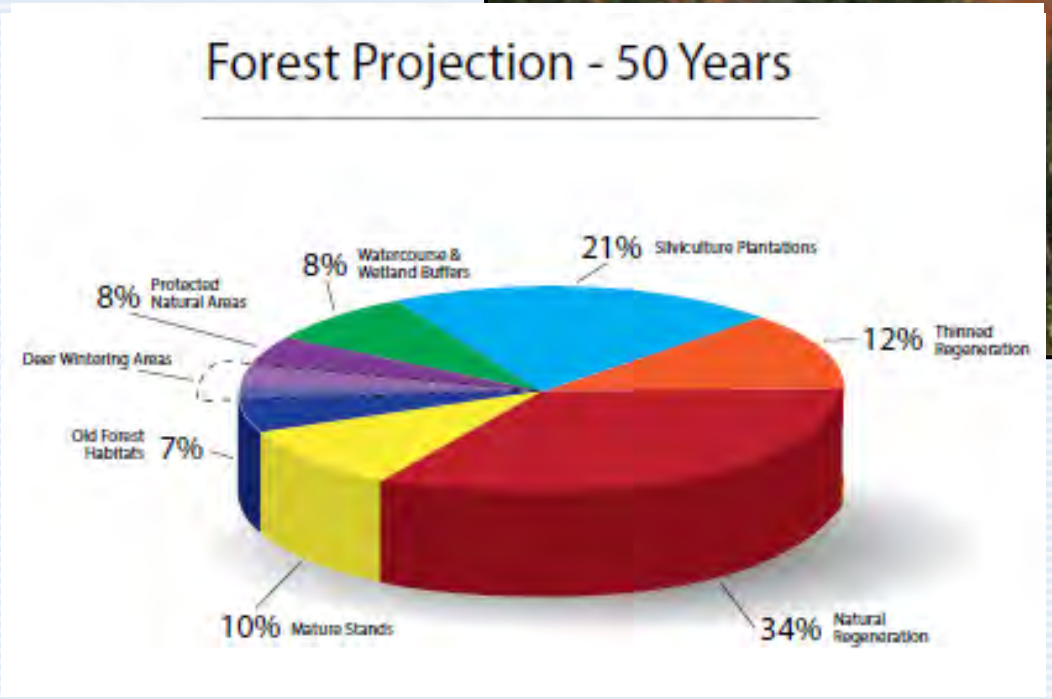
- **Natural disturbances**
  - Stand replacing: **spruce budworm** & fire
  - Gap-replacing: old age, disease, windthrow
  - Gap-stand & stand-gap mixes

General occurrence of natural disturbance types in NB



Forestry in NB

- **The most forestry-dependent province**
  - **Largest economic sector in NB at 3.5% of GDP**
  - **Highest per capita forest products exports**



Understanding stand dynamics underpins effective SFM

- **Stand dynamics with & without natural disturbances**
- **Sustainable Forest Mgmt (SFM) balance should include:**
  - maintenance of natural processes, habitats & populations
  - conservation and protected natural areas
  - consideration of climate change
  - ecosystem goods and services as well as timber, recreation & habitat values
- **Is there room for intensive forest mgmt.?**
  - forest zoning approaches to increase the flow of certain values from certain areas
- **Learning: research, questions, experiments, monitoring**

1. Spruce budworm

Quebec 2011

New Brunswick – 1956

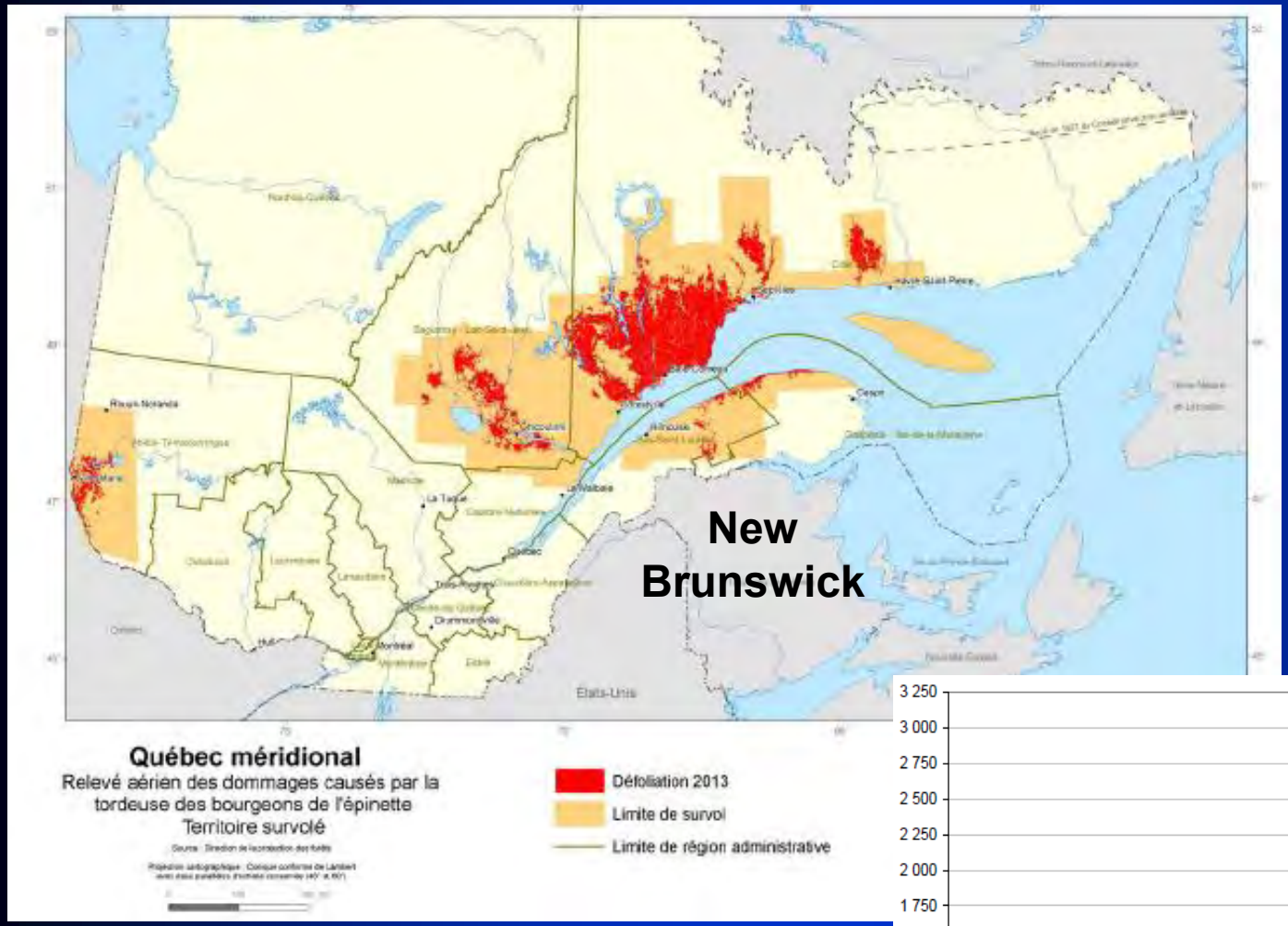

NBDNR

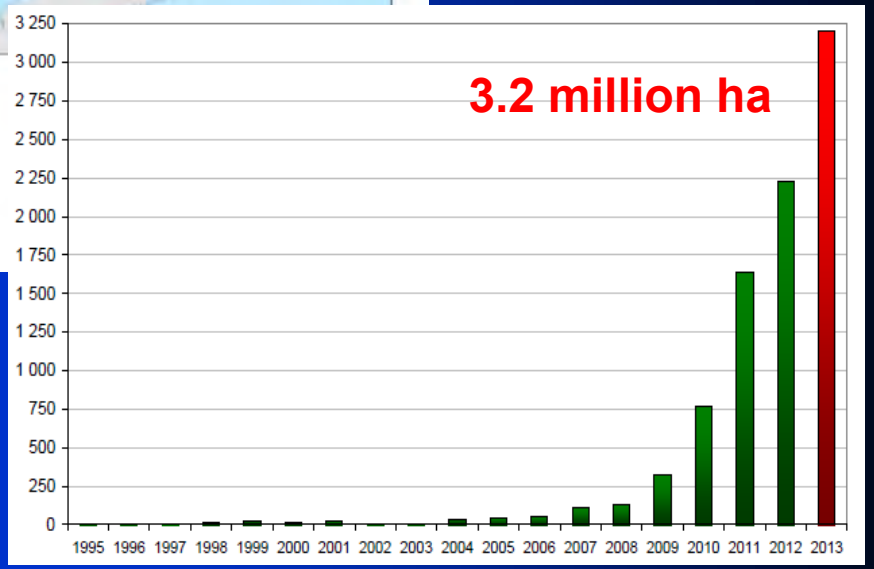

J.D. Irving Limited


NBDNR

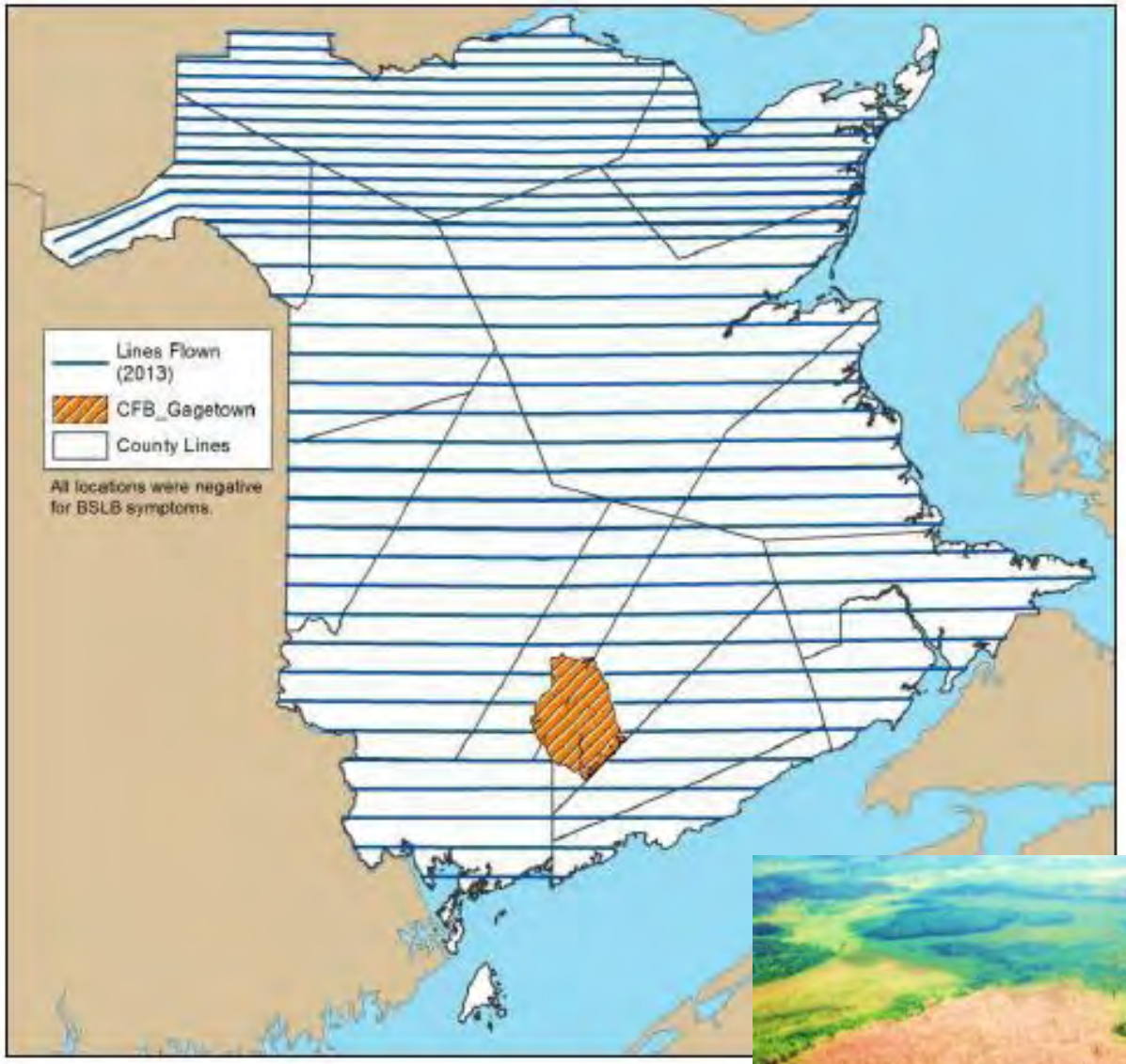

J.D. Irving Limited

SBW defoliation in Quebec 2013






Moderate defoliation only
25km from NB border
© 2013 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth
Imagery Date: 4/9/2013



2013 Aerial Survey

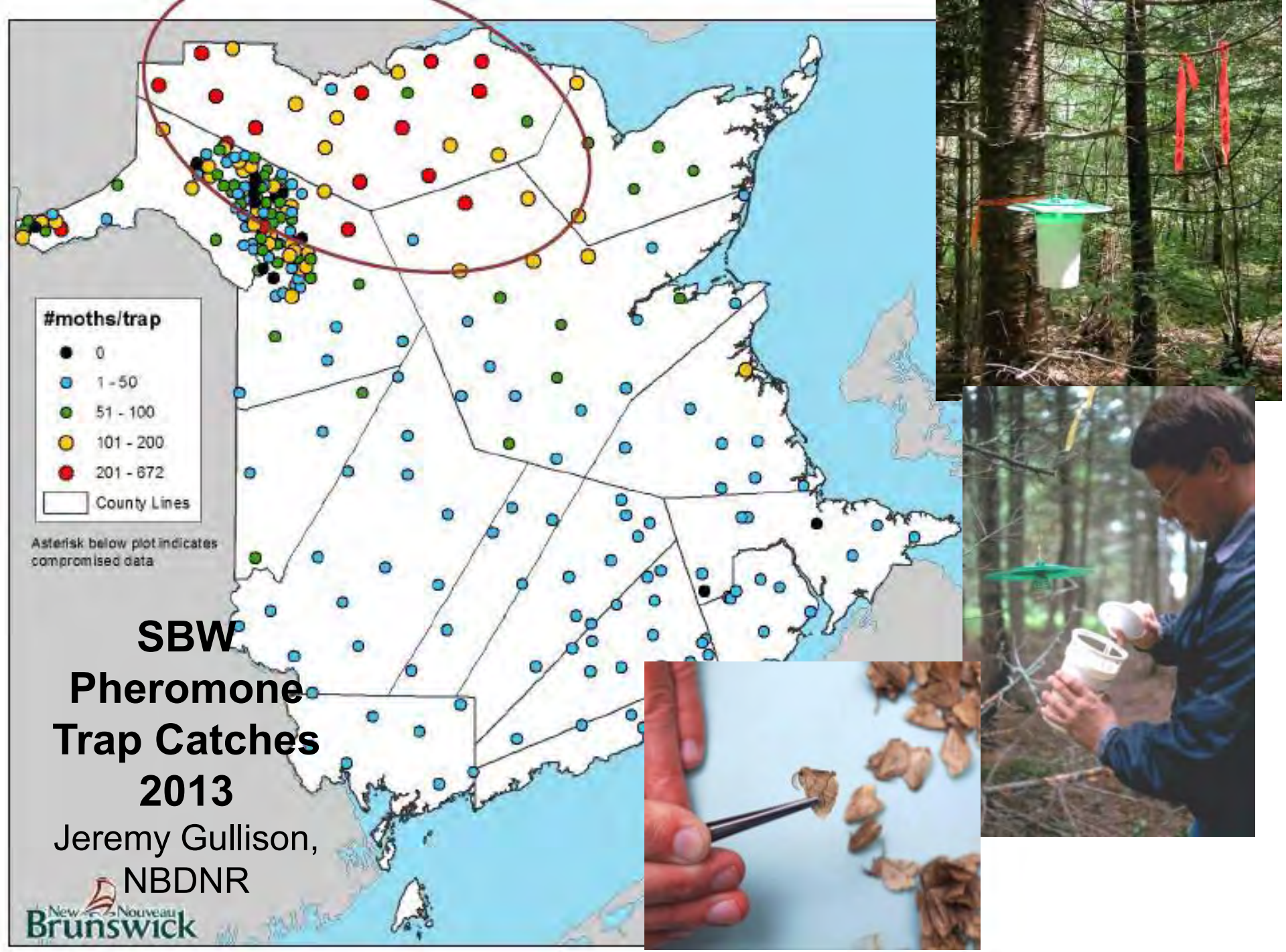
50 survey hours

June 25- July 7th

No SBW defoliation observed

Jeremy Gullison, NBDNR

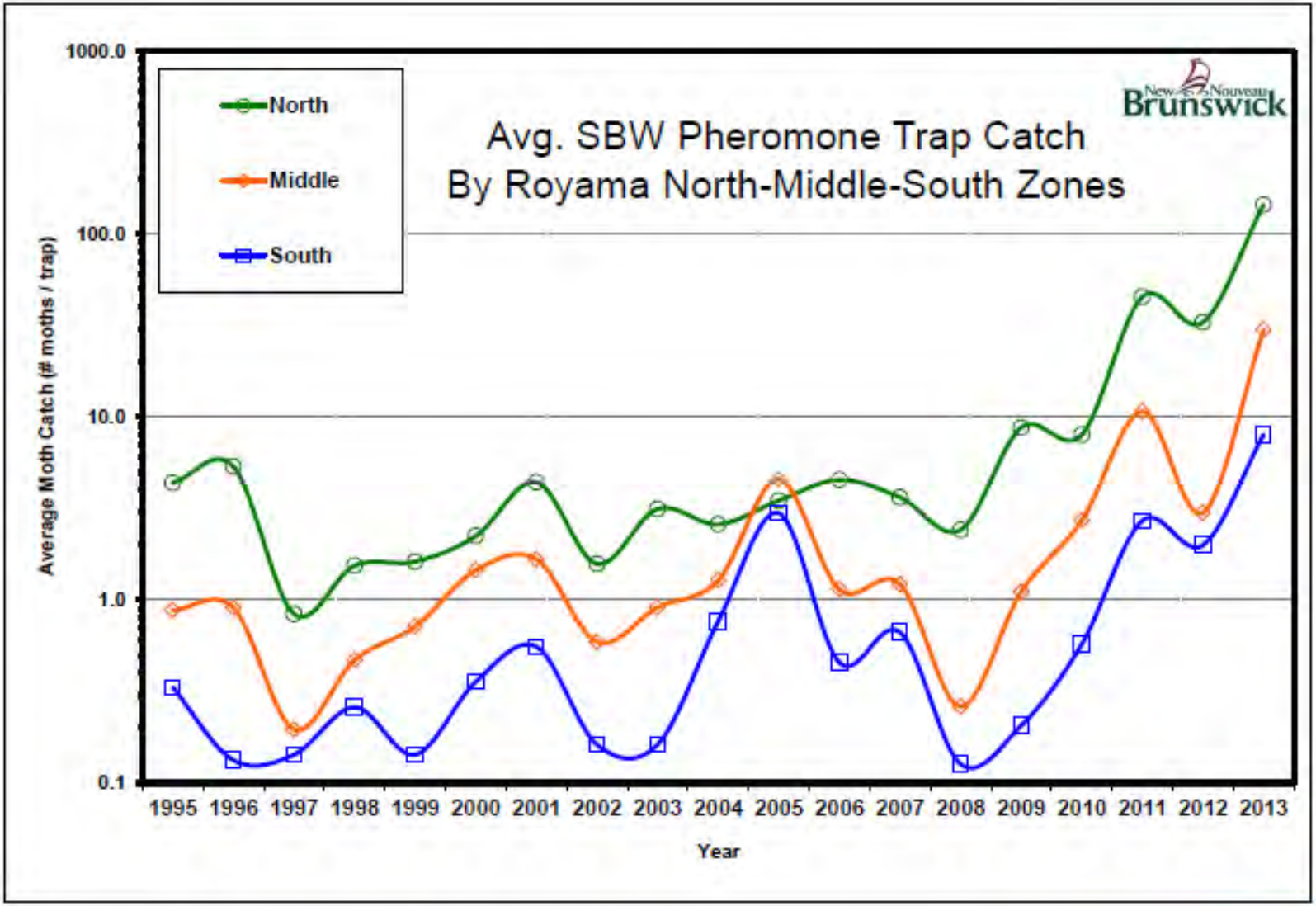
New Nouveau Brunswick



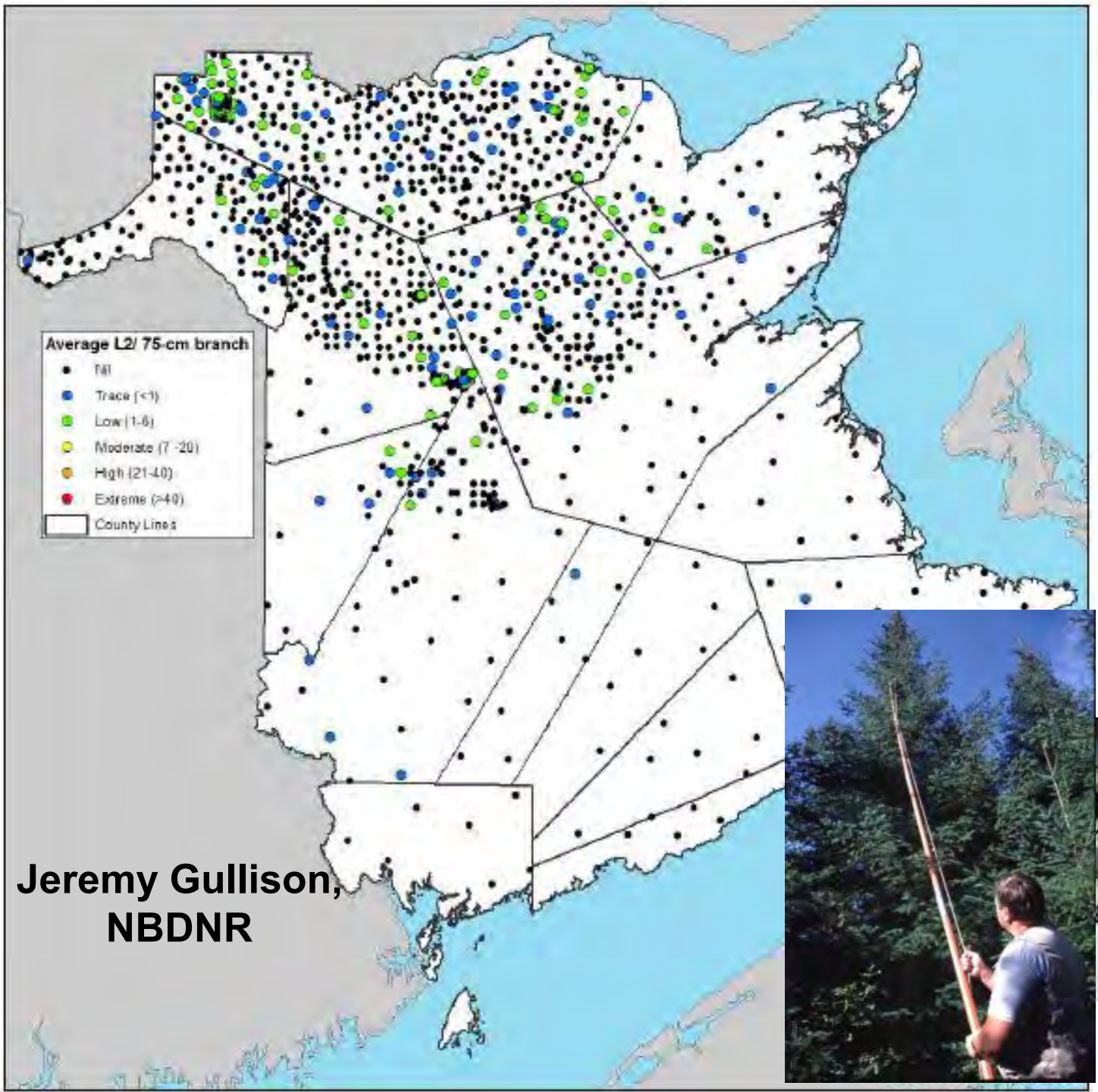
SBW Pheromone Trap Catches 2013

Jeremy Gullison, NBDNR

New Nouveau Brunswick



Jeremy Gullison, NBDNR



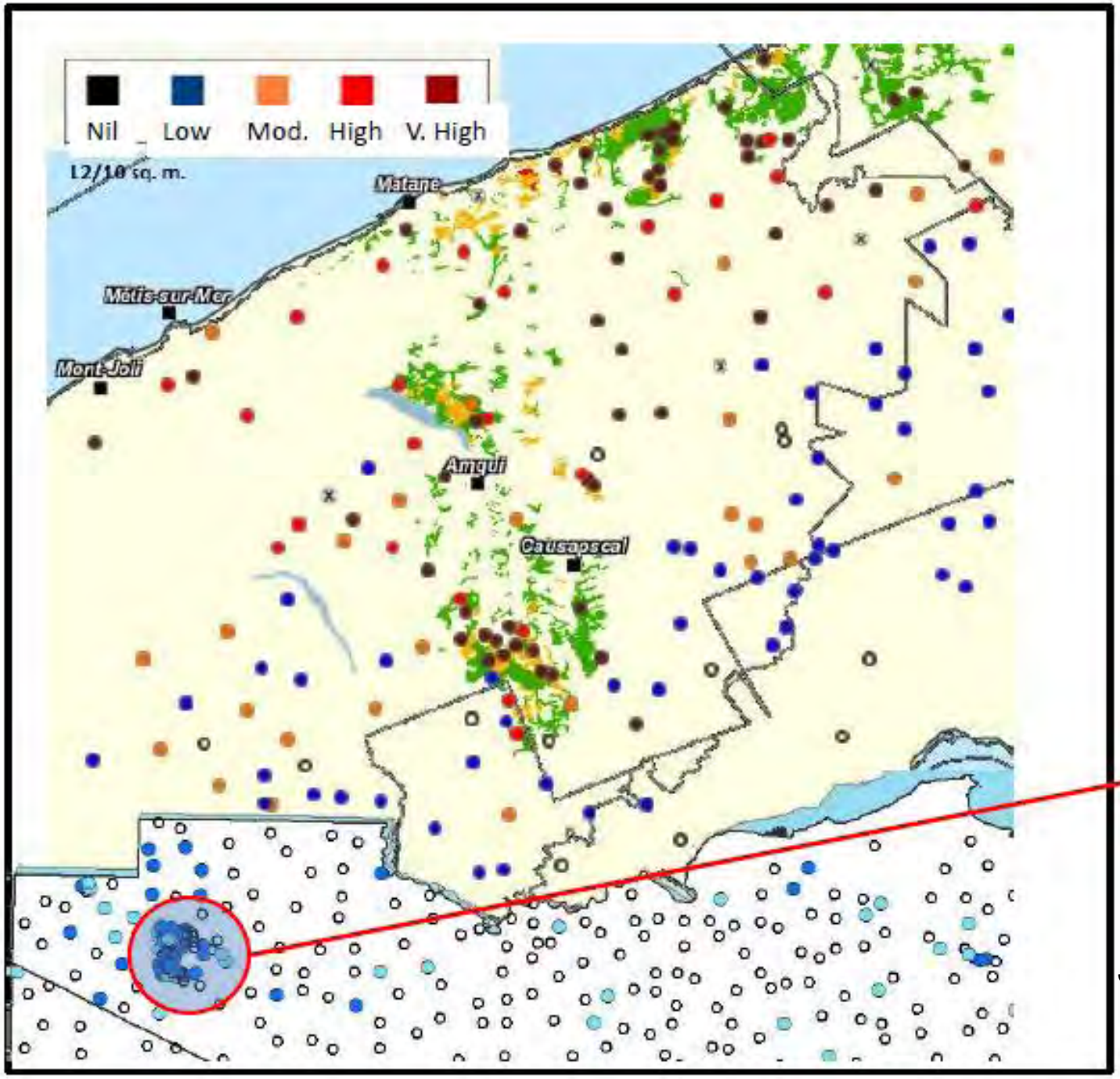
2013 L2 Survey
(Overwintering Larvae)

Collaboration between DNR, FPL & Crown Licensees

1,136 locations

17% of plots positive for SBW

Jeremy Gullison, NBDNR



2014 Quebec & NB Population Forecast

(2013 L2 Survey)

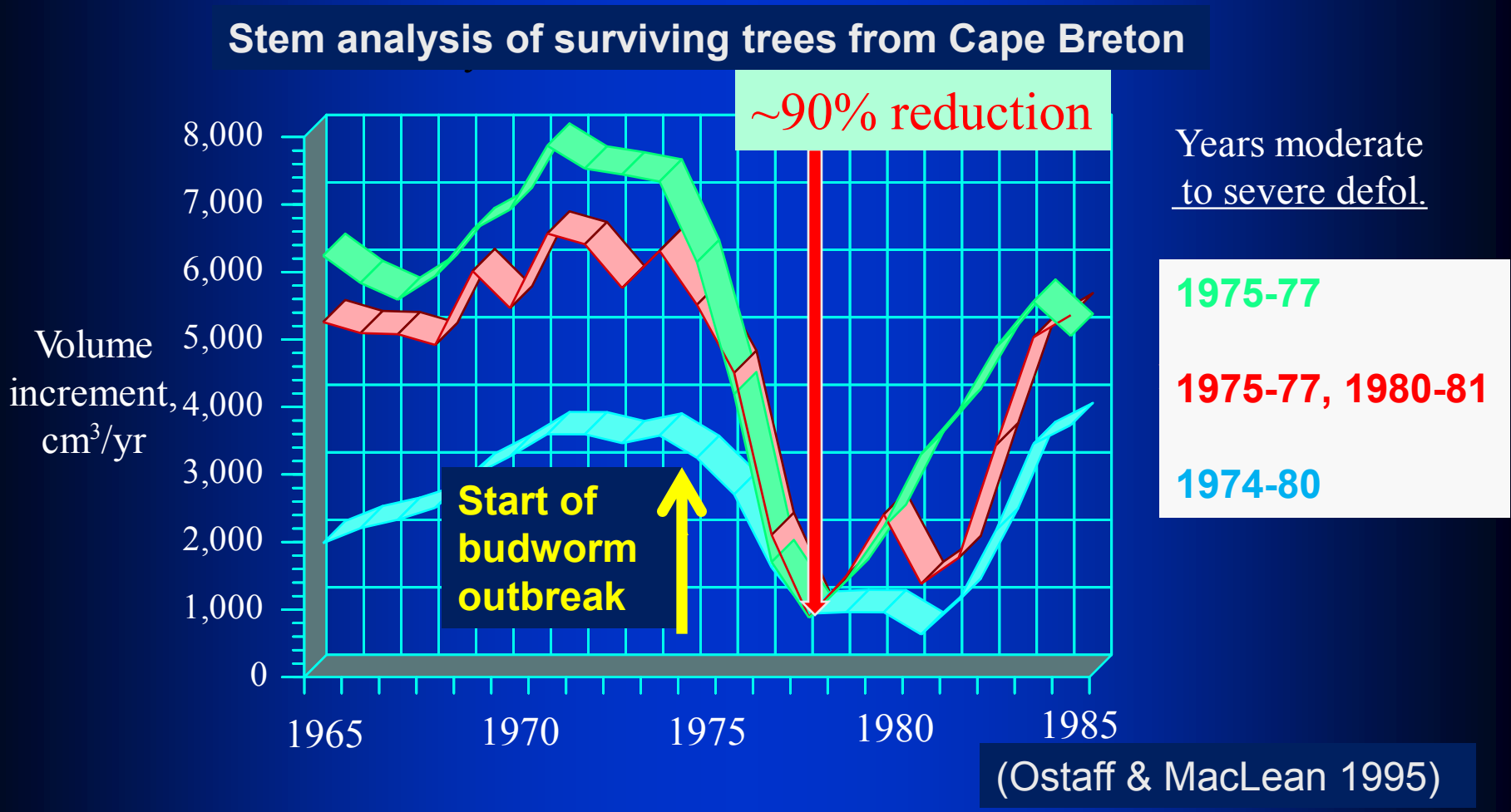
Area of Interest

62% Positive

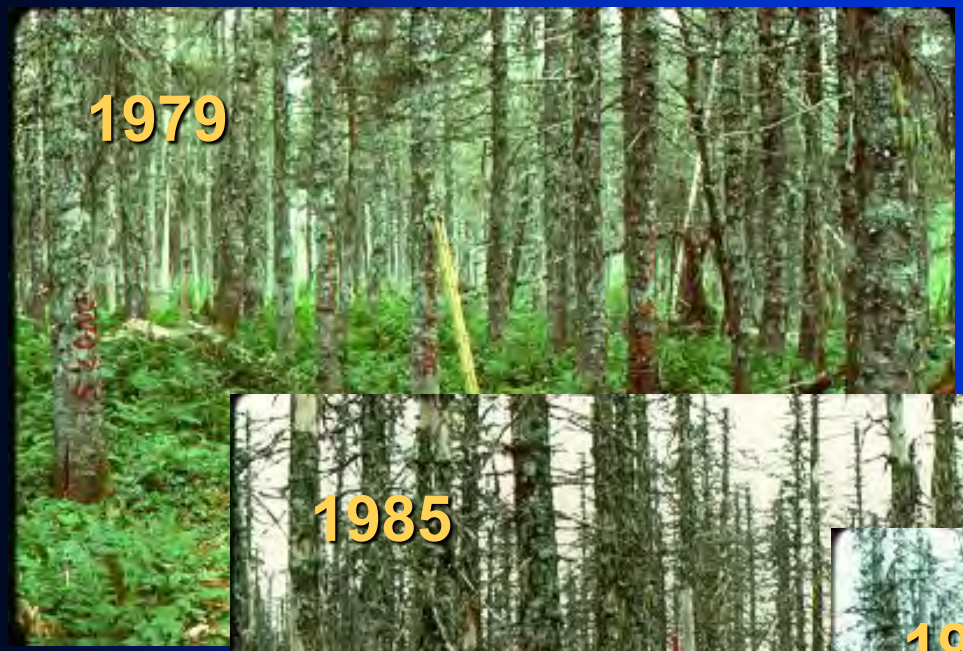
Jeremy Gullison, NBDNR

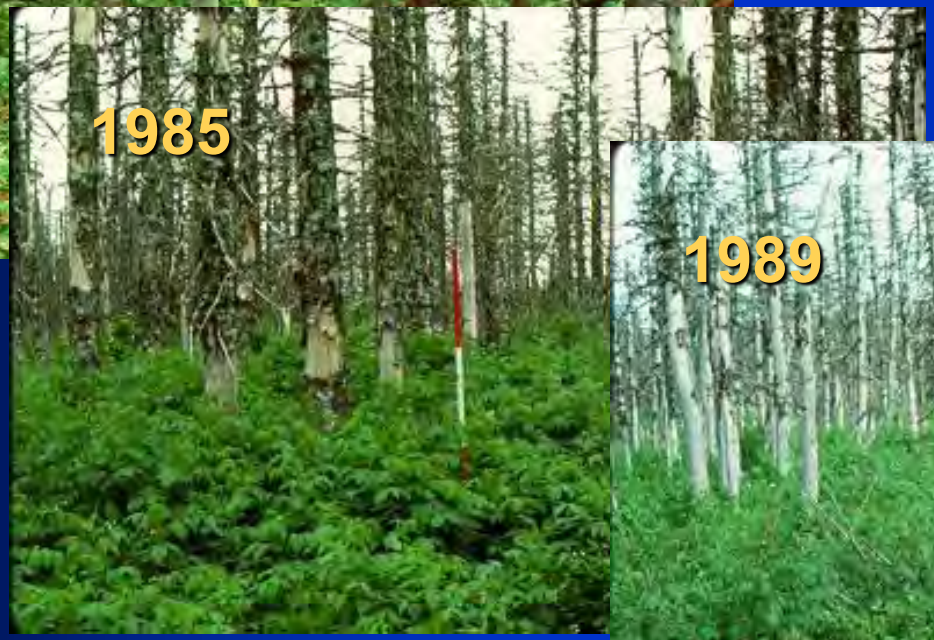
Serious Damage to Forest Inventory

Growth loss during a budworm outbreak



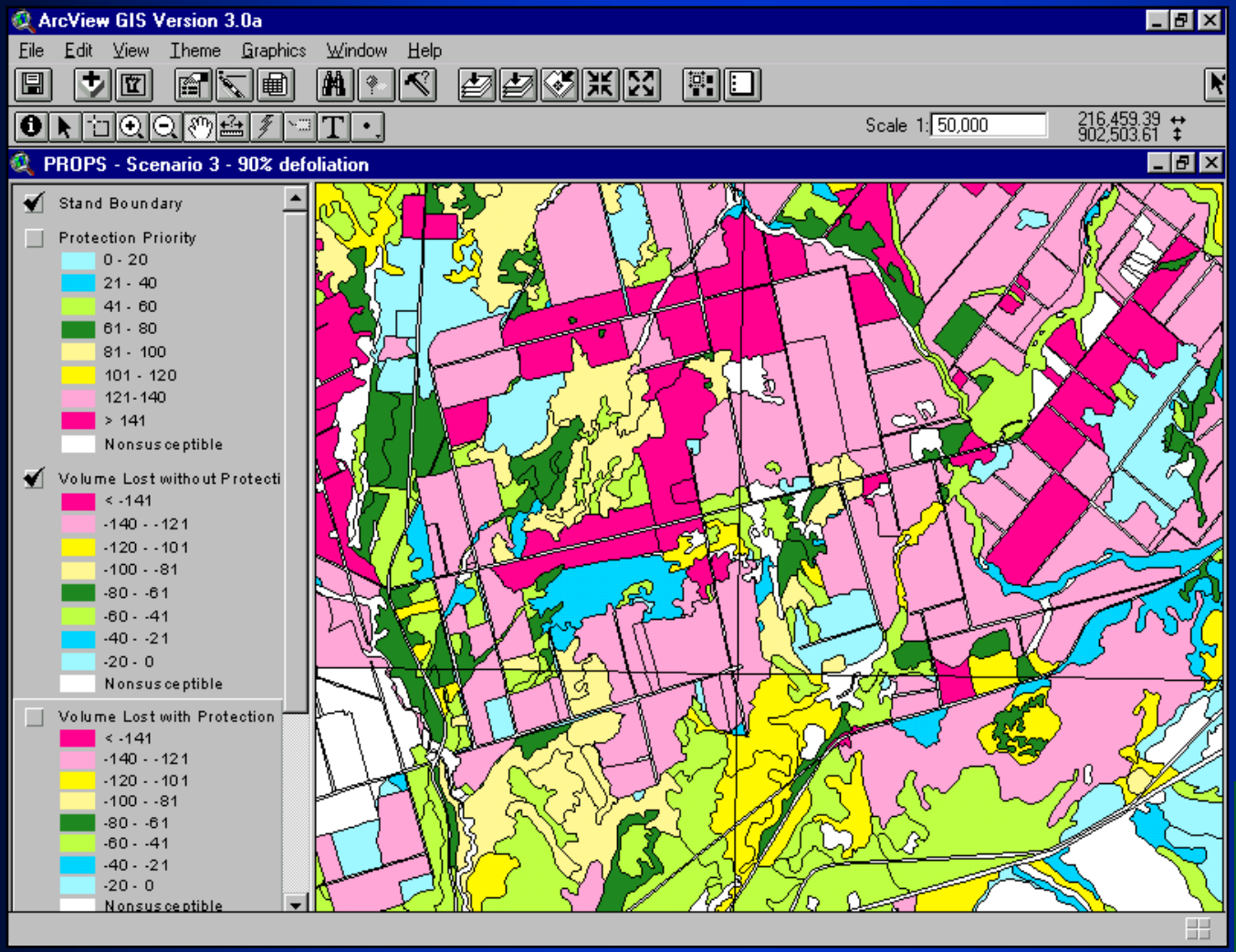
Potential of NB SBW Outbreak?





Unprotected Cape Breton plot in a mature fir stand

Spruce Budworm DSS



Volume loss m^3/ha

- 0-30
- 31-60
- 61-90
- >91

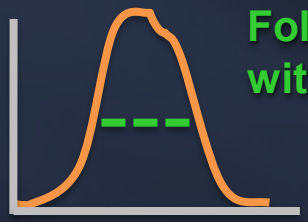
(MacLean et al. 2001. Can. J. For. Res.)

Implemented for all forest in NB, used in SK, tested in AB, ON, QC, ME; ongoing projects in MB, NS, NL

Forecasting *stand impact* for each defoliation & mgmt. scenario

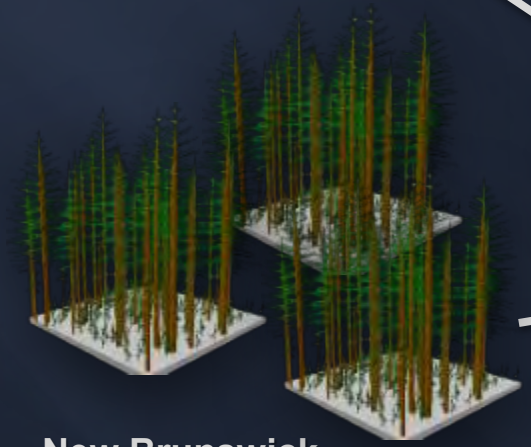
Expected Host % Defoliation

% current defoliation by host



Foliage Protection with Insecticide

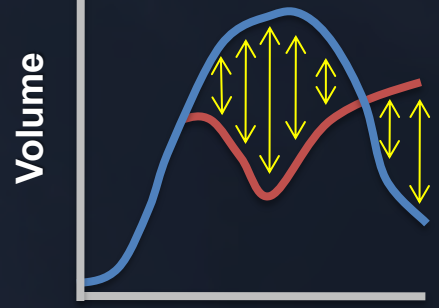
Time



New Brunswick Stand Tables

STAMAN

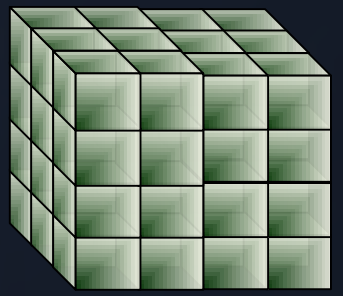
New Brunswick's stand growth model



Mean % volume reduction
Mean % periodic mortality

Stand Impact Matrix

20 Stand Type Classes
- % host species
- Immature and mature
- Managed or not

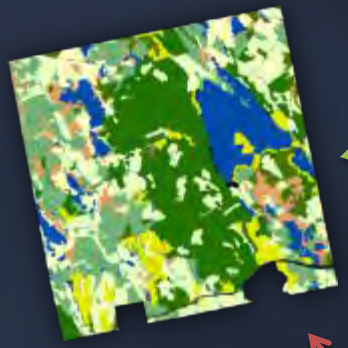


Time

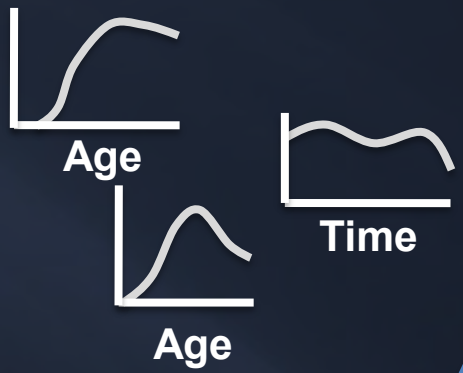
Defoliation Scenario

Forecasting *forest impact* for each defoliation & mgmt scenario

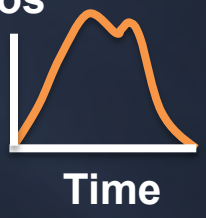
GIS Stand Inventory (area, types, age)



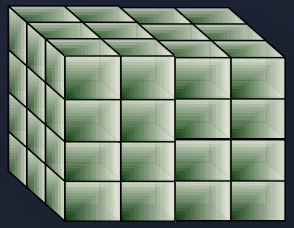
Stand Volume Host Yields



Defoliation scenarios



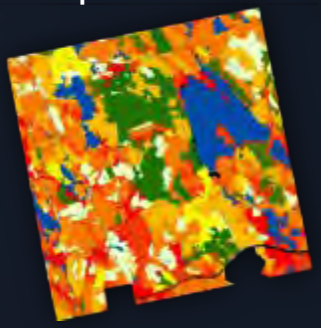
Stand Impact Matrix

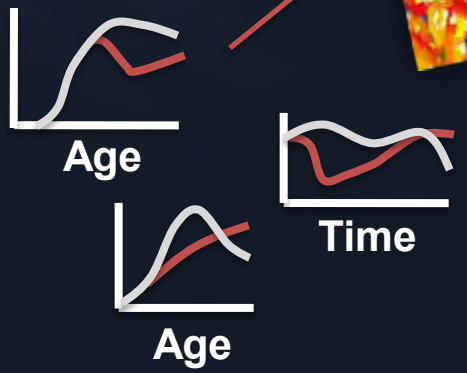


Microsoft Access Geo-database Or Woodstock Model

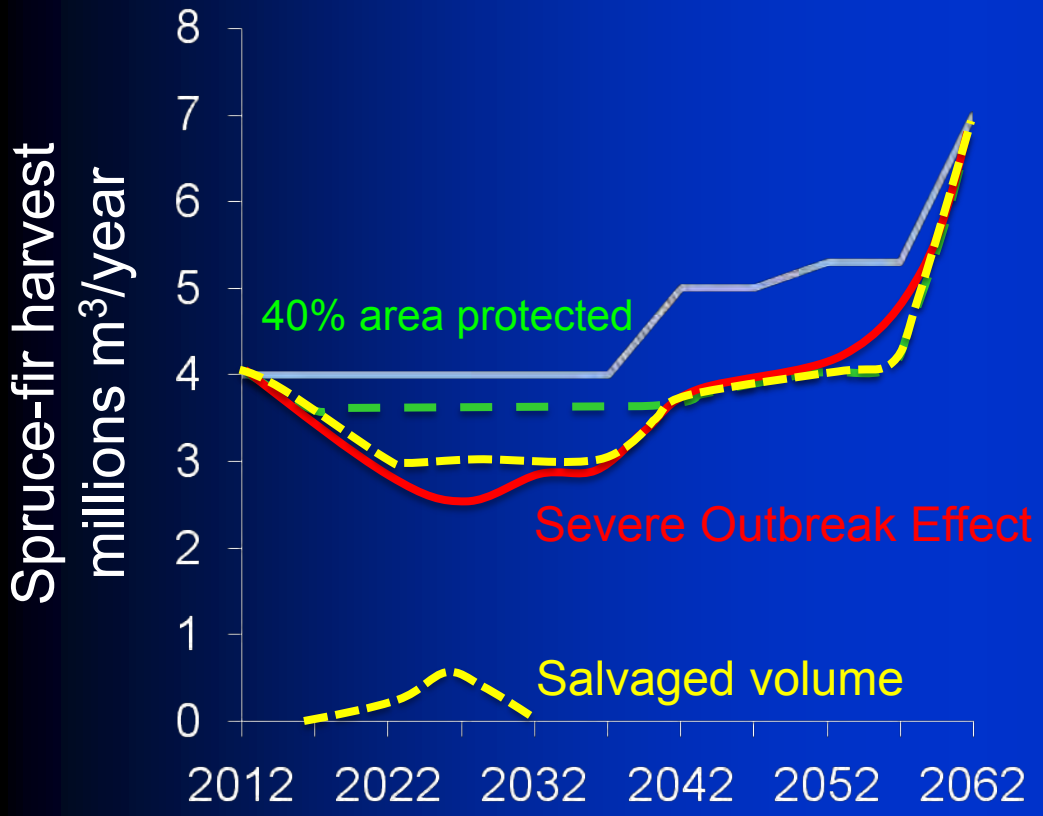
Stand Impact Results:

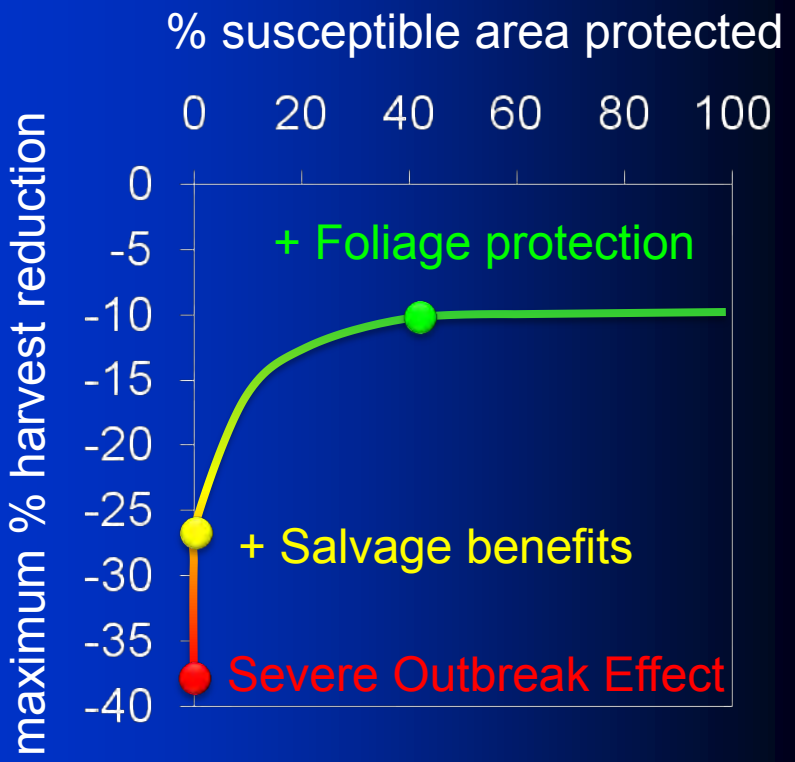
- Maps of spruce-fir volume impact for future time periods.
- Forest level spruce-fir growing stock impact.





Sensitivity of AAC in NB to SBW, salvage, & protection?





Hennigar et al. 2013 For. Chron.

Protecting our Forests
From the Next Spruce Budworm Infestation

POTENTIAL SOCIO-ECONOMIC IMPACTs

Follow-up from a November 7, 2013 Presentation to the Atlantic Conservative Caucus

November 21, 2013

TWIN RIVERS PAPER COMPANY

ADITYA BIRLA AV GROUP

Fornebu Lumber Woodlands

IRVING J.D. IRVING, LIMITED

NORTHERN PULP NOVA SCOTIA CORPORATION A PAPER EXCELLENCE COMPANY

ACADIANTIMBER

Forest Products Association of Nova Scotia

New Nouveau Brunswick CANADA

New Brunswick Forest Products Association

Association des produits forestiers du Nouveau-Brunswick

Economic Impact of the Last Outbreak

- During the peak of the last outbreak (1977-1981), SBW defoliation caused an estimated timber volume loss of **44 million m^3 per year** in Canada or **30%** of the total Canadian harvest in 2012.

- Without spraying on the Cape Breton Highlands, mortality in spruce-fir forests was **over 85%.**

- To prevent extensive tree mortality in NB an average of **2.0 million hectares per year** were sprayed between 1970-1983 with an average cost of **$7.7 million per year**.

Economic Impact of the Next Outbreak

- A reactive protection strategy on 2 million hectares today would cost between **$90 and $160 million** per year.
- An estimated **harvest reduction of 18% - 25%** is expected without mitigation.
- Potential SBW outbreak scenarios indicate the timber supply reduced by **2.4 – 3.3 million cubic meters per year** in the Atlantic Region.
- **Atlantic Regional direct and indirect economic losses** from a reduction in timber supply could total:
  - **$10.8 Billion** resulting from a **moderate** outbreak
  - **$15.3 Billion** resulting from a **severe** outbreak.

Social Impact of the Next Outbreak

- Jobs will be **negatively impacted** over a period of **30 years.**

- Potential SBW outbreak scenarios indicate the **Atlantic regional direct and indirect job losses** over 30 years in NB, NS, PE and NF could total:
  - **1530 jobs per year on average for 30 years** resulting from a **moderate** outbreak
  - **1870 jobs per year on average for 30 years** resulting from a **severe** outbreak.

- **underestimates job losses** during periods of temporary mill closures or in communities where mills could permanently close due to lack of timber supply.

Social Impact of the Next Outbreak

In a 2007 survey:

- **94%** of New Brunswick respondents **support funding research & development** on pest control.

- **82%** of New Brunswick respondents **support controlling future spruce budworm outbreaks.**

Contents lists available at ScienceDirect

Forest Ecology and Management
257: 1333-1343 (2009)
journal homepage: www.elsevier.com/locate/foreco

Public attitudes about forest pest outbreaks and control: Case studies in two Canadian provinces

Wei-Yew Chang, Van A. Lantz *, David A. MacLean

Faculty of Forestry and Environmental Management, University of New Brunswick, P.O. Box 4400, Fredericton, NB, Canada E3B 6C2

Our "ASK" from the Federal Government:

1. **Supporting an Early Intervention Strategy should be a priority for Natural Resources Canada and CFS-Atlantic.**

2. **Approval of our Early Intervention ACOA Proposal for funding support - $18 million over 4 years ($2 million from industry, $4 million from Provincial Governments, $12 million from Federal Government).**

Strategic Options for SBW?

1. Reactive:

a) After immediate threat or presence of defoliation.

b) Apply insecticide to target areas to reduce damage.

2. Crisis:

a) When it becomes impossible to treat all areas

b) Decision makers balance funds (Quebec)

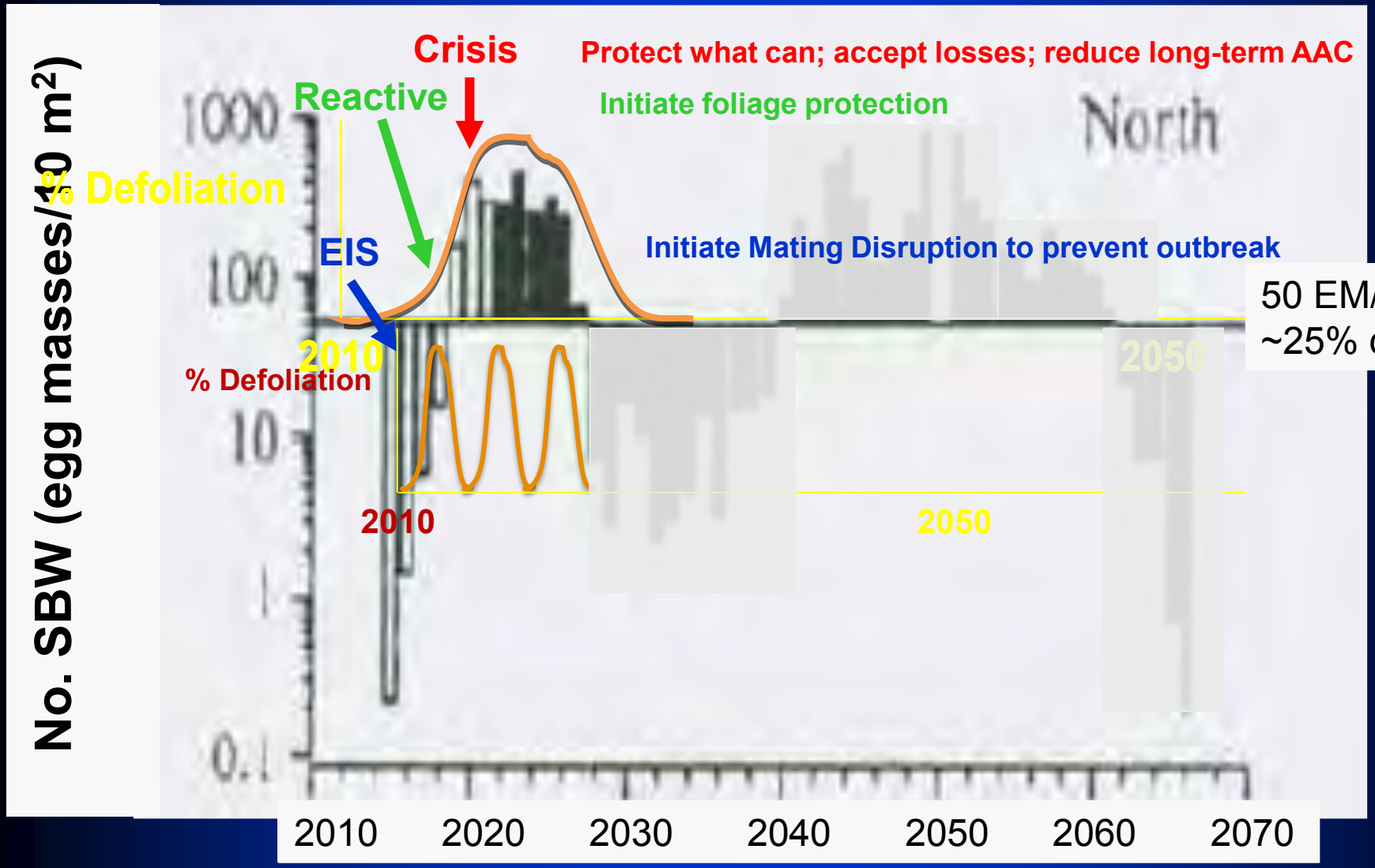
3. Early Intervention Strategy:

a) Suppress the populations before they cause damage?

b) Pesticide or Pheromone application to reduce SBW density

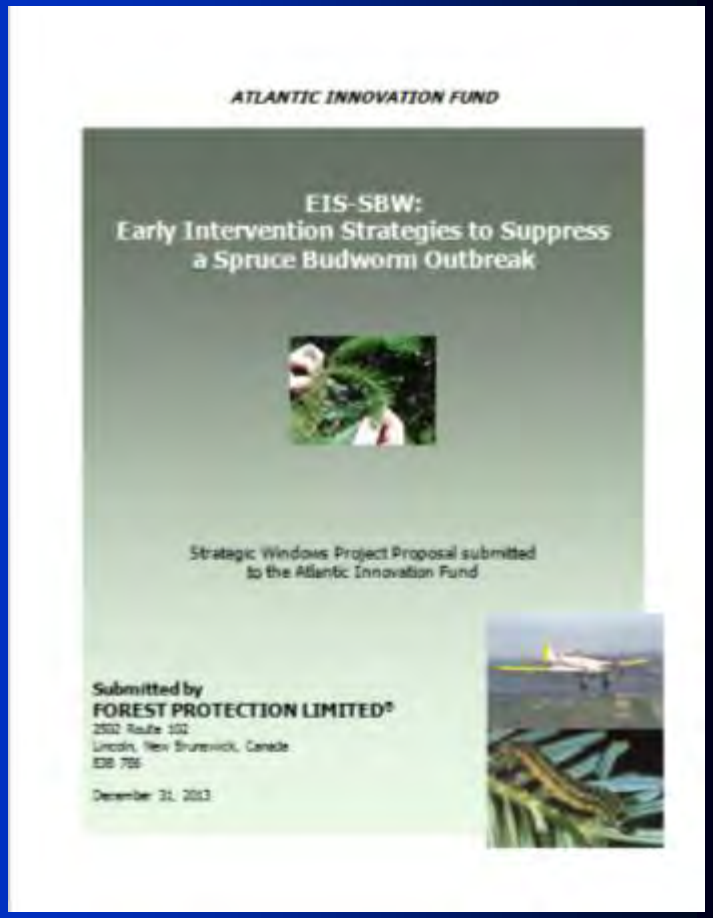
c) Increase predator /parasite impact and/or decrease mating success

Management strategies for coping with the next SBW outbreak



(Royama et al. 2005 Ecology)

4-year Research program to test Early Intervention Strategy against SBW



Cost-shared by federal & provincial governments & industry

1. Intensive monitoring & study of SBW population responses
2. Use *Bt*, Mimic, &/or pheromone to treat rising populations <u>before</u> defoliation in an attempt to prevent outbreaks
3. Test EIS with SBW DSS; economic analyses

Steering Committee

FPL, Industry, CFS, NBDNR, UNB

Dave Davies, FPL Project Lead

Communications Committee

Scientific Project Management Team

Dr. David MacLean, UNB – Science Lead, DSS
Dr. Jacques Régnière, CFS LFC – EIS strategy
Dr. Rob Johns, CFS AFC – EIS trials
Dr. Peter Silk, CFS AFC – Pheromones
Mr. Greg Adams, JDI – Endophytes
Mr. Peter Amirault, FPL – Aerial application
Ms. Wendy Flowers, FPL – Project Admin.

Other Research Team Members

CFS AFC: Kathy Beaton, Eldon Eveleigh, D. Gray, G. Forbes, G. LeClair , P. Mayo
CFS LFC: Drs. Louis De Grandpré, V. Martel, Deepa Pureswaran, Lucie Royer

Univs: Drs. Chris Hennigar, Van Lantz (UNB); Patrick James (Univ. Montréal); Dan Kneeshaw (UQAM); Alex Smith, Kevin McCann (Univ. of Guelph); J. David Miller (Carleton University)

FPL: Luke Amos-Binks, Drew Carleton , Gerry Cormier
NBDNR: Jeremy Gullison, Lester Hartling
AV Nackawic, AV Cell: Kevin Larlee
J.D. Irving, Limited: Andrew Willett
Acadian Timber Corp.: Kevin Topolniski
Fornebu Lumber: Pierre Lebel
MFRL: Andrew McCartney
Agrifor Biotech.: Dr. Chris Riley
FP Innovations: Dr. Udaya Vepakomma

A1: SBW Population dynamics during the rise of an outbreak *(Régnière)*

- what SBW density to initiate an EIS?
- what products may be most effective?

A2.1. Impacts of Early Intervention on SBW and associated natural enemies

(Johns, Martel, Eveleigh, McCann, Pureswaren)

- test efficacy and possible unintended impacts on very low density SBW and its parasitoid complex
- increasing size trials in 2014-2017

A2.2. Barcoding: Innovative DNA-based diagnostic for SBW & its natural enemies

(Smith, Eveleigh, Johns, Martel, McCann)

- develop novel genomics tools to quantify and identify parasitism of SBW larvae and pupae
- less cost than insect rearing; ID parasitoids in larvae killed by pesticide treatments

A2.3. Aerial application of pesticides and pheromones *(Amirault, Cormier, Amos-Binks)*

- EIS SBW trials in northern NB & *Bt* and pheromone control trials on low populations in QC

A3.1. Epicenter formation & migratory behavior of adult SBW moths in eastern Canada *(Pureswaren, Johns, Gray, Royer, Kneeshaw, James, De Grandpré)*

- study migratory behavior from 'epicenters' (QC) & associated formation of epicenters (NB)
- methods to differentiate resident & migrant SBW moths, & contrib. of migrant moths to outbreaks

A4. SBW sex pheromone: effect of blend composition on mating *(Silk, Eveleigh, & others)*

- develop & register a more potent 4-component sex SBW pheromone blend for use in mating disruption
- do pheromones promote dispersal of female moths?

B. Use of endophytic fungi to reduce SBW impacts *(Adams, Miller, Quiring, McCartney)*

- inoculate spruce seedlings with insect toxin-producing endophytic fungi
- first application in forest trees

C. Modeling and DSS/ economic analyses *(MacLean, Hennigar, Lantz, Gullison, Vepakomma)*

- SBW population & defoliation scenarios for alternative EIS strategies; EIS monitoring tools
- effects of EIS on timber supply & economics

Conclusions – EIS against SBW?

- research project; no guarantees
- focus is to protect our forests against SBW
- potential to revolutionize how we protect forests
- time-limited opportunity to attempt it
- $10-15 Billion SBW impacts over 30 yrs is at stake
- ***EIS?*** 1) intensive monitoring & early detection
  2) small area target-specific pesticide application
  3) tools/techniques to disrupt mating & migration

#2

A Comprehensive Greenhouse Gas Balance for a Forest Company Operating in Northeast North America

Ryan E. Cameron, Chris R. Hennigar, David A. MacLean, Greg W. Adams, and Thom A. Erdle

Journal of Forestry (2013)

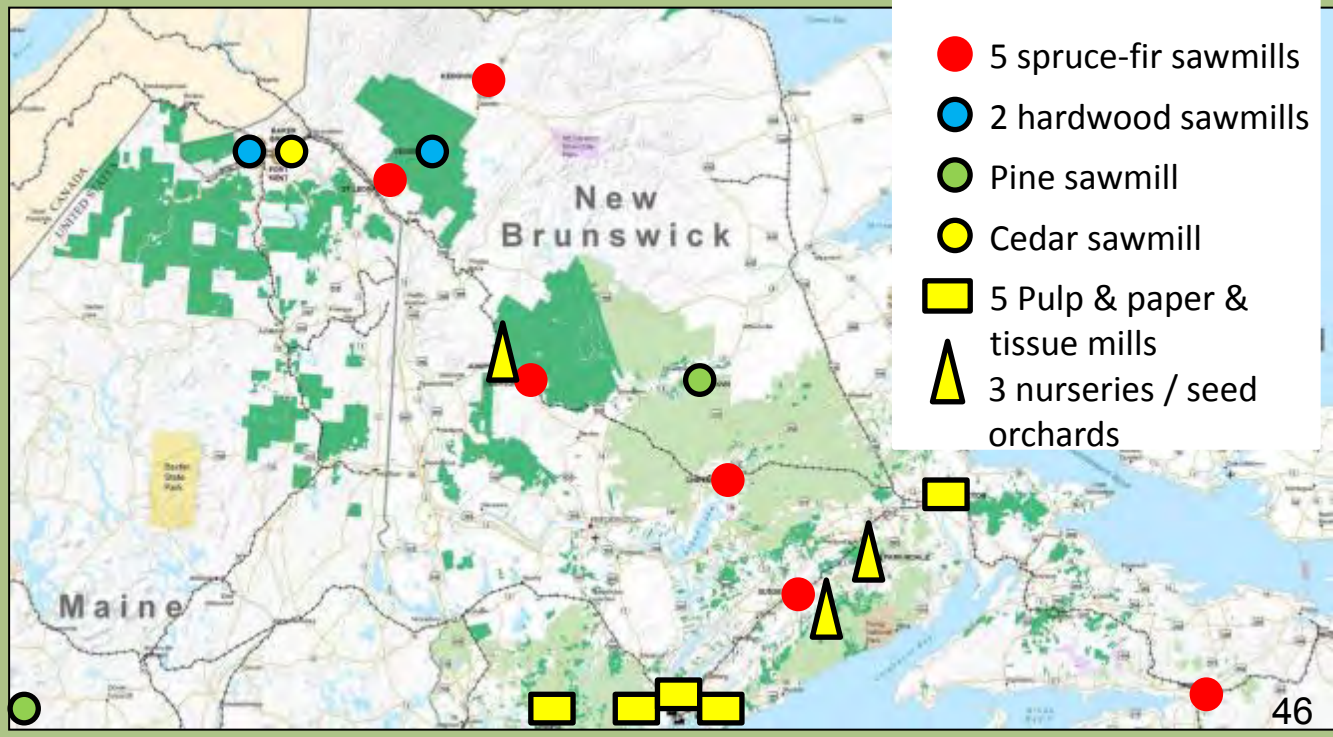






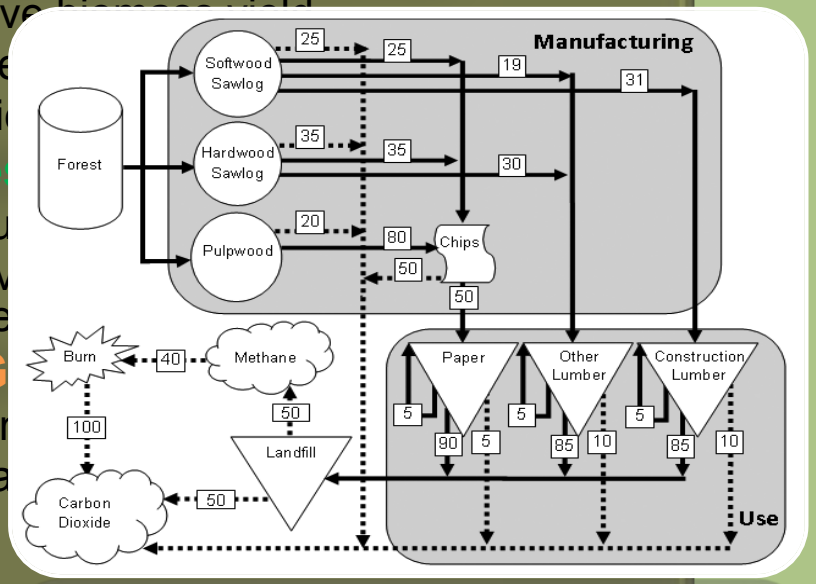

2. GHG emissions & carbon stocks for 100 yrs

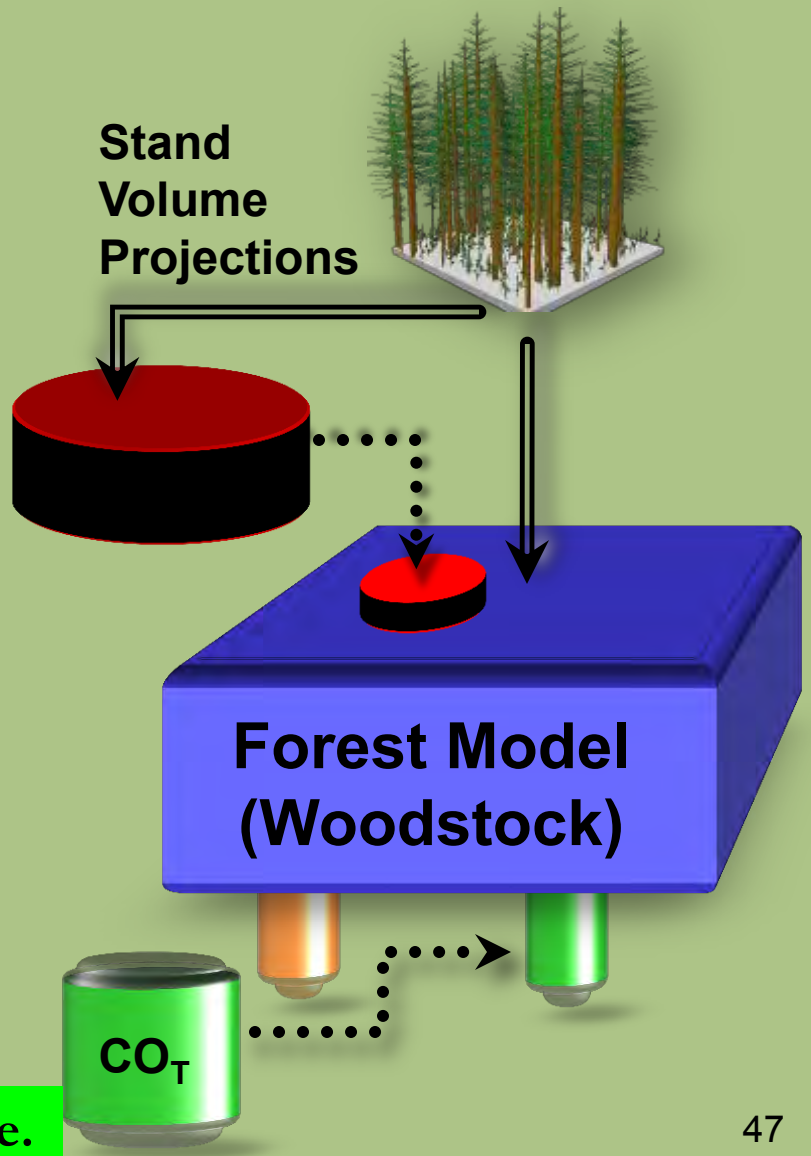
- 2.2M ha managed by J.D. Irving, Ltd. (1.0 M Crown,1.2M freehold)
- Carbon & CO_2 emissions: forest, wood & paper products, operations emissions, sawmills, pulp mills, purchased electricity, all fuel, potential substitution benefits, alternative mgmt. strategies
- Forest estate model baseline planned harvest/silviculture



Forest & carbon modeling framework

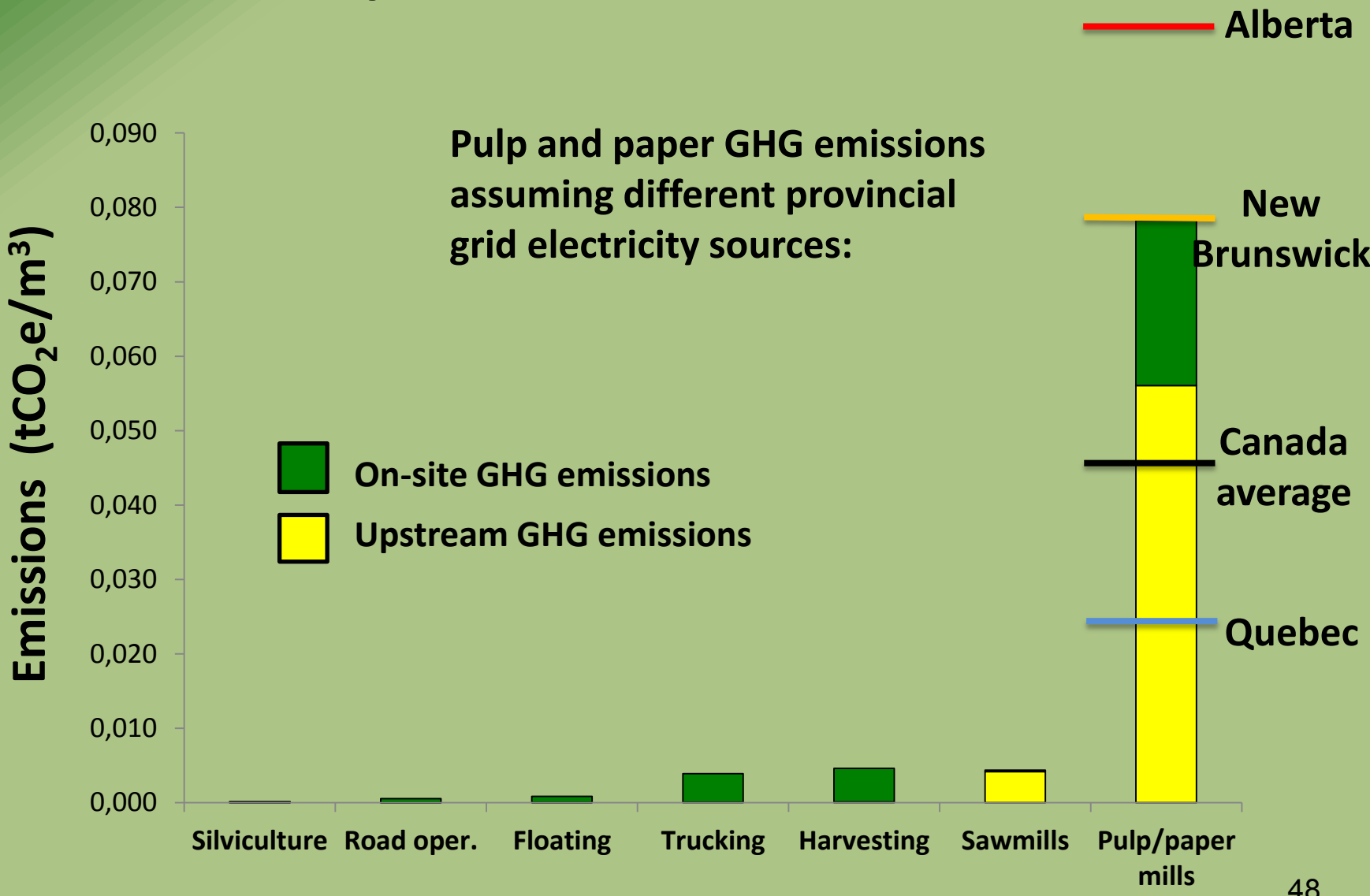
- **Forest Model**
  - Stand Dynamics
  - Forest Dynamics
  - Management Optimization
- **Forest Carbon Dynamics**
  - Live biomass yield
  - De
  - Bi
- **Fores**
  - Lu
  - Av be
- **GHG**
  - Or
  - La



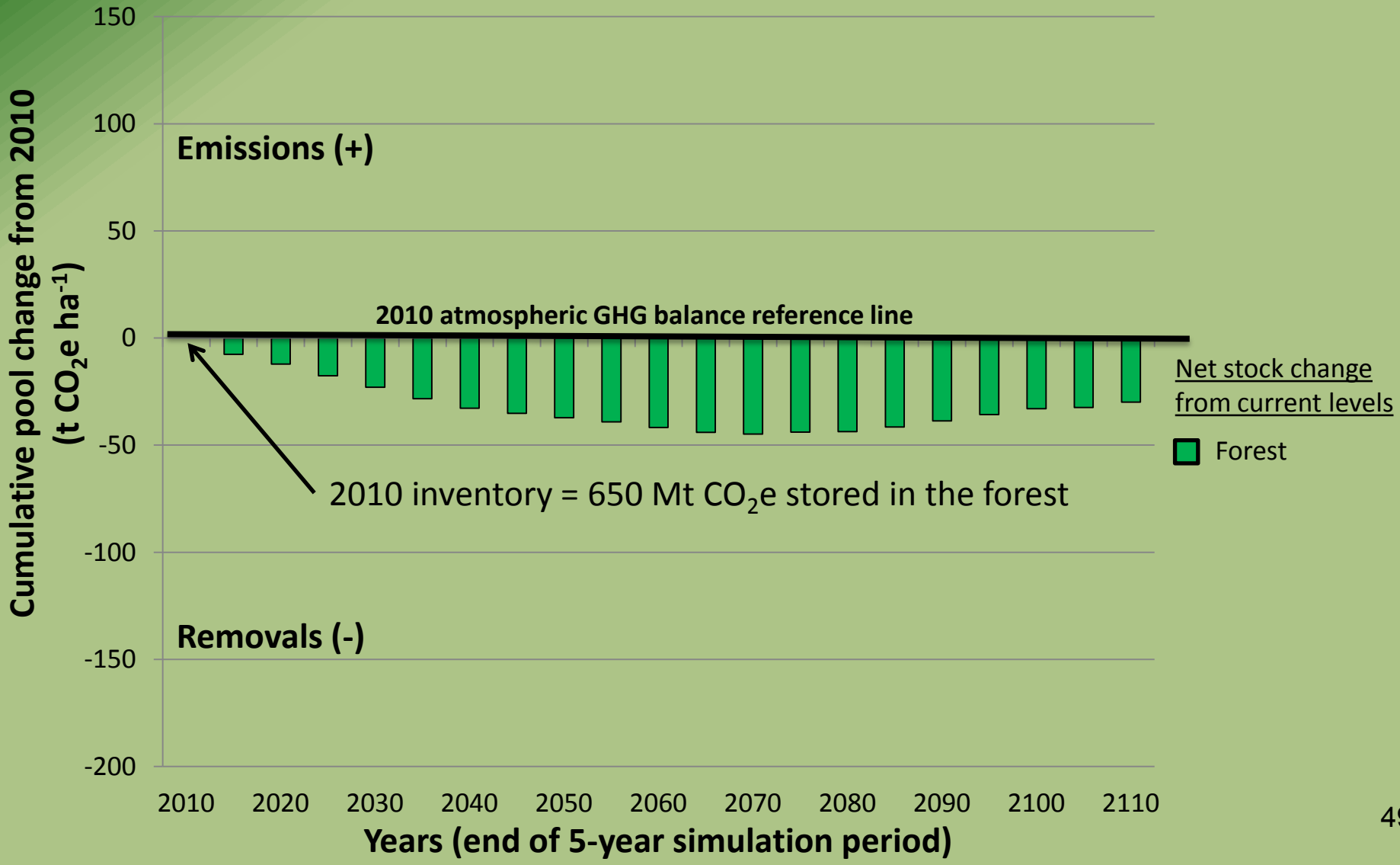


Hennigar et al. 2008 For. Ecol. Manage.

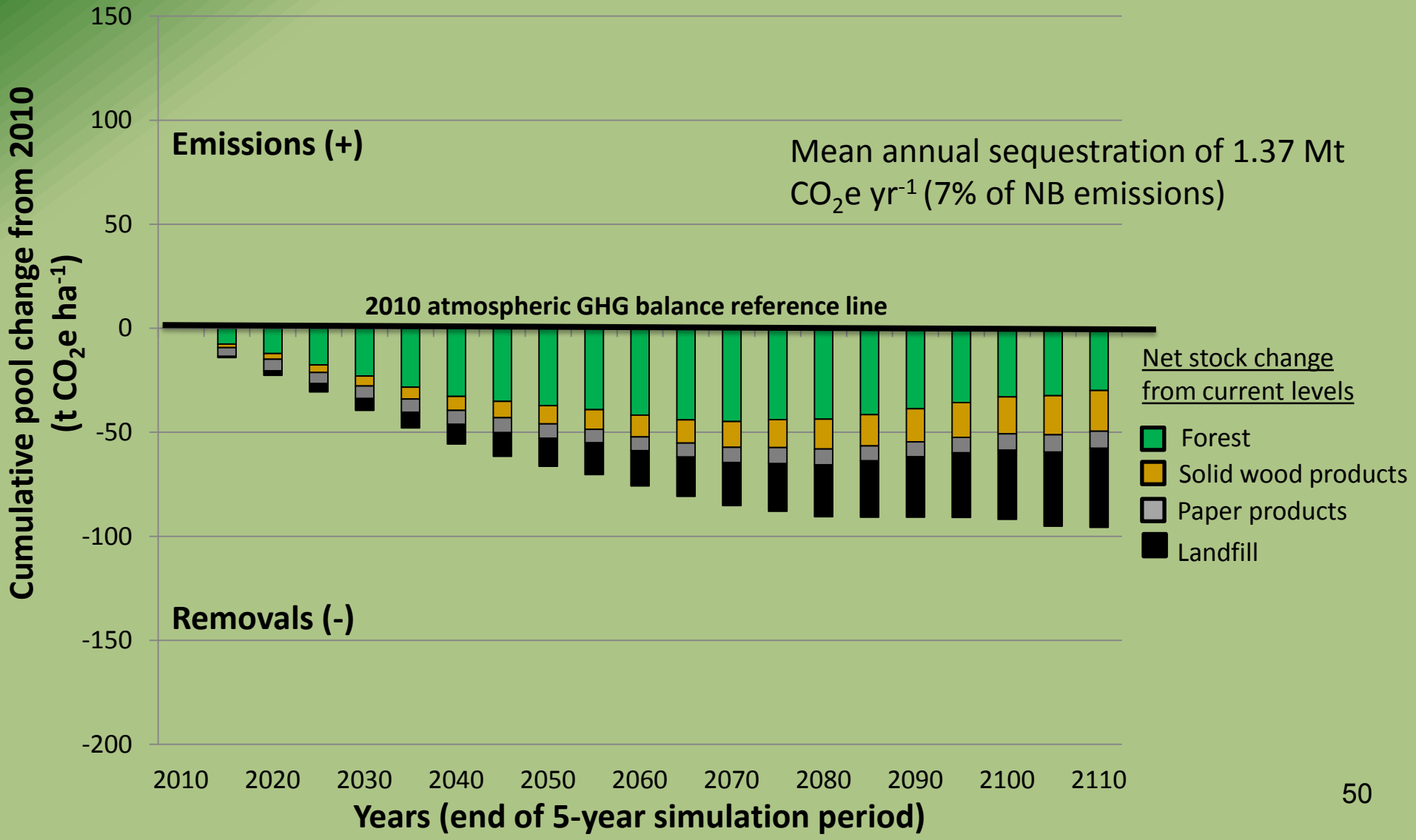
GHG Emissions From Planned Forest Operations 2010-2015



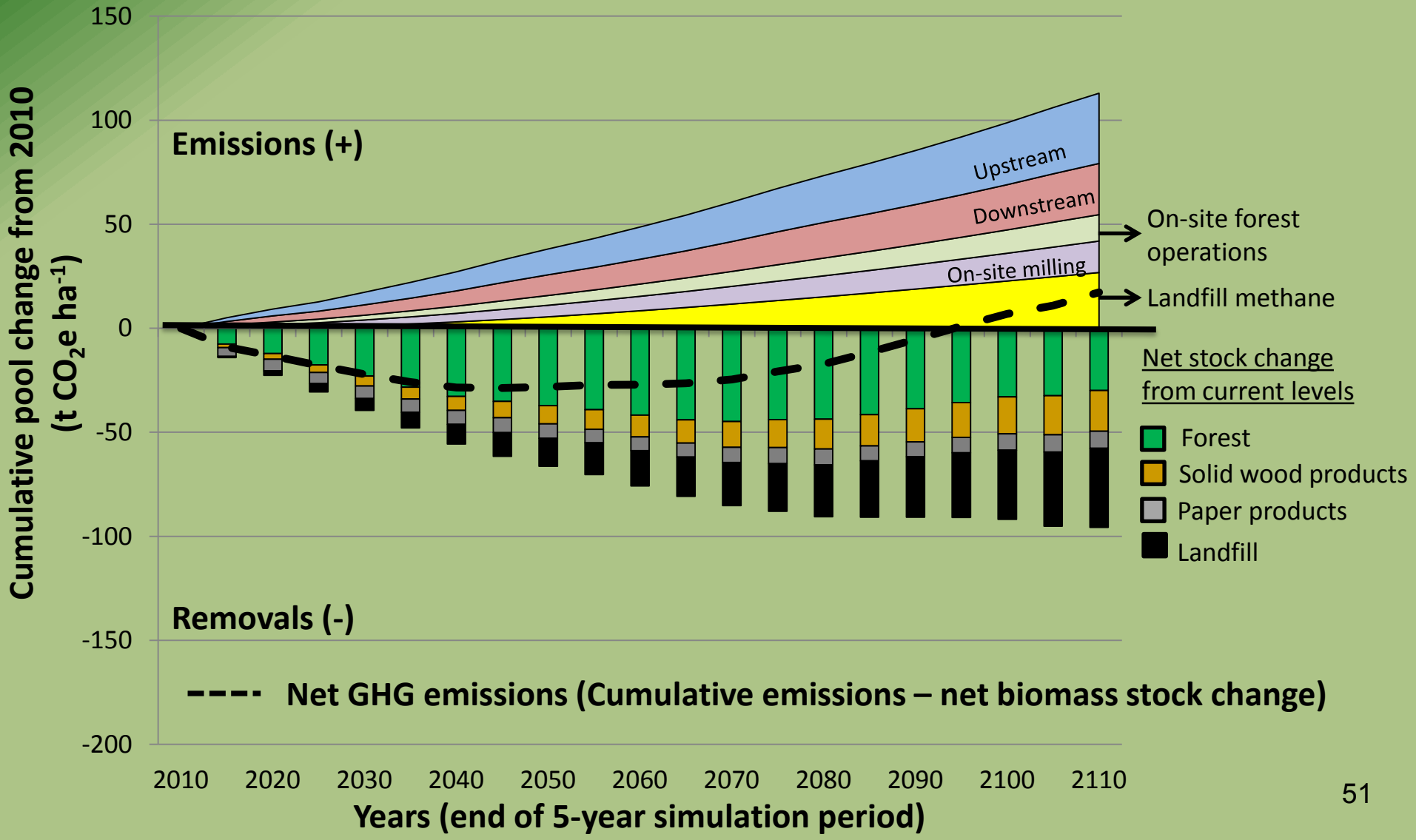
Forest-level C storage change from 2010-2110 as a result of JDI's 100 year mgmt. strategy



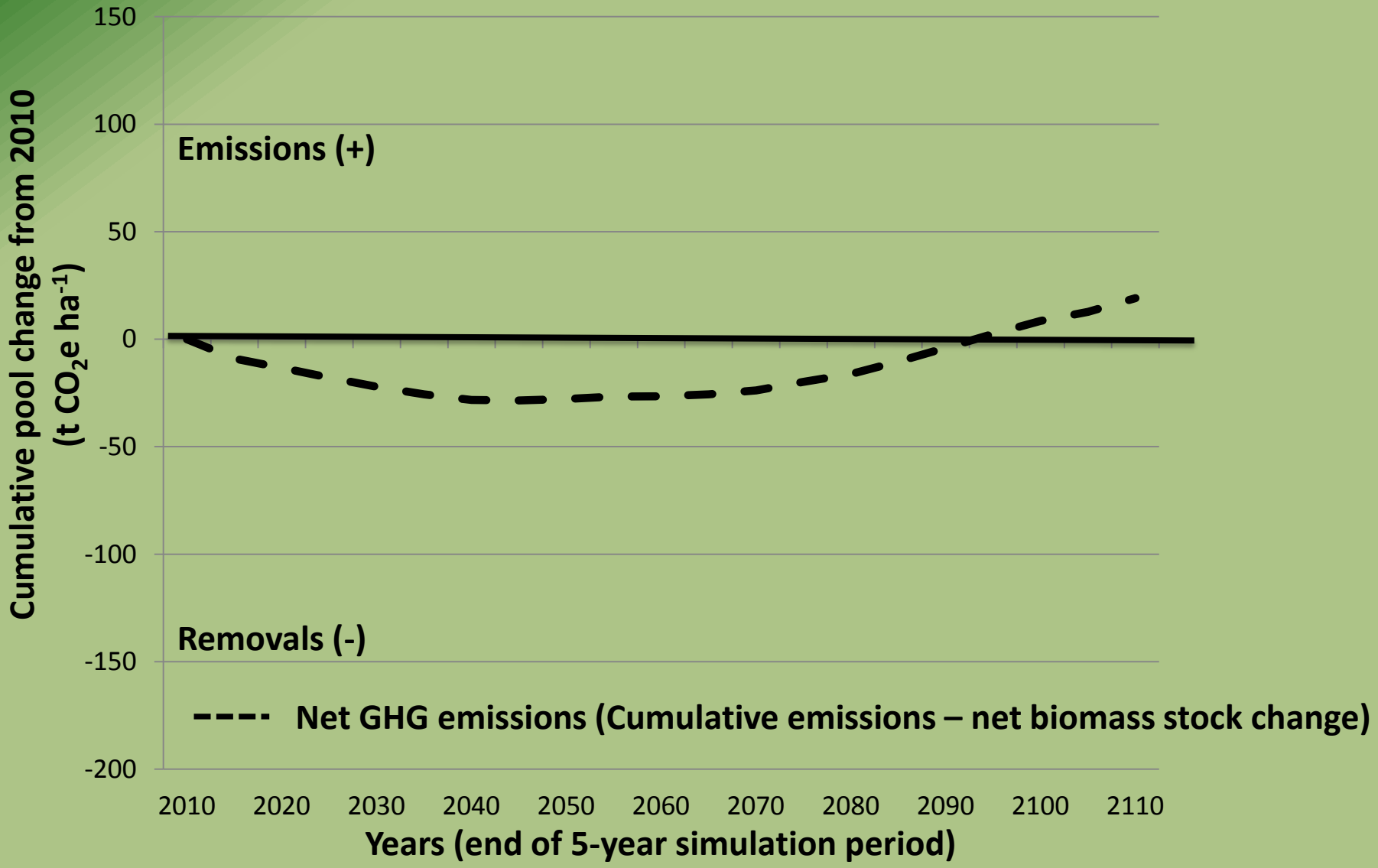
Forest-level C storage change from 2010-2110 as a result of JDI's 100 year mgmt. strategy



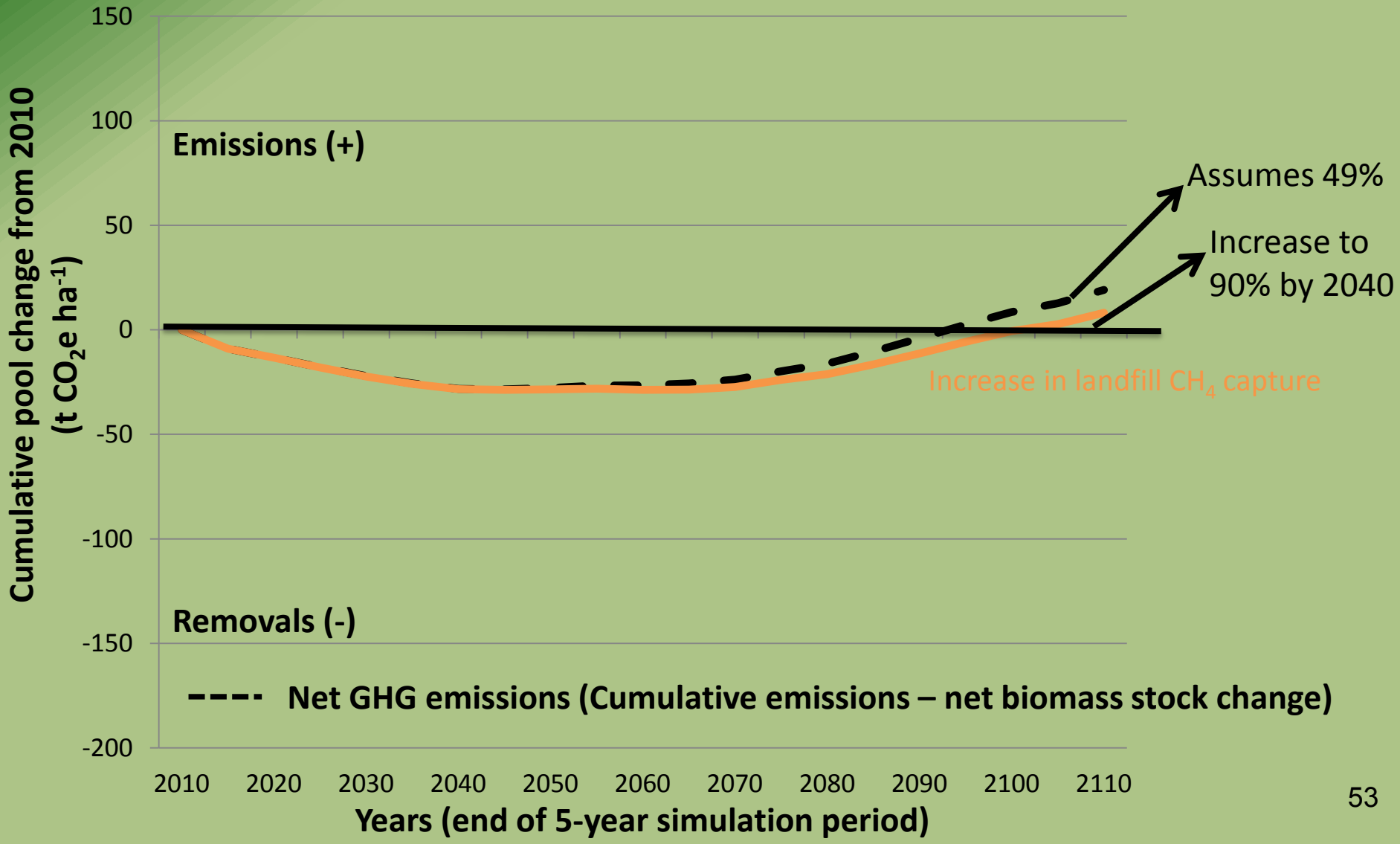
Forest-level C storage change from 2010-2110 as a result of JDI's 100 year mgmt. strategy



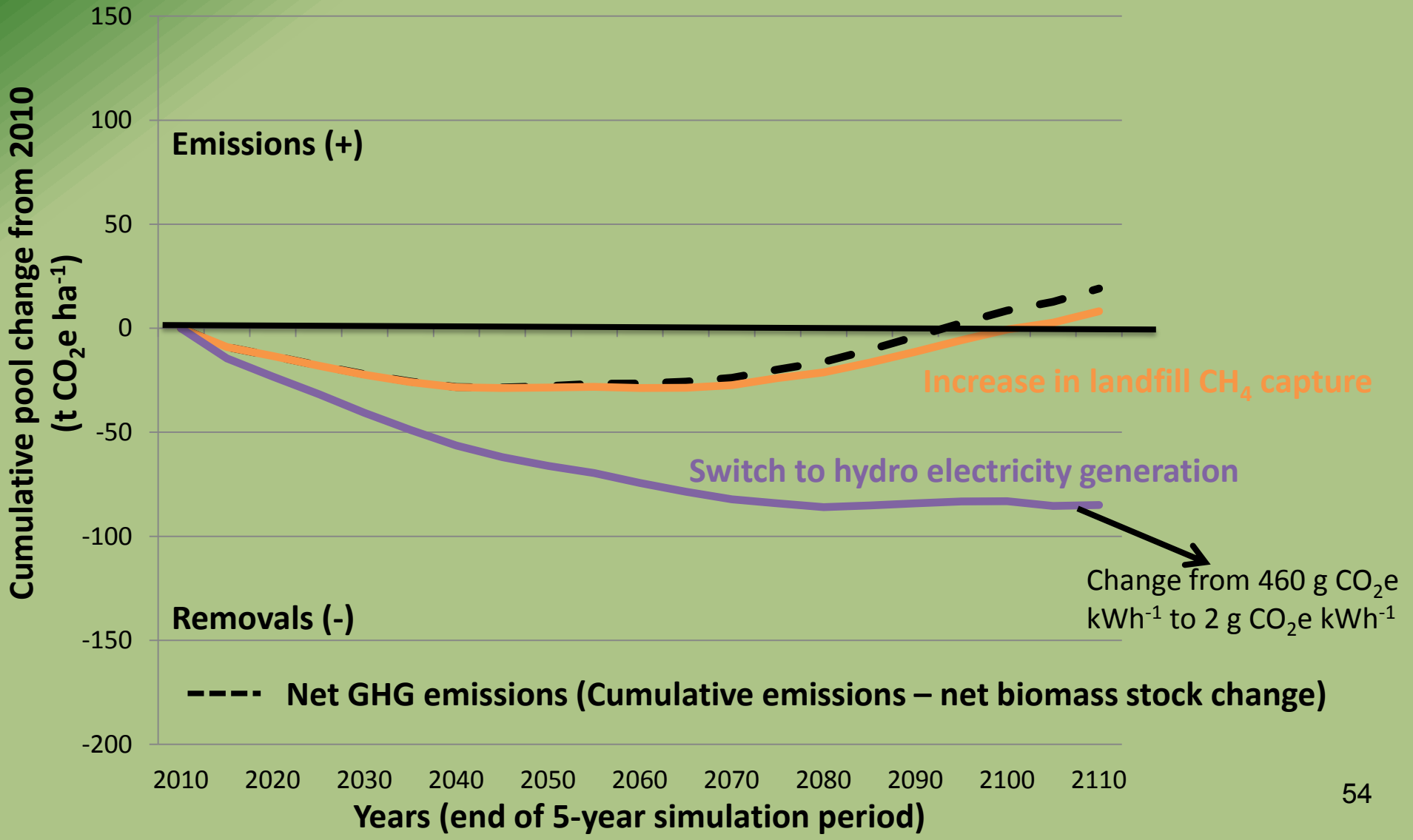
Effects on the baseline GHG profile:



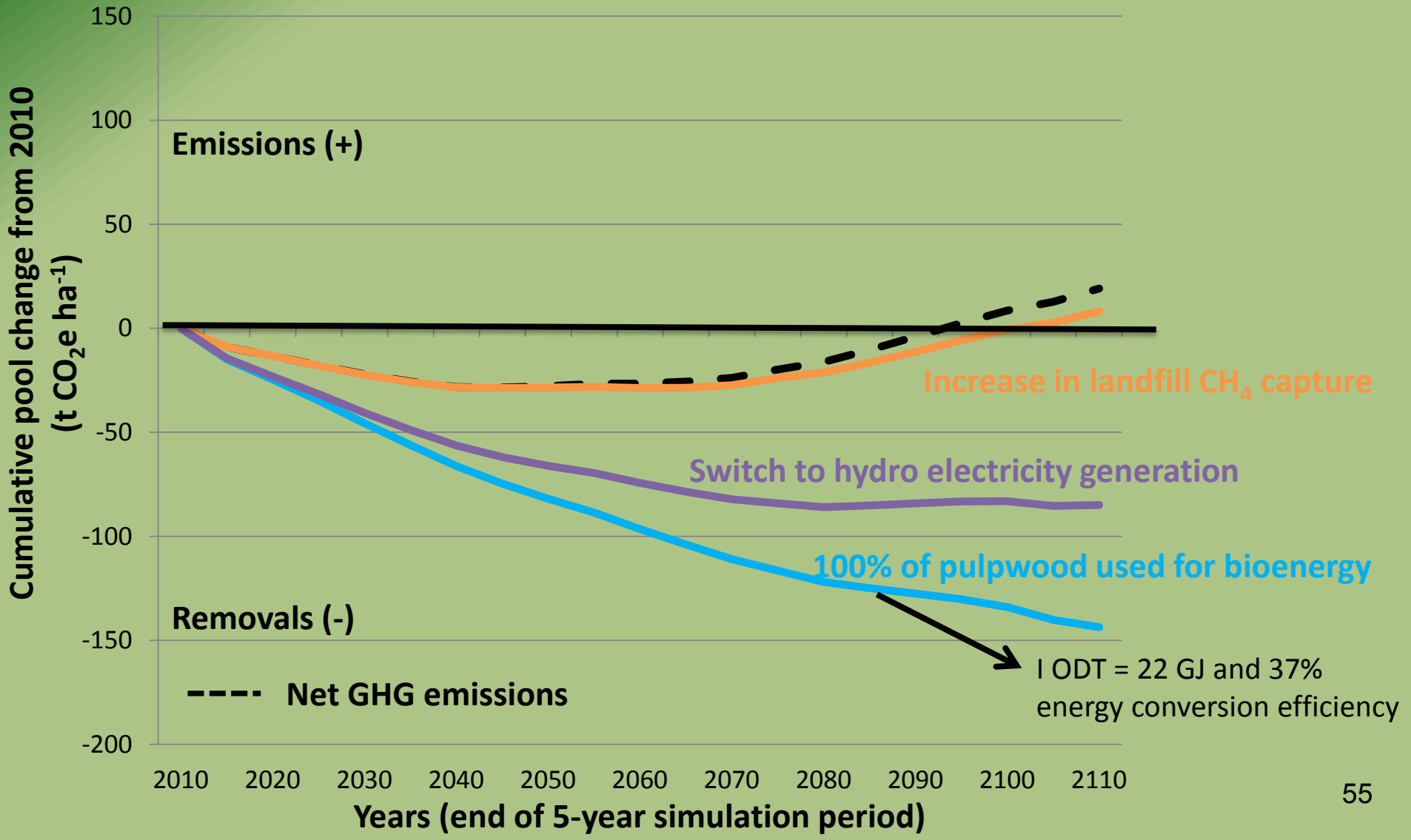
Effects on the baseline GHG profile:



Effects on the baseline GHG profile:



Effects on the baseline GHG profile:

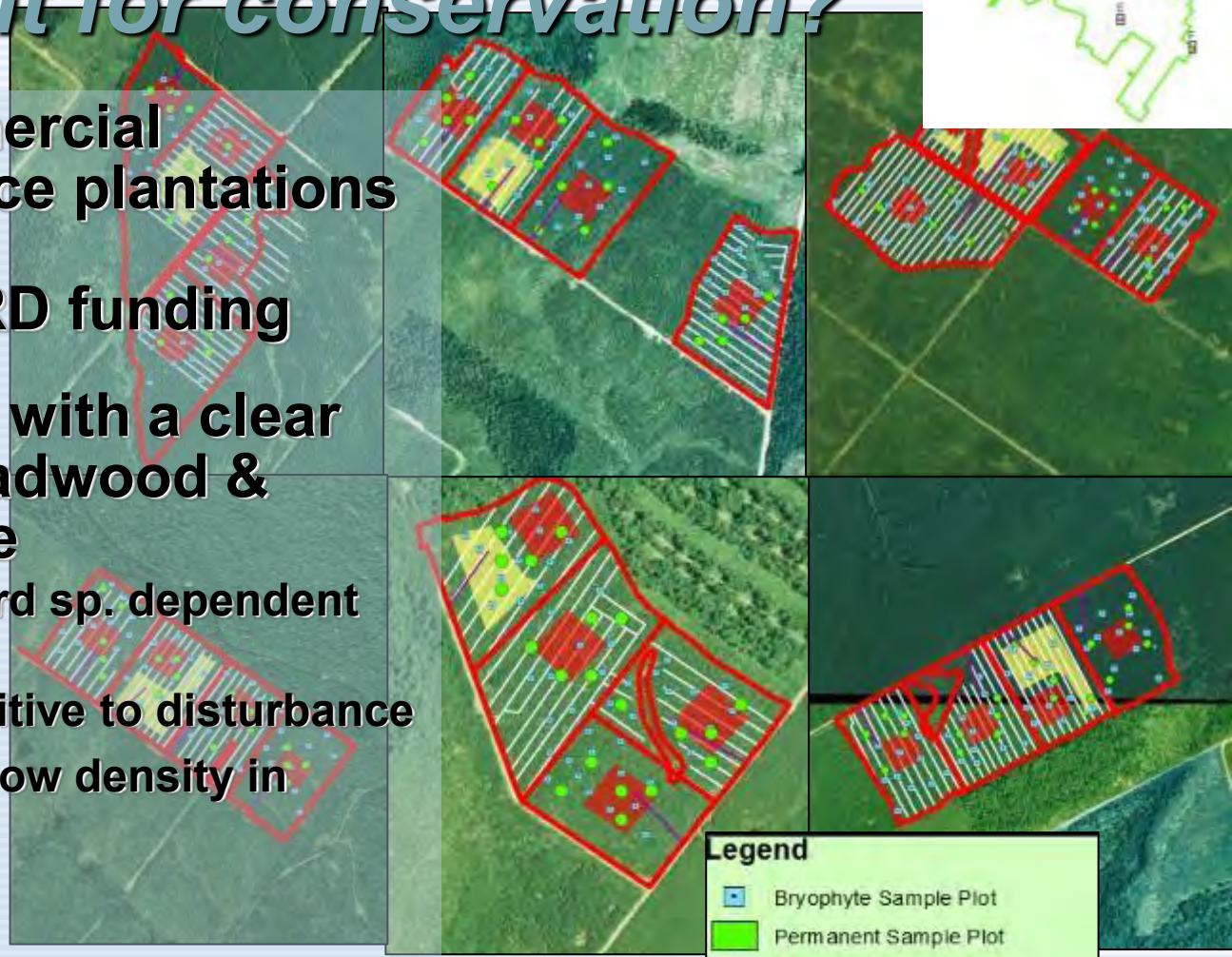


2. GHG Study Conclusions

- **From 2010-2015 total emissions were:**
  - 21% forest operations 4% sawmills 75% pulp/paper mills
- **Forest & products net GHG (sequestration minus emissions):**
  - sink of 30.7 t CO_2e ha^{-1} in year 50
  - as harvest levels increased, emissions > sequestration by yr 85
  - GHG source of 6.4 t CO_2e ha^{-1} by year 100
- **Includes SW harvest increases of 23% in 2045 & 50% in 2070**
- **Paper has high energy & emissions in manufacturing, short in-use life, & large emissions from landfills**
- **Consider disturbance risk, products & grid electricity emissions**
- **Intensive forest mgmt. may result in similar GHG mitigation potential as allowing forests to grow unmanaged, while providing forest products that produce societal benefits**

#3. Modifying intensive forest management for conservation?

- **Alternative commercial thinnings of spruce plantations**
- **5-year NSERC CRD funding**
- **Focusing on taxa with a clear connection to deadwood & thinning response**
  - **beetles, mosses, bird sp. dependent upon deadwood**
  - **vegetation sp. sensitive to disturbance**
  - **small mammals w/ low density in planted stands**
- **6 plantations**
  - **age 26-32 yrs, >20 ha**
  - **4 blocks, 120 plots**



Four treatments:
A. Unthinned (control)

B. Status quo commercial thinning (CT)

C. Biomass removal CT (branches & tops)

D. Enhanced structure

1. Left unthinned clumps

2. Girdled half the clump trees in 2011

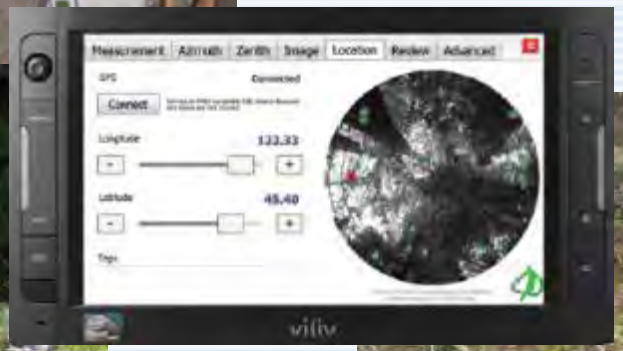
Six grad student projects at UNB & UdeM:

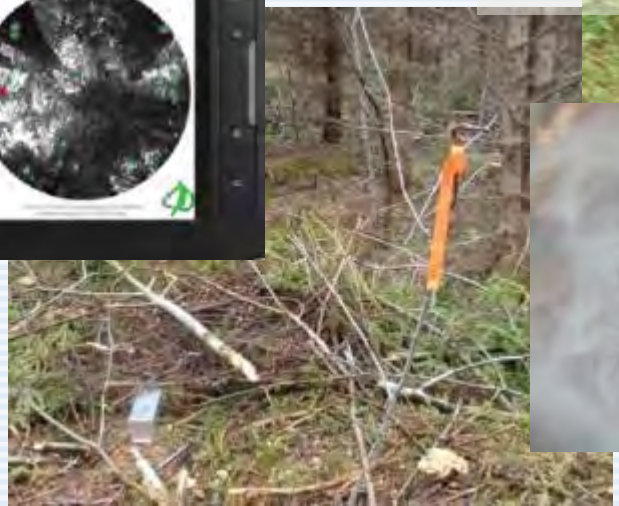
Effects on A) stand growth, light, photosynthesis

B) small rodents

Kwadwo Omari, PhD UNB

Evan Dracup, MSc UNB



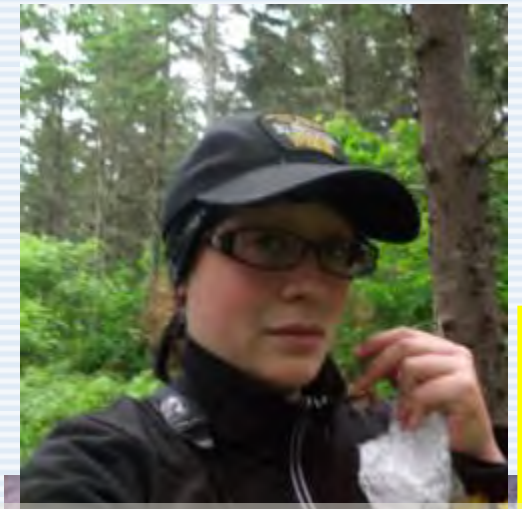


Six grad student projects at UNB & UdeM

Effects on C) mosses & ground vegetation

D) birds

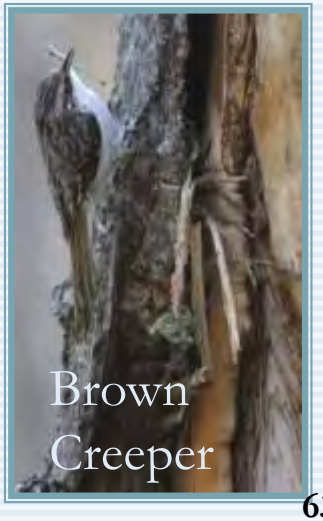
Sean Haughian, PhD UNBSJ



Allison MacKay, MSc UdeM

Hermit Thrush

White throated Sparrow



Brown Creeper

Six grad student projects at UNB & UdeM:

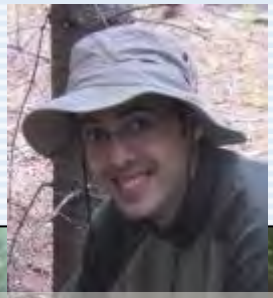
Paryse Nadeau, MSc UdeM

E) Saproxylic beetles response to CT & deadwood

F) Importance of:

i) quality of dead wood (age & type of wood)

ii) surrounding areas: type of forest mgmt. & vegetation



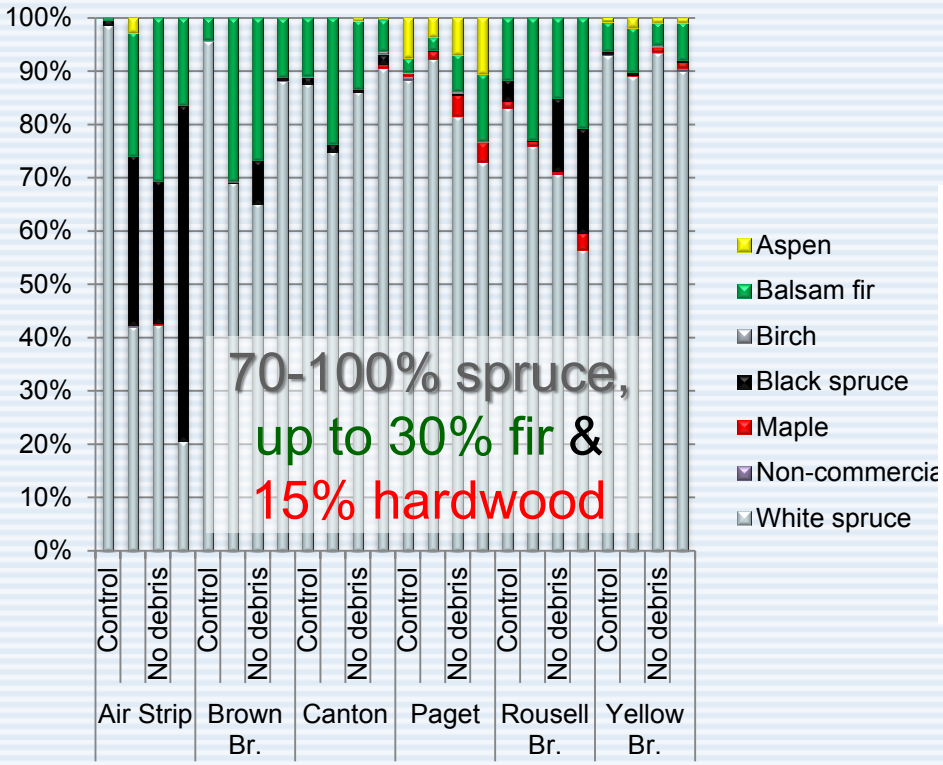
Franck Gandiaga, PhD UdeM

UNIVERSITÉ DE MONCTON
CAMPUS DE MONCTON

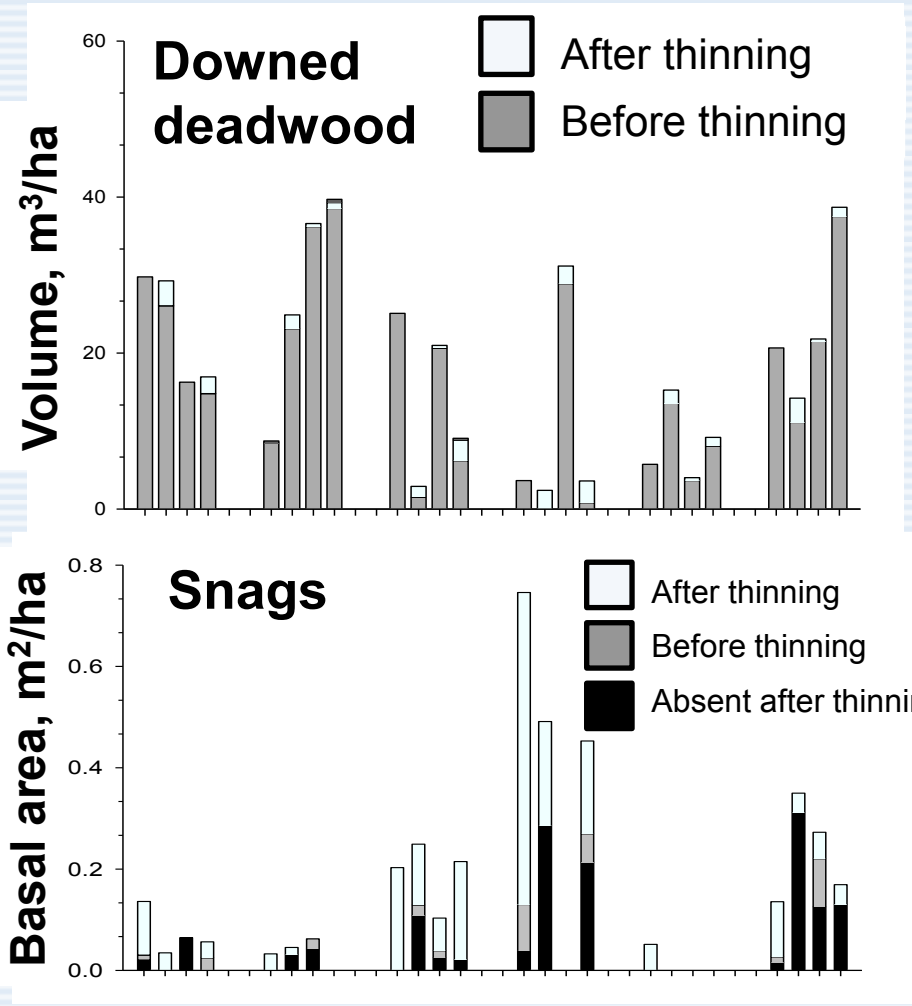
A. Plots measured & mapped pre- & post-thinning

Kwadwo Omari, UNB (MacLean)

Deadwood, snags, tree size, volume, etc.

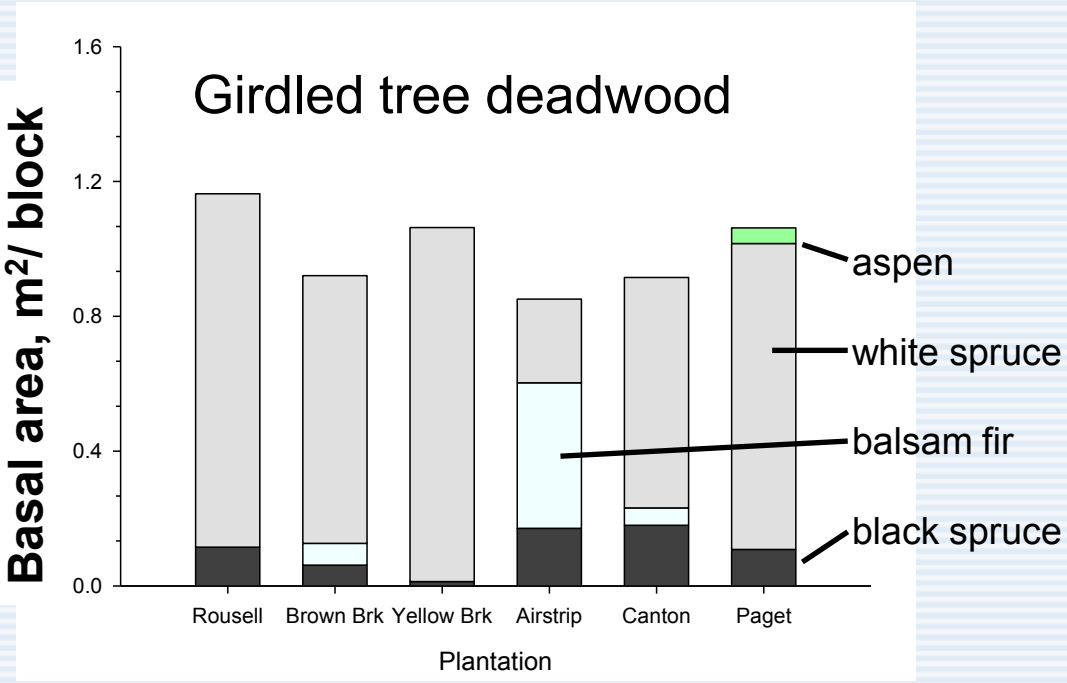


Little addition of downed deadwood



Some snags added, some lost during CT

10-12 clumps/ 5 ha block
10 trees per clump; half girdled in 2011



A. Deadwood by treatment: Girdled trees added snags experiment

Treatment	Downed deadwood (m^3/ha) New added	Downed deadwood (m^3/ha) Total	Snags (m^2/ha) New added	Snags (m^2/ha) Total	Girdled tree snags (m^2/ha)
Unthinned	0.04	15.6	0.19	0.20	
Status quo CT	2.26	14.8	0.07	0.07	
Biomass removal CT	0.62	21.8	0.02	0.05	
Enhanced structure CT	1.88	19.5	0.07	0.09	0.20

B. Experimental Design – Small Rodents

Evan Dracup, UNB (D. Keppie)

Treatment Type	Plants shelter food	Dead wood shelter	Fruit food
Control	Low	Low	Low
Biomass removal CT	High	Low	Medium
Status Quo CT	Medium	High	Medium
Added food CT Enhanced structure	Medium	High	Very high *Added fruit*

B. Small Rodent Mark Recapture Trapping

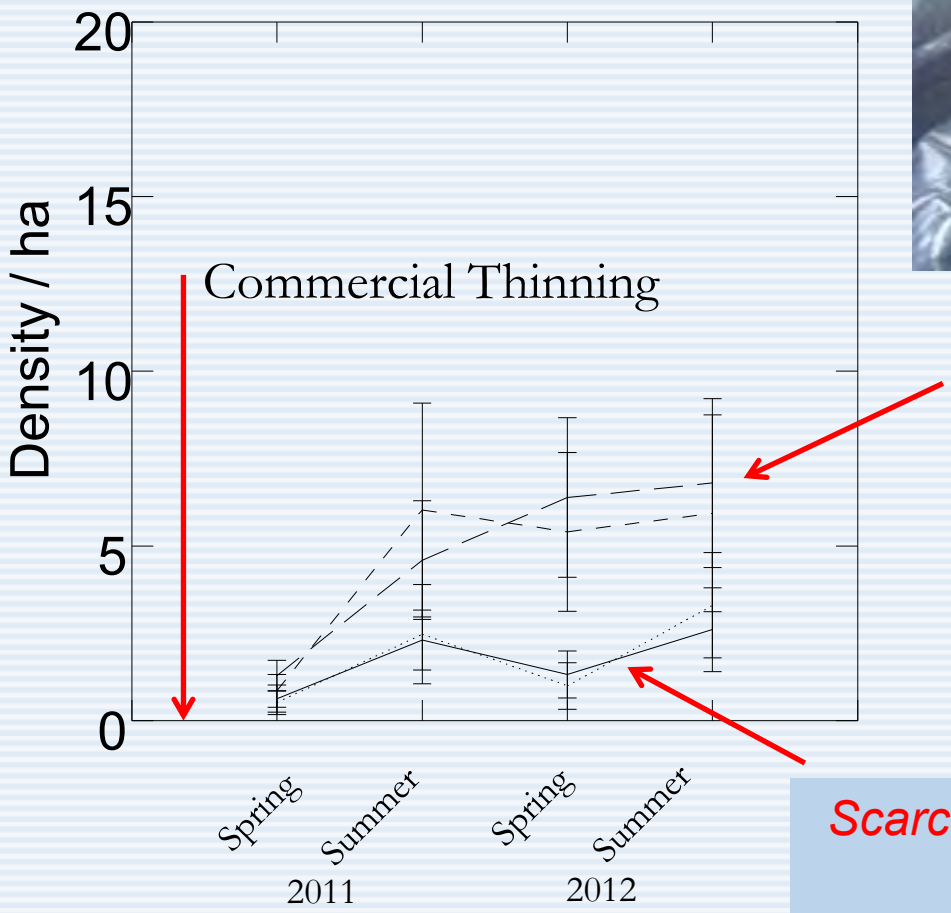
Evan Dracup, UNB
(D. Keppie)

- One trapping grid per treatment block
  - Square grids of 100 traps (10 X 10) with 10 m spacing

- Trap Spring & Summer 2011, 2012
  - 5 days/plantation
  - 24,978 trap nights
  - 368 rodents caught

- Upon capture animals:
  - Weighed, sexed, ear tagged

B. Southern Red-Backed Vole



Plentiful dead wood – SQ CT & Enhanced/Added food CT

Treatment
- Control
- Biomass removal CT
- Status Quo CT
- Added Food CT

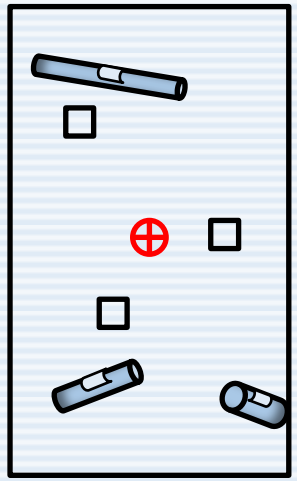
Scarce dead wood – Unthinned & biomass removal CT

Dead wood availability restricts vole populations

B. Woodland Jumping Mouse

Commercial thinning negatively impacts jumping mice

C. Ground vegetation & bryophyte response



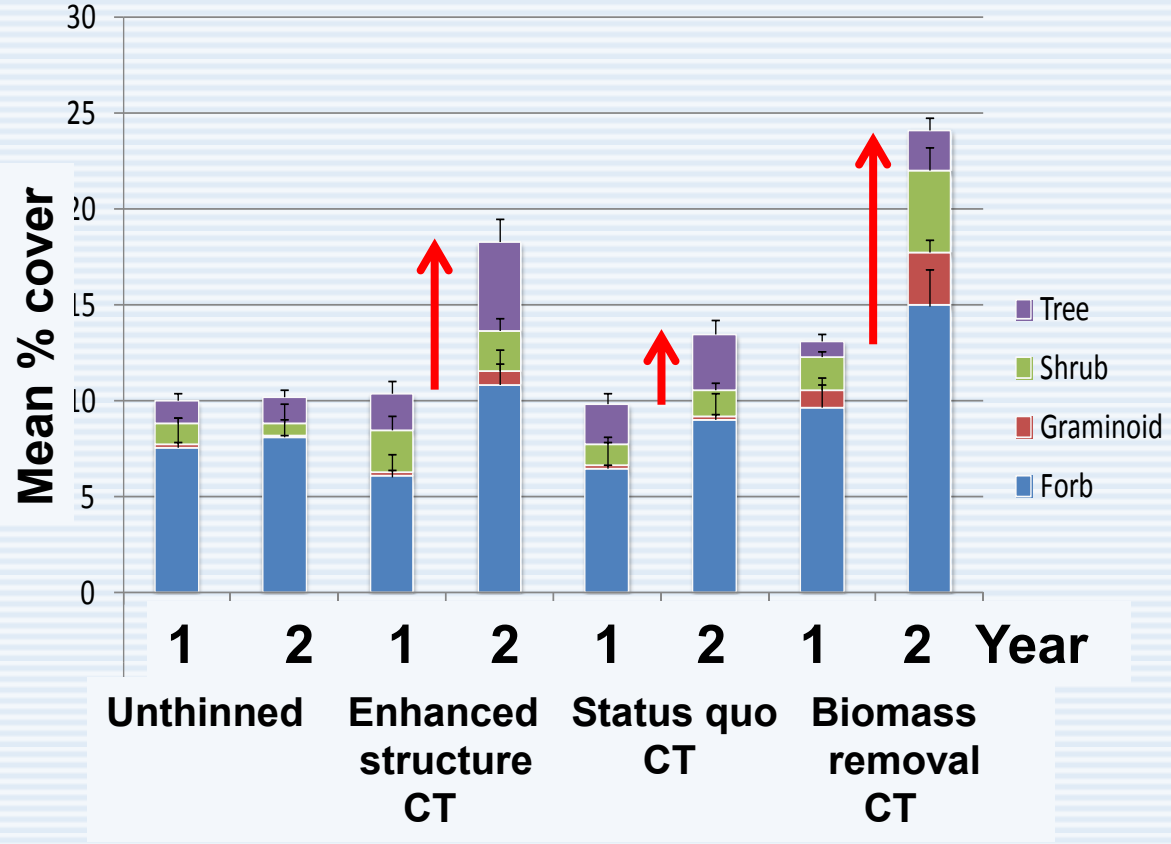
Sean Haughian, PhD UNBSJ (Kate Frego)

- Epixylic bryophytes
  - Sensitive to disturbance, depend on CWD
- Understory vascular plants
  - Potential indicator species
- Veg-environment relationships (bryophytes)
  - Bryophyte growth experiments
  - Microclimate measurement, diversity modeling
- Hypothesis: Understory humidity is main control of epixylic bryophyte community

Sean Haughian, UNBSJ (Frego)

C. Plants Results

- **Vascular plants**
  - yr 1 180 sp. yr 2 183 sp.
  - Mostly graminoids & composites
- **Bryophytes**
  - Over 50 sp.
  - Second survey summer 2013



- **204 total sp., > 50 sp. bryophytes**
- **Total cover ↑ 50% in yr 2 over yr 1**

D. Birds

Allison Mackay, MSc UdeM (M-A. Villard)

Hypothesis: **Creating dead wood** through altered thinning treatments in spruce plantations will **increase bird species richness**

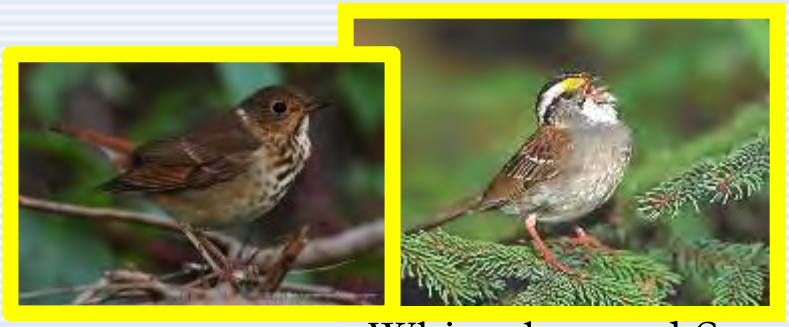
Prediction: Higher densities of dead wood dependent birds.

Birds ecologically dependent on:

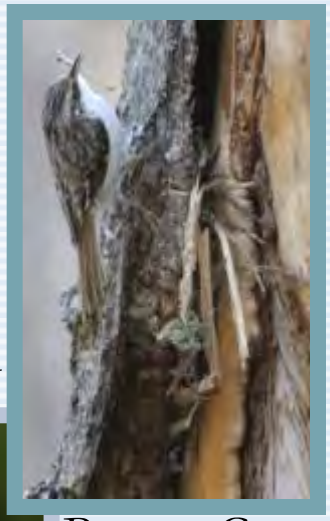
Woody debris

Uprooted trees and large stumps

Well decayed snags



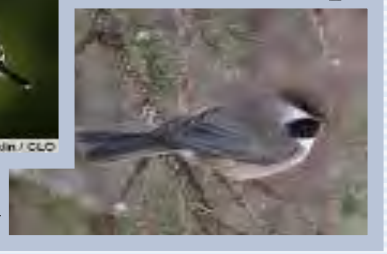
Hermit Thrush White throated Sparrow



Brown Creeper

Winter Wren

Red-breasted Nuthatch



Boreal Chickadee

E. Saprophylic beetles

- **Flight Intercept Traps set up in a line transect**
  - 6 spruce plantations
  - 3 old-growth coniferous reserves
- **5 traps per line**
  - 5, 15, 30, 60, 120m from the road
- **Traps emptied biweekly June to August (2011-2013)**
- **135 Traps in Black Brook District**

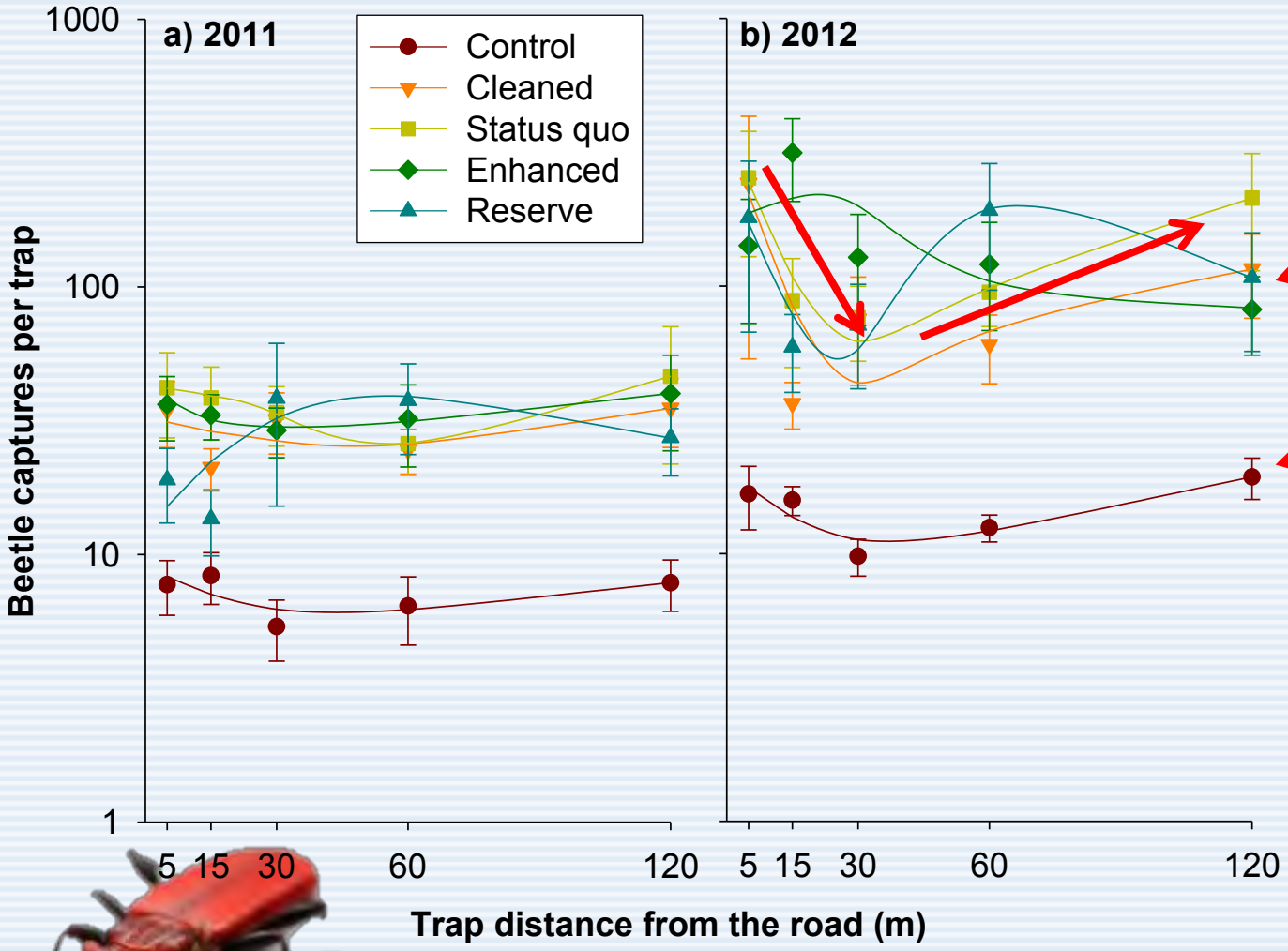
Paryse Nadeau, MSc UdeM (G. Moreau)

48 families – 208 species – 60 350 individuals 2011-2012

Families		Feeding guilds	# spp	# individuals
Staphylinidae	*Eusphalerum fenyesi*	Pollen	1	37365
	Others	Bolit, Bolit/Mycet, Mycet, Pollen, Pred	32	2508
				(39873)
Elateridae		Mycet, Pred, Rhizo, Rhizo/Pred	20	3983
Curculionidae	Curculioninae	Phyto	3	115
	Scolytinae	Phloe, Mycet	10	2463
	Others	Phlo, Rhizo, Phyto	9	92
				(2670)
Nitidulidae		Phyto, Sap	6	2466
Tenebrionidae		Bolit, Mycet, Sapro	5	2240
Mordellidae		Phyto	5	1948
Monotomidae		Pred	1	1435
Scirtidae		Sapro	4	941
Scraptiidae		Mycet	2	800
Histeridae		Pred, Sapro	2	573
Cerambycidae		Phloe, Xylo	21	509
Clambidae		Mycet	1	375
Other families (36)			86	2537
48			208	60350

- 7 new spp in NB and 1 rare spp new for NB and for Atlantic Canada (*Euaesthetus brevipennis* Casey)

Preliminary results



More beetles in CT & reserves than unthinned

Tendency to be more adjacent to & far from roads

Paryse Nadeau, MSc UdeM (G. Moreau)

Effective University-Industry Collaboration

J.D. Irving Ltd. Forest Research Advisory Committee

- Founded in 1998 as a product of FSC Certif. audits
- Experts in ecological fields, orig. led by G. Baskerville
- Profs. from UNB, UdeM, U. Maine; Manomet, NBDNR
- *"Empower the forest manager"* as decision maker
- Active partnership of researchers & forest managers
  - seek co-funding; 31 grad student projects at UNB & UdeM
  - bi-annual meetings, grad students present & get feedback
- Research quality – peer reviewed publications
- Managers involved project selection/design/proposals
  - actively monitor/evaluate research project progress

JDI Forest Research Advisory Committee

- Two-way learning/ education
- Company capacity for uptake of results
- Investment of time as well as $$
- Current JDI FRAC questions:
  1. How do intensively managed stands contribute to habitat & biodiversity?
  2. What role do mixedwood stands play in terms of diversity & habitat?
  3. What do we know about stand dynamics under a natural disturbance regime?
  4. What is the importance of context within which stands occur throughout the landscape?

Conclusions

- **Remember the changing context for SFM, the 'urban scorekeeper'**
  - credibility, communication, proof of performance
- **Understand ecology of forest treatments & disturbance**
  - can we use planning to reduce insect impacts?
  - natural disturbance-based silviculture, relation to habitat
  - how does intensive mgmt. affect sensitive taxa?
  - new values like carbon
- **Forest zoning a possible approach**
  - intensive, extensive, protected; specialized mgmt. in separate portions of forest
- **Linking *intensively managed & protected forest*, toward meeting agreed-upon forest production & conservation goals, a viable way forward?**

Thanks to:

- **31 Graduate students at UNB & UdeM in current & previous JDI FRAC projects:**
  Anne-Sophie Bertrand, Luke Amos-Binks, Jean-François Carle, Wei-Yew Chang, Bruno Chicoine, Amanda Colford-Gilks, Adam Dick, Evan Dracup, Dave Etheridge, Janie Fauteux, Pascale Forget, Franck Gandiaga, Jean-Sébastien Guénette, Samuel Haché, Sean Haughian, Julie Henderson, Chris Hennigar, Jeff Higdon, Kerienne La France, Jérôme Lemaître, Allison Mackay, Mike Montigny, Paryse Nadeau, Eric Neilson, Kwadwo Omari, Aurore Perot, Jean-François Poulin, Greg Slaney, Matt Smith, Chris Ward, Amy Witkowski
- **Researchers, J.D. Irving staff, collaborators**:
  - Greg Adams, Gaetan Pelletier, John Gilbert, Pamela Hurley-Poitras
  - Profs. Kate Frego, Dan Keppie, Gaetan Moreau, Marc-Andre Villard
- **<u>MANY</u> student field assistants & Funders**

IRVING

NSERC CRSNG

UNB UNIVERSITY OF NEW BRUNSWICK

FUNDY MODEL FOREST NETWORK RÉSEAU DE FORÊTS MODÈLES

UNIVERSITÉ DE MONCTON