Silvicultural Rehabilitation of Cutover Mixedwood Stands: Results from Maine

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Exploitative cutting

- Timber extraction without attention to regeneration or tending
- Understocked and patchy residual stands
- Undesirable species
- Low vigor and quality

Acadian Forest

Northern conifers

- Spruce
  - red, white, and black
- Balsam fir
- Eastern hemlock
- Northern white-cedar
- Eastern white pine
- Hardwoods
  - maple, birch, and aspen

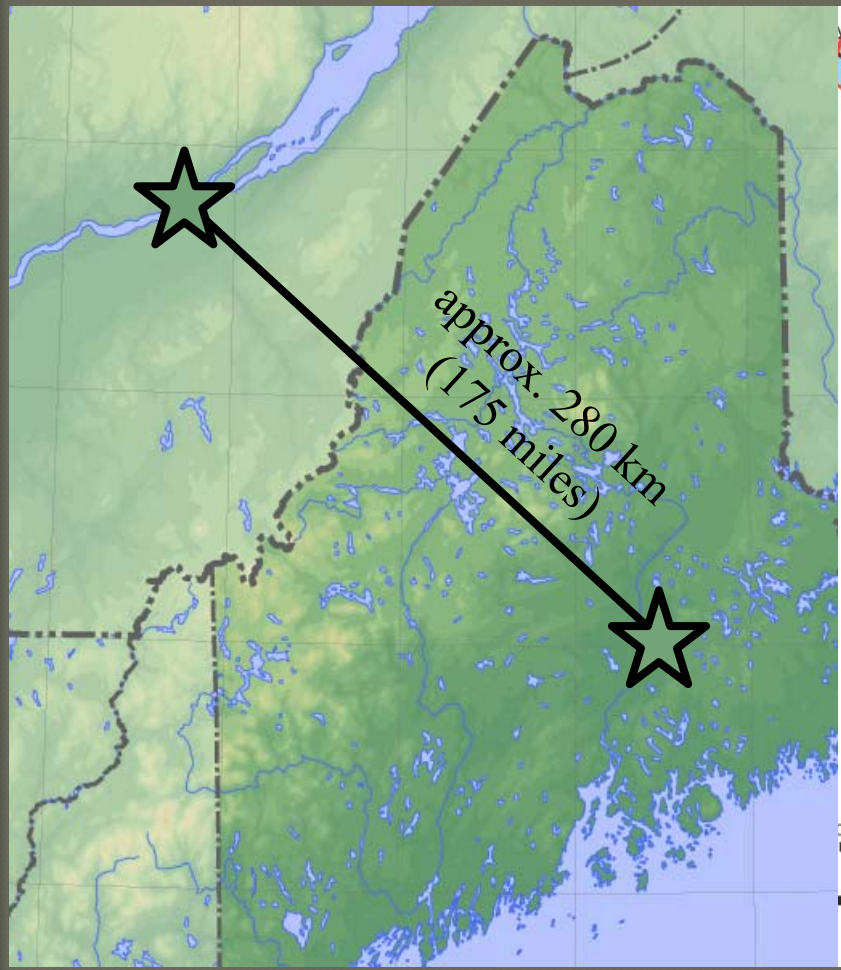
Historical context

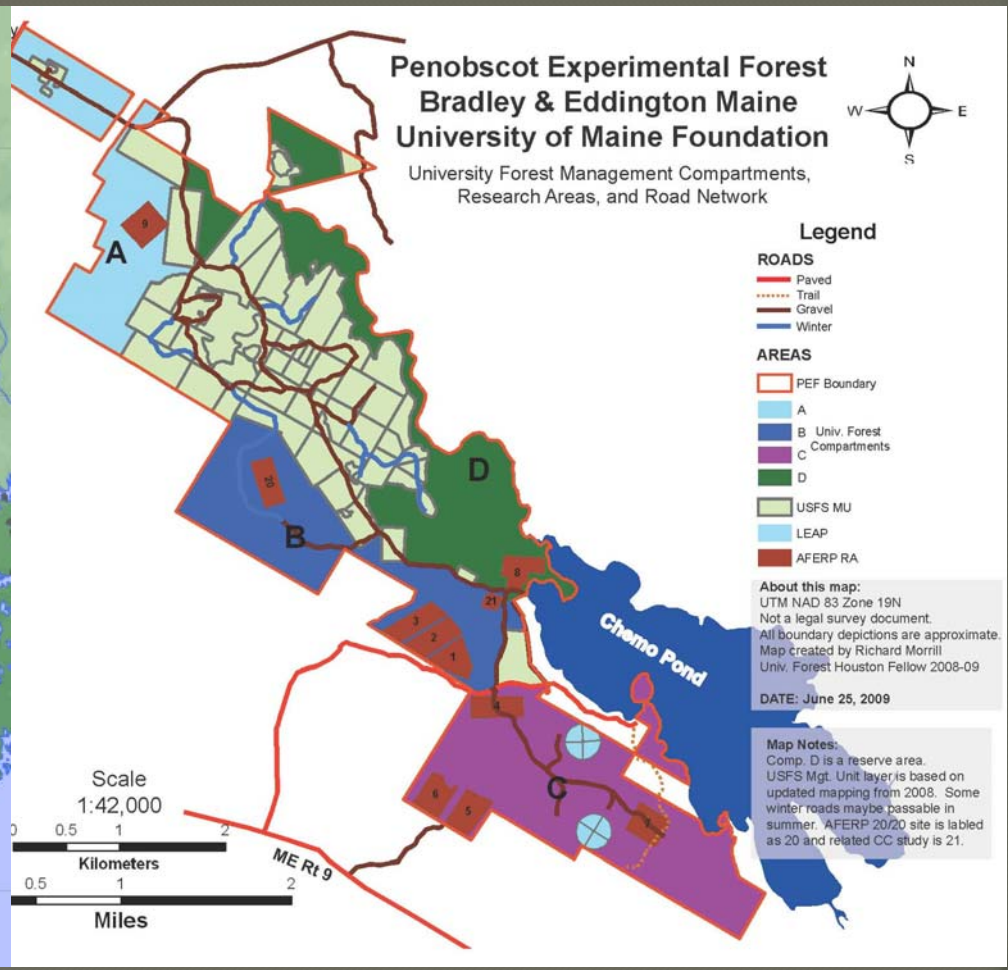
- History of repeated partial cutting
- Selective removals
- Degraded species composition

Penobscot EF

- 1500-ha (4000-ac) forest in central Maine
- Owned by University of Maine Foundation
- U.S. Forest Service
  - silviculture experiment
  - 60+ years of research

Penobscot EF





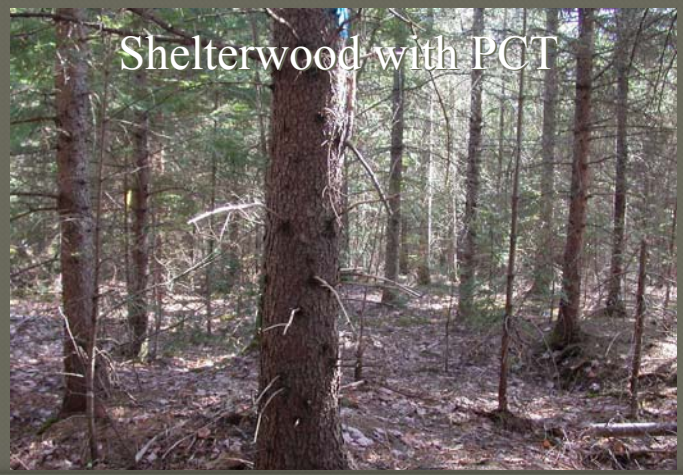
Treatments

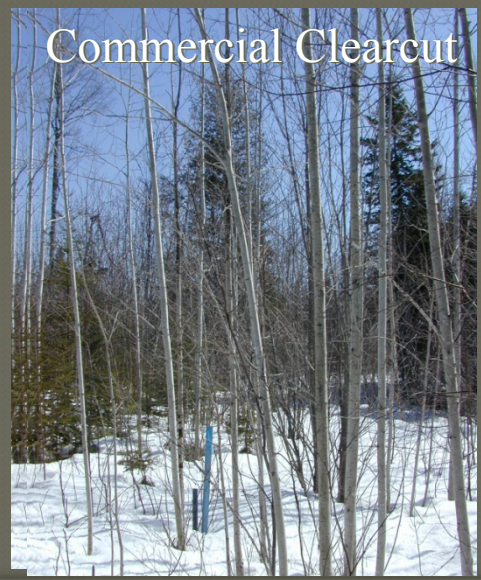
- Shelterwood cutting
  - Two-stage
  - Three-stage
    - PCT
- Selection system
  - 5-year
  - 10-year
  - 20-year
- Exploitative cutting
  - Commercial clearcutting
  - Fixed diameter-limit
  - Modified diameter-limit
- Reference

Treatments


Reference

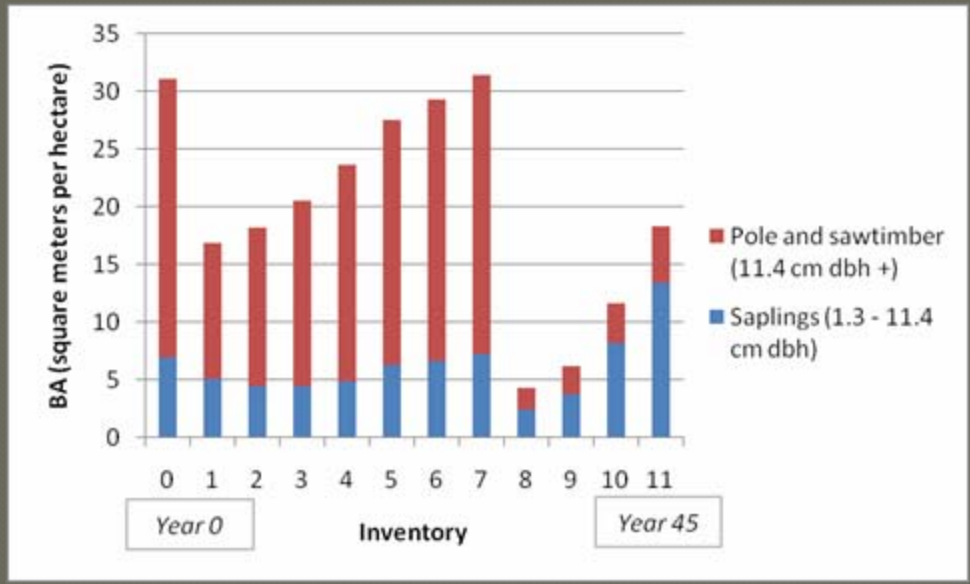

Selection Cutting


Shelterwood with PCT


Commercial Clearcut

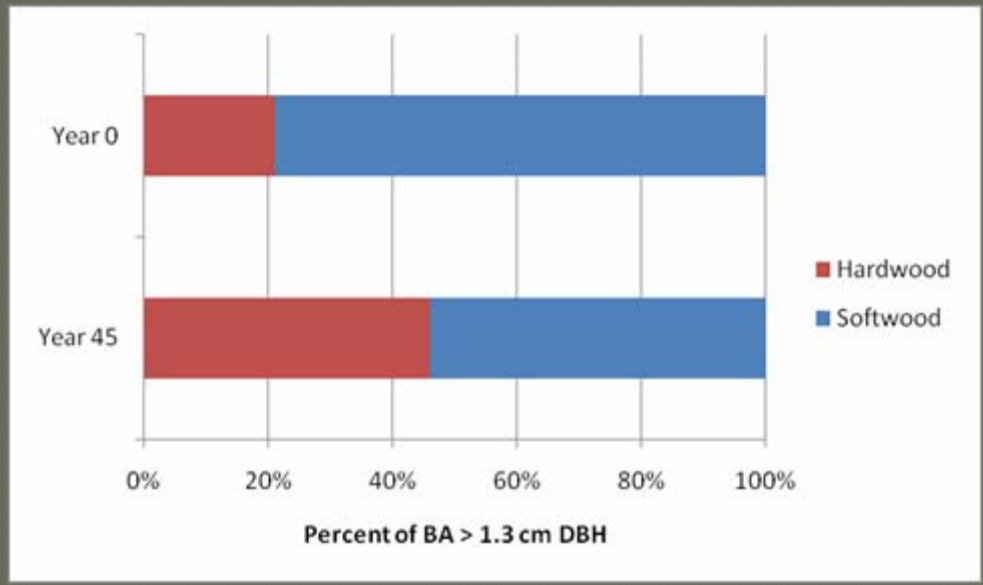
Commercial clearcutting

- not a silvicultural clearcut
- all merchantable trees harvested in the 1950s and 1980s
- no attention to regeneration



Prior to rehabilitation

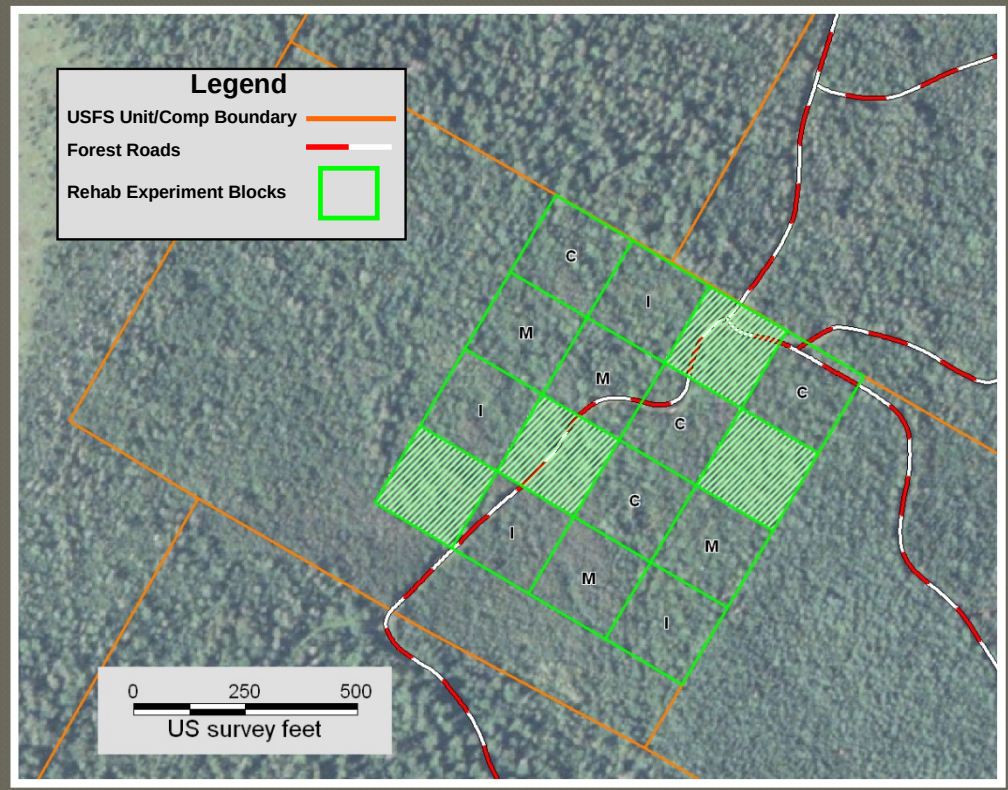
- dominated by sapling-sized trees, poor-quality residuals and clumps and voids of vegetation
- degraded species composition



Pre-treatment conditions

Treatments

- four replicates of three treatments
  - no rehabilitation
  - moderate
  - intensive
- precommercial



Data collection

- 0.4-ha (~1-ac) treatment blocks
- 0.2-ha (0.5-ac) overstory and 0.005-ha (0.002-ac) sapling plots
  - species, dbh and merchantability
- 0.0004-ha (milacre) regeneration plots
  - species and height
- crop trees
  - species, dbh, height, height to crown and crown width
- photo points, variable radius (prism) plots and canopy gap fraction

Treatments

Moderate rehabilitation

- objectives: improved growth, value, species and spacing
- release of crop trees ≥ 1.3 m (4.5 ft)
  - hardwoods: 7.5-m (25 ft)
  - softwoods: 5.0-m (15 ft)

Moderate treatment

Crop tree release.

Kill trees:

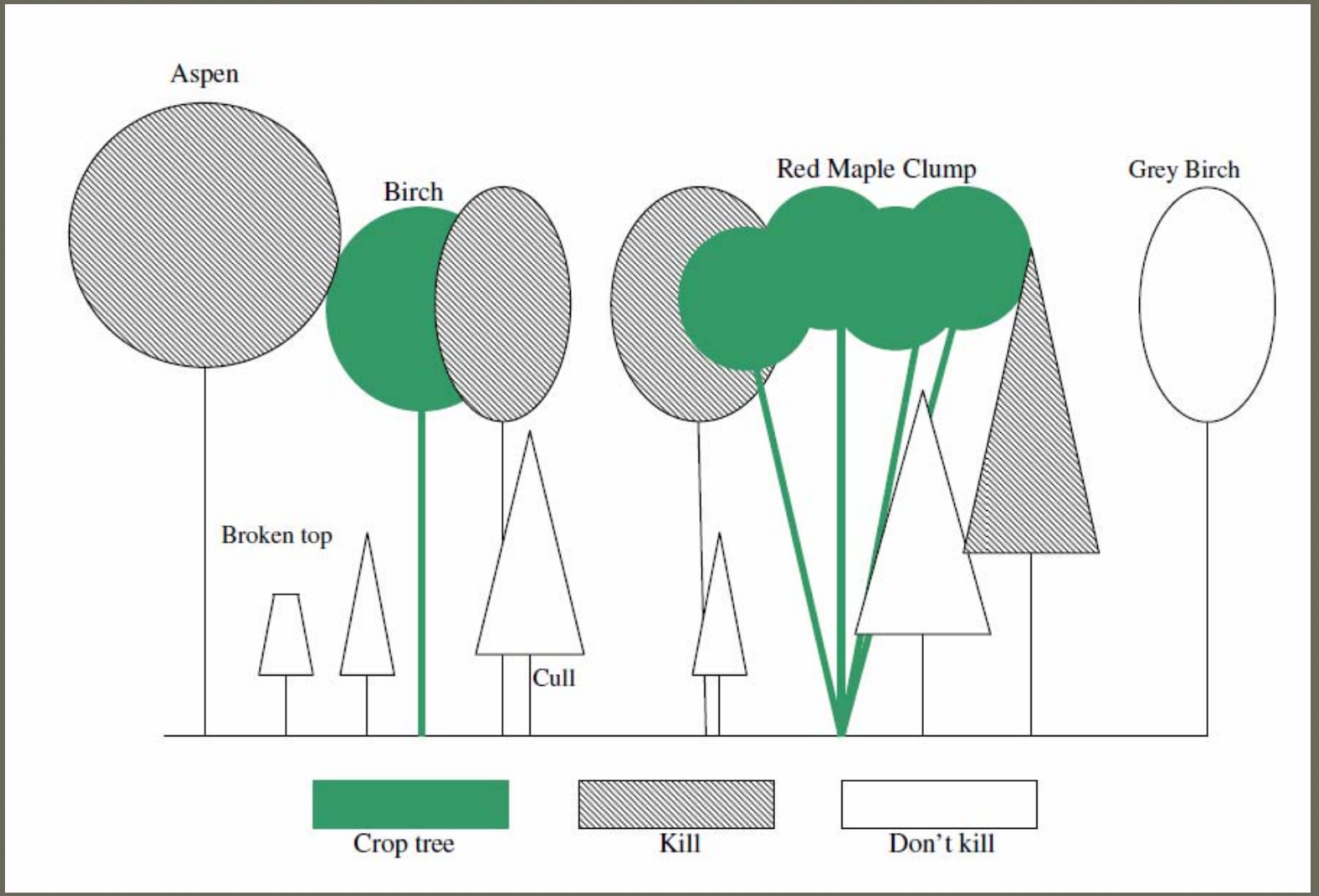
- within 2.5-3 m (8-12 ft) of a crop tree, with crowns at the same level or above
- overtopping a crop tree
- crown-touching or abrading a crop tree
- overstory residuals if they are competing with the crop tree and are fir, aspen, or cull/UGS red maple or paper birch

Moderate treatment

Do not kill trees:

- crop trees
- within 2.5-3 m (8-12 ft) of a crop tree, with a crown below
- not affecting the crown of a crop tree
- spruce, pine, or oak, if the crop tree is already released on three sides
- overstory residuals competing with the crop trees that are spruce, pine, oak, hemlock, cedar, or AGS red maple or paper birch

Moderate treatment



Treatments

Intensive rehabilitation

- objectives: improved growth, value, species and spacing
- release of crop trees ≥ 1.3 m (4.5 ft)
  - hardwoods: 7.5-m (25 ft)
  - softwoods: 5.0-m (15 ft)
- TSI: removal of non-commercial species and UGS
- fill- and under-planting red spruce

Intensive treatment

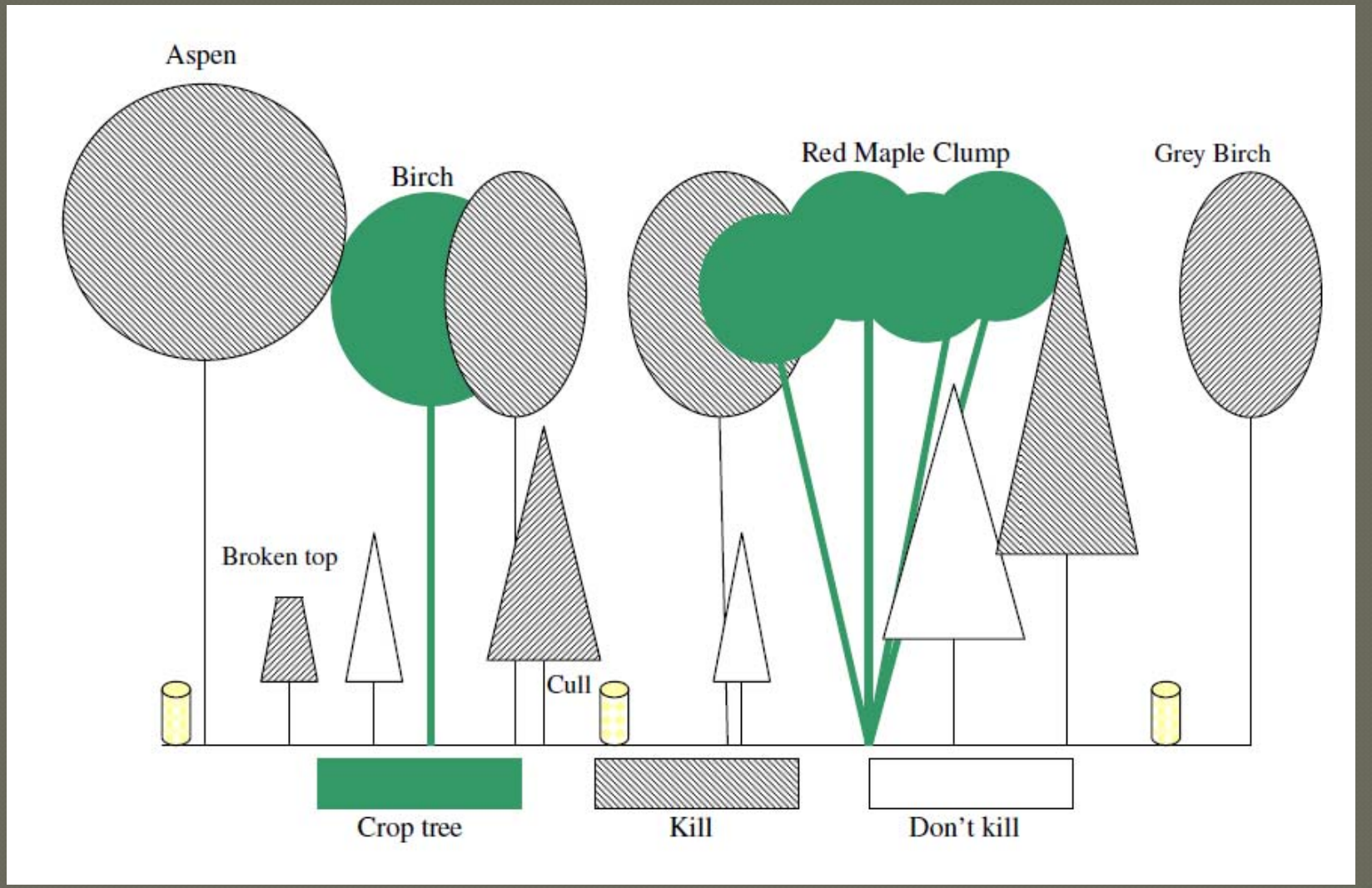
Crop tree release: same as Moderate.

TSI:

- UGS
- Poor vigor trees
- Cull
- Noncommercial tree species

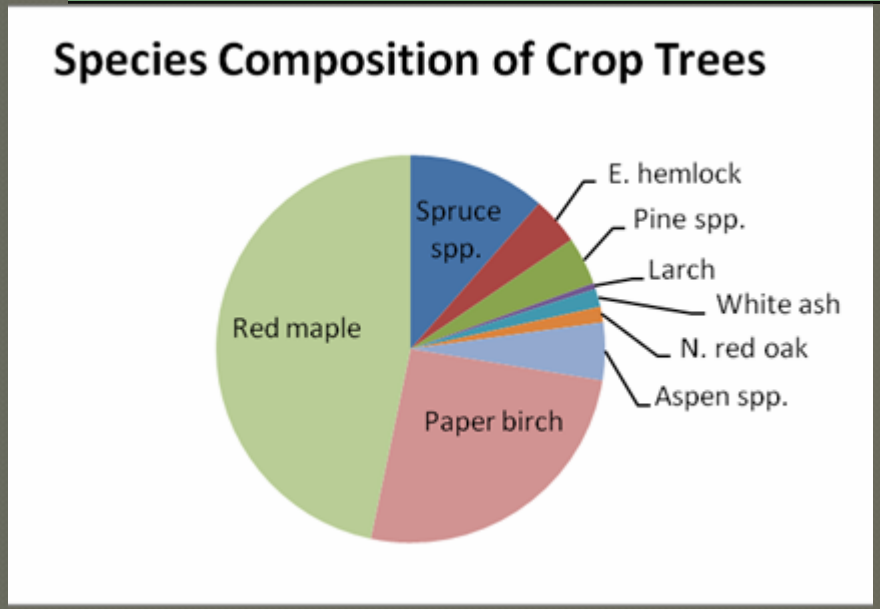
Note: conifer thickets without crop trees and free of cull/UGS were left intact.

Intensive treatment



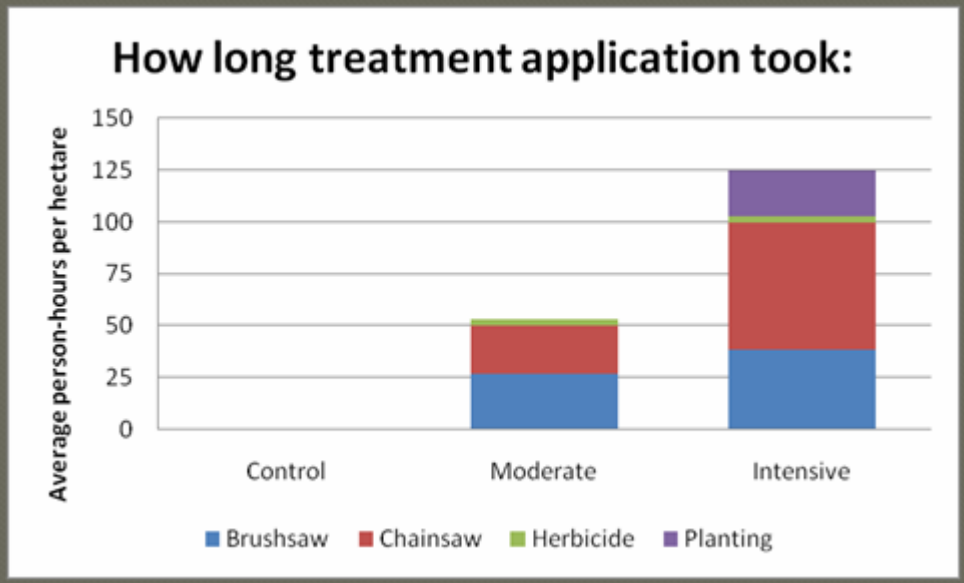
Treatments

Results



- 300 crop trees/ha (~120 trees/ac)

Results

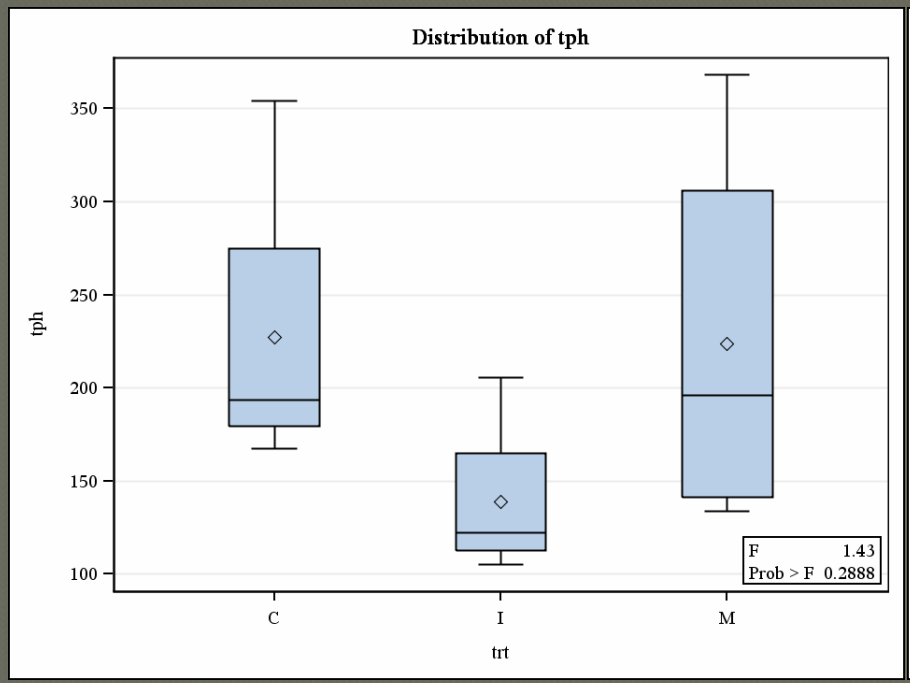

How long treatment application took:
Average person-hours per hectare
150
125
100
75
50
25
0
Control
Moderate
Intensive
Brushsaw
Chainsaw
Herbicide
Planting

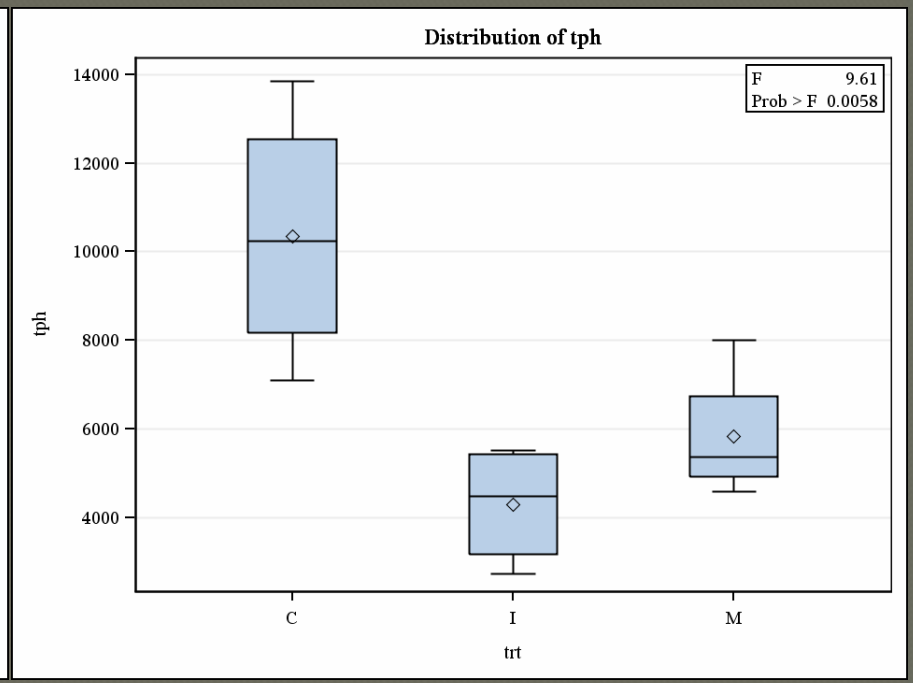
Results

- Overstory
  - BA reduced by 1.2 m^2/ha (5.3 ft^2/ac) in both treatments
  - Percent hardwood unchanged
- Understory
  - BA reduced by 5.8 m^2/ha (25 ft^2/ac) in moderate and 7.6 m^2/ha (33 ft^2/ac) in intensive
  - Percent hardwood reduced by 8% in moderate and 13% intensive

Post-Treatment Structure

- Overstory
- Understory



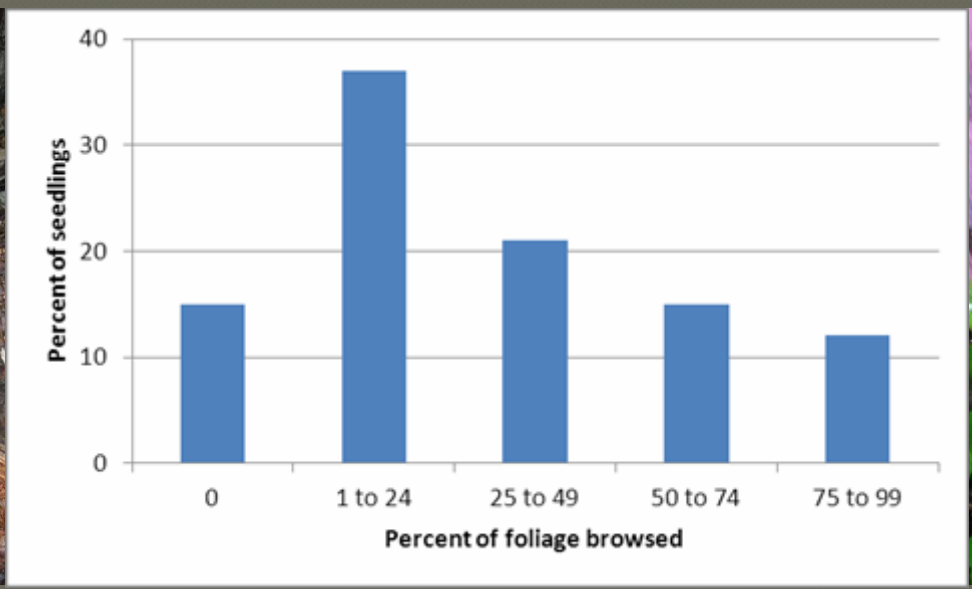


Results

- Percent cull
  - Pre-treatment stand average 20%
  - Post-treatment
    - Moderate: 1%
    - Intensive: 0%

Results

- planted 435 seedlings/ha (176 per ac)
- 3-yr mortality: 30%
- many surviving seedlings were browsed



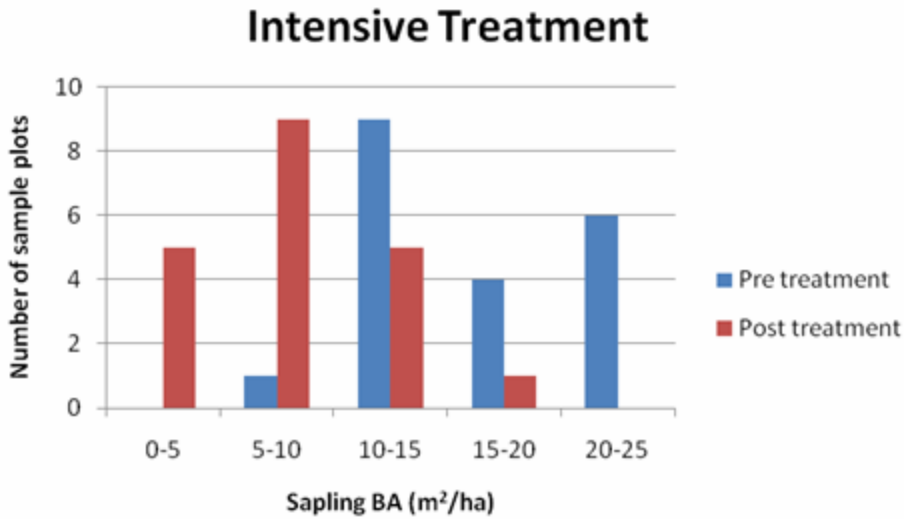
Results

Regeneration Stocking

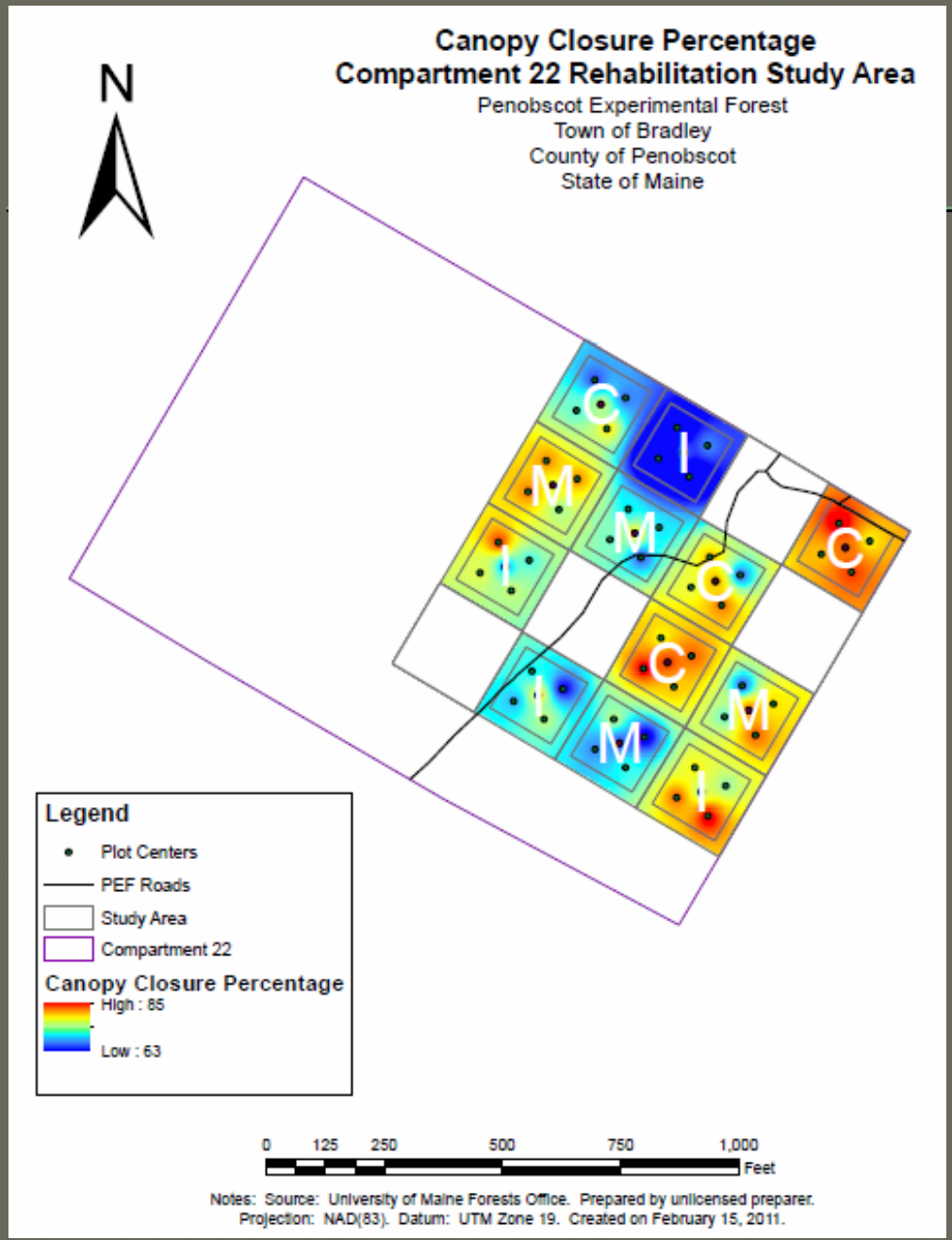
- Pre-treatment
  - 93% hardwoods
    - Red maple (88%), Paper birch (33%), Pin cherry (20%)
  - 89% softwoods
    - Balsam fir (86%), White-cedar (15%), Hemlock (10%)
- Red spruce
  - Pre-treatment: 0%
  - Post-treatment (Intensive): 20%

Results

- spatial variability

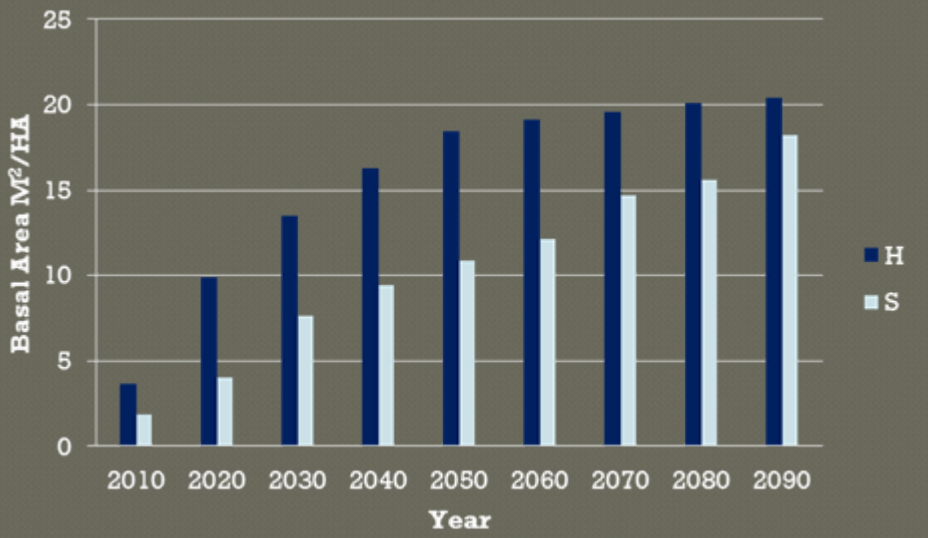


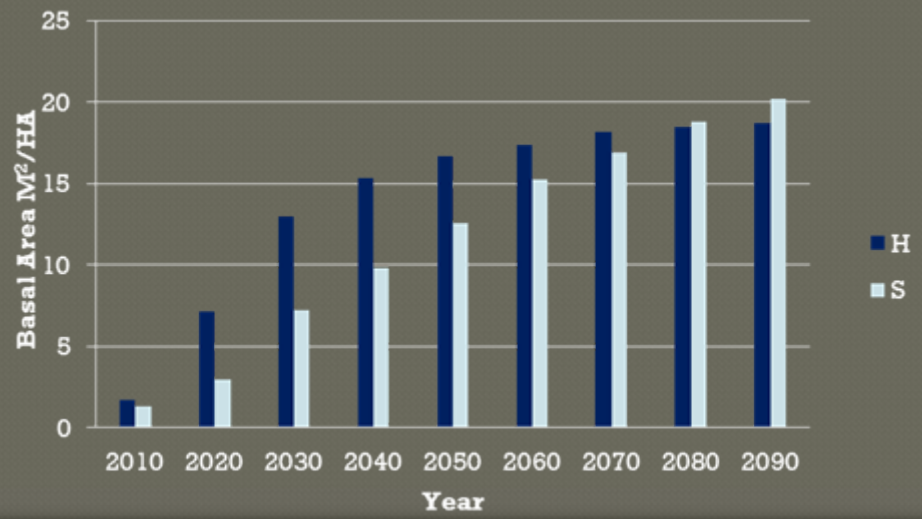
Results


Canopy Closure Percentage
Compartment 22 Rehabilitation Study Area
Penobscot Experimental Forest
Town of Bradley
County of Penobscot
State of Maine
N
C
I
M
M
C
C
I
C
M
I
M
I
Legend
Plot Centers
PEF Roads
Study Area
Compartment 22
Canopy Closure Percentage
High : 85
Low : 63
0 125 250 500 750 1,000
Feet
Notes: Source: University of Maine Forests Office. Prepared by unlicensed preparer.
Projection: NAD(83). Datum: UTM Zone 19. Created on February 15, 2011.

Results

Projected hardwood and softwood BAs without (top) and with (bottom) intensive treatment:



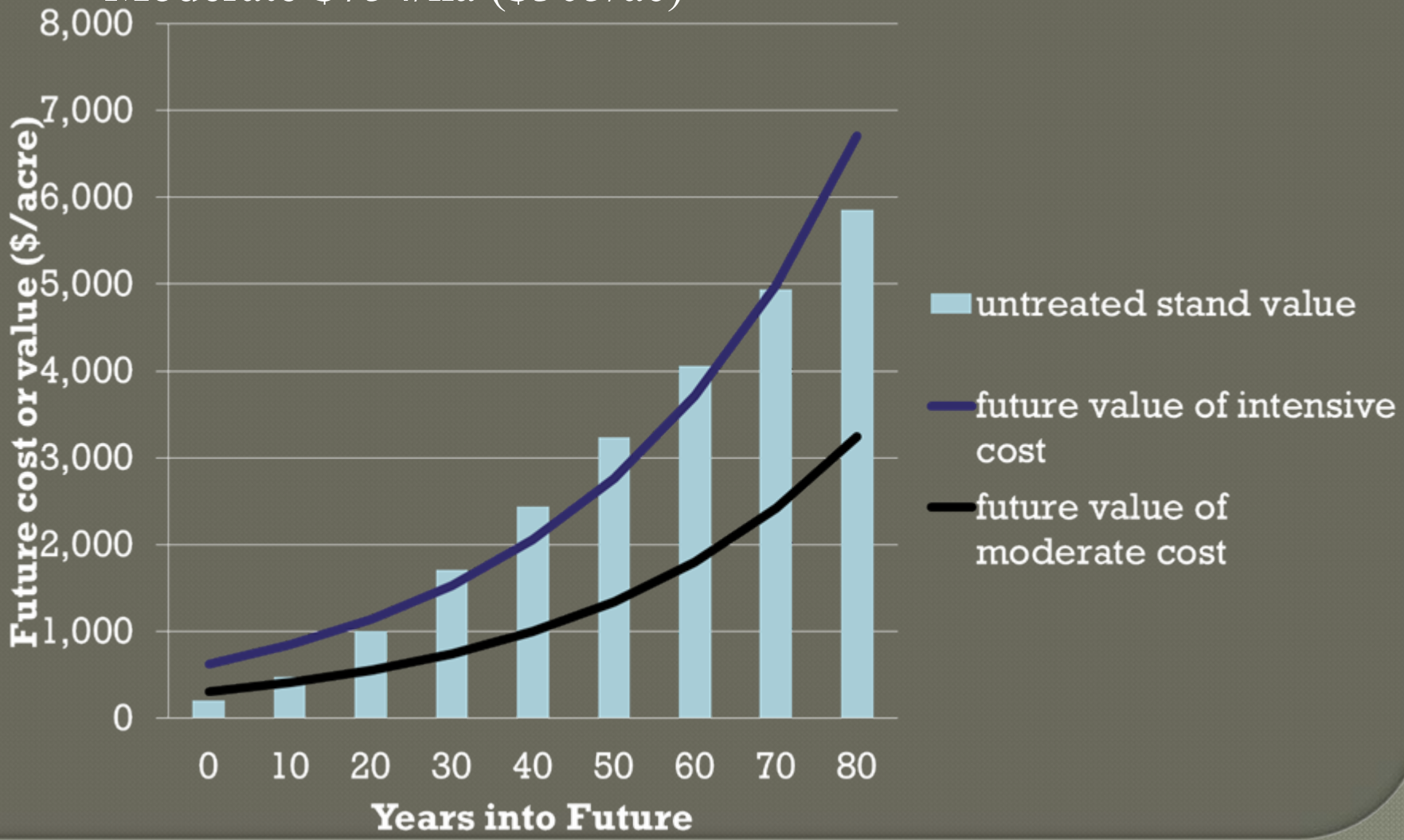


- Forest Vegetation Simulator, Northeast Variant (FVS-NE)
- rehabilitation of species composition takes many decades even after intensive treatment
- higher softwood levels associated with treatment are subtle and take many decades to materialize

Results

ost of treatments:

- Intensive $1,577/ha ($638/ac)
- Moderate $754/ha ($305/ac)



Implications

Results applicable to degraded forests throughout northern New England and adjacent Canada.

Early findings and projection results suggest that rehabilitation is very expensive and positive results take decades to emerge.

Current and future findings:

- inform management decisions for cutover and degraded forests, and
- serve as a cautionary tale for those considering short-term gains through exploitative partial cutting.

Future directions

This study is part of the long-term Forest Service experiment on the Penobscot EF.

Repeated remeasurements are planned.

Evaluate growth model efficacy, treatment impacts on stem quality and value, and treatment outcomes.

On-going work: analysis of outcomes from projections, evaluation of growing space occupancy, understory vegetation response, and crop tree growth.

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Treatment application and data collection and management:

- University students and Forest Service staff