THE COOPERATIVE FORESTRY RESEARCH UNIT
Forest Engineering, From Where We've Been, to Where We're Going.

Council On Forest Engineering
40th COFE Annual Meeting, Bangor ME
Monday, July 31, 2017

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Cooperative Forestry Research Unit
CFRU

COUNCIL ON FOREST ENGINEERING
COFE

Overview

- CFRU Background

- Soil Disturbance: Weymouth Point Study

- Tree Damage: Austin Pond Study

- New Long-Term Trial: MASEN

What is the CFRU?

Partnership between Maine's forest landowners, managers and the University of Maine to solve most important problems facing managers of Maine's commercial forestlands

42-Years of Stakeholder Driven Research

- Formed in 1975

- Among the oldest industry / university forest research cooperatives in the US

- Funded by private forest landowners (Family, TIMO, REIT, industrial), wood processors, government, NGO, and individual contributors

CFRU Membership

- CFRU members work on ½ of the Maine forest (8.2 million acres)

- Members contribute $500K annually based on company size

- Model for stakeholder-driven research on UMaine campus

CFRU Research Project Locations
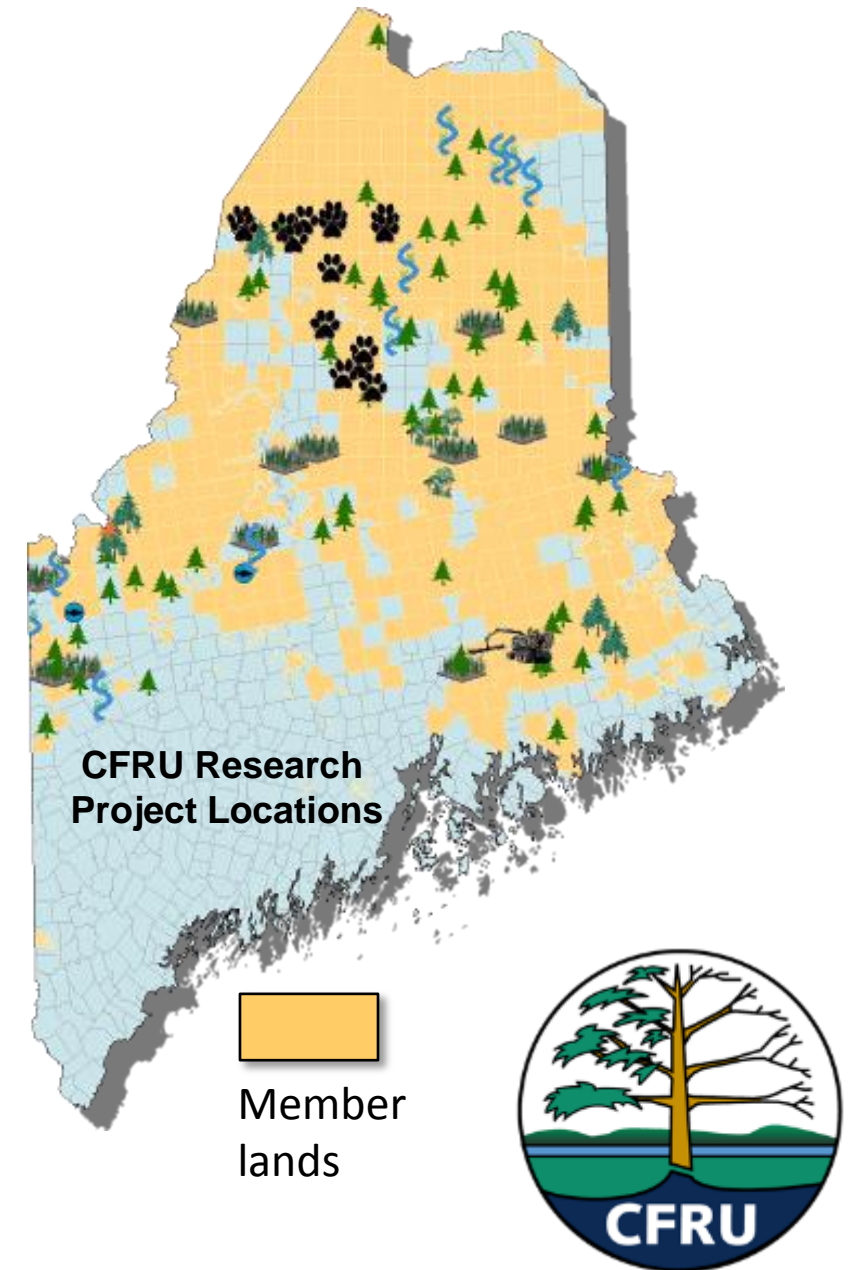
Member lands

35 CFRU Member Organizations

LANDOWNER / MANAGER:

- Irving Woodlands, LLC
- Wagner Forest Management
- BBC Land, LLC
- Weyerhaeuser
- Prentiss and Carlisle Company, Inc.
- Seven Islands Land Company
- Clayton Lake Woodlands Holding, LLC
- Maine Bureau of Parks & Public Lands
- Katahdin Forest Management, LLC
- The Tall Timber Trust
- The Nature Conservancy
- Snowshoe Timberlands, LLC
- Baskahegan Corporation
- Sylvan Timberlands, LLC
- Sandy Gray Forest, LLC
- North Woods Maine, LLC
- Appalachian Mountain Club
- Simorg North Forest LLC
- Frontier Forest, LLC

- Downeast Lakes Landtrust
- Baxter State Park, SFMA
- Robbins Lumber Company
- Timbervest, LLC
- St. John Timber, LLC
- EMC Holdings, LLC
- Mosquito, LLC
- New England Forestry Foundation

WOOD PROCESSOR:

- SAPPI Fine Paper

CORPORATE and INDIVIDUAL:

- ReEnergy Holdings, LLC
- James W. Sewall Co.
- Huber Engineered Woods, LLC
- Forest Society of Maine
- LandVest
- Field Timberlands
- Acadia Forestry, LLC

Focus of CFRU Research

- Forest Productivity / Silviculture

- Harvest Productivity & Costs

- Growth & Yield Modeling/Remote Sensing

- Wildlife Habitat

Effect of Soil Disturbance on Stand Growth and Species Composition 32 Years Following Whole-Tree Harvesting

Cody Lachance, Robert Wagner, Jeffrey Benjamin, Brian Roth

Weymouth Point Study: 1981

- Located adjacent to Chesuncook Lake

- Owned by Katahdin Forest Management (GNP)

- Study the Effects of WT harvesting

- Clearcut in 1981 with WT system
  - Harvested in June and July
  - Koehring feller-forwarder
  - Feller-buncher
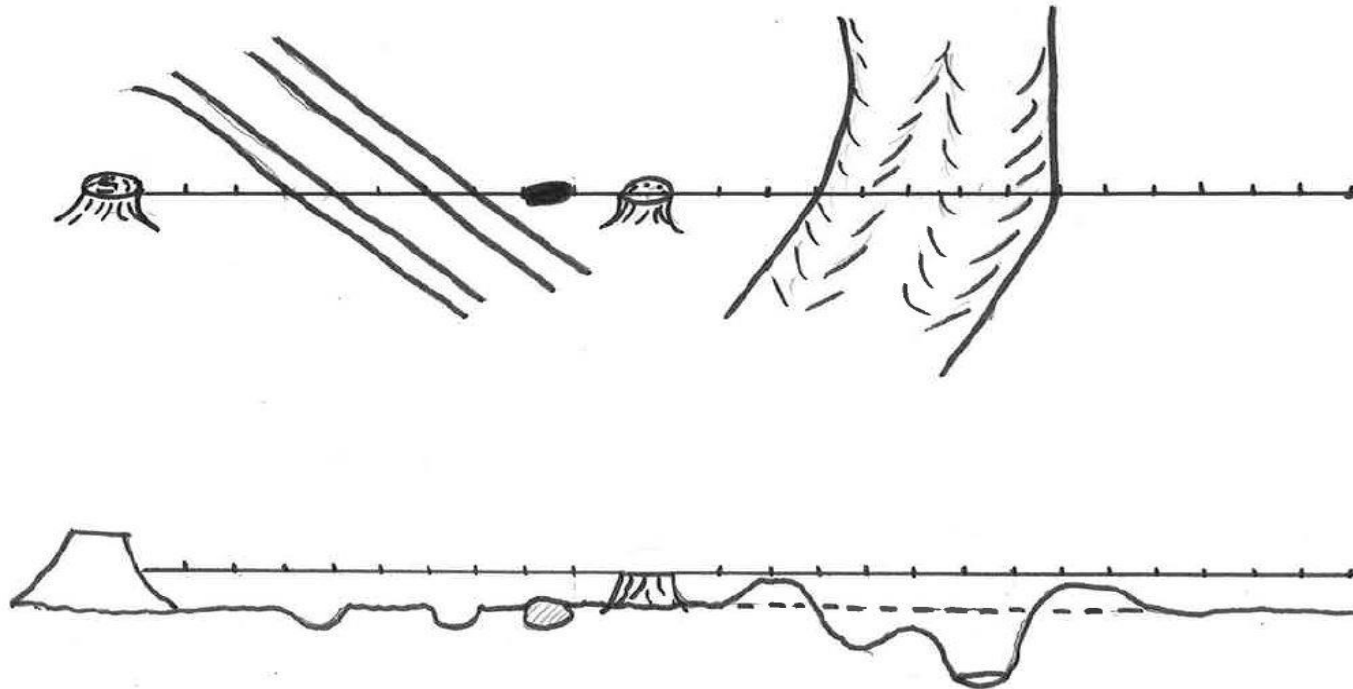 - Grapple skidder

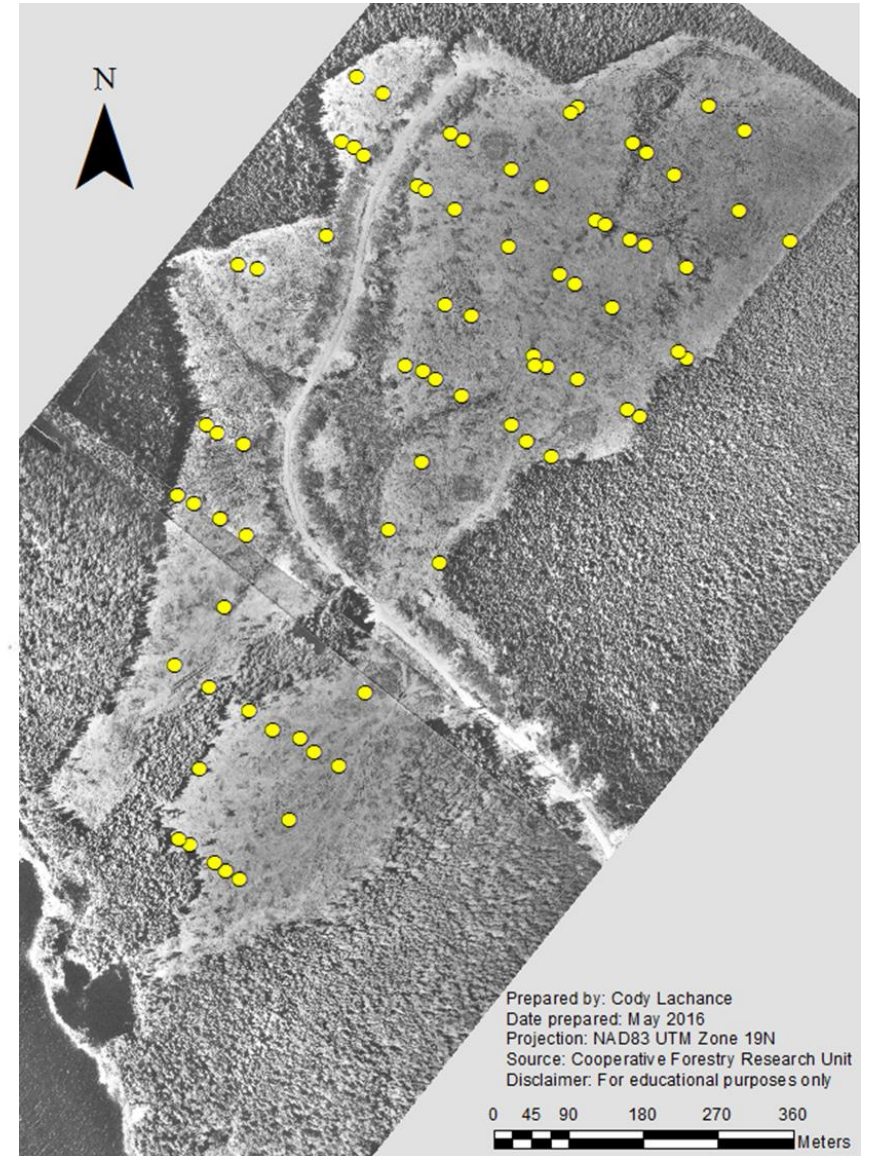- Herbicide application in 1984

Image from: Wayne Martin

Measurements

- Soil disturbance measured on transects in 1981
  - Grid system established post-harvest
  - 100 – 25m long transects from random position & azimuth
  - Categorized soil disturbance every 10 cm
  - 10 soil disturbance categories and depth of displacement in dm

Drawing by Wayne Martin

N

Prepared by: Cody Lachance
Date prepared: May 2016
Projection: NAD83 UTM Zone 19N
Source: Cooperative Forestry Research Unit
Disclaimer: For educational purposes only

0   45   90   180   270   360
                                          Meters

Class	Name	Description
A	Undisturbed	No visual disturbance of any type
B	Depressed	Forest floor not disturbed laterally, but depressed by equipment or by a falling tree
C	Organic scarification	Forest floor disturbed laterally, but no evidence of compression by wheels, tracks, or falling trees
D	Mineral scarification	Complete removal of the organic horizons but no disruption of the mineral soil
E	Organic mounds	Mounds of soil, still covered by organic material, created during harvesting usually as a berm parallel to wheel ruts or near tree roots disturbed through shearing
F	Mineral mounds	Mounds of mineral soil or organic soil covered by mineral soil deposits created during harvesting
G	Organic ruts	Shallow wheel or track ruts within the organic horizons or deep compression ruts still lined with organic soil
H	Mineral ruts	Wheel or track ruts in mineral soil
Dead wood	Dead wood	Stumps, logs in contact with the soil, or slash too dense to allow evaluation of soil disturbance
Rock	Rock	Bare rocks that occupied 10 cm or more of the transect line

Images from: Wayne Martin
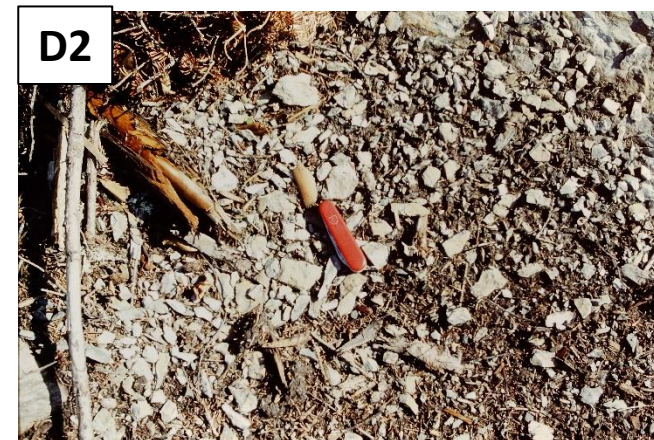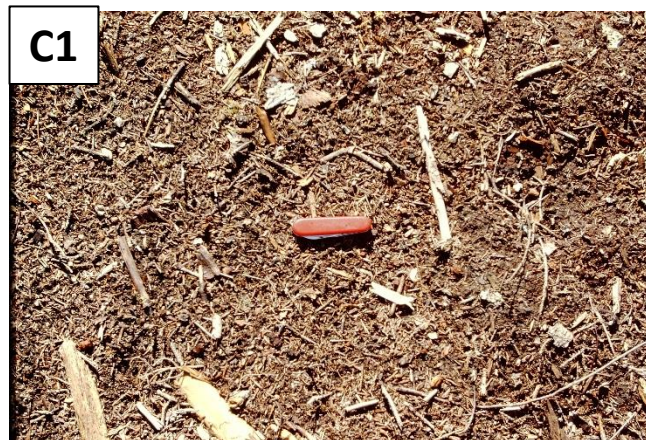
Type	Depth or height (dm)								Total	SE
	0	1	2	3	4	5	6	7		
............................%..										
Undisturbed	7.7								7.7	1.2
Depressed		7.2	0.4						7.6	1.1
O. scar.	5.9	15.6	1.6						23.1	2.5
M. scar.		0.8	0.5						1.3	0.4
O. mounds		3.0	2.6	0.9	0.1	0.1			6.7	0.7
M. mounds		0.9	2.0	0.7	0.1				3.7	0.6
Organic ruts		16.8	8.1	2.3	0.3	0.1	0.0	0.1	27.7	2.2
Mineral ruts		3.9	3.6	2.7	1.4	1.0	0.1	0.2	12.9	1.7
Dead wood	8.8								8.8	1.1
Bare rocks	0.5								0.5	0.2
Total	22.9	48.2	18.8	6.6	1.9	1.2	0.1	0.3	100.0	-

Least Disruptive

Most Disruptive
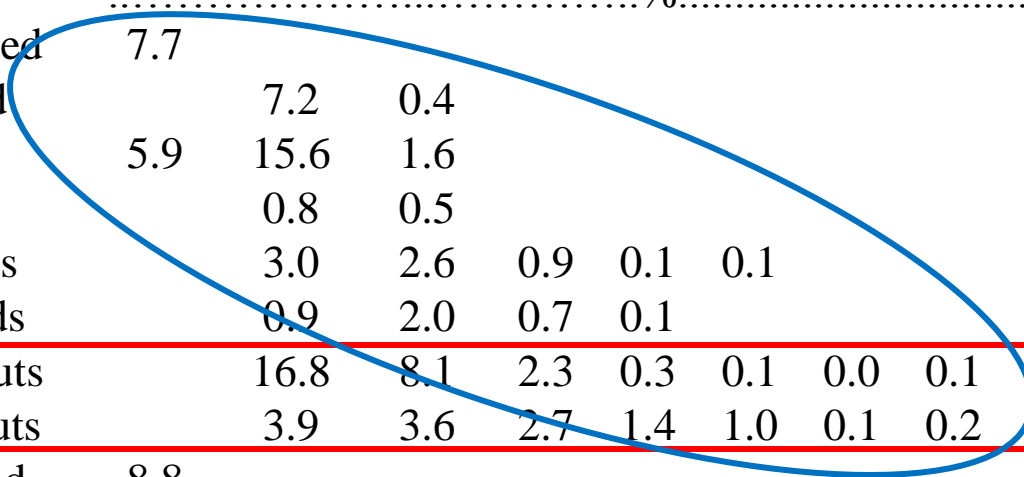
40.6% in ruts

Martin, 1988

Measurements

- Transects relocated in 2013 (32 years after harvest)

- Established crop trees
  - Within 0.5 m of transect
  - > 4 inches DBH
  - Species, DBH, height

- Established 1/100th acre fixed area plots (11.78' radius)
  - Measure competition around crop tree
  - Species, DBH

Stand-level response variables:
1. Basal Area (ft^2 ac^{-1})
2. Volume (ft^3 ac^{-1})
3. Density (trees per acre)
4. % Hardwood

Crop tree response variables:
1. DBH (in)
2. Volume (ft^3)
3. Height (ft)

Tree 4

Tree 3

Tree 2

Tree 1

Transect End
25 m

Transect Origin
0 m

1 m

25 m
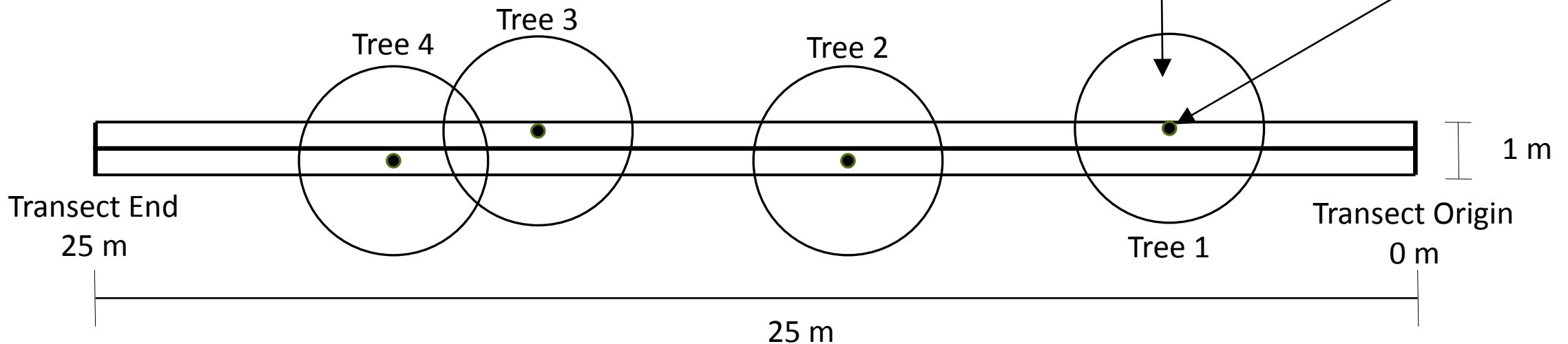
Balsam Fir Tree Core Subset

- Trees on relatively high and low disturbed soils targeted
  - High disturbed trees (n = 40): > 70% segment in organic or mineral ruts
  - Low disturbed trees (n = 32): 100% segment in undisturbed, depressed, or organic scarification

- Trees cored in August 2015

- Tree cores brought back to lab for processing

- Ring-widths measured

- Basal area increment (BAI) calculation

Analysis

- Stand-level analysis:
  - Modeled to account for type & severity of disturbance and various weighting schemes along transect

- Crop tree analysis:
  - Covariates used to adjust for competition: density (trees ha^{-1}), stand density index, & basal area (m^2 ha^{-1})

- Balsam fir radial growth analysis:
  - Response variables: basal area increment (cm^2) by soil disturbance (high vs. low)
  - Covariates used to adjust for competition: density (trees ha^{-1}) and basal area (m^2 ha^{-1})

Results

- Stand-level analysis:
  - ***No significant effect*** of soil disturbance with linear weighting scheme

- Crop tree analysis:
  - ***No significant effect*** of soil disturbance on tree-level response variables
  - Accounted for plot-level competition with covariates

- Balsam fir radial growth analysis:
  - ***No significant effect*** of soil disturbance on basal area increment
  - Accounted for plot-level competition with covariates
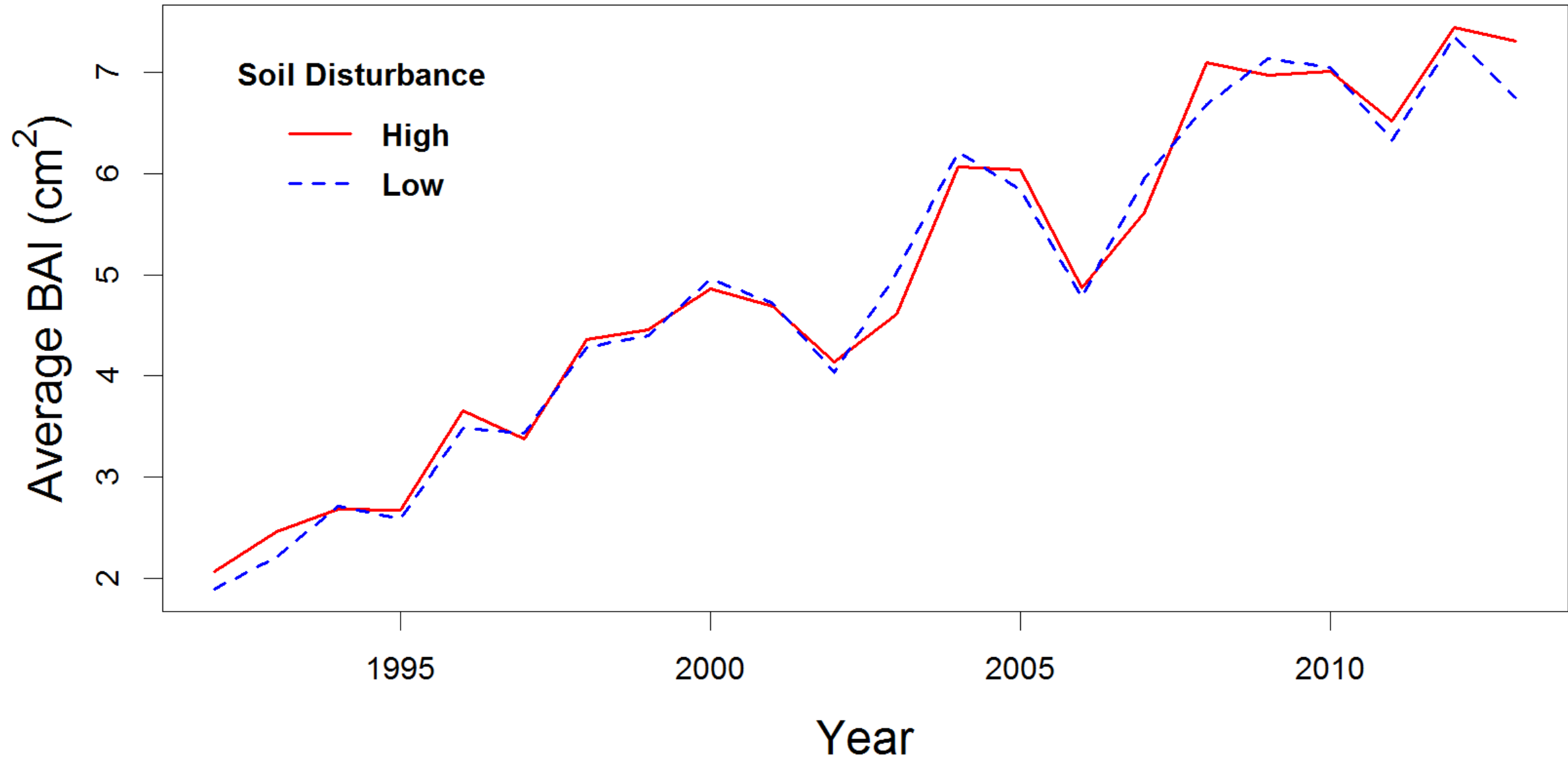
Conclusions

The Weymouth Point Study location was relatively robust and resilient to soil disturbance and it did not effect subsequent composition, structure, or growth of merchantable stand 32 years following harvesting

# Residual Stem Damage Following CT Operations in Spruce-fir Stands

Objectives: Investigate the effects of initial stand density, level of commercial thinning (CT) removal, and distance from trail on residual stem damage following CT operations in spruce-fir stands that had previously received precommercial thinning (PCT) or no PCT.

Cody Lachance, Robert Wagner, Jeffrey Benjamin, Brian Roth

Austin Pond Study Site

- Owned by Weyerhaeuser
  (formerly Plum Creek/Scott Paper)

- Located in Bald Mountain Township in Somerset County, Maine

- Clearcut in 1970

- Regeneration dominated by red spruce, black spruce, balsam fir, and eastern white pine

- Herbicide screening treatments in 1977 (hardwood competition)

- Twelve treatment units were PCT in 1986 to 700 tpa

- Third wave of treatment (CT) in 2013/14
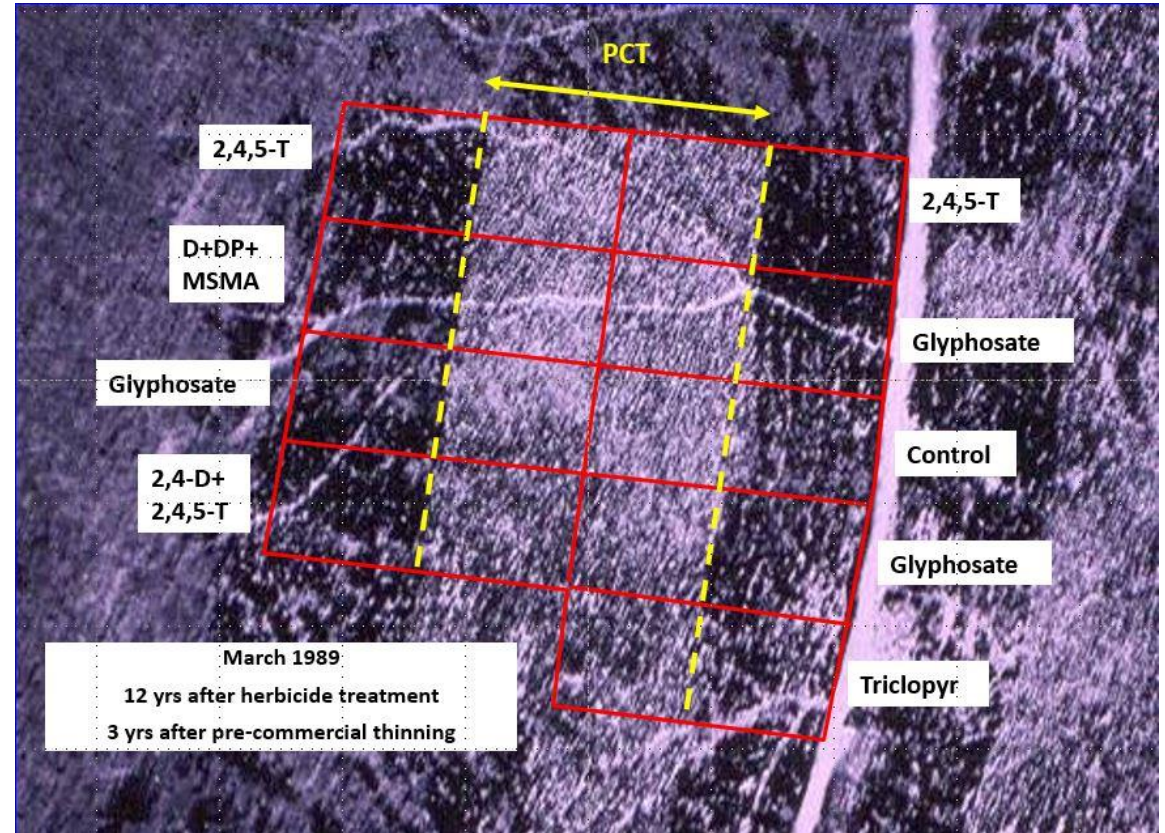
PCT

Non-PCT

Commercial Thinning Treatments

Three removal levels of standing softwood volume
- 33, 50, and 66%

Key consideration is difference in harvest system

- PCT plots thinned with cut-to-length (CTL) system (2013)

- Non-PCT plots thinned with whole-tree (WT) system (2014)

CTL System in PCT'd Stands

WT System in non-PCT'd Stands
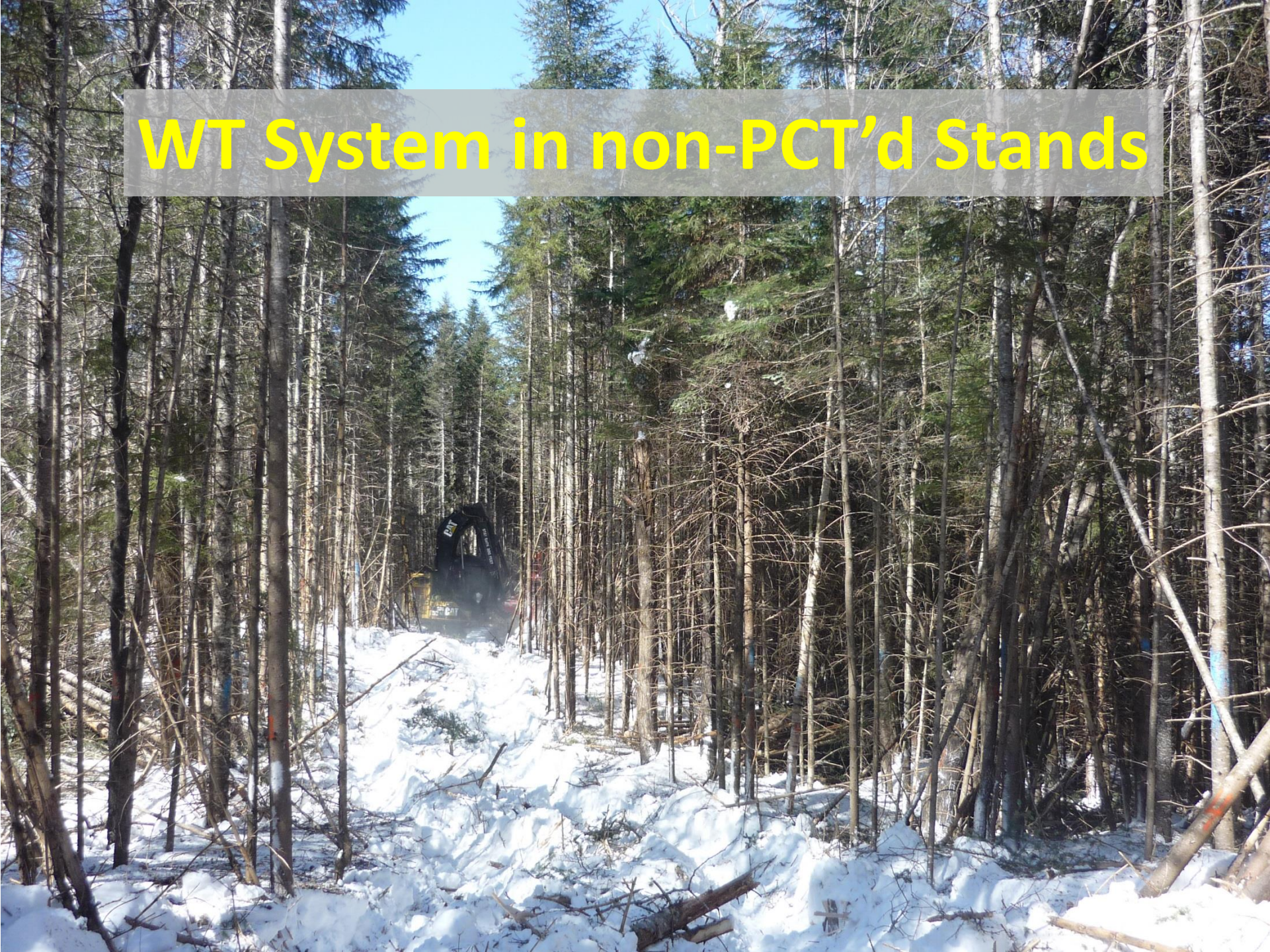
Cut-to-length (CTL): Processor & forwarder

- 13% of timber production in Maine (Leon, 2012)

Ponsse Ergo processor

Timberjack 1110 forwarder

Whole-tree (WT): Feller-buncher & grapple skidder

- 80% of timber production in Maine (Leon, 2012)

CAT 501 feller-buncher

John Deere 648 GIII grapple skidder

Measurements

- 21 treatment plots visited (12 PCT, 9 non-PCT)
  - 30 m by 27 m

- Measured every tree within treatment plot
  - DBH
  - Species
  - Distance from the center of the closest trail

- Potential wounds tallied at:
  - Stem (size, height)
  - Roots
  - Crown

Response Variables

- Stand-level:
  - Wound Area (m^2 ha^{-1})
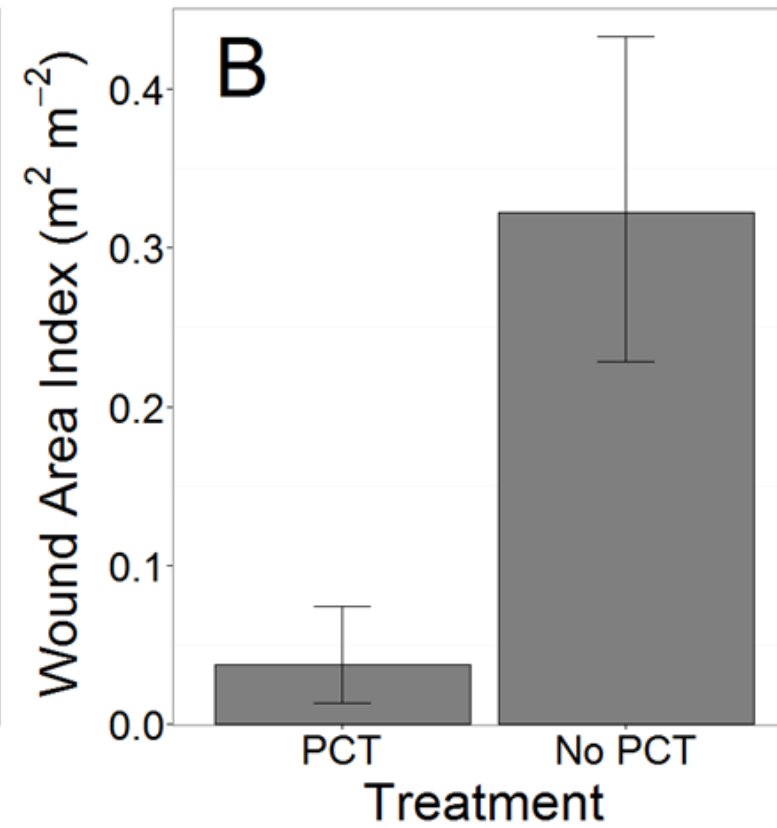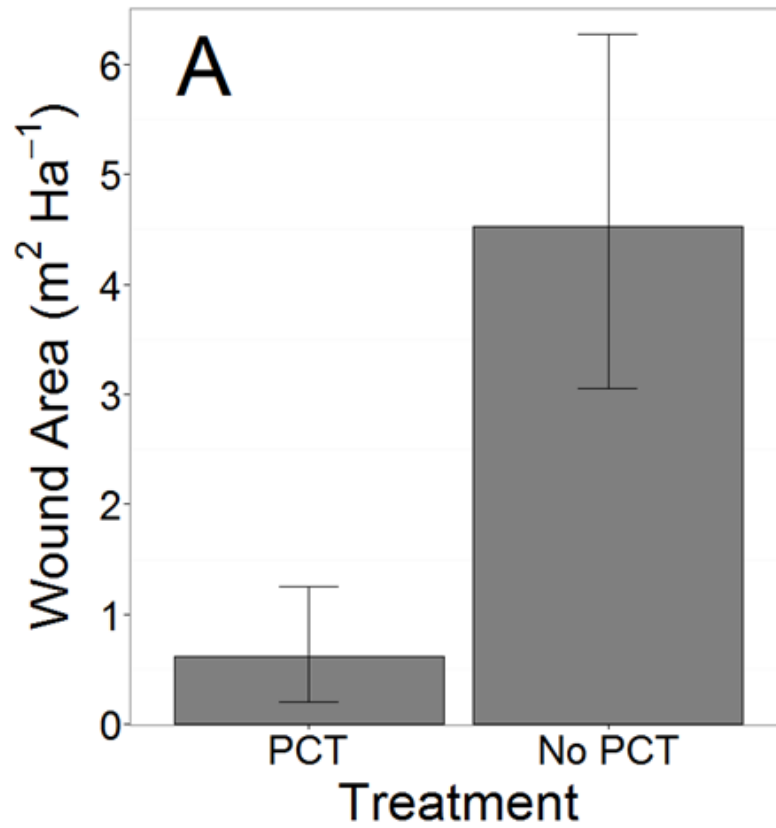 - Wound Area Index (m^2 m^{-2})

- Tree-level:
  - Probability of stem wounding
  - Probability of root wounding
  - Probability of crown wounding
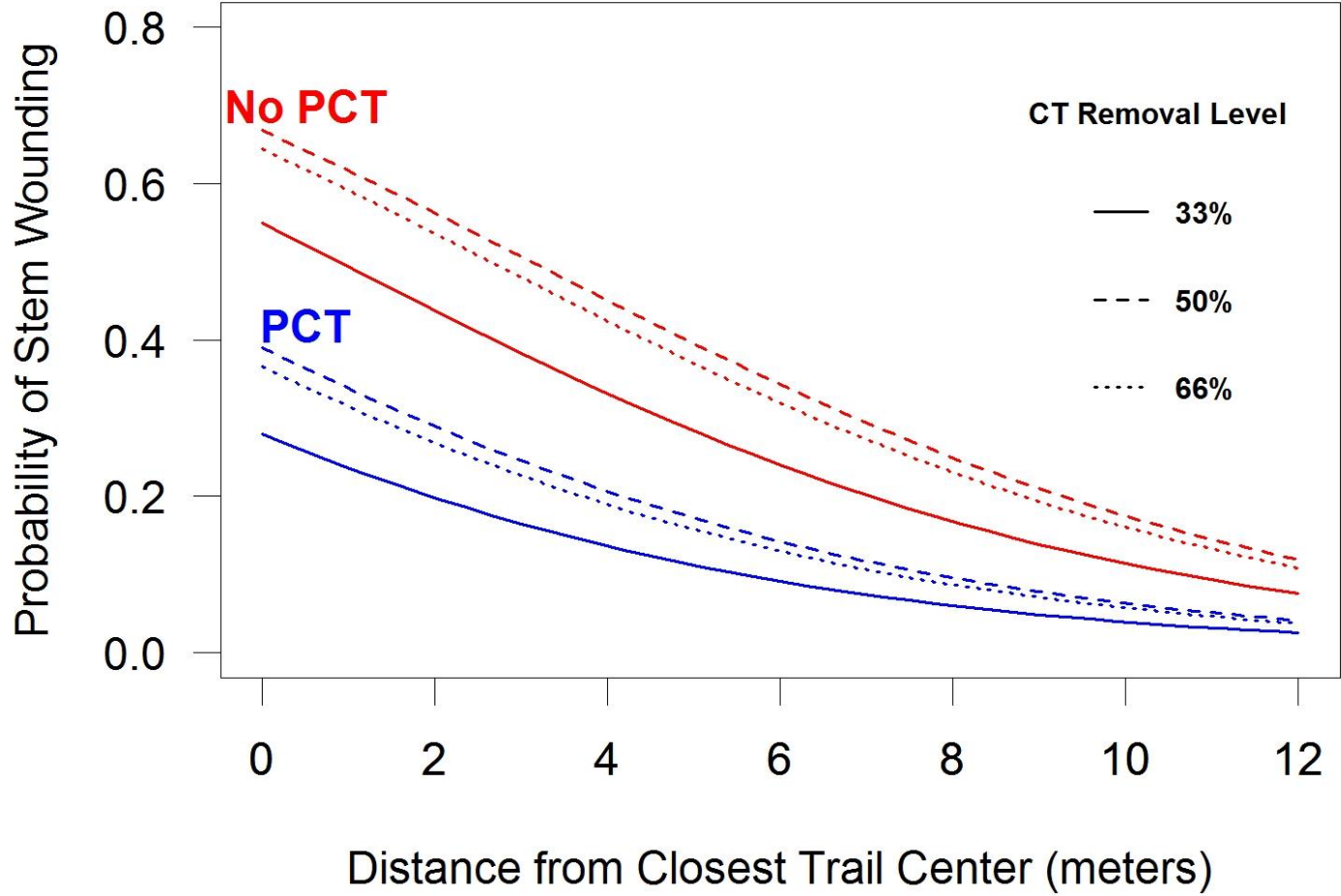 - Wound area per tree (cm^2)

- Wound-level:
  - Surface area (cm^2)
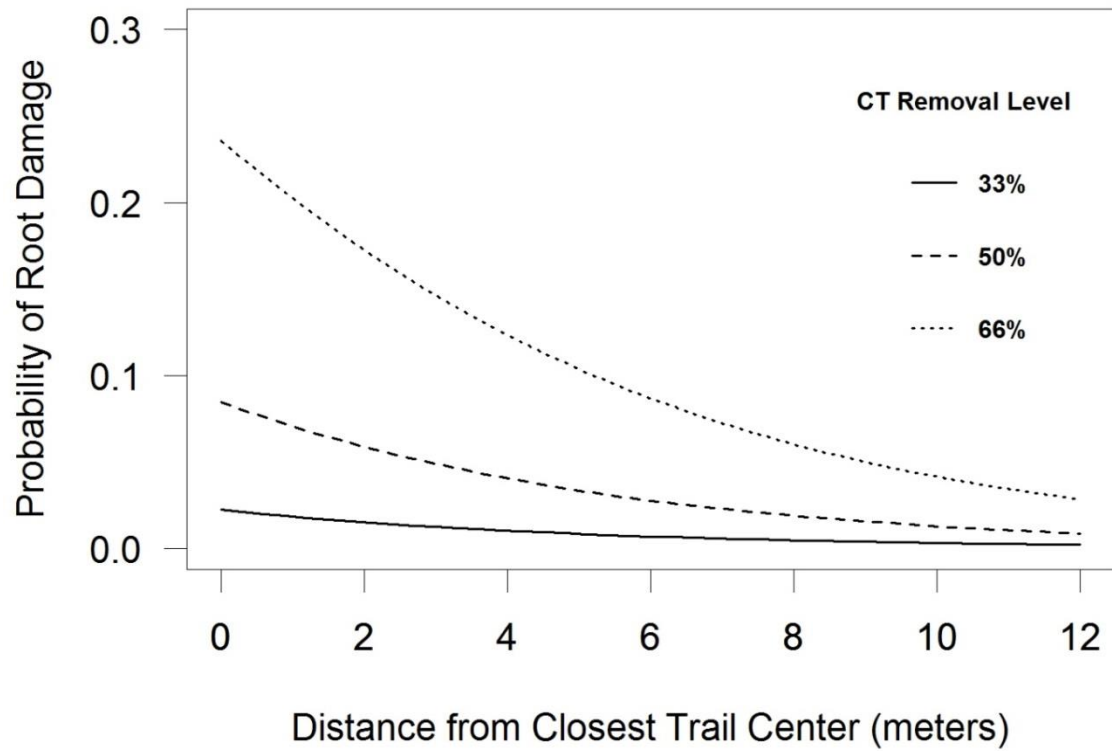 - Wound height (m)

Stand-level Results

Probability of Stem Wounding

# Probability of Root and Crown Damage

Summary

- PCT vs. Non-PCT most important factor
  - Higher initial stand density increased risk for residual stem damage
  - Differences in harvest system could have played a role

- Higher CT removal levels (> 33%) resulted in more damage
  - More wound area per tree
  - Higher chance for stem wounding
  - Higher chance for root damage
  - Higher chance for windthrow

- Trees closer to trails at higher risk for damage
  - Stem wounding
  - Root damage
  - *Opposite for crown damage*

- Need to factor operator experience and ability

MASEN: Maine's Adaptive Silviculture Experiment Network

• A network of 18 operational scale study installations distributed across the state

• All combinations of forest types and site qualities

• Field Laboratory to:

• 1) compare silvicultural treatments,

• 2) quantify productivity & costs of harvest methods,

• 3) provide data to improve growth and yield (G&Y) models,

• 4) validate remotely sensed forest inventory & habitat quality,

• 5) quantify the effects of forest management on wildlife habitat

https://youtu.be/1CC0FMGIyng
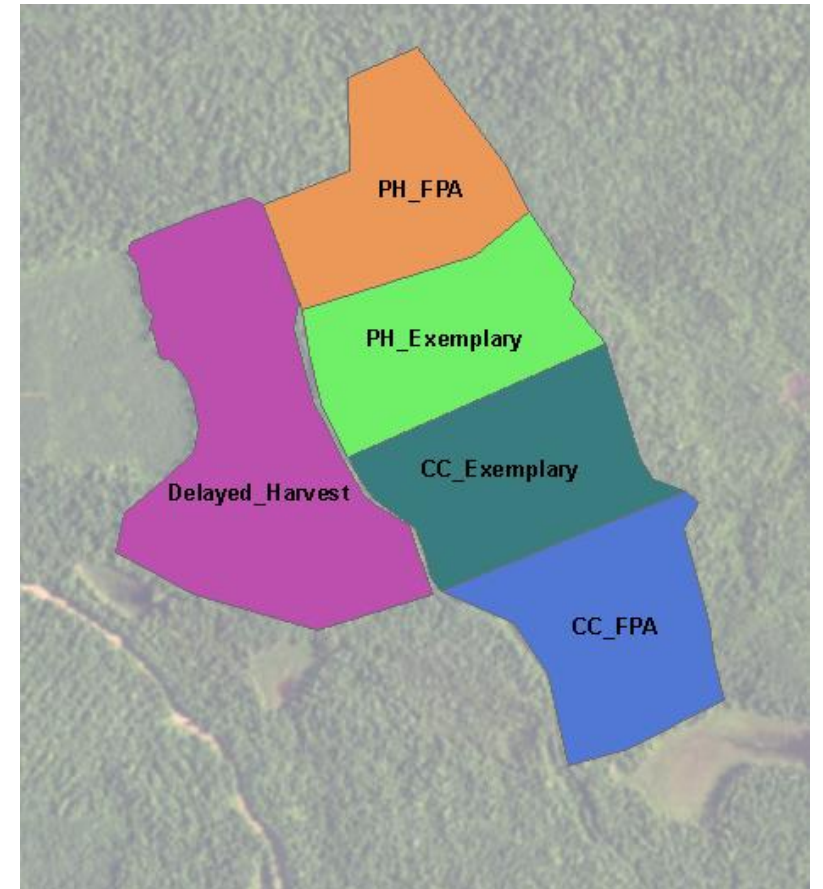
Questions ?

Roger Avery and Ernie Leveille