Land-Use History And Vegetation Composition Of Monhegan Island

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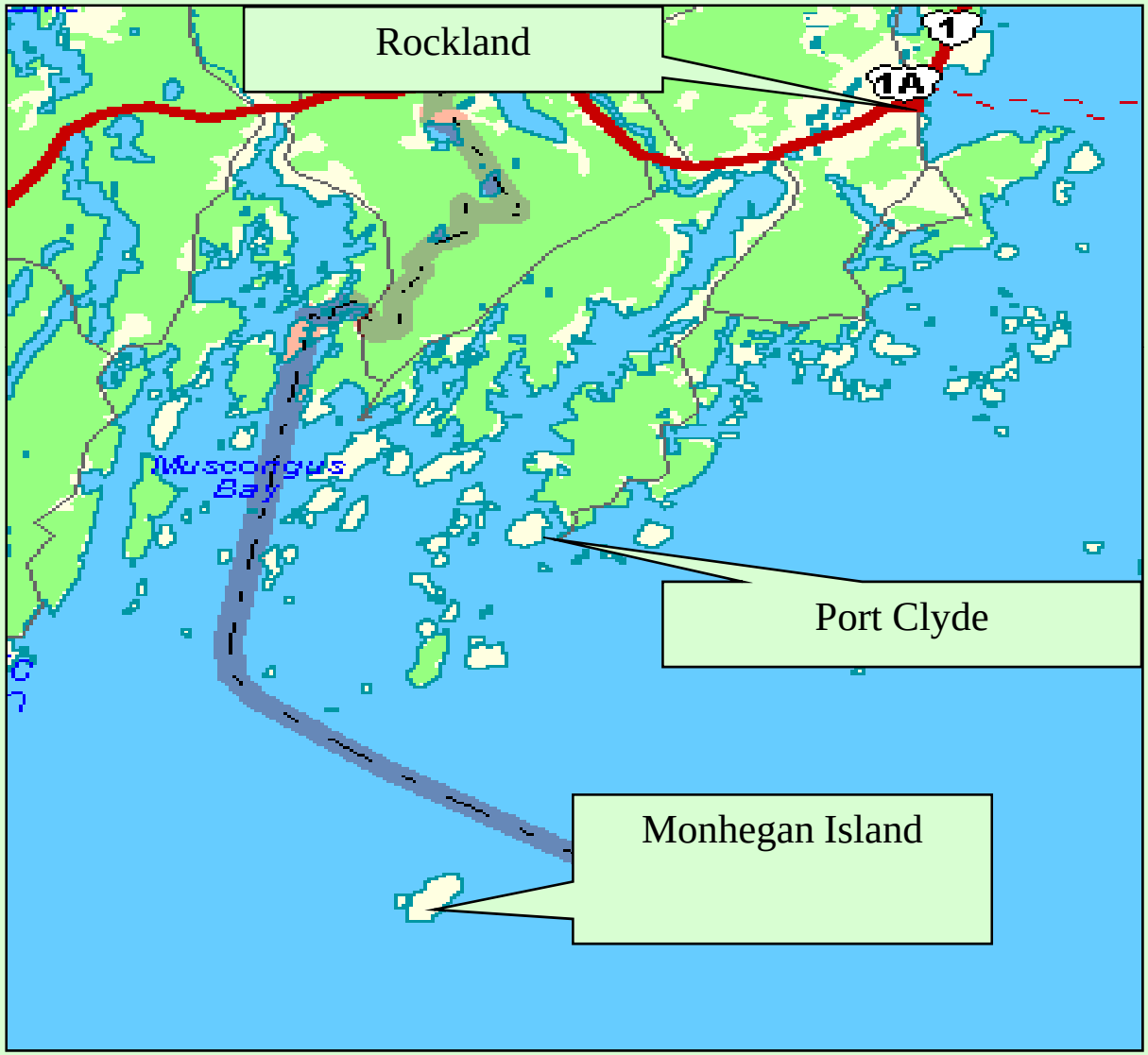
August 2003

Readings

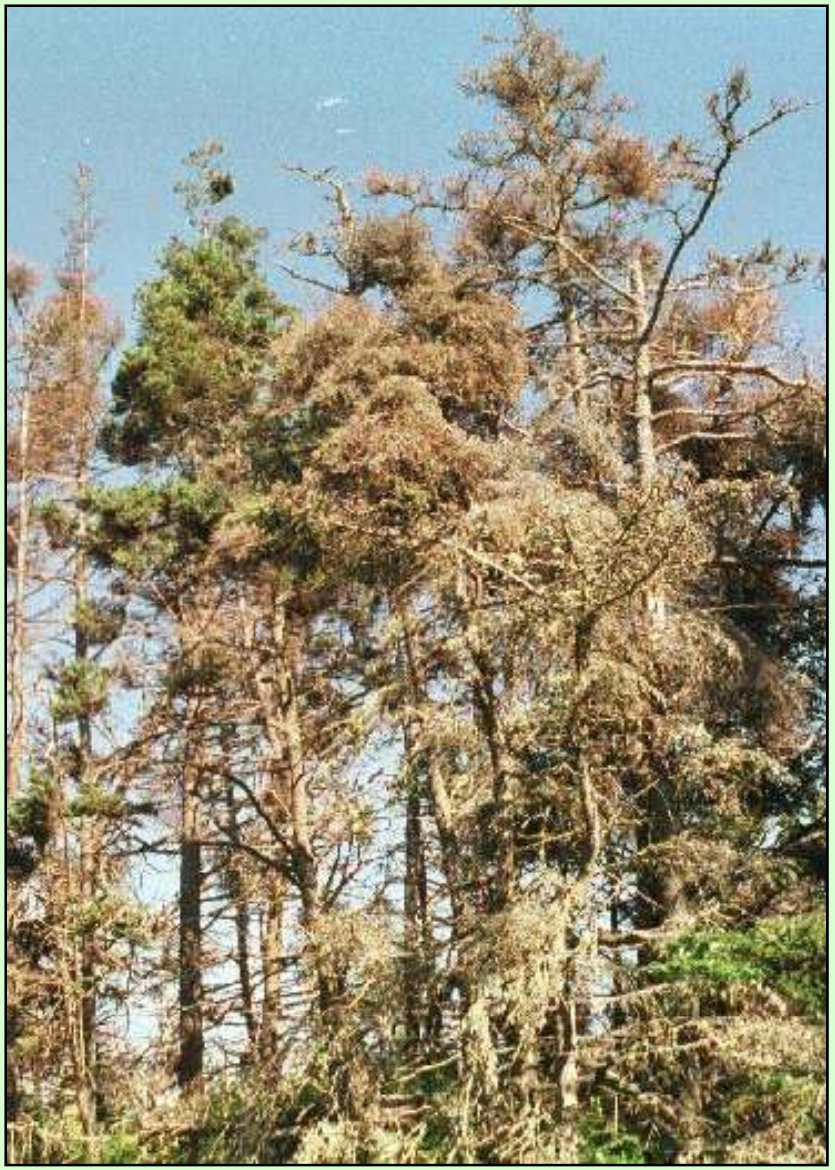
- USFS Forest Pest Leafletfor EDMT
  - http://www.na.fs.fed.us/spfo/pubs/fidls/dwarf_mistletoe/fidl-dm.htm
- General Information
  - http://www.forestpathology.org/mistle.html
- Class Web Page for EDMT
  - http://www.umaine.edu/fes/Classes/int256/DiseaseID/dis16/dis16.htm

Monhegan Island



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



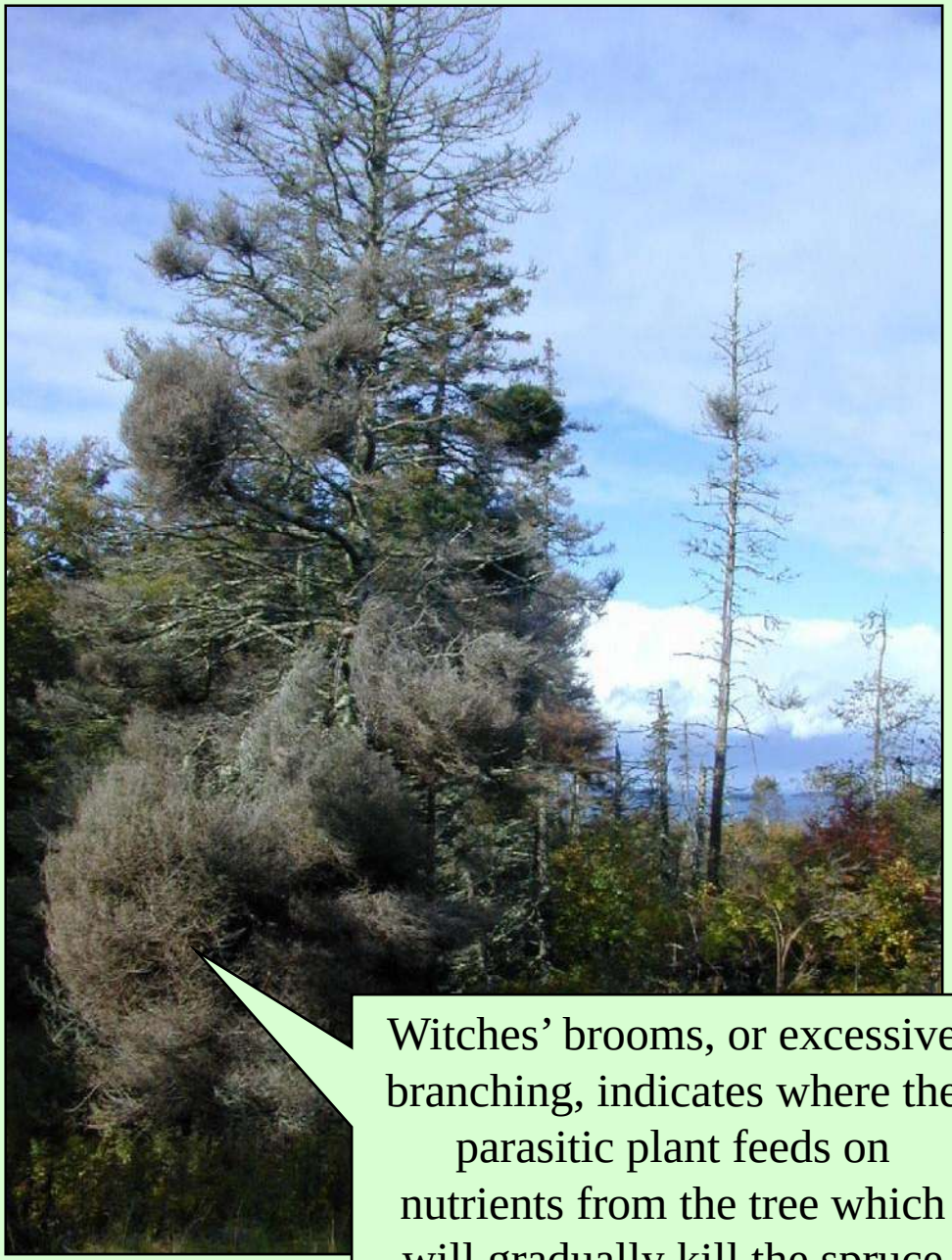
Red Spruce On Monhegan

- 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

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

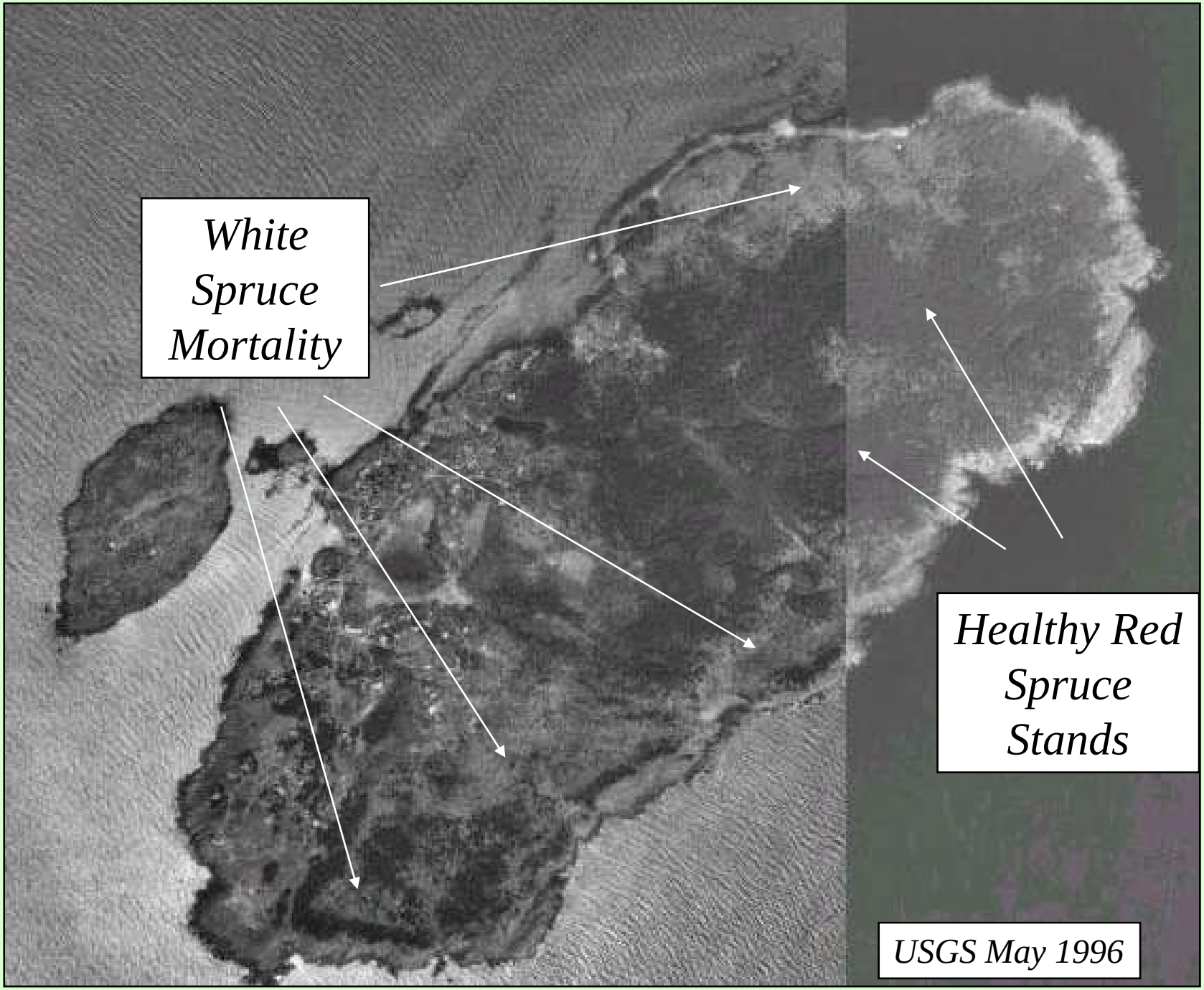
Eastern Dwarf Mistletoe



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

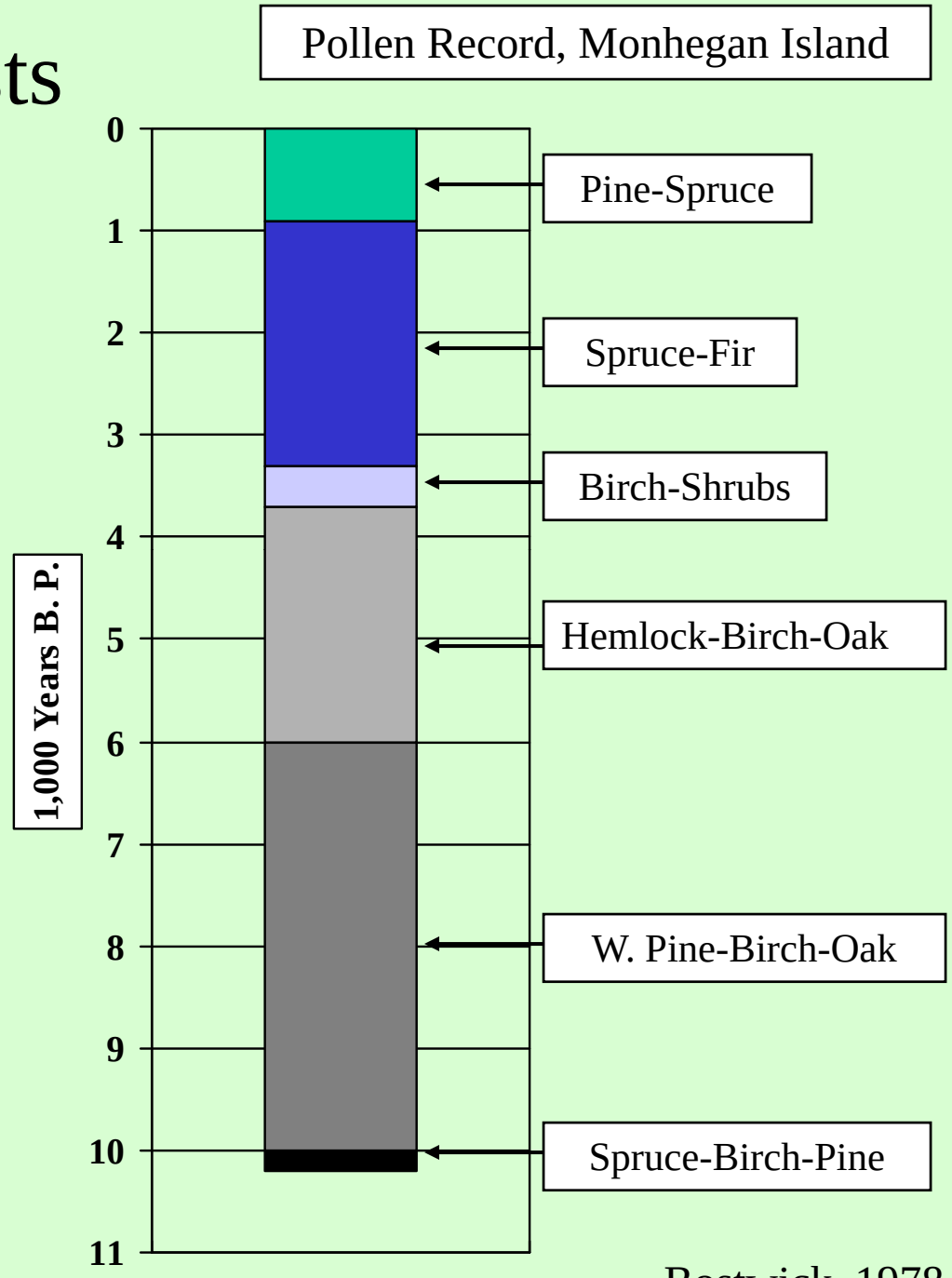

Spruce Mortality
Monhegan Island 1990


White Spruce Mortality
Healthy Red Spruce Stands
USGS May 1996

Predisposing Factors: Land-Use History

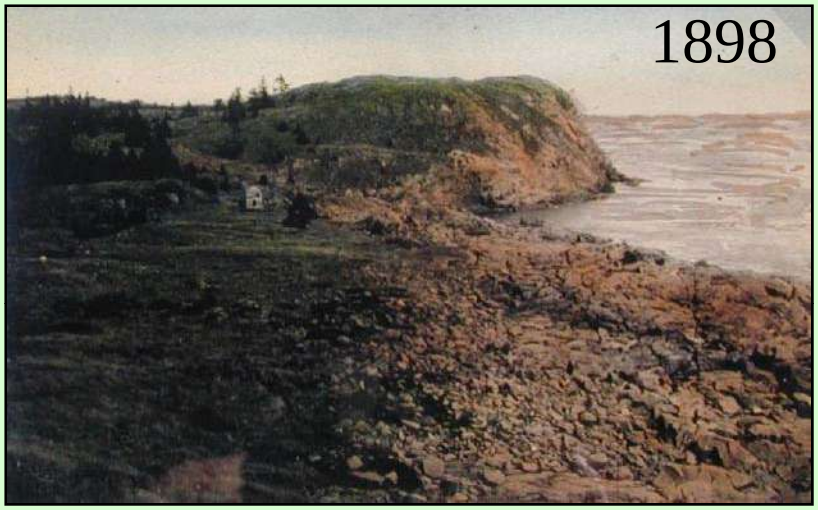
Pre-settlement Forests On Monhegan

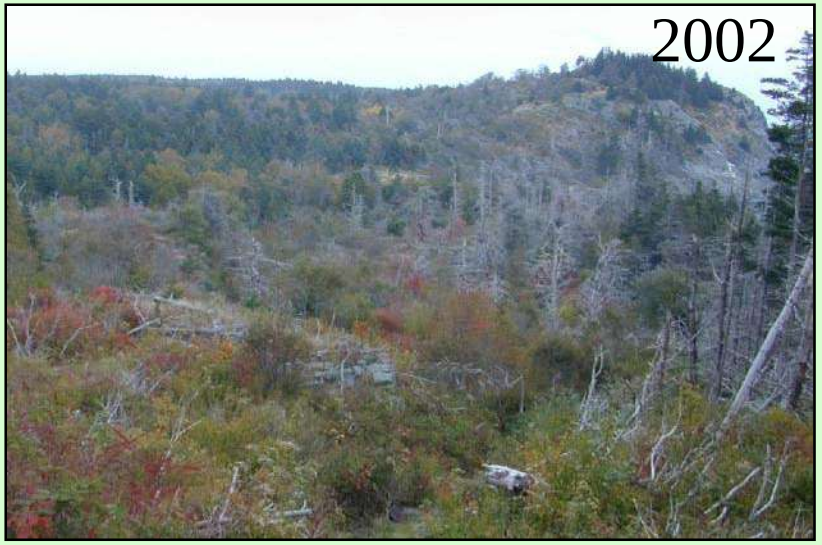
- Coastal spruce-fir forest over the past 3,000 yrs.
  - Bostwick, 1978
  - Tolonen, 1983
- Speculation
  - White spruce near the shore
  - Red spruce in the interior
- Rosier, 1605
  - “This island is woody, grouen with Firre, Birch, Oke and Beech, as farre as we saw along the shore; and so likely to be within.”



Land-Use History Documentation

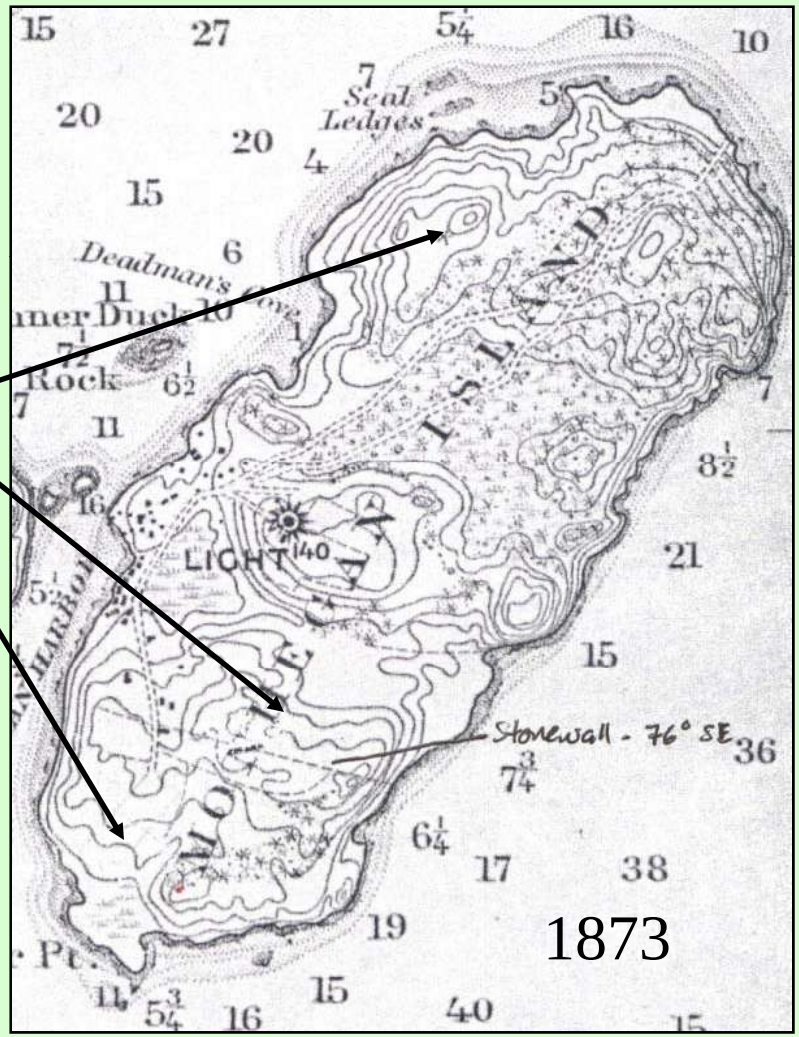
- maps: forest cover in 1873, 1922, USGS
- pollen records
- land deeds
- 1870 agricultural census
- aerial photos
  - 1951, 1996
- old photographs
  - early 1900's
- personal communications





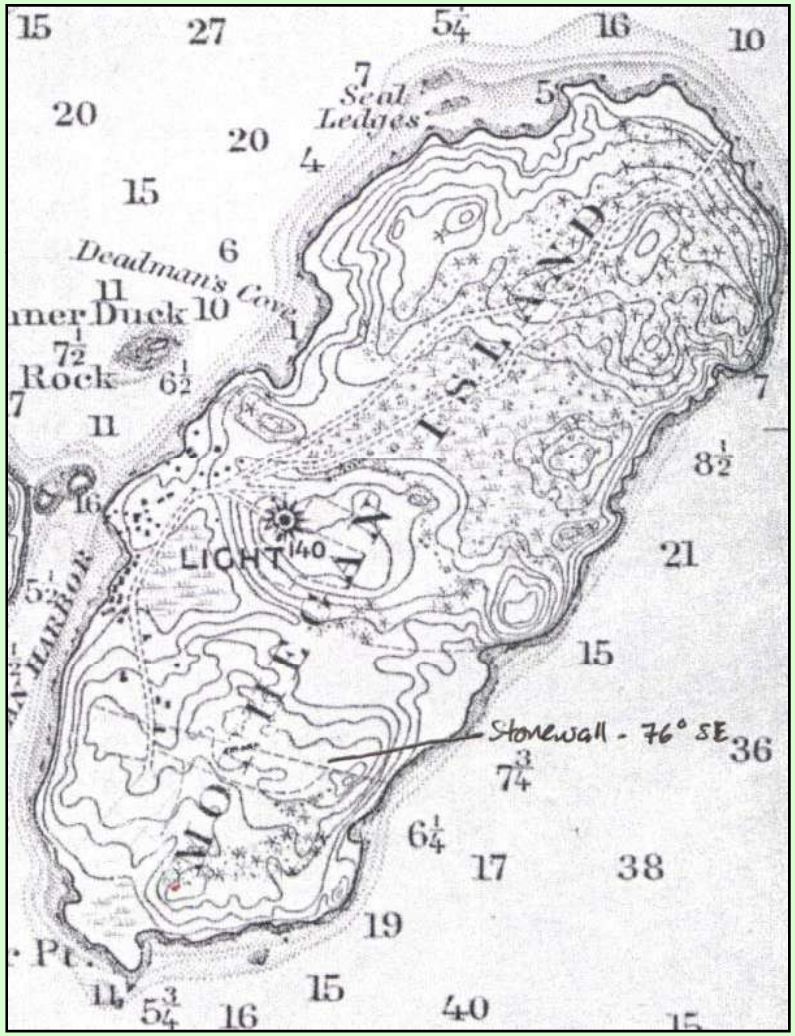
The Land-Use History of Monhegan Island

- 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

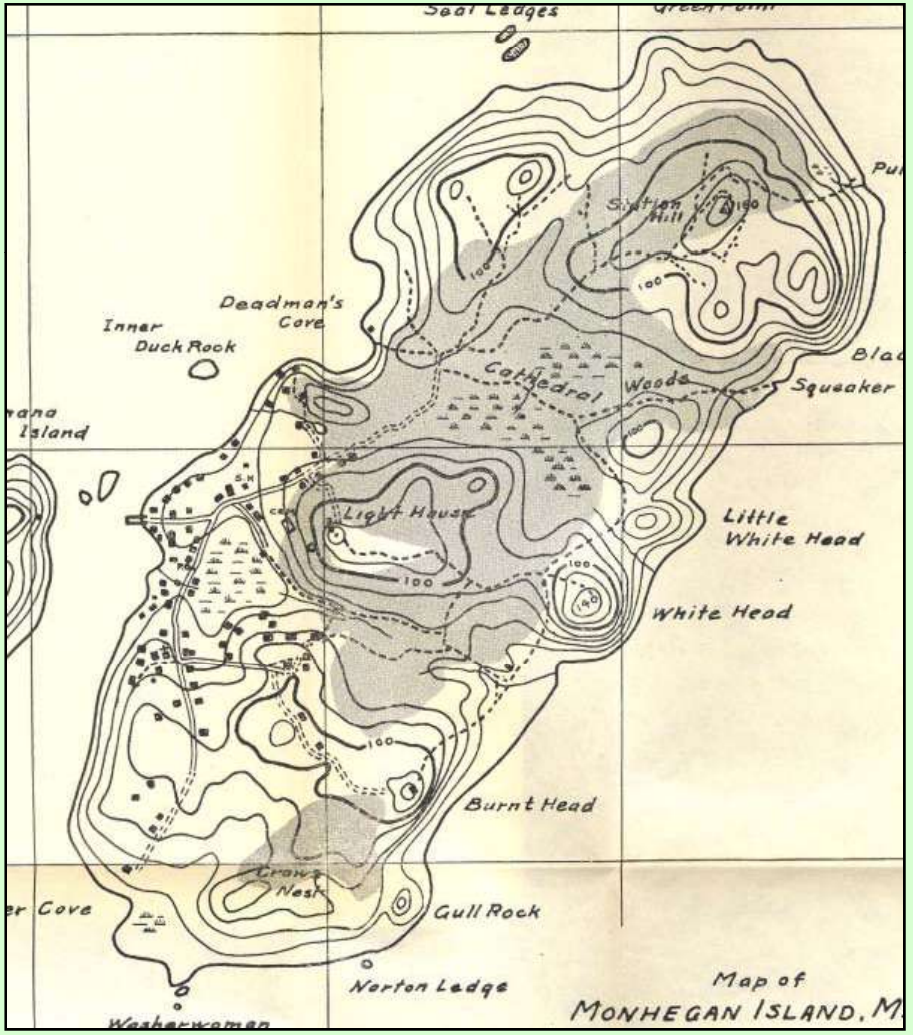


Change In Forest Cover

1873

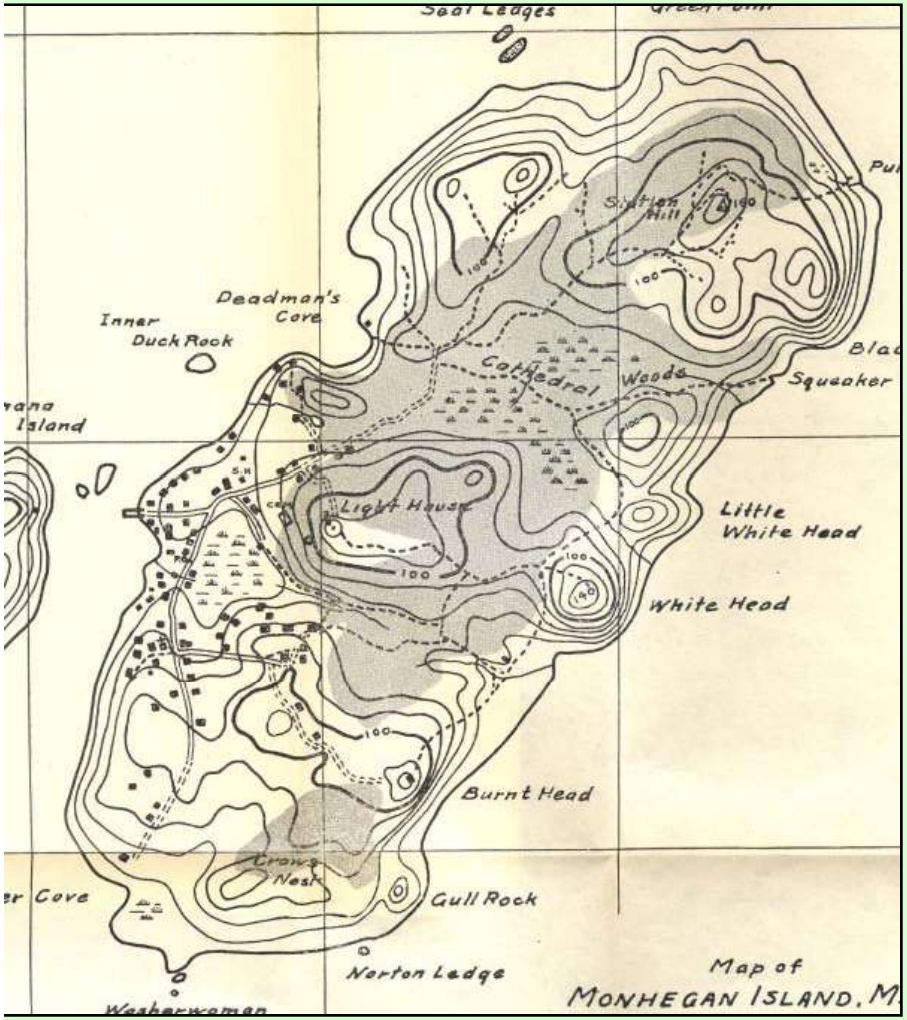


1922

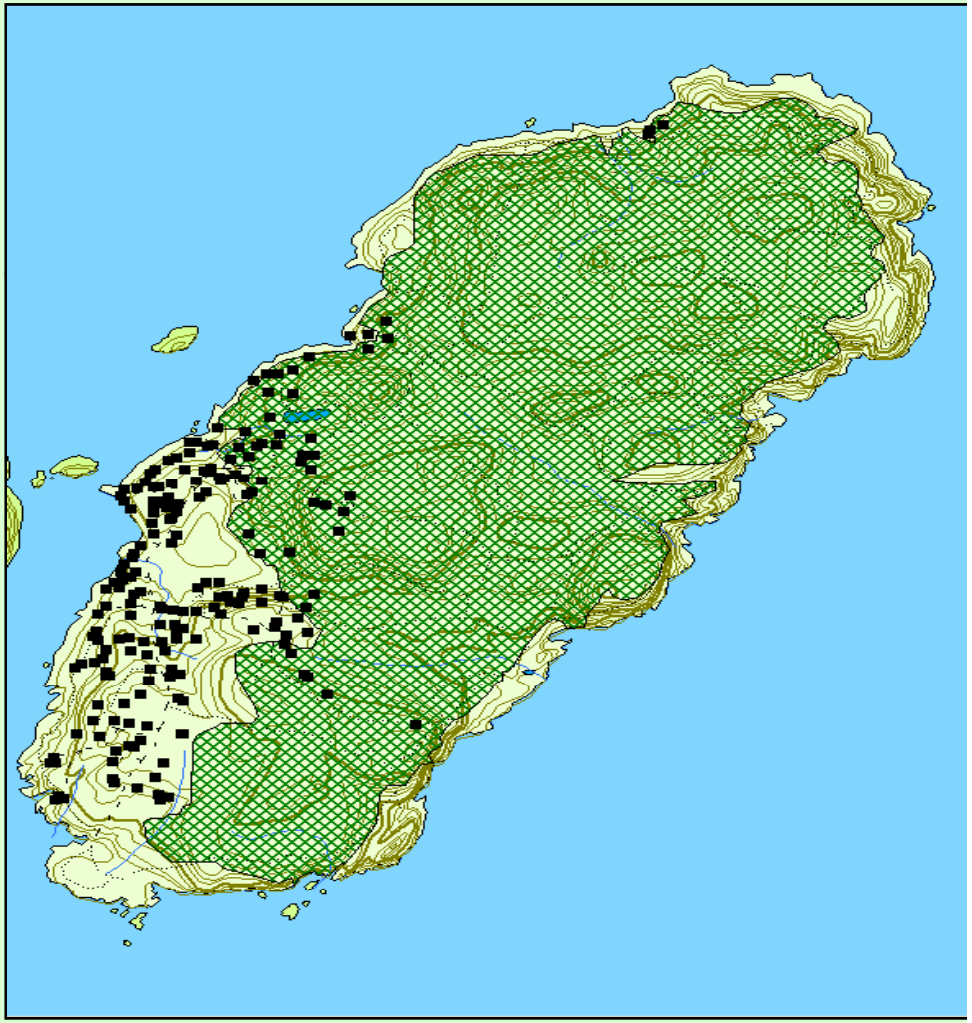


Change In Forest Cover

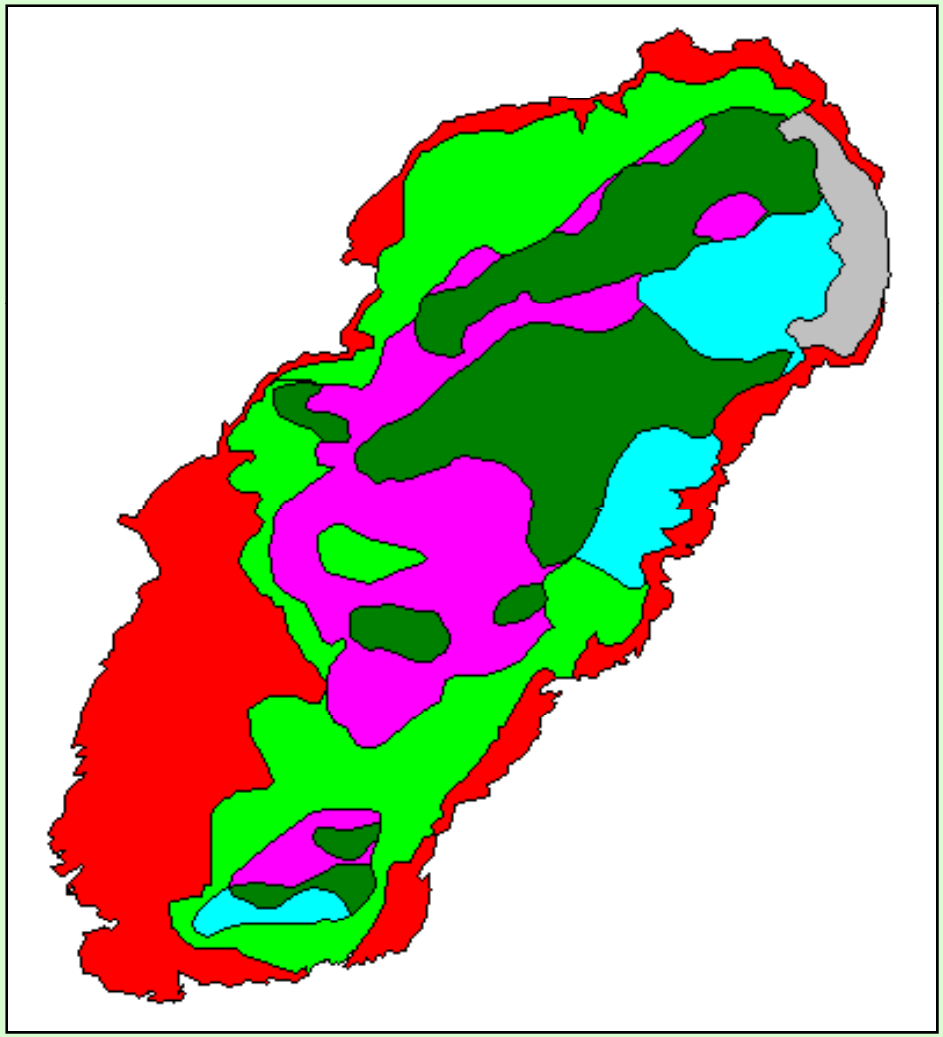
1922



1988 USGS topo

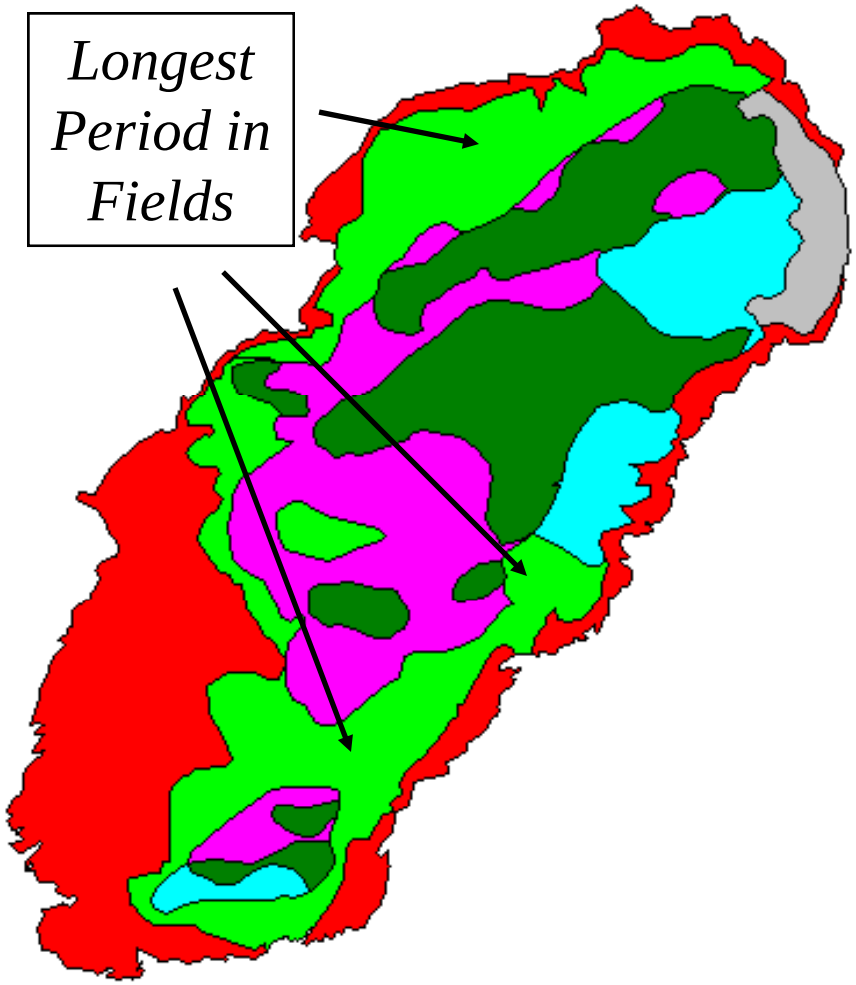


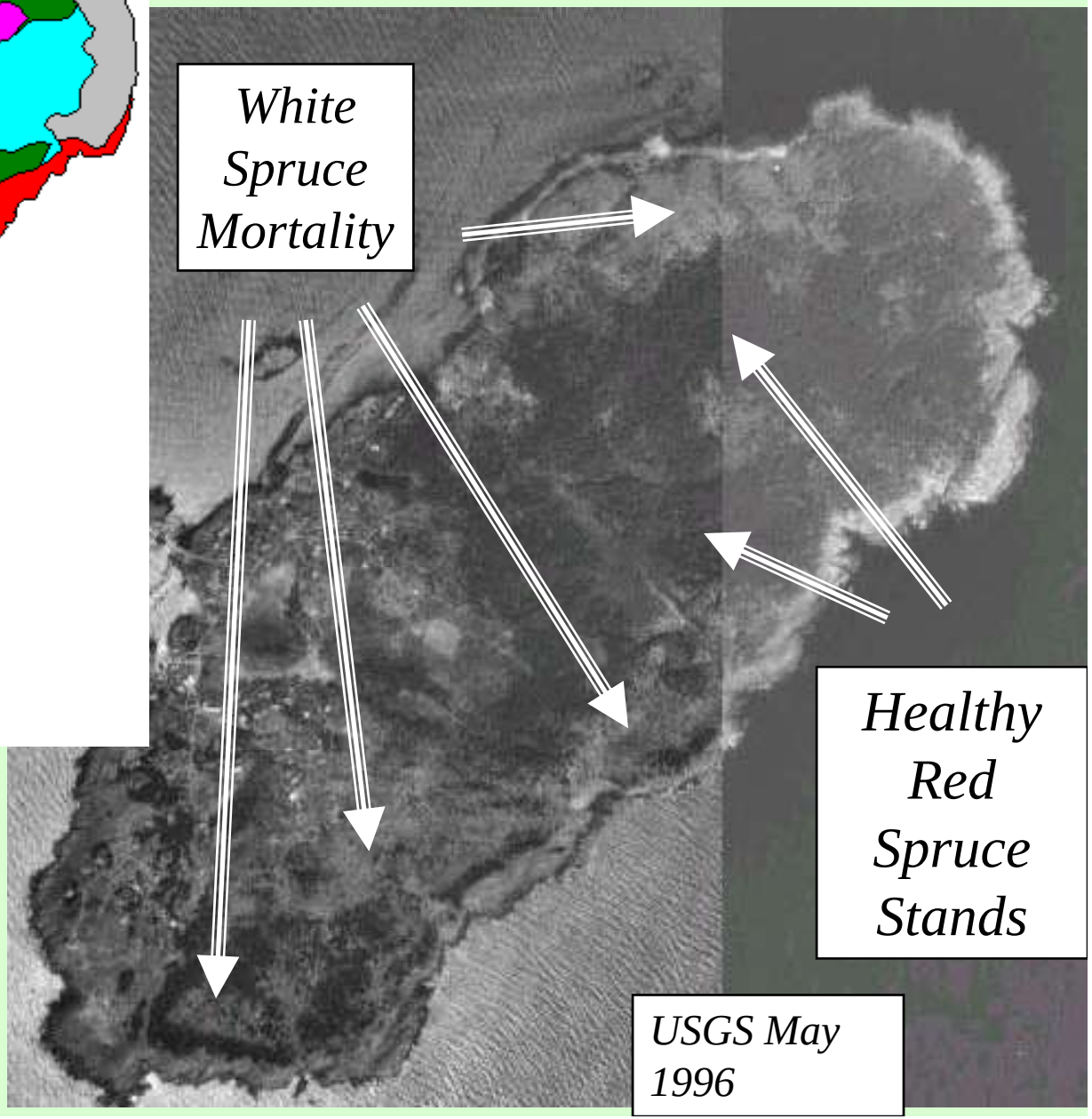
Stratified Land-Use History Map



Legend

Strata	1873	1922	USGS
	forested	forested	forested
	forested	cleared	forested
	cleared	forested	forested
	cleared	cleared	forested
	cleared	cleared	cleared
	?	?	forested





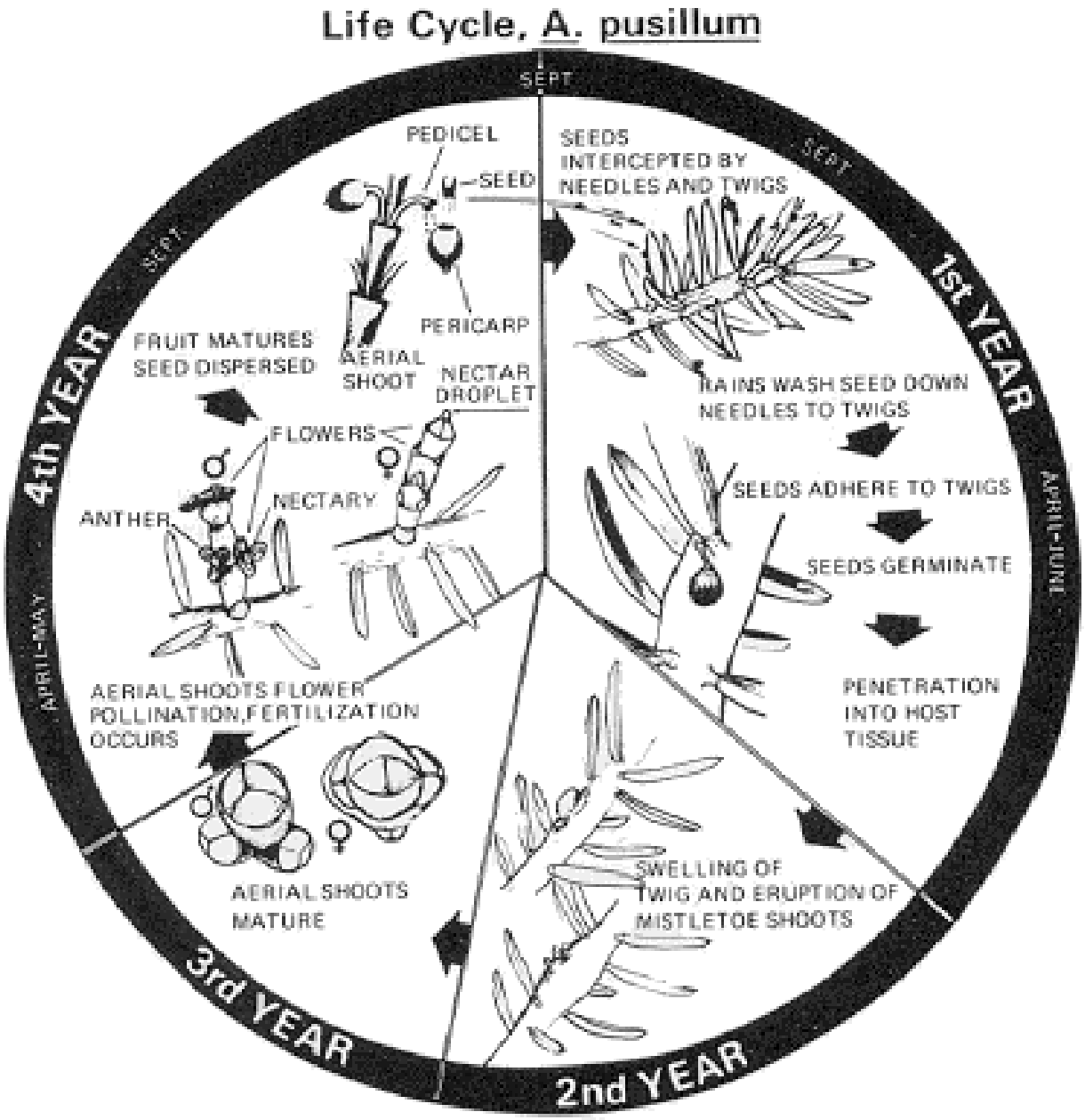
Quantify Association Between Mortality and Land Use

Association Between White Spruce Mortality and Land-Use History

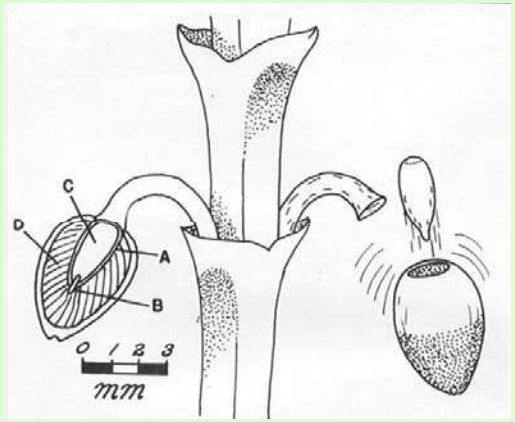
- As of 1996, 25% of forests were killed (122 ac)
- 94 % on white spruce
- In locations with a history of forest clearance and field abandonment

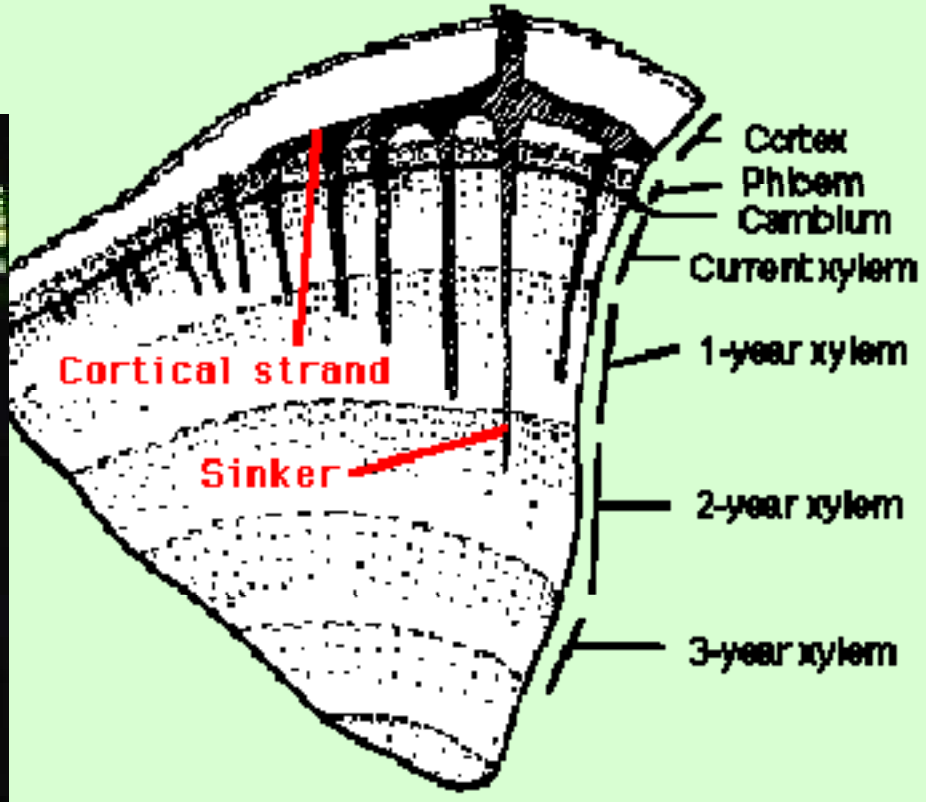
Strata	Mortality
Cont.	7%
Least	54%
1873	24%
1922	16%

EDMT Life Cycle



Life Cycle in Pictures





Inciting Factors: Dwarf Mistletoe Favored on White Spruce Growing in Former Fields

- Pure white spruce stands regenerated on old fields
- Trees were widely spaced; DM seeds could spread quickly
- Large, healthy crowns allow brooms to live long
- Pure stands susceptible to dwarf mistletoe infestation

Inciting Factors Lacking in Red Spruce Stands

- 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

Secondary Factors

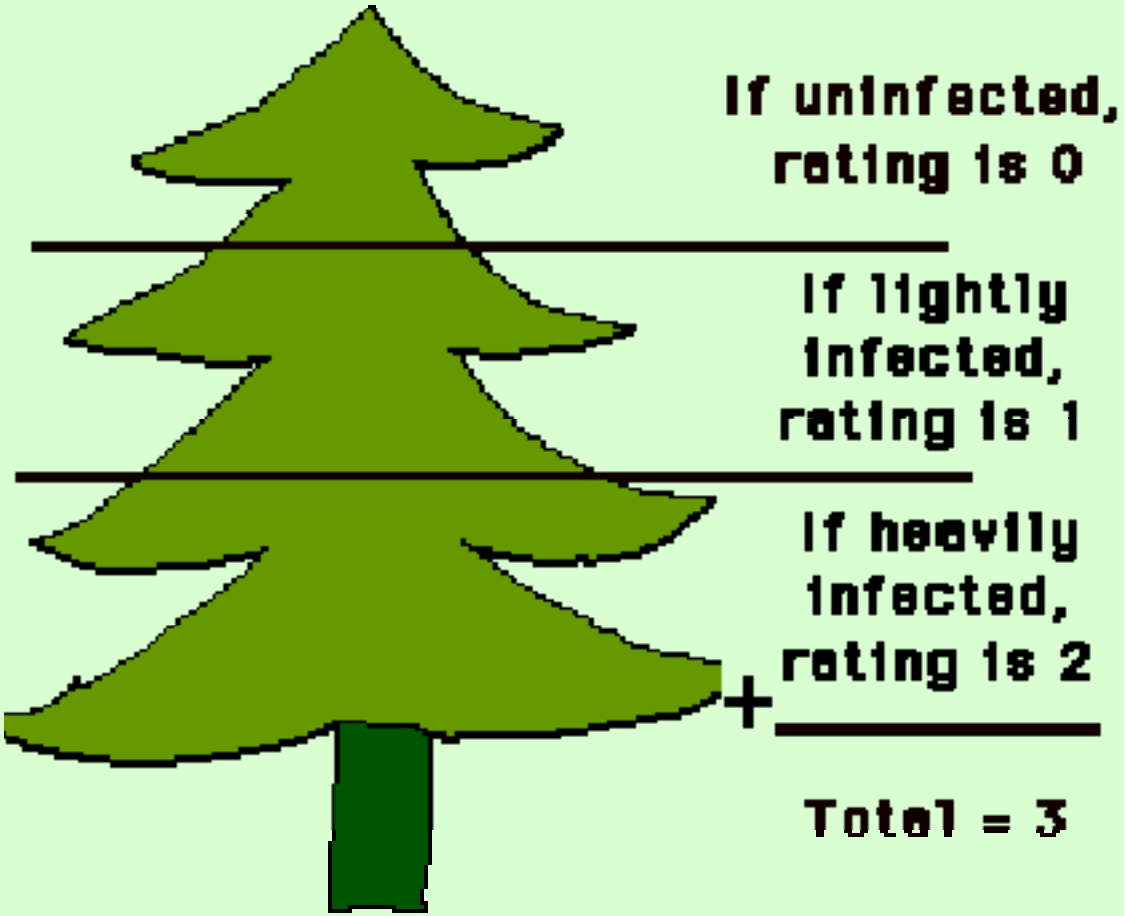
- Windthrow
- Bark beetles

Pre-emptive Options

- Manage for height growth
  - Height growth exceeds DM ability spread upward
  - Shade kills older brooms
- Increase species diversity

Monitor

- Damage classification system

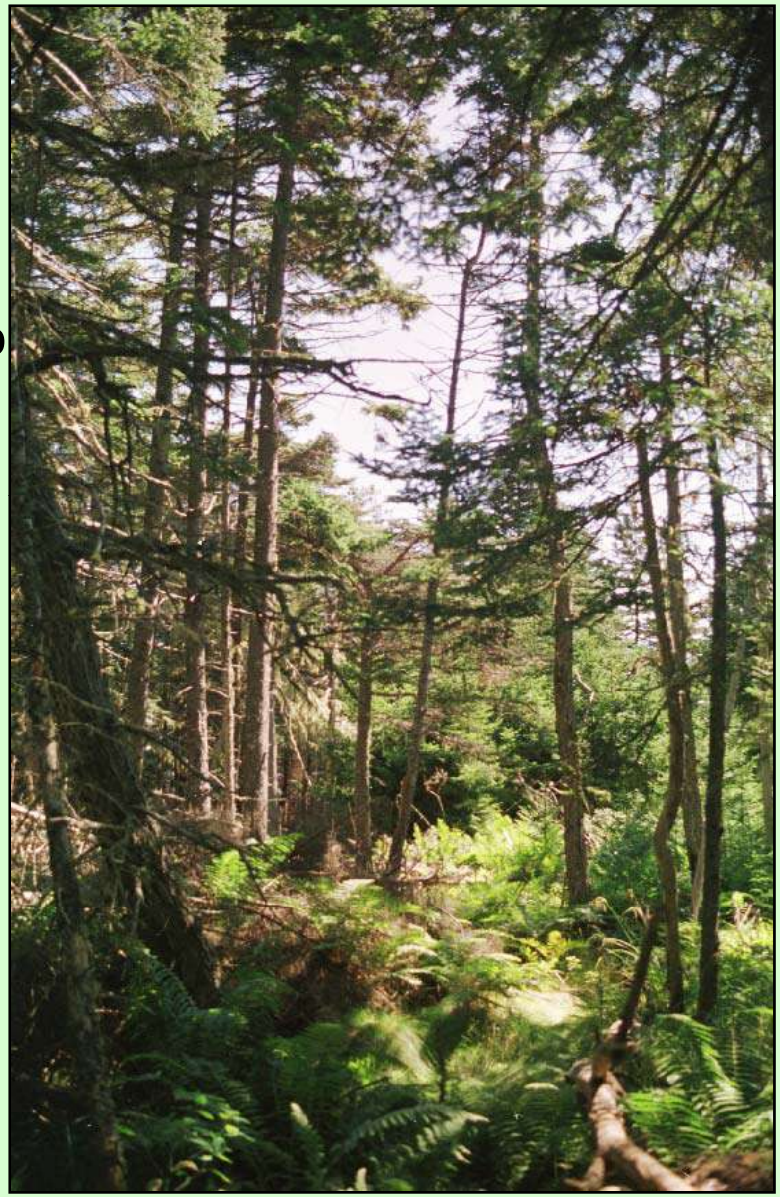


Reactive Options

- Clear-cut infected stands
  - Must remove all infected trees
  - Otherwise, regeneration will fail
- Prune infected branches
- Apply ethephon
  - Releases ethylene – get abscission
  - Prevents seed dispersal
  - Shoots will grow back

Preemptive Measure on Red Spruce Stands

- Red spruce 74% of stems, balsam fir 10%, hardwoods 16%
- Multi-aged stands: 27-185 yr (avg = 90); fully stocked
  - DM brooms shaded and die
  - Does not become established
- Red spruce regeneration favored, 76%
- No action needed for DM
- Remove barberry bushes



Monitor Abandoned Field Sites

- Trees with dwarf mistletoe
  - WS still 40% of trees, 18-87yr old (avg = 47)
  - Infection rating = 4.3
  - Half of trees have rating=6
- Regenerating species (saplings) include:
  - Red spruce: 46%
  - White spruce: 33%
  - Hardwoods: 21%
- Plants include grasses, bayberry, raspberry, goldenrod, barberry

Barberry Threat!

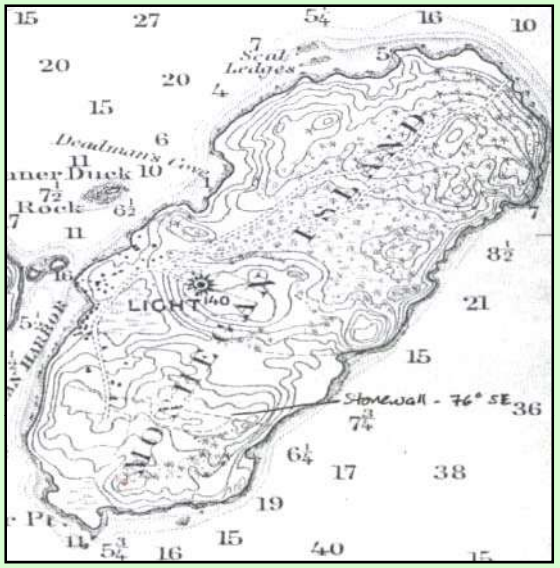
- Detected in 1971
- Now regenerating on:
  - entire island
  - high density on 40% of forest area
  - over 150 acres
- Spread favored by:
  - deer browsing other plants
  - birds feeding on berries
- Future impact
  - exclude regeneration of other plant species
  - restrict forest access

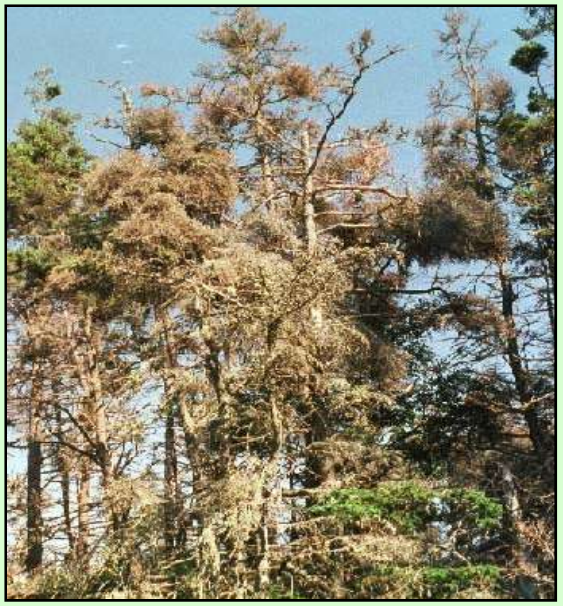
Reactive Measures

- Cut infected overstory trees
- Kill barberry and other shrub competition to release regeneration

Summary

- 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





Health Mangement Plan for Monhegan Forests

- Monitor old field sites
  - Infected white spruce
  - Tree regeneration
- Monitor all forest for barberry
- Reactive measures
  - Remove infected white spruce
  - Remove barberry