Silvicultural rehabilitation of cutover mixedwood stands

Laura Kenefic, Jeremy Wilson, John Brissette, Ralph Nyland and Rob Lilieholm

U.S. Forest Service, Northern Research Station

University of Maine, School of Forest Resources

SUNY College of Environmental Science and Forestry

Exploitive cutting

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

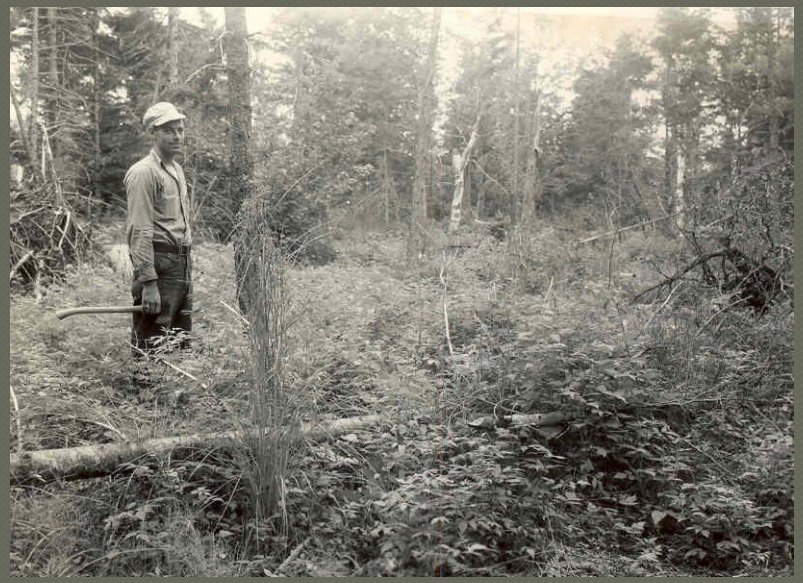
Acadian Forest

Northern conifers

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

Historical context

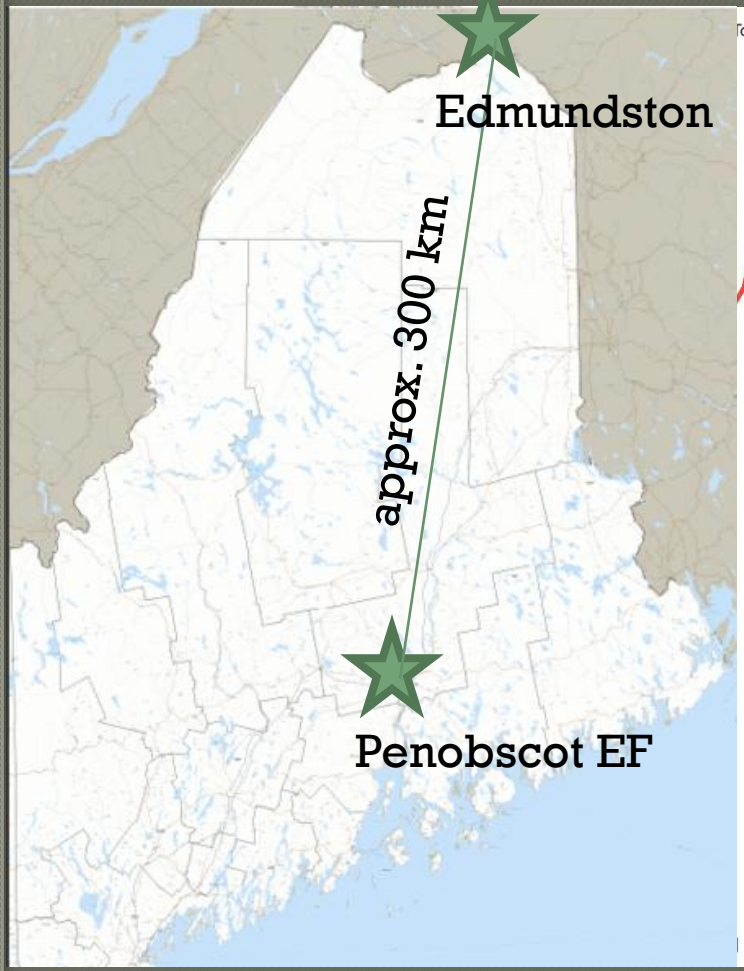
- History of repeated partial cutting
- Selective removals
- Degraded species composition

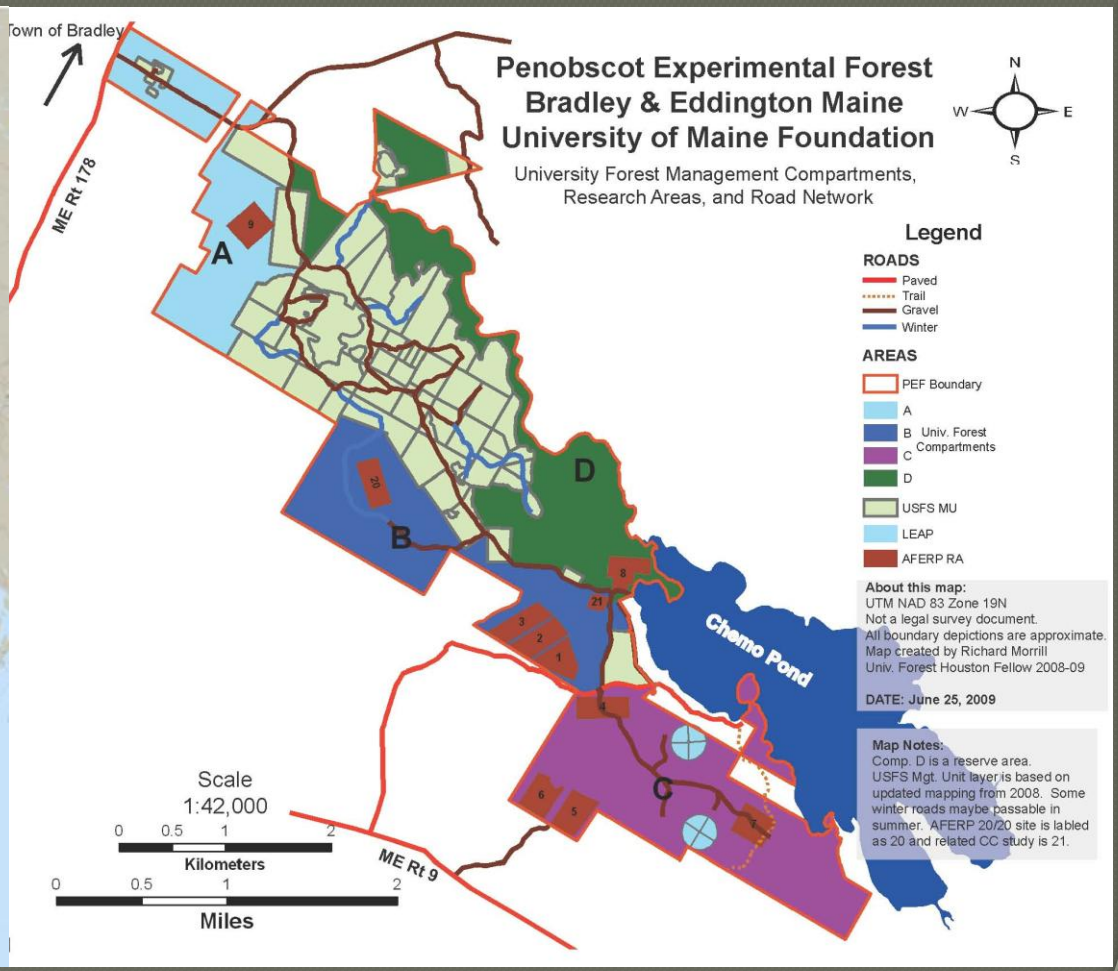


Penobscot EF

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

Penobscot EF





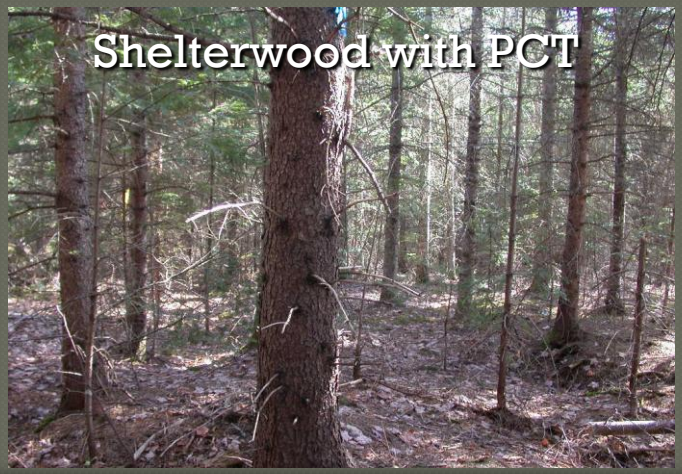
Treatments

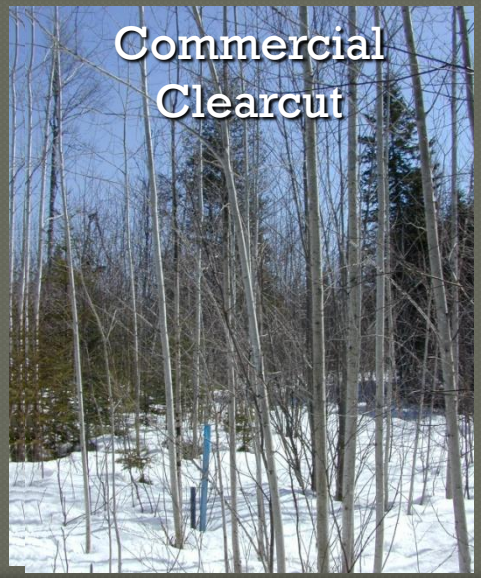
- Shelterwood cutting
  - Two-stage
  - Three-stage
    - PCT
- Selection system
  - 5-year
  - 10-year
  - 20-year
- Exploitive cutting
  - Commercial clearcutting
  - Fixed diameter-limit
  - Modified diameter-limit
- Reference

Treatments


Reference

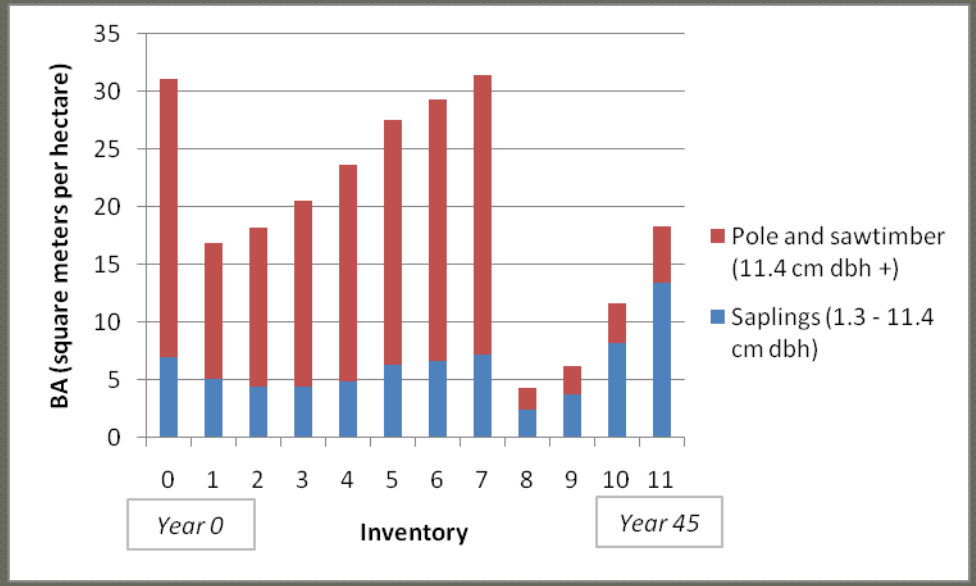

Selection Cutting


Shelterwood with PCT


Commercial
Clearcut

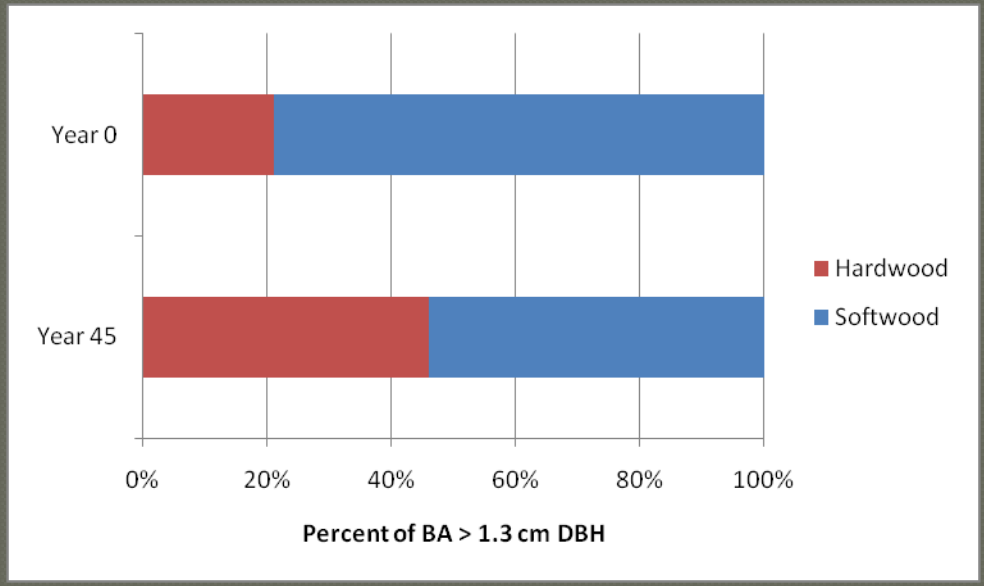
Commercial clearcutting

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



Prior to rehabilitation

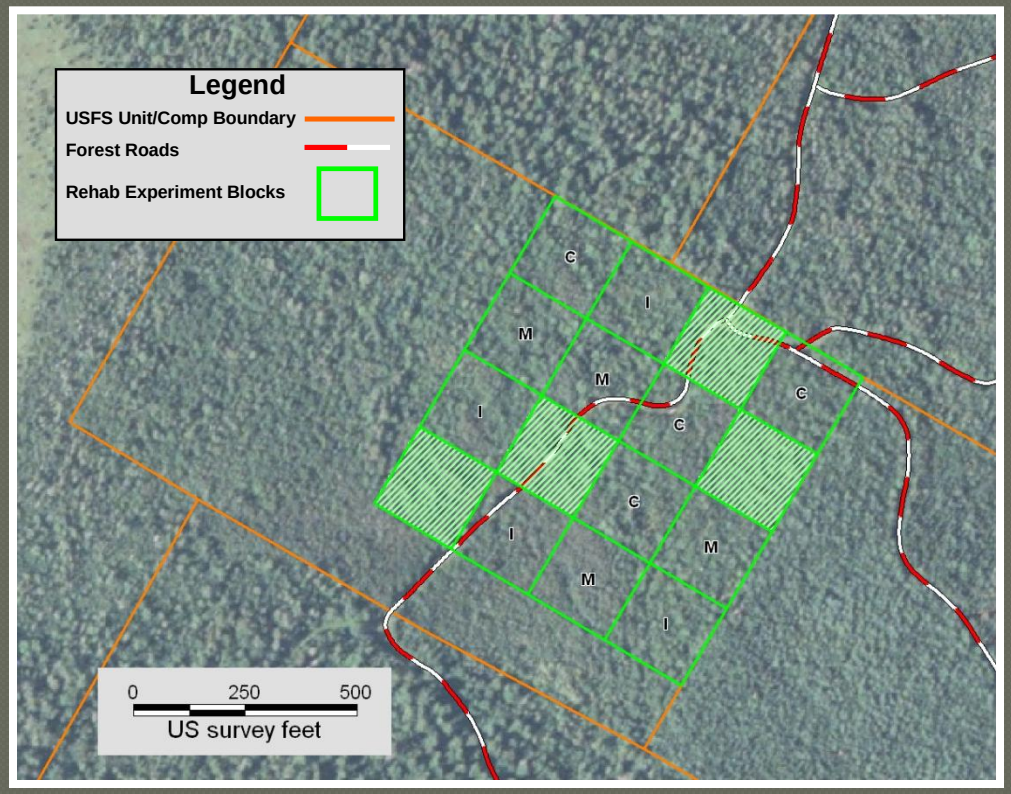
- dominated by sapling-sized trees, poor-quality residuals and clumps and voids of vegetation
- degraded species composition



Pre-treatment conditions

Treatments

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



Data collection

- 0.4-ha treatment blocks
- 0.2-ha overstory and 0.005-ha sapling plots
  - species, dbh and merchantability
- 0.0004-ha 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 and value, species and spacing
- release of crop trees ≥ 1.3 m
  - hardwoods: 7.5-m
  - softwoods: 5.0-m

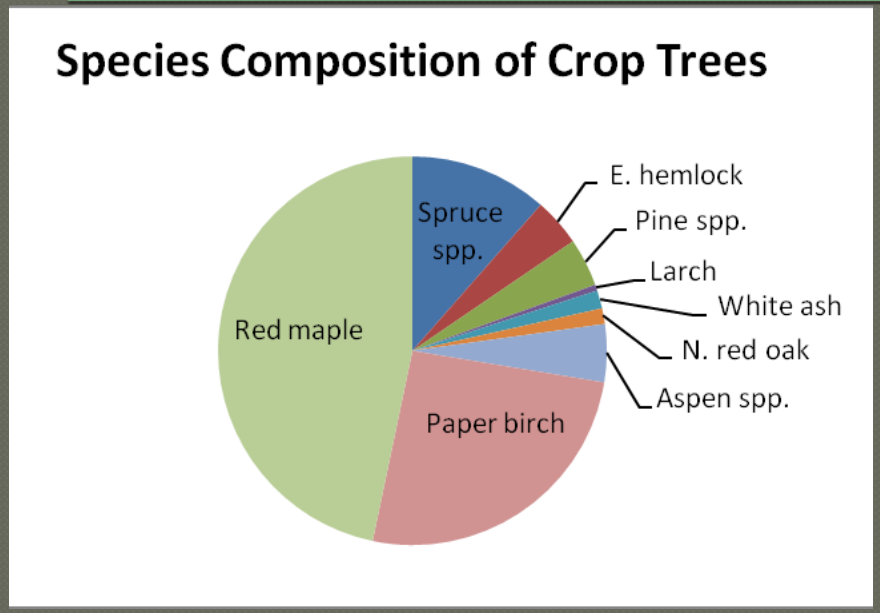
Treatments

Intensive rehabilitation

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

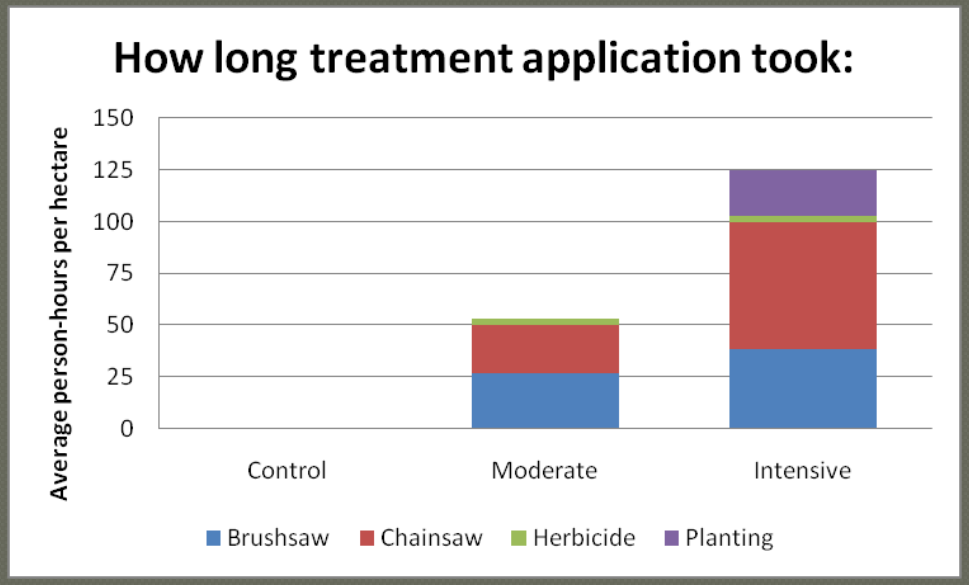
Treatments

Results



- 300 crop trees/ha

Results

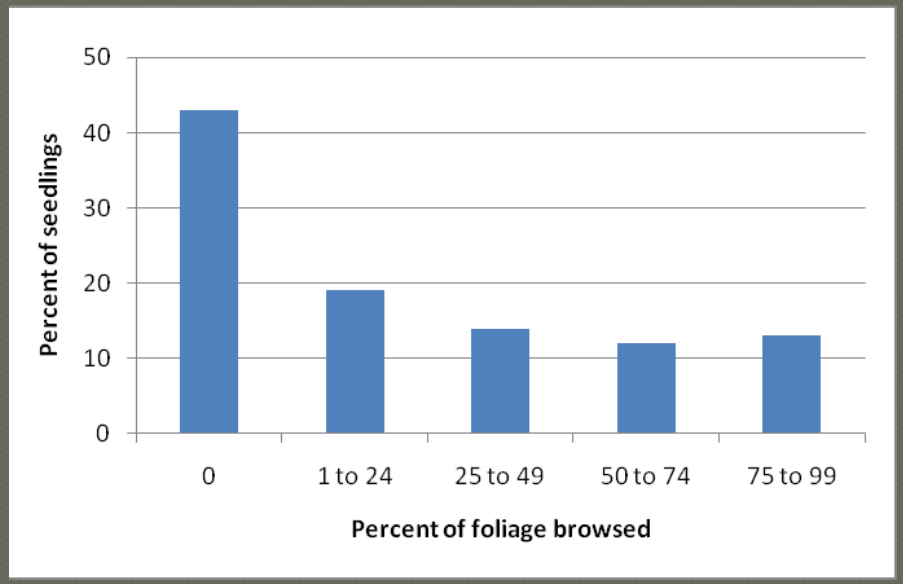

How long treatment application took:
Average person-hours per hectare
150
125
100
75
50
25
0
Control
Moderate
Intensive
Brushsaw
Chainsaw
Herbicide
Planting

Results

- Overstory
  - BA reduced by 1.2 m^2/ha in both treatments
  - Percent hardwood unchanged
- Understory
  - BA reduced by 5.8 m^2/ha in moderate and 7.6 m^2/ha in intensive
  - Percent hardwood reduced by 8% in moderate and 13% intensive

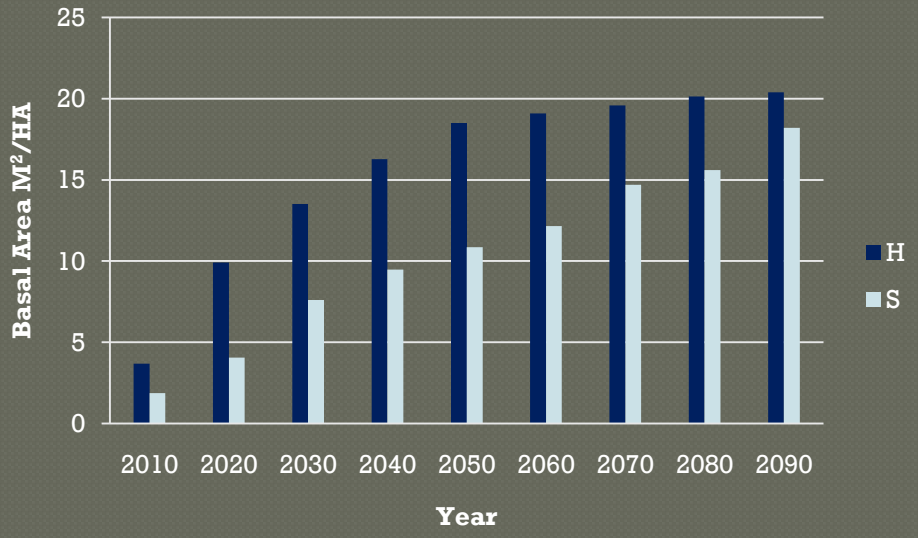
Results

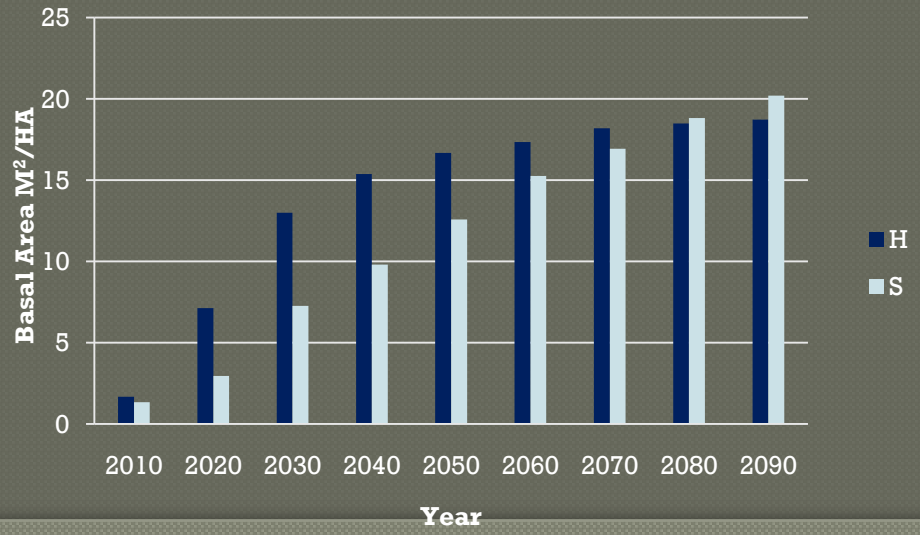
- fill- and under-planted 435 seedlings/ha
- first-year mortality: 17%
- many surviving seedlings were browsed



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

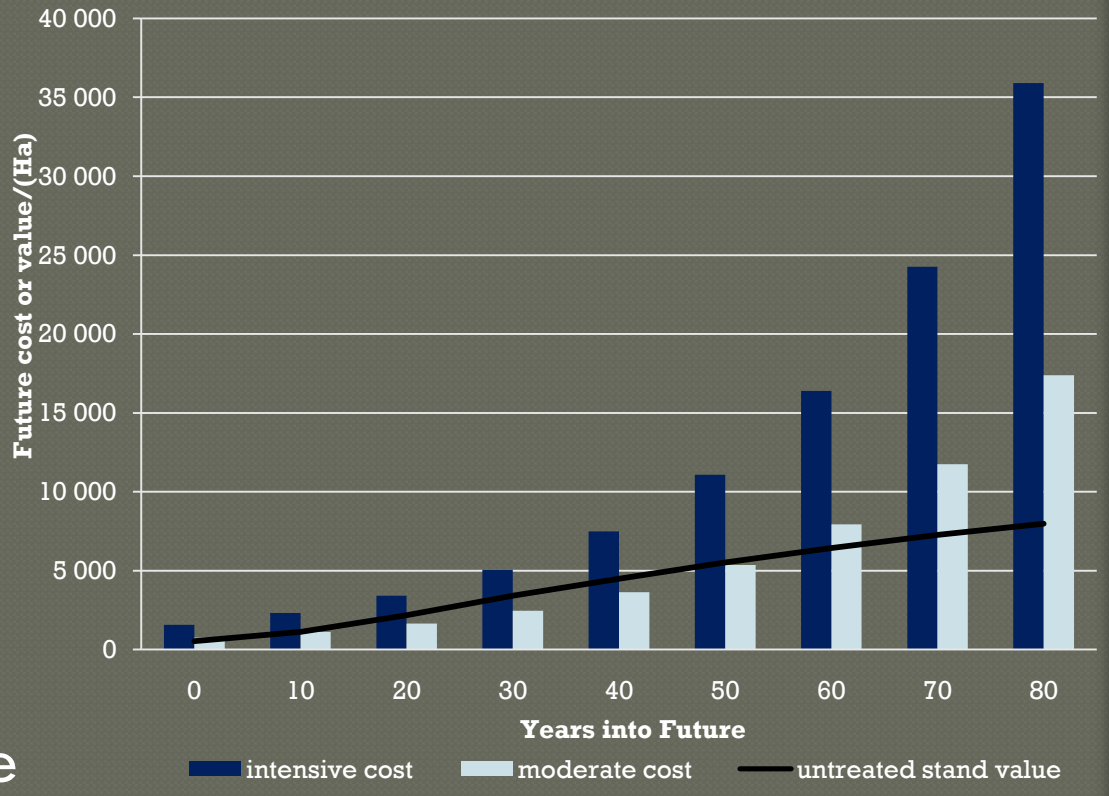
Results

Cost of treatments:

- Intensive $1,577/ha
- Moderate $754/ha

Difficult to forecast stand value because crop tree selection implies quality improvements not shown in model.

At 4% real interest rate (after inflation) value of treated stands in 50 yrs needs to be doubled in the moderate and quadrupled in the intensive to break even.



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 remeasurement is planned.

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

On-going work : analysis of outcomes from projections and evaluation of growing space occupancy.