Land-Use History And Vegetation Composition Of Monhegan Island

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Land-Use History And Vegetation Composition Of Monhegan Island

- The problem
- Background on land-use history
- Hypotheses
- Methods
- Results
- Discussion
- Recommendations
Island Forest Health Problems

• Tree mortality in last decade
  – Mostly white spruce (*Picea glauca*)
  – Eastern dwarf mistletoe, spruce bark beetle, hemlock looper, windthrow

• Monhegan Island
  – Eastern dwarf mistletoe (*Arceuthobium pusillum*) causing heavy mortality
  – Red spruce (*Picea rubens*) much less affected
Witches’ brooms, or excessive branching, indicates where the parasitic plant feeds on nutrients from the tree which will gradually kill the spruce.

Flower shoots of the parasitic plant can be seen on branch tips within living brooms. Seeds will disperse from these shoots in the fall and land on neighboring trees.
White Spruce Mortality

Healthy Red Spruce Stands

USGS May 1996
Vegetation Changes and Land-Use History
Pre-settlement Forests On Monhegan

• Coastal spruce-fir forest over the past 2,000 yrs.
  – Bostwick, 1978
  – Tolonen, 1983

• Speculation
  – White spruce near the shore
  – Red spruce in the interior

• Rosier, 1605
  – “This island is woody, grouen with Firre, Birch, Oke and Beech, as farre as we saw along the shore; and so likely to be within.”

Pollen Record, Monhegan Island

Bostwick, 1978
The Land-Use History of Monhegan Island

- **1605-1780**: history is not well documented
- **1800-1910**: land clearance, fires, intensive agriculture and grazing
- **1910-today**: field abandonment, reforestation, dwarf mistletoe, and deer
White Spruce On Monhegan

- Suffering severe mortality
- Heavily infected with dwarf mistletoe
- Intermediate shade tolerance
- Tolerates wide range of moisture conditions
- Low capacity to survive in suppressed condition
- Old-field colonizer
  - Westveld, 1931
  - Davis, 1966
Red Spruce On Monhegan

- Continually present in old wood lots
- Relatively unaffected by dwarf mistletoe
- Regeneration requires ample moisture
- Germination and establishment proceed best under shade
- Heavy mortality of seedlings in the open
Hypothesis: White Spruce Dominates Abandoned Field Sites

- Occurrence of white spruce is consistent with records of cleared areas
- Age is consistent with time of field abandonment
- Herbaceous vegetation typical of highly disturbed sites
- White spruce regeneration is favored
- Pure stands susceptible to dwarf mistletoe infestation
Hypothesis: Red Spruce Dominates Continually Forested Sites

- Occurrence of red spruce is consistent with records of continuously forested areas
- Multi-aged stands
- Herbaceous vegetation typical of coastal spruce-fir forests
- Red spruce regeneration favored
Methods: Land-Use History Documentation

- maps: forest cover in 1873, 1922, USGS
- pollen records
- land deeds
- 1870 agricultural census
- aerial photos
  - 1951, 1996
- old photographs
  - early 1900’s
- personal communications
Change In Forest Cover

1873

1922
Change In Forest Cover

1922

1988 USGS topo
Quantify Association Between Mortality and Land Use
Vegetation Sampling

- **Tree sampling**
  - 16 circular plots located randomly per stratum
  - 1/50 ha (40 ft dia.)
  - all tree species ≥ 4 in. dbh
  - spp., dbh, age, crown position, edm rating

- **Sapling sampling**
  - 1/100 ha (30 ft dia.)
  - < 4 in. dbh and ≥ 6 ft tall
  - spp., dbh

- **Herbaceous, shrub and tree regeneration sampling**
  - 4 fixed, 1m² satellite plots within each randomly stratified plot
  - % cover for herbaceous and shrub species
  - height classes and stem counts for all tree regeneration < 6 ft
Analysis

• Vegetation data
  – Discriminant analysis
  – Descending Correspondence Analysis (DCA)
• Tree ages
  – Analysis of Variance
• Dwarf mistletoe damage rating
  – T-test
Results:
White Spruce Dominated Abandoned Field Sites, But Regeneration is Diverse

- Still 40% of trees, 18-87yr old (avg = 47)
- Regenerating species (saplings) include:
  - Red spruce: 46%
  - White spruce: 33%
  - Hardwoods: 21%
- Plants include grasses, bayberry, raspberry, goldenrod
Results: Red Spruce Dominates Continually Forested Sites and Its Regeneration

- Red spruce 74% of stems, balsam fir 10%, hardwoods 16%
- Multi-aged stands: 27-185 yr (avg = 90)
- Herbaceous vegetation typical of coastal spruce-fir forests: Canada mayflower, wild raisin, starflower
- Red spruce regeneration favored, 76%
Association Between White Spruce Mortality and Land-Use History

- As of 1996, 25% of forests were killed (122 ac)
- 94% on white spruce
- In locations with a history of forest clearance and field abandonment

<table>
<thead>
<tr>
<th>Strata</th>
<th>Mortality</th>
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<tbody>
<tr>
<td>Cont.</td>
<td>7%</td>
</tr>
<tr>
<td>Least</td>
<td>54%</td>
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<tr>
<td>1873</td>
<td>24%</td>
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<tr>
<td>1922</td>
<td>16%</td>
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</tbody>
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• Infected white spruce most susceptible:
  – 4.3 avg. infection rating
  – About 2/3 of crown affected

• Infected red spruce more tolerant
  – 2.6 rating
  – About 1/3 of crown affected
  – Many brooms die due to shading

• Future impact of dwarf mistletoe
  – Kills white spruce regeneration
  – Less impact in the future
    • White spruce numbers decreasing
    • Red spruce tolerates it
    • Hardwoods not susceptible
Other Plant Species on Monhegan

• Introduction and expansion of non-natives
  – *Asiatic bittersweet*
  – *Black swallowwort*
  – *Deadly nightshade*
  – *Japanese barberry*
  – *Japanese honeysuckle*
  – *Japanese knotweed*
Barberry Threat!

- Detected in 1971
- Now regenerating on:
  - entire island
  - high density on 40% of forest area
  - over 150 acres
- Spread favored by:
  - deer browsing other plants
  - birds feeding on berries
- Future impact
  - exclude regeneration of other plant species
  - restrict forest access
Discussion

• Large stands of white spruce established on fields that had been abandoned in the early 1900’s
• Dwarf mistletoe induced mortality was limited to these stands
• Red spruce is healthy and is regenerating abundantly across the island
• Future forest will be more diverse, less susceptible to dwarf mistletoe and other pests
• Barberry is a threat to the forest!
  – regenerating across the entire island
  – excludes regeneration of other species
Recommendations

• No action needed on forest composition
  – unhealthy white spruce forests will recover with time
  – red spruce forests are healthy
• The threat of invasive species needs to be dealt with before they replace native species
• Japanese barberry poses the biggest threat at this time but there are other species waiting for the opportunity to spread
• Efforts should focus on controlling large stands of barberry and any regenerating patches
• Educate the public on potential invasives
Forests
In 1873