



# Assessing the impacts of intensive biomass removals and ash applications in the boreal forest



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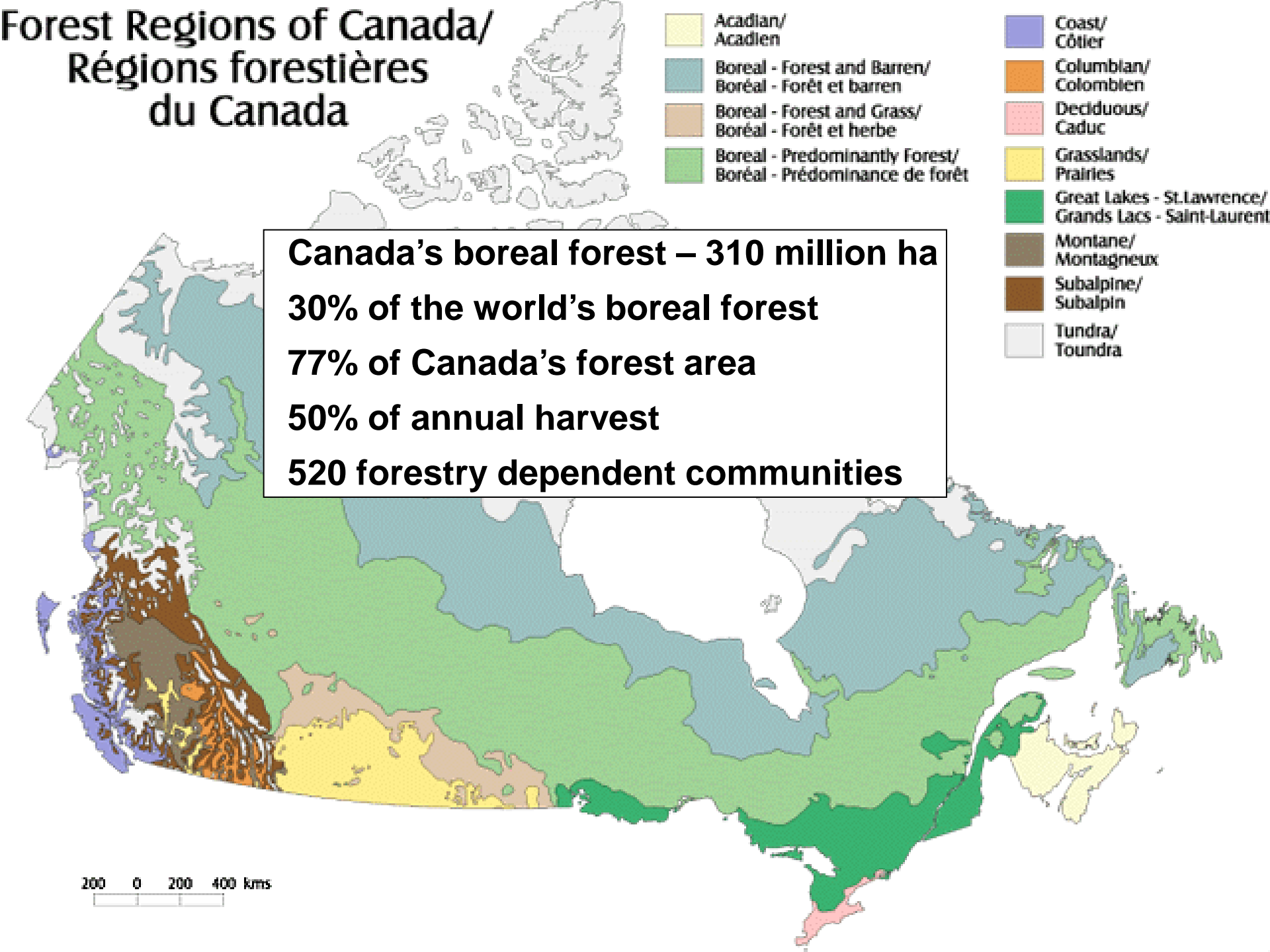


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Forest Regions of Canada/ Régions forestières du Canada

- 
- The map displays various forest regions across Canada, color-coded according to the legend. The largest region is the Boreal - Predominantly Forest (green), covering most of the central and northern parts of the country. Other regions include the Boreal - Forest and Barren (blue-green), Boreal - Forest and Grass (tan), and Boreal - Forest and Barren (teal). The western coast features the Coast/Côtier (purple), Subalpine/Subalpin (brown), and Montane/Montagneux (dark brown) regions. The eastern coast includes the Deciduous/Caduc (pink) and Great Lakes - St. Lawrence/Grands Lacs - Saint-Laurent (dark green) regions. The northernmost areas are Tundra/Toundra (light grey). The legend also includes Acadian/Acadien (yellow), Columbian/Colombien (orange), Grasslands/Prairies (light yellow), and Tundra/Toundra (light grey).
- Acadian/  
Acadien
  - Boreal - Forest and Barren/  
Boréal - Forêt et barren
  - Boreal - Forest and Grass/  
Boréal - Forêt et herbe
  - Boreal - Predominantly Forest/  
Boréal - Prédominance de forêt
  - Coast/  
Côtier
  - Columbian/  
Colombien
  - Deciduous/  
Caduc
  - Grasslands/  
Prairies
  - Great Lakes - St. Lawrence/  
Grands Lacs - Saint-Laurent
  - Montane/  
Montagneux
  - Subalpine/  
Subalpin
  - Tundra/  
Toundra

**Canada's boreal forest – 310 million ha**  
**30% of the world's boreal forest**  
**77% of Canada's forest area**  
**50% of annual harvest**  
**520 forestry dependent communities**

200 0 200 400 kms



# The Canadian forest industry



**40% loss of direct jobs in the last decade  
140,000 industry employees out of work  
340 mill closures, 20% decrease in capacity  
Ontario - 1200 logging companies to 700,  
some communities completely shut-down**

# Ontario's bioenergy policy drivers



- **Green Energy Act - 2009**  
Feed-in Tariff that guarantees rates for energy generated from renewable sources, right to connect to the electricity grid for renewable energy projects
- **Ontario Power Generation Coal Phase Out**  
phase out coal-fired electricity generation by 2014  
- Atikokan 205 MW
- **Forest Sector Prosperity Fund/Loan Guarantee Program** - Thunder Bay 60 MW, Hornepayne 15 MW
- **Low Carbon Fuel Standard (LCFS) - 2007**  
reduce lifecycle C of transportation fuels, 10% by 2020

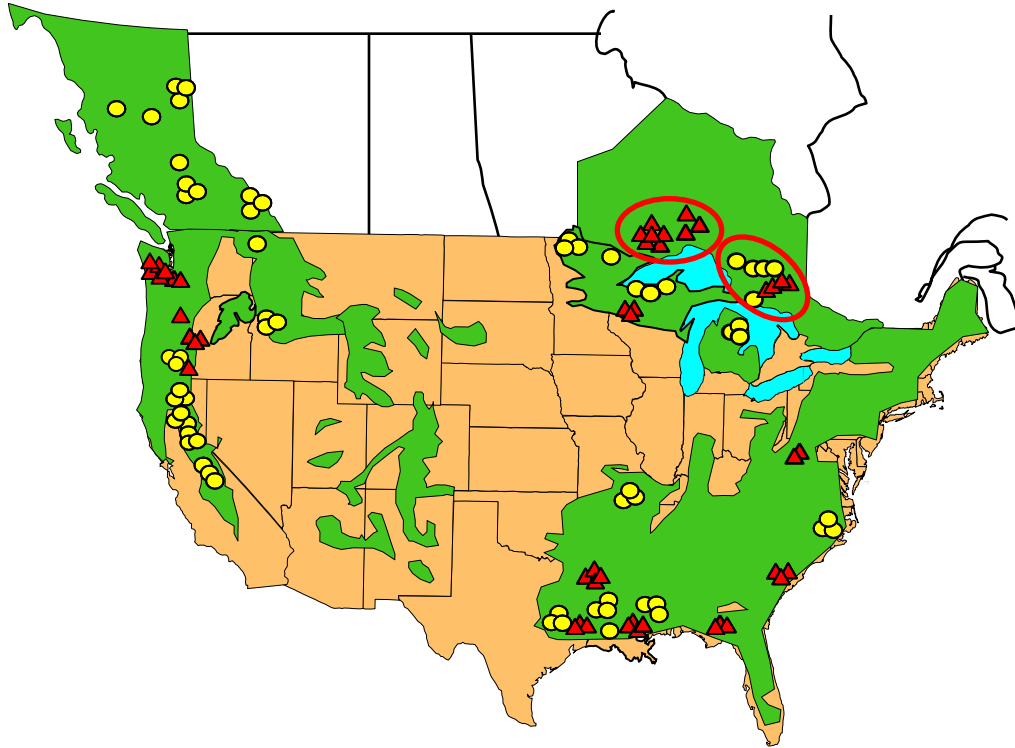


can we turn this

into this without compromising soil productivity and biodiversity?



# Long-Term Soil Productivity (LTSP) experiment and bioenergy



- conceptual model - organic matter a major variable regulating soil processes affecting productivity
- modification of site organic matter is a main effect treatment
- long-term forest growth measurements
- pre- and post-harvest measurements of site C and nutrient pools that enable accurate determination of site removals and retention





%	Sa	Si	Cl	Pit 137
Ae	68	26	6	
Bf	61	31	8	
Bm	79	16	5	
C	94	2	3	

A photograph of a soil profile. A red and white measuring rod is placed vertically in the soil. A pair of red pliers is placed on the surface. A white sign with the text "Pit 137" is attached to the top of the soil profile.

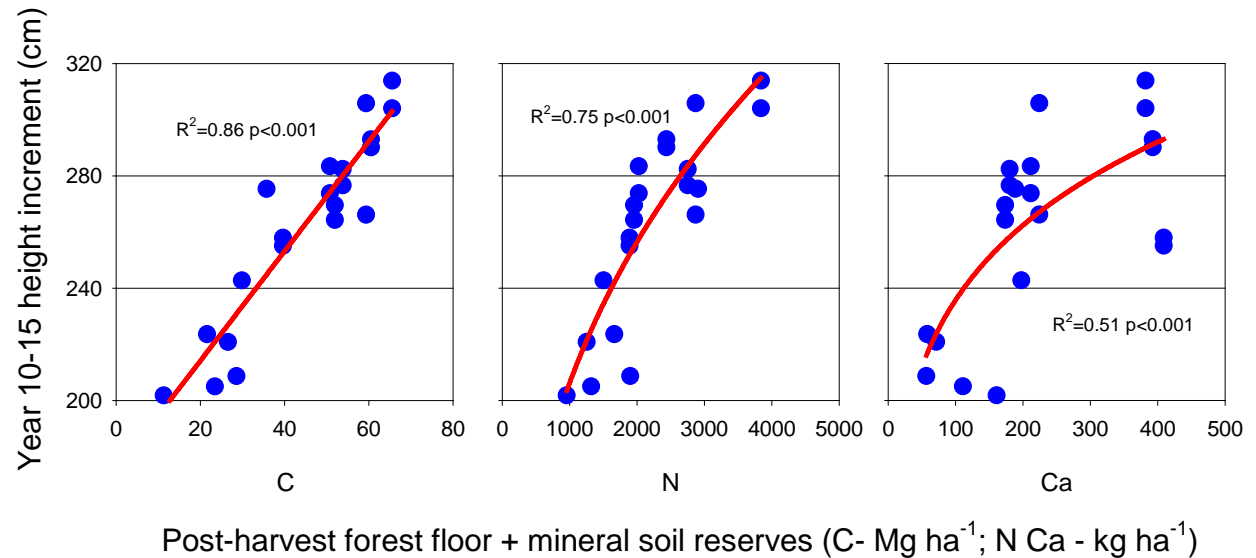


# Ontario LTSP



- TL harvest retained between 1.5 and 4 times more residue than FT – but greater removals than predicted by theoretical harvests
- at 15 years post-harvest jack pine growth the same on TL and FT plots but greater than FFR removal
- at 15 years post-harvest soil C and nutrient reserves on TL harvest not different from FT – generally lower than uncut forest - large decreases with FFR, also removed upper 5 cm of mineral soil

coarse vs fine textured soils  
thin vs thick forest floors



Does a productivity gradient  
provide a proxy for a more  
intensive range of biomass  
removals from any particular site?

# Building on the LTSP experience

## Collaborative science: multi partnership

Forest communities  
& First Nations



Industries



Government  
agencies



Universities



# Building on the LTSP experience



## Issues/Questions:

- potential bioenergy utilization scenarios - increased biofibre removal

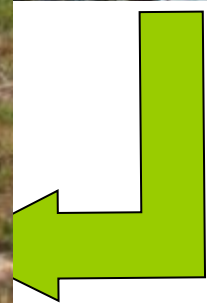


# Harvest



fo

Full-tree biomass



Full-tree stumped

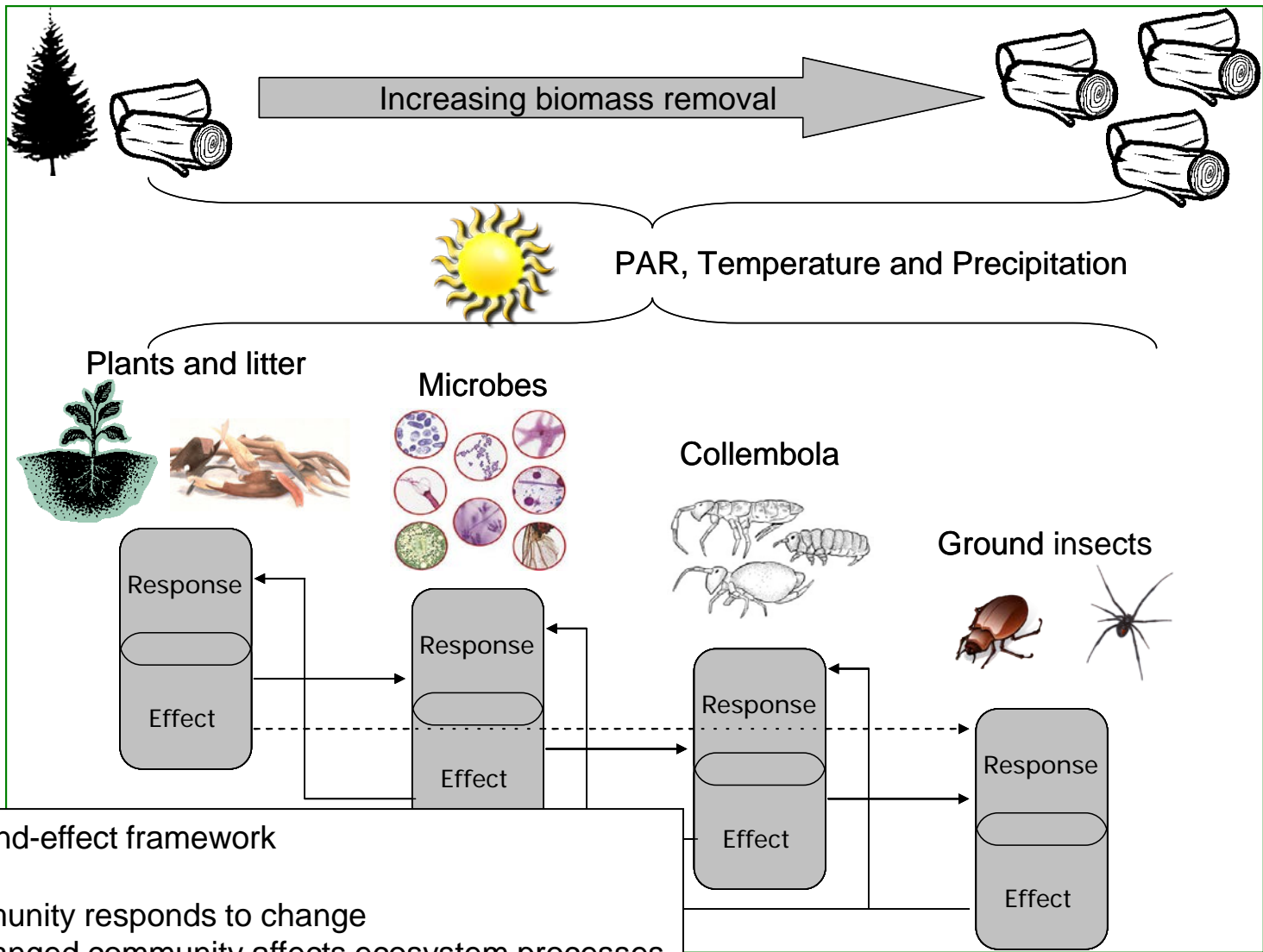
# Building on the LTSP experience



## Issues/Questions:

- potential bioenergy utilization scenarios - increased biofibre removal
- impact of biomass harvesting on biodiversity





**Response-and-effect framework**

How a community responds to change  
 How that changed community affects ecosystem processes

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 Natural Resources Canada, Canadian Forest Service  
 University of Toronto, Laurentian University, UQAM,  
 UQAR, Western University

# Building on the LTSP experience



## Issues/Questions:

- potential bioenergy utilization scenarios - increased biofibre removal
- impact of biomass harvesting on biodiversity
- site remediation – wood ash waste







# Island Lake Biomass Research and Demonstration Area








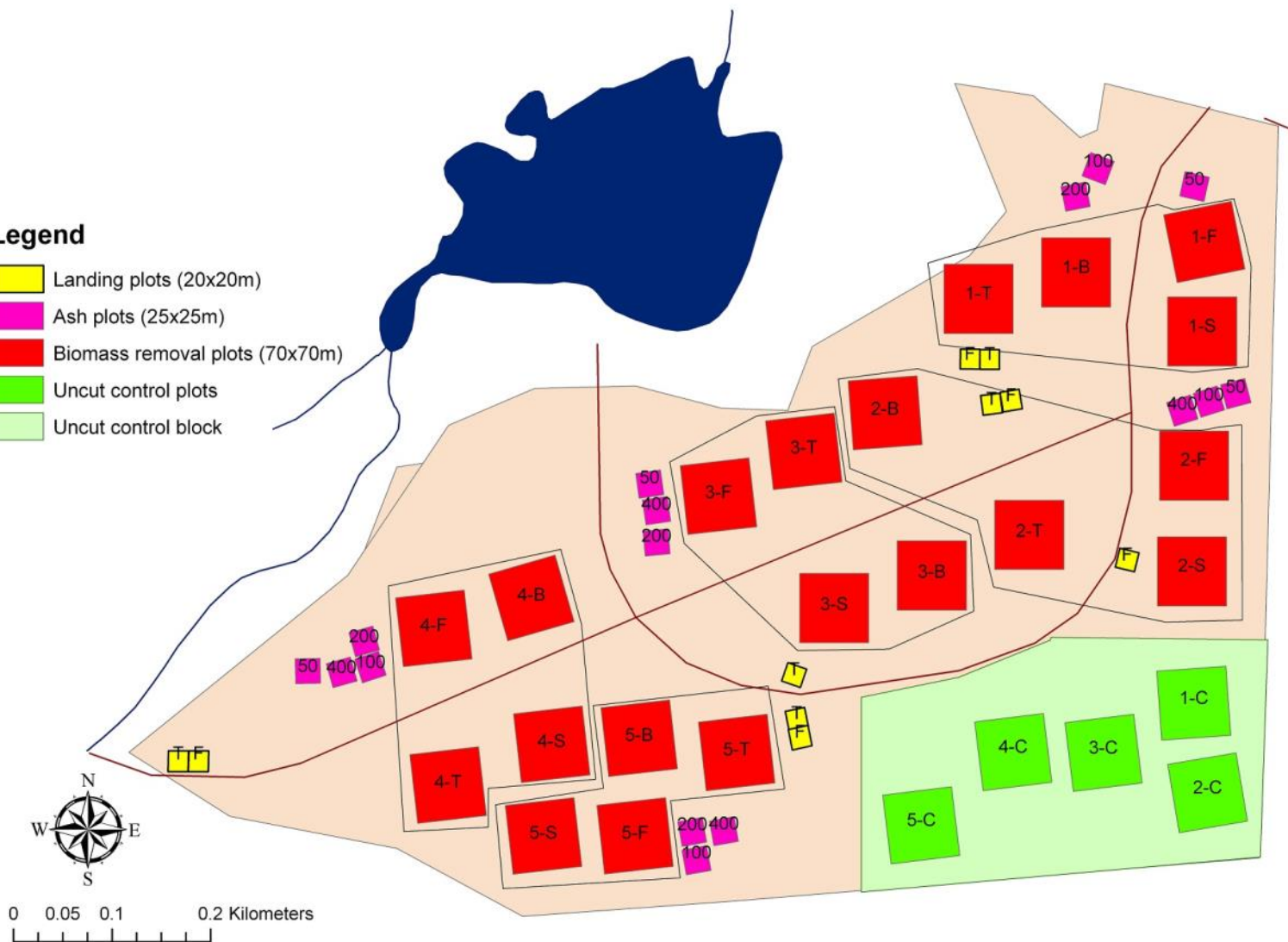
## Measurements:

- tree productivity and nutrition
- soil C and nutrients: pools, fluxes and processes
- plant community dynamics, functional diversity, biogeochemical traits.
- microbial processes, soil respiration, below /above-ground productivity, ecosystem carbon.
- terrestrial invertebrates / soil arthropods
- biodiversity assessment, multitrophic approach, response and effect traits

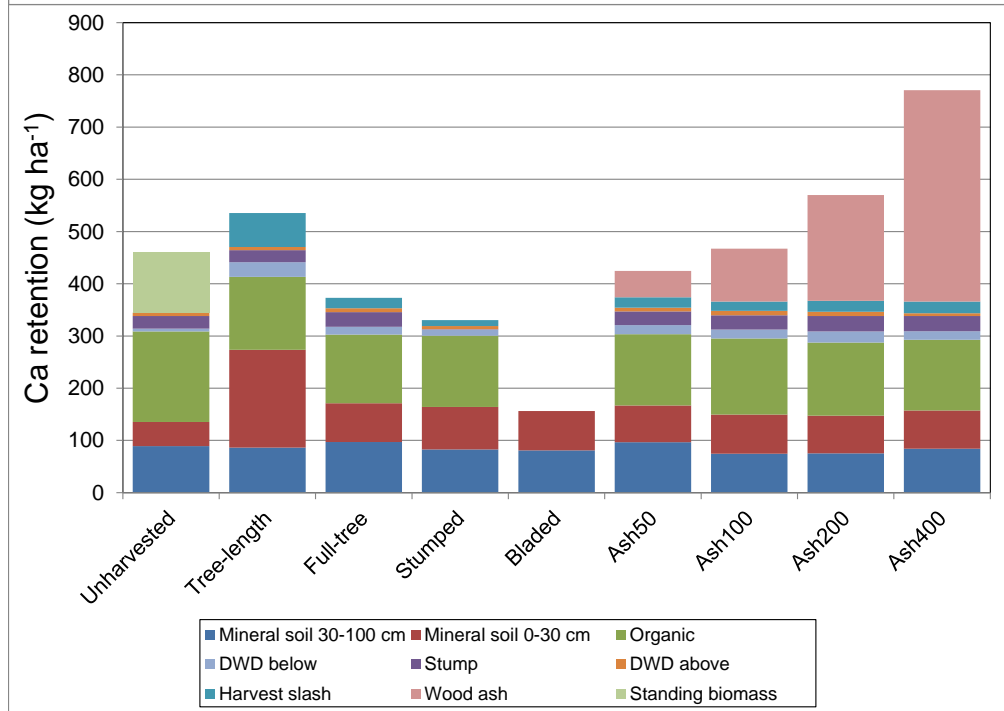
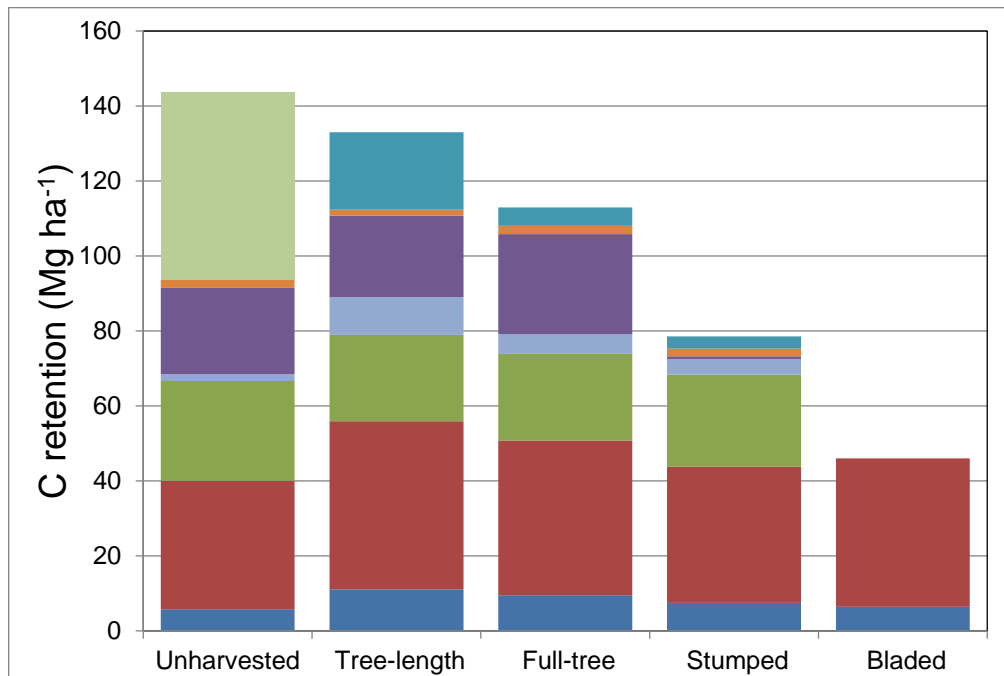
# Island Lake Biomass Harvest Research and Demonstration Area

## Legend

-  Landing plots (20x20m)
-  Ash plots (25x25m)
-  Biomass removal plots (70x70m)
-  Uncut control plots
-  Uncut control block



# C and nutrient retention



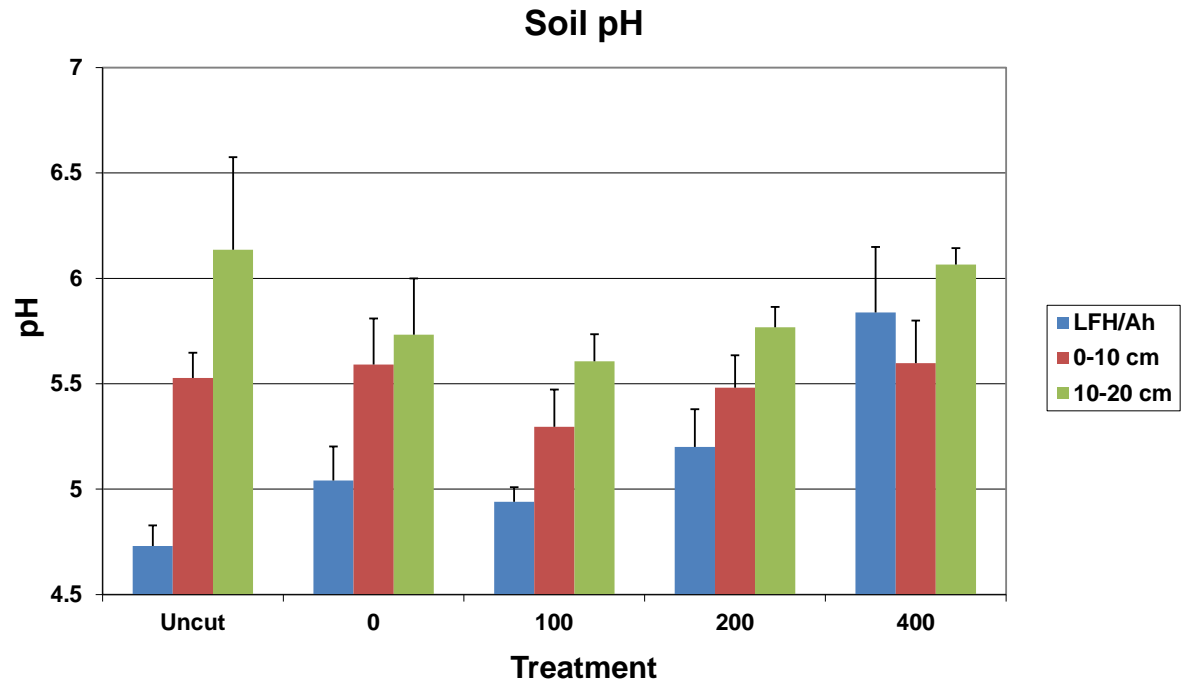
# Wood ash – potential problems



- soil pH increase, increased soil N production, increased N levels in soil water
- heavy metal contamination
- impacts on vegetation and soil biota

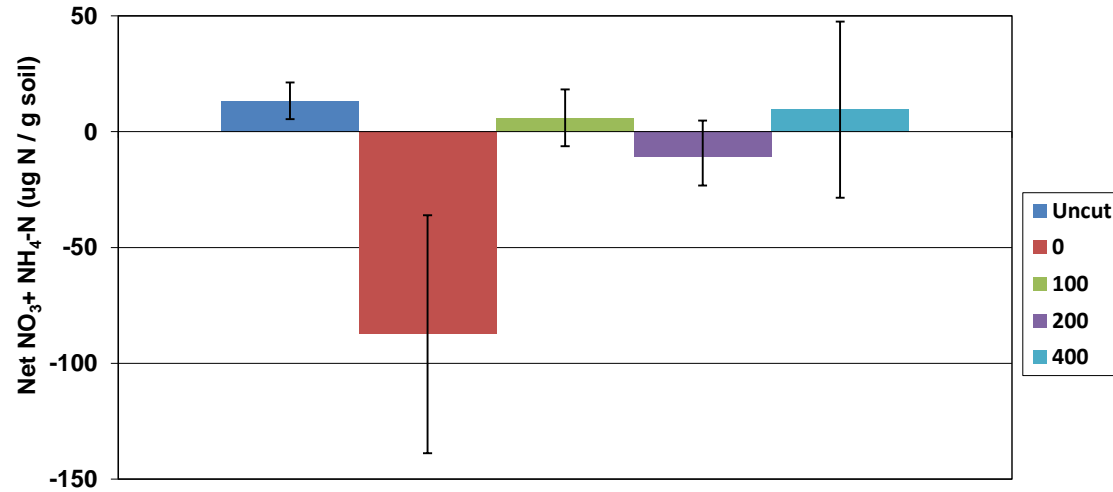


# Wood ash experiment— early results

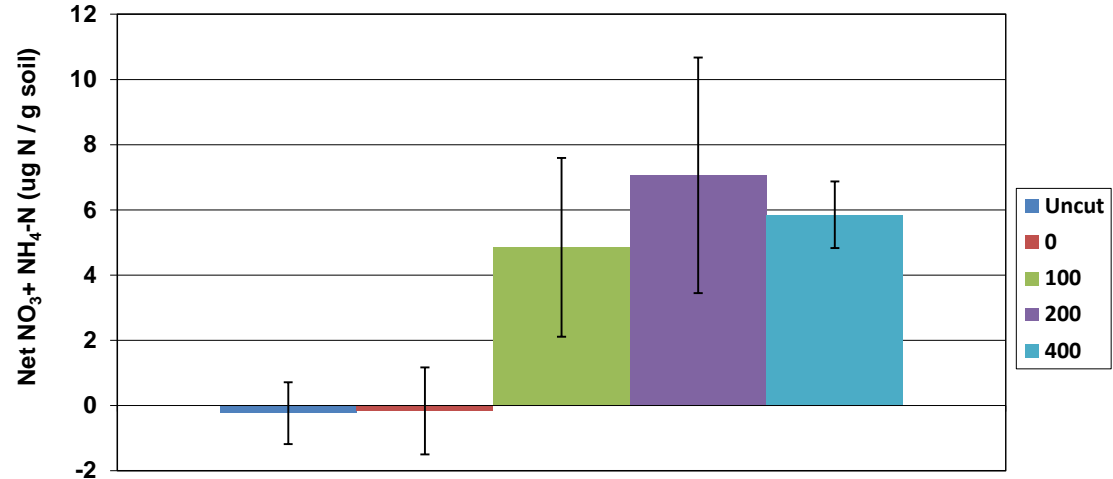


# Soil incubation studies – 165 day totals

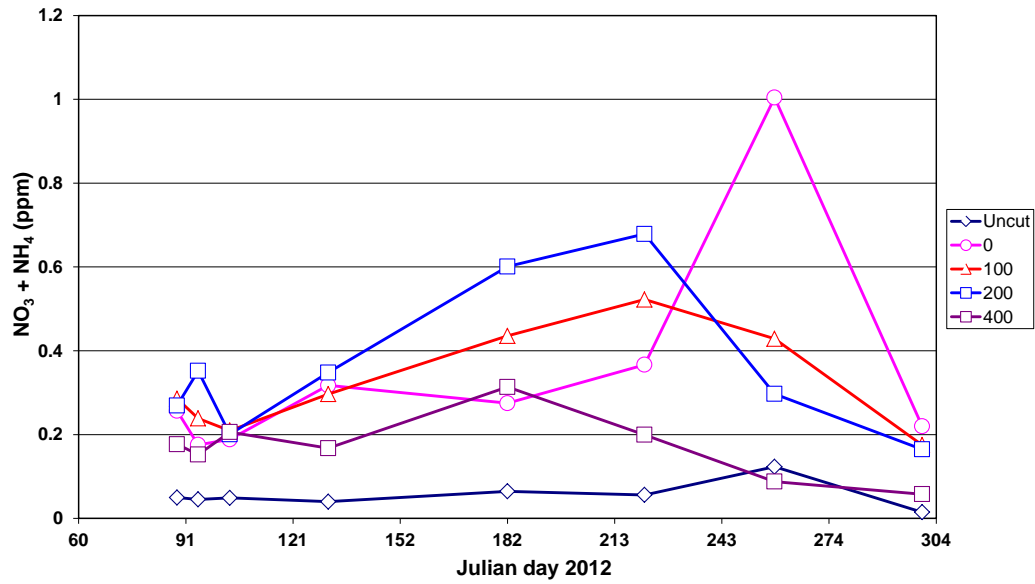
## Net mineralization (LFH/Ah)



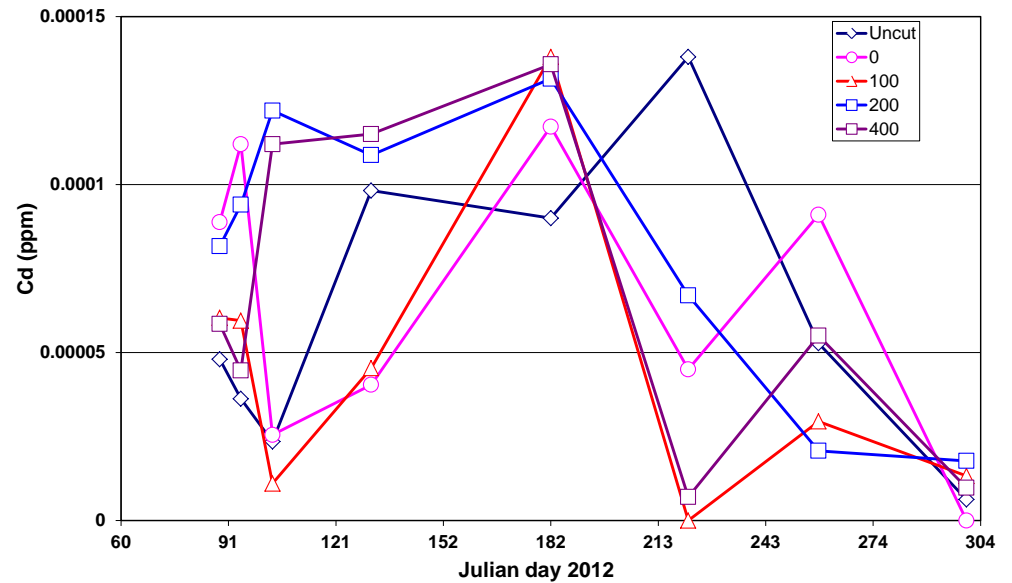
## Net mineralization (0-10 cm)



Soil solution 30 cm depth



Soil solution 30 cm depth





# Thank you Questions?



More information:

<http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/35102.pdf>

<http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/33032.pdf>

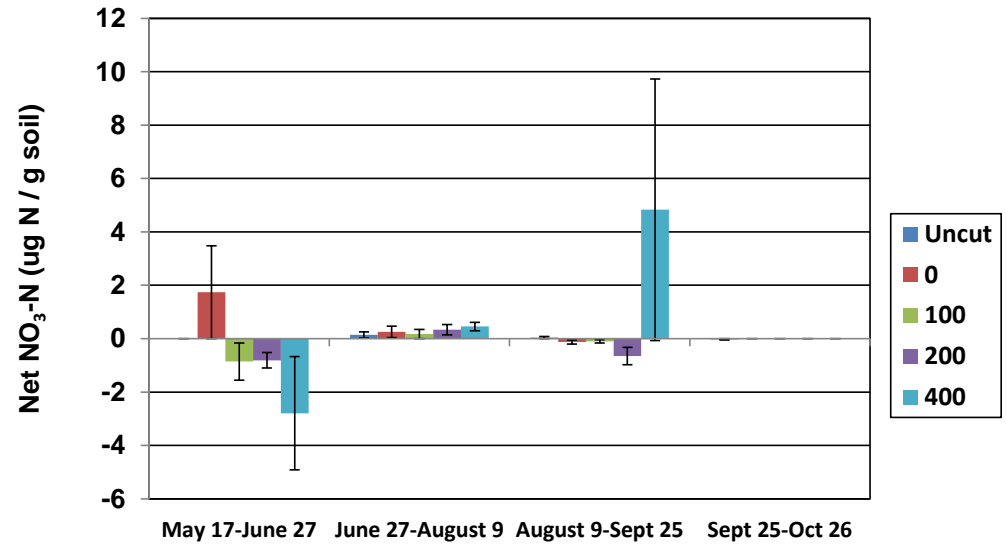


# Soil incubation studies



Neal Scott, Bill Peng  
Queen's University

## Net nitrification (LFH/Ah)



## Net mineralization (LFH/Ah)

