Climate Adapted Forest Management Tools and Pilot Projects

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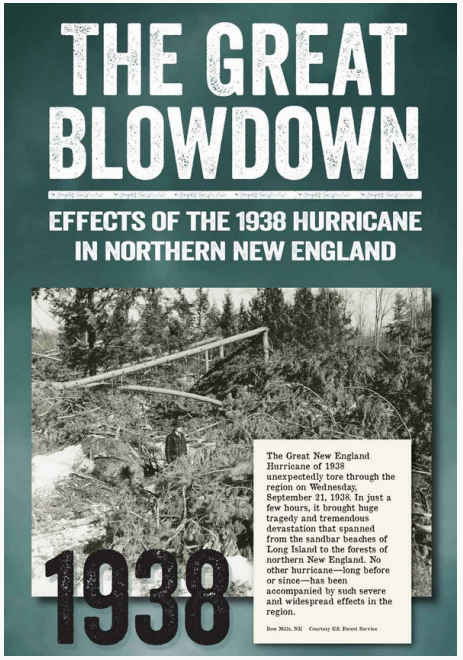
Forest Resilience

The ability of a forest to absorb disturbances and re-organize under change to maintain similar functioning and structure (Scheffer 2009).

The capacity of a site to maintain diversity, productivity, and ecological function as the climate changes (Anderson et al. 2014).



Road Map

1. Forest Health and Resilience Outreach Tool
2. Applying Climate Adapted Forest Restoration on TNC's Tug Hill Lands
    - Climate adapted forest restoration planting
    - Diversifying forest structure through patch selection harvest

Forest Health and Resilience Outreach Tool

The Nature Conservancy

NIACS Northern Institute of Applied Climate Science

Cornell Cooperative Extension Onondaga County

Three Components:

1. Guiding principles
2. Forest Condition Scorecard
3. Strategy recommendations

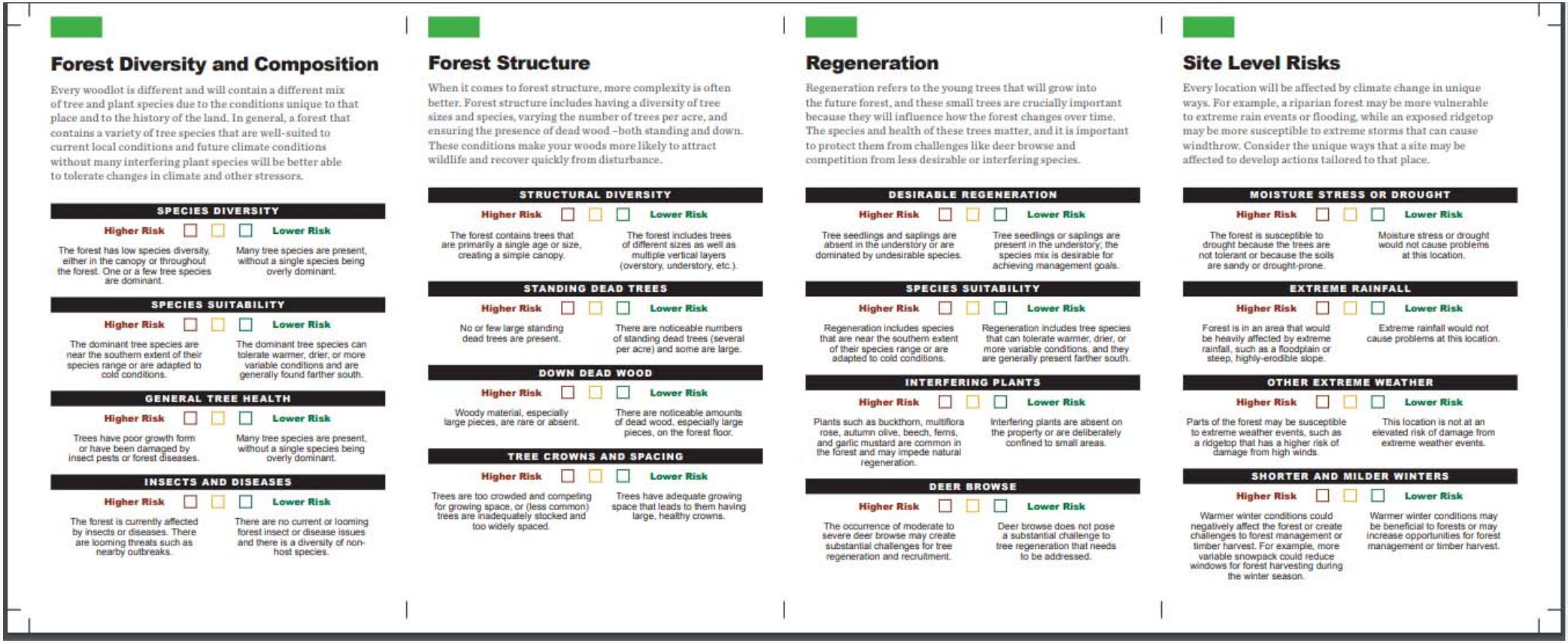
Principles of Resilient Forest Management

- Keep forests as forests
  - ✓ Larger, contiguous blocks of forest tend to be less impacted from stressors
  - ✓ Consider long-term protection tools like legacy planning and conservation easements
- Reduce stressors
  - ✓ Forests under pressure are more susceptible to pests and pathogens
  - ✓ Nurture and encourage healthy, younger trees
- Address vulnerabilities
  - ✓ Encourage a diversity of age, species, and structure

Forest Health and Condition Scorecard

1. Assess condition
2. Identify stressors and vulnerabilities

The Forest Resilience Scorecard:
An entry point for landowners



Forest Diversity and Composition

Every woodlot is different and will contain a different mix of tree and plant species due to the conditions unique to that place and to the history of the land. In general, a forest that contains a variety of tree species that are well-suited to current local conditions and future climate conditions without many interfering plant species will be better able to tolerate changes in climate and other stressors.

SPECIES DIVERSITY

Higher Risk ☐ ☐ ☐ Lower Risk

The forest has low species diversity, either in the canopy or throughout the forest. One or a few tree species are dominant.

Many tree species are present, without a single species being overly dominant.

SPECIES SUITABILITY

Higher Risk ☐ ☐ ☐ Lower Risk

The dominant tree species are near the southern extent of their species range or are adapted to cold conditions.

The dominant tree species can tolerate warmer, drier, or more variable conditions and are generally found farther south.

GENERAL TREE HEALTH

Higher Risk ☐ ☐ ☐ Lower Risk

Trees have poor growth form or have been damaged by insect pests or forest diseases.

Many tree species are present, without a single species being overly dominant.

INSECTS AND DISEASES

Higher Risk ☐ ☐ ☐ Lower Risk

The forest is currently affected by insects or diseases. There are looming threats such as nearby outbreaks.

There are no current or looming forest insect or disease issues and there is a diversity of non-host species.

Forest Structure

When it comes to forest structure, more complexity is often better. Forest structure includes having a diversity of tree sizes and species, varying the number of trees per acre, and ensuring the presence of dead wood –both standing and down. These conditions make your woods more likely to attract wildlife and recover quickly from disturbance.

STRUCTURAL DIVERSITY

Higher Risk ☐ ☐ ☐ Lower Risk

The forest contains trees that are primarily a single age or size, creating a simple canopy.

The forest includes trees of different sizes as well as multiple vertical layers (overstory, understory, etc.).

STANDING DEAD TREES

Higher Risk ☐ ☐ ☐ Lower Risk

No or few large standing dead trees are present.

There are noticeable numbers of standing dead trees (several per acre) and some are large.

DOWN DEAD WOOD

Higher Risk ☐ ☐ ☐ Lower Risk

Woody material, especially large pieces, are rare or absent.

There are noticeable amounts of dead wood, especially large pieces, on the forest floor.

TREE CROWNS AND SPACING

Higher Risk ☐ ☐ ☐ Lower Risk

Trees are too crowded and competing for growing space, or (less common) trees are inadequately stocked and too widely spaced.

Trees have adequate growing space that leads to them having large, healthy crowns.

Regeneration

Regeneration refers to the young trees that will grow into the future forest, and these small trees are crucially important because they will influence how the forest changes over time. The species and health of these trees matter, and it is important to protect them from challenges like deer browse and competition from less desirable or interfering species.

DESIRABLE REGENERATION

Higher Risk ☐ ☐ ☐ Lower Risk

Tree seedlings and saplings are absent in the understory or are dominated by undesirable species.

Tree seedlings or saplings are present in the understory; the species mix is desirable for achieving management goals.

SPECIES SUITABILITY

Higher Risk ☐ ☐ ☐ Lower Risk

Regeneration includes species that are near the southern extent of their species range or are adapted to cold conditions.

Regeneration includes tree species that can tolerate warmer, drier, or more variable conditions, and they are generally present farther south.

INTERFERING PLANTS

Higher Risk ☐ ☐ ☐ Lower Risk

Plants such as buckthorn, multiflora rose, autumn olive, beech, ferns, and garlic mustard are common in the forest and may impede natural regeneration.

Interfering plants are absent on the property or are deliberately confined to small areas.

DEER BROWSE

Higher Risk ☐ ☐ ☐ Lower Risk

The occurrence of moderate to severe deer browse may create substantial challenges for tree regeneration and recruitment.

Deer browse does not pose a substantial challenge to tree regeneration that needs to be addressed.

Site Level Risks

Every location will be affected by climate change in unique ways. For example, a riparian forest may be more vulnerable to extreme rain events or flooding, while an exposed ridgetop may be more susceptible to extreme storms that can cause windthrow. Consider the unique ways that a site may be affected to develop actions tailored to that place.

MOISTURE STRESS OR DROUGHT

Higher Risk ☐ ☐ ☐ Lower Risk

The forest is susceptible to drought because the trees are not tolerant or because the soils are sandy or drought-prone.

Moisture stress or drought would not cause problems at this location.

EXTREME RAINFALL

Higher Risk ☐ ☐ ☐ Lower Risk

Forest is in an area that would be heavily affected by extreme rainfall, such as a floodplain or steep, highly-erodible slope.

Extreme rainfall would not cause problems at this location.

OTHER EXTREME WEATHER

Higher Risk ☐ ☐ ☐ Lower Risk

Parts of the forest may be susceptible to extreme weather events, such as a ridgetop that has a higher risk of damage from high winds.

This location is not at an elevated risk of damage from extreme weather events.

SHORTER AND MILDER WINTERS

Higher Risk ☐ ☐ ☐ Lower Risk

Warmer winter conditions could negatively affect the forest or create challenges to forest management or timber harvest. For example, more variable snowpack could reduce windows for forest harvesting during the winter season.

Warmer winter conditions may be beneficial to forests or may increase opportunities for forest management or timber harvest.

Forest Regeneration

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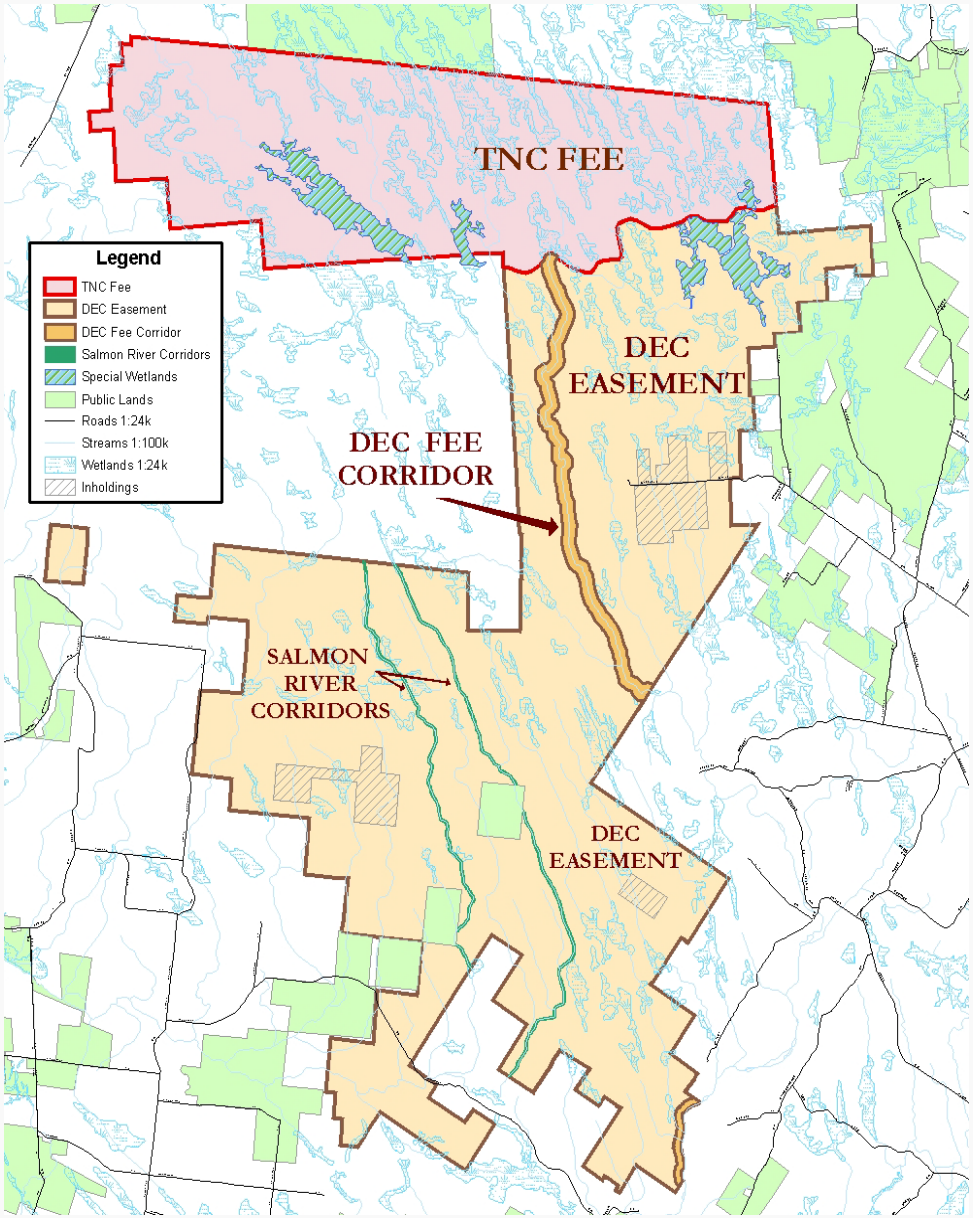
Strategy Recommendations
Taking Action to Improve Resilience

Concerns	Strategies
Tree Health Trees have poor form reflecting more challenging site conditions or have damage from insect pests or forest diseases.	• Thin forest stands to remove crowded, damaged or stressed trees to reduce competition for light, nutrients, and water.
Insects & Disease The forest is currently affected by insects or diseases or there are looming threats (such as problematic pests nearby).	• Retain survivors of pest or disease outbreaks, droughts, windthrow events, or other disturbances during salvage or sanitation operations. • Create a diverse mix of forest or community types, age classes, and stand structures to reduce the availability of host species for pests and pathogens. • Thin to reduce the density of a pest's host species to discourage infestation, knowing that species are especially susceptible to pests and pathogens at stocking levels.

Applying Climate Adapted Forest Restoration on TNC's Tug Hill Lands

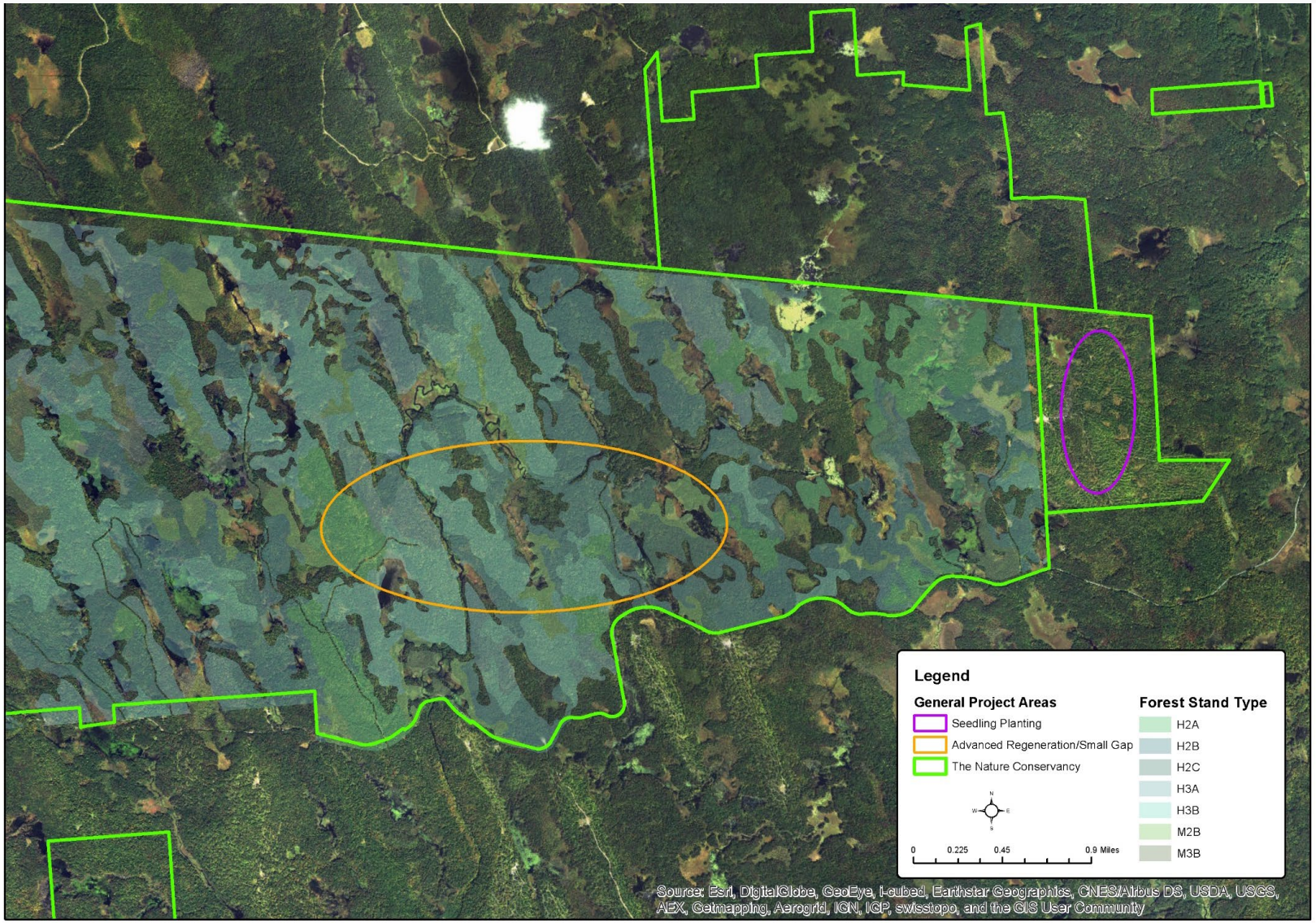


TNC's Tug Hill Ownership

- In 2002, purchased 45,000 acres.
- TNC retained 15,000 acres and transferred the rest to DEC with a conservation easement.
- Current Ownership ~ 17,000 acres.

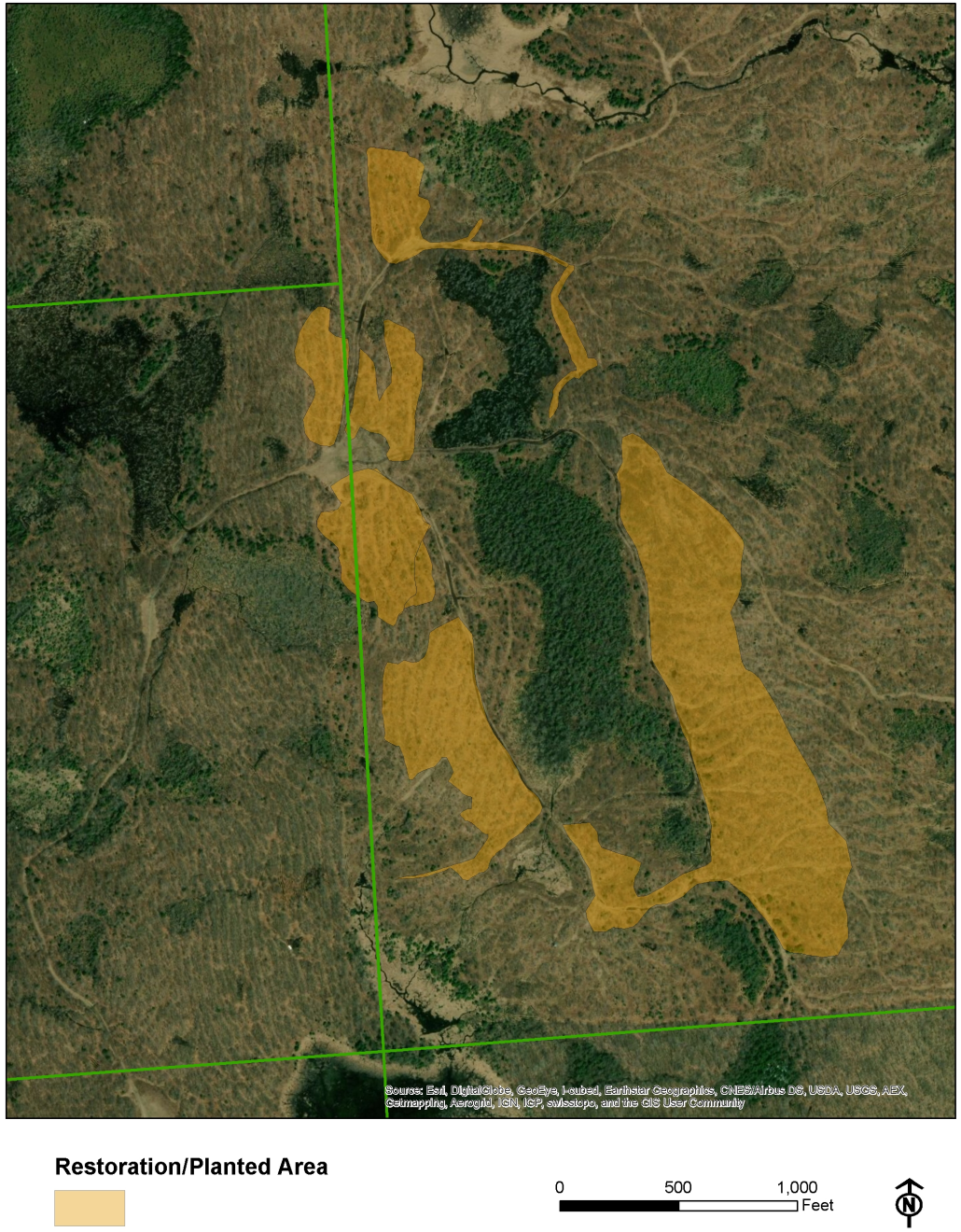
Climate Adapted Forest Restoration Projects

1. Climate adapted planting
2. Patch selection harvest



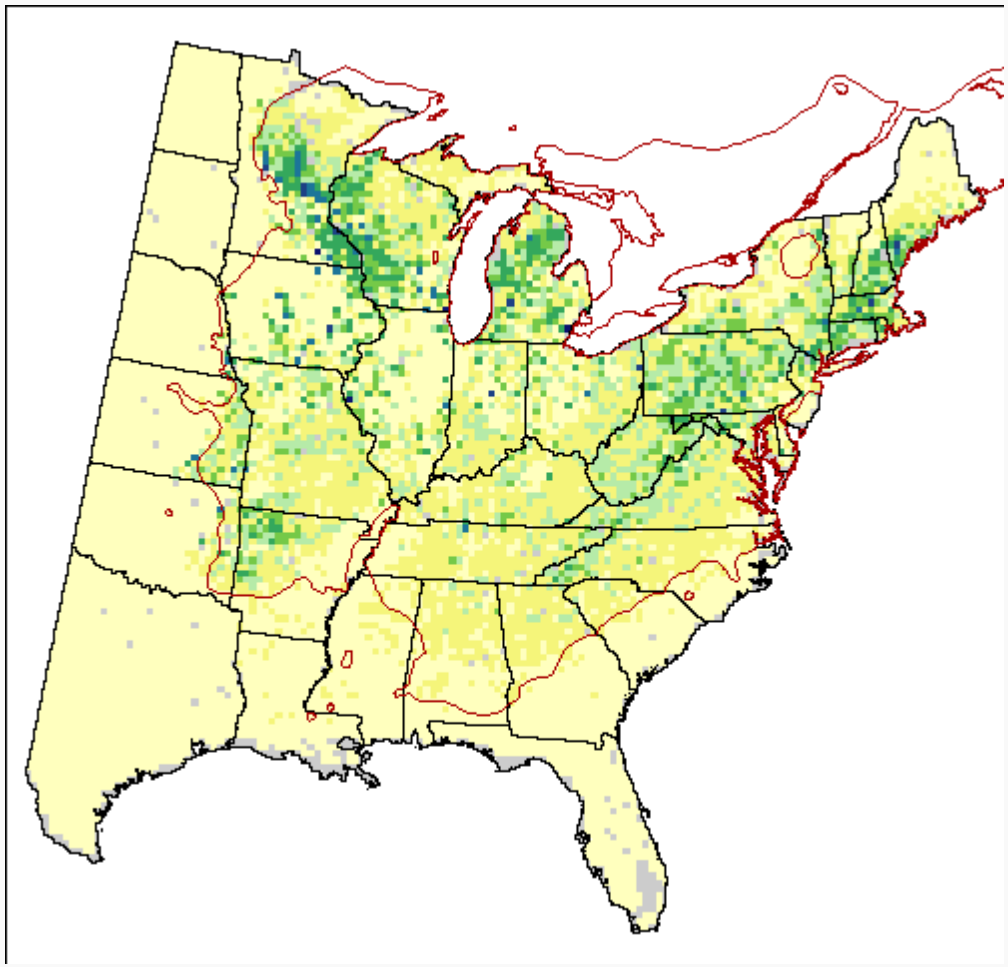
Climate Adapted Forest Restoration Planting

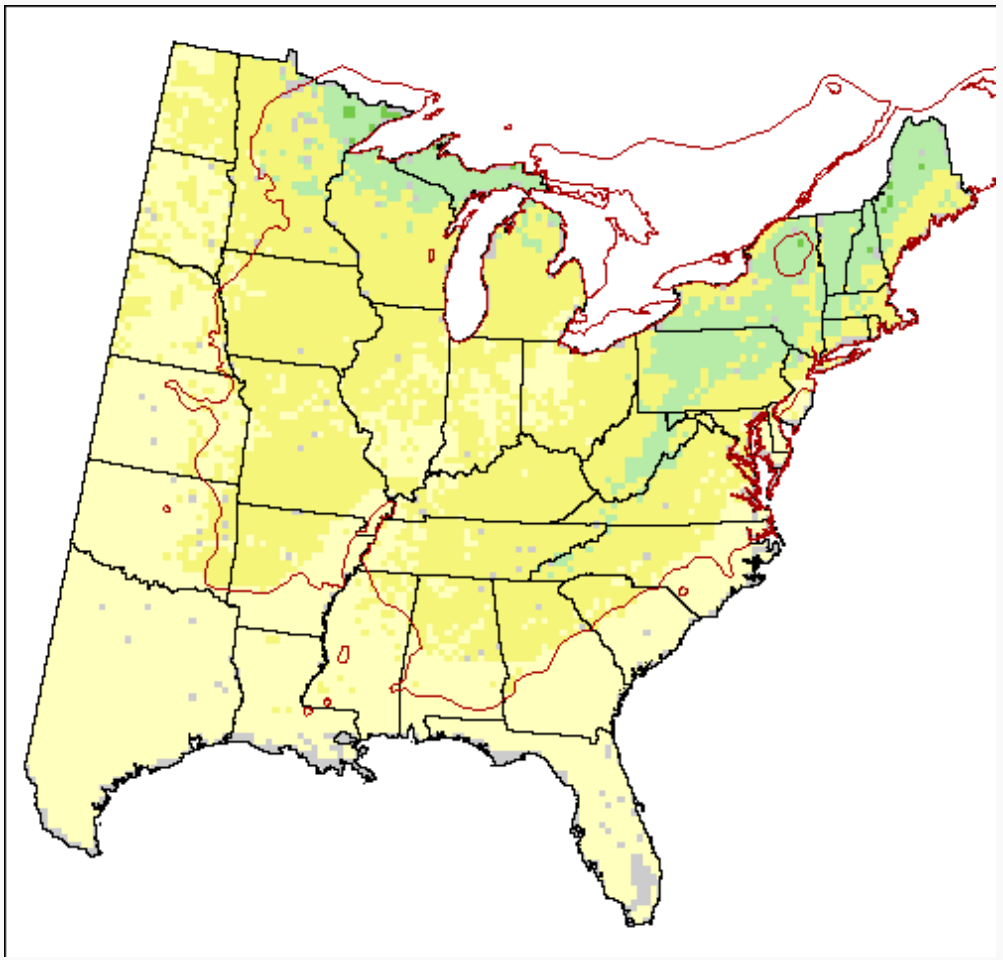
- Acquired 415 parcel in 2014 with ~ 300 acre high graded harvested area.
- Planted 35,000 bareroot seedlings across 50 acres.



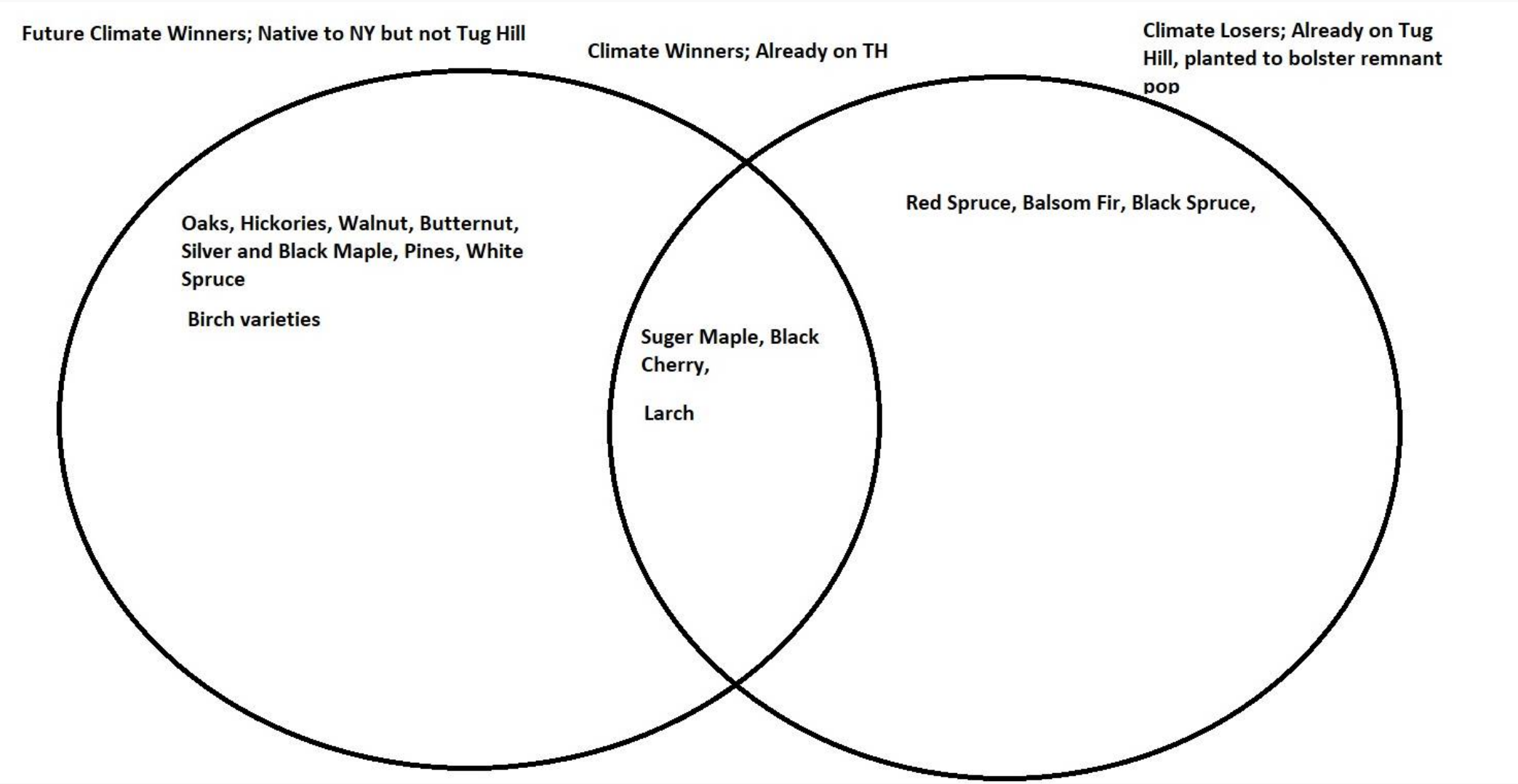
USFS Climate Change Tree Atlas

Tree species selected based on current and predicted distribution





Planted Tree Species with Range of Climate Vulnerability



Pre-Planting Vegetation Management

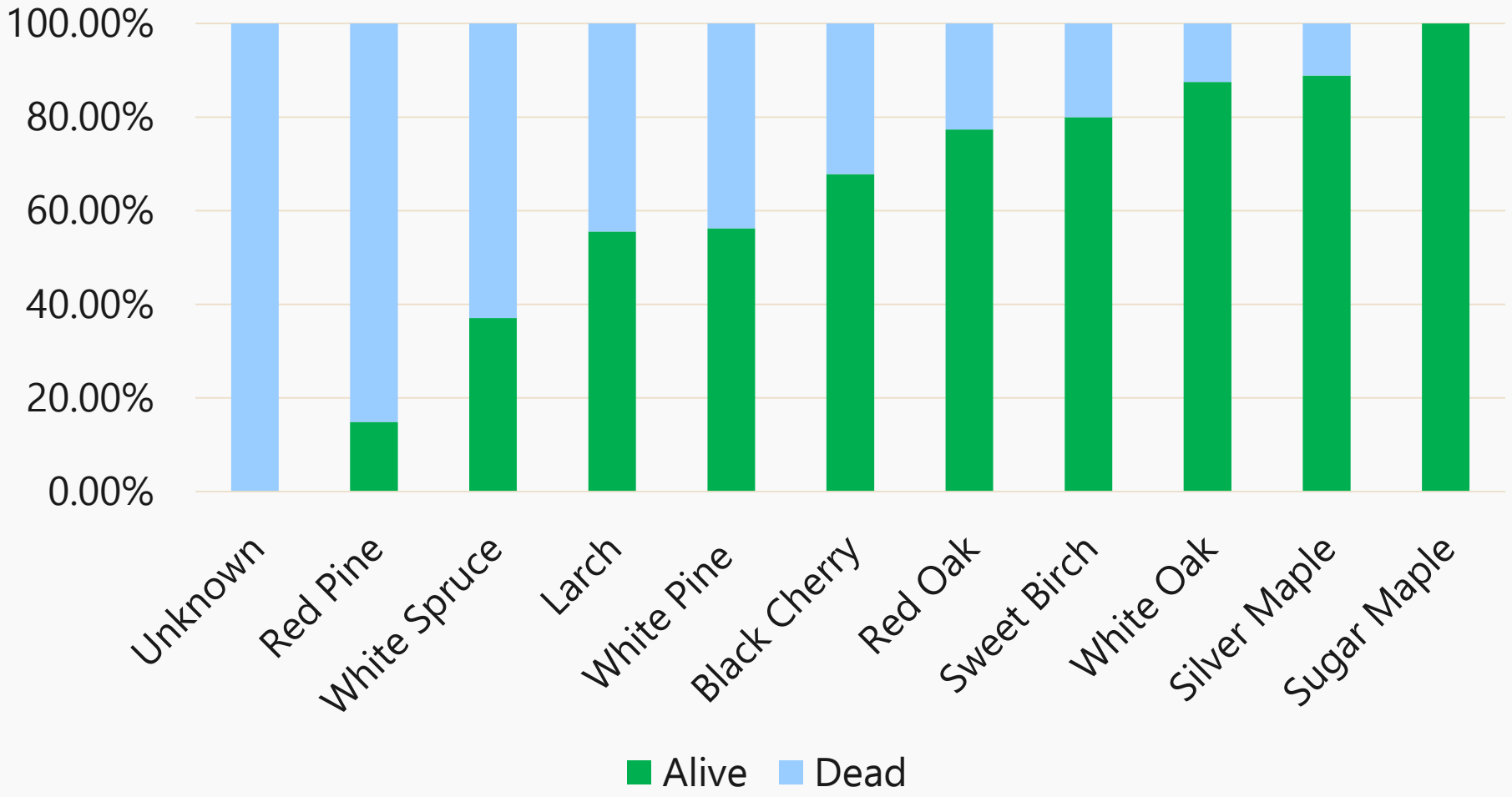
Method
Mechanism of Control

Mode Target Specificity	*Mechanical*	*Chemical*
Selective	*Examples* **Brush saw**	**Hack-n-squirt Basal bark**
Broadcast	**Pulverizing Machine Head**	**Mist blower**

Select a management option(s) that is compatible with owner objectives, efficient, effective, and minimizes negative impacts

Climate Adaption Planting

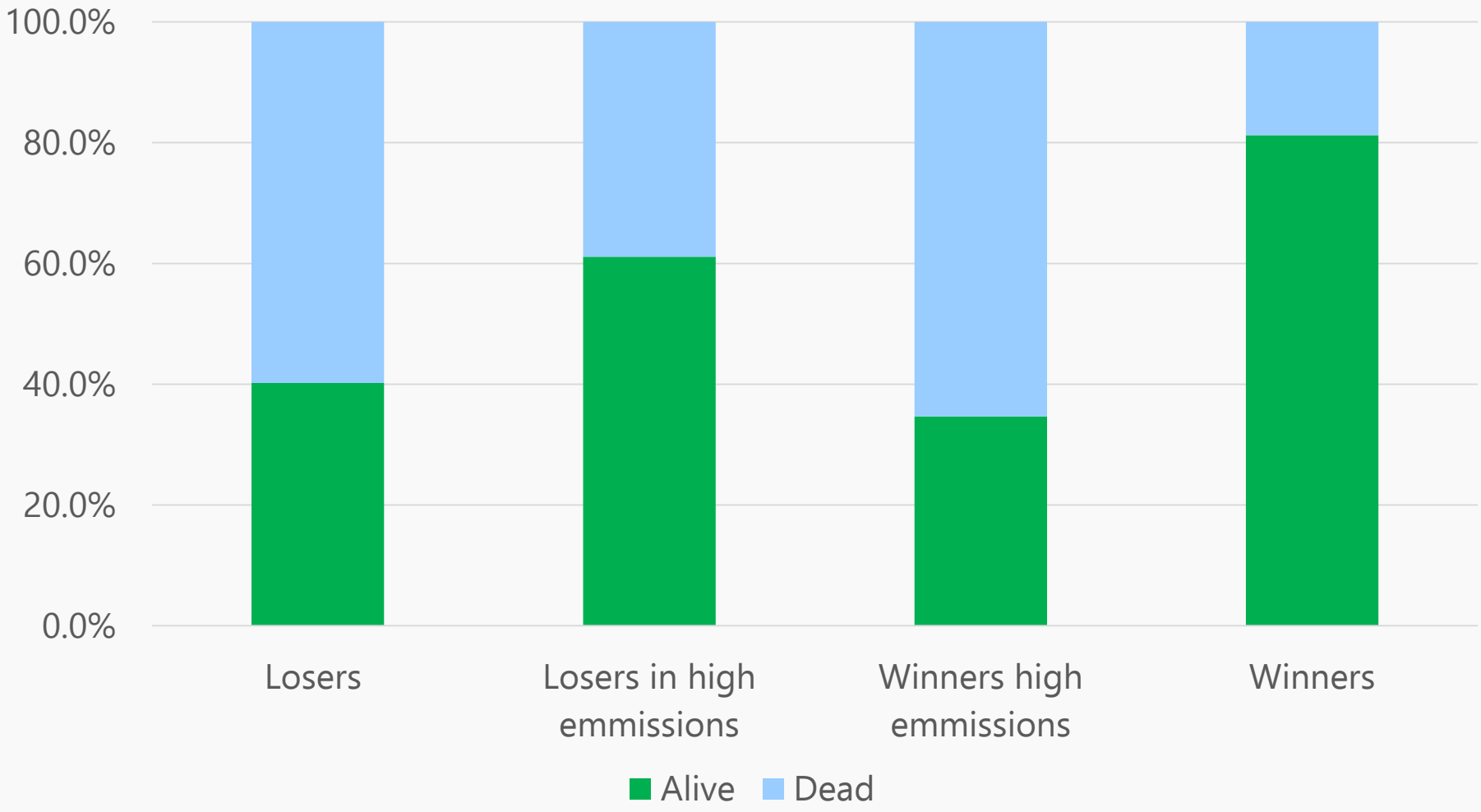
Tree Survival – 2 Years Post Planting



Grouped Plant Species using Northern NY Vulnerability Assessment

	PCM B1	GFDL A1FI	Group
Larch	small decrease	small decrease	Decrease
White Spruce	small decrease	large decrease	Decrease
Eastern White Pine	no change	small decrease	Decrease with high emissions
Sugar Maple	no change	small decrease	Decrease with high emissions
Red Pine	no change	large increase	Increase with high emissions
Black Cherry	no change	small increase	Increase with high emissions
White Oak	small increase	large increase	Increase
Northern Red Oak	small increase	small increase	Increase
Silver Maple	small increase	large increase	Increase
Sweet Birch	small increase	small increase	Increase

Tree Survival by Climate Change Vulnerability Groups



Patch Selection Harvest in 2018

Project Goals

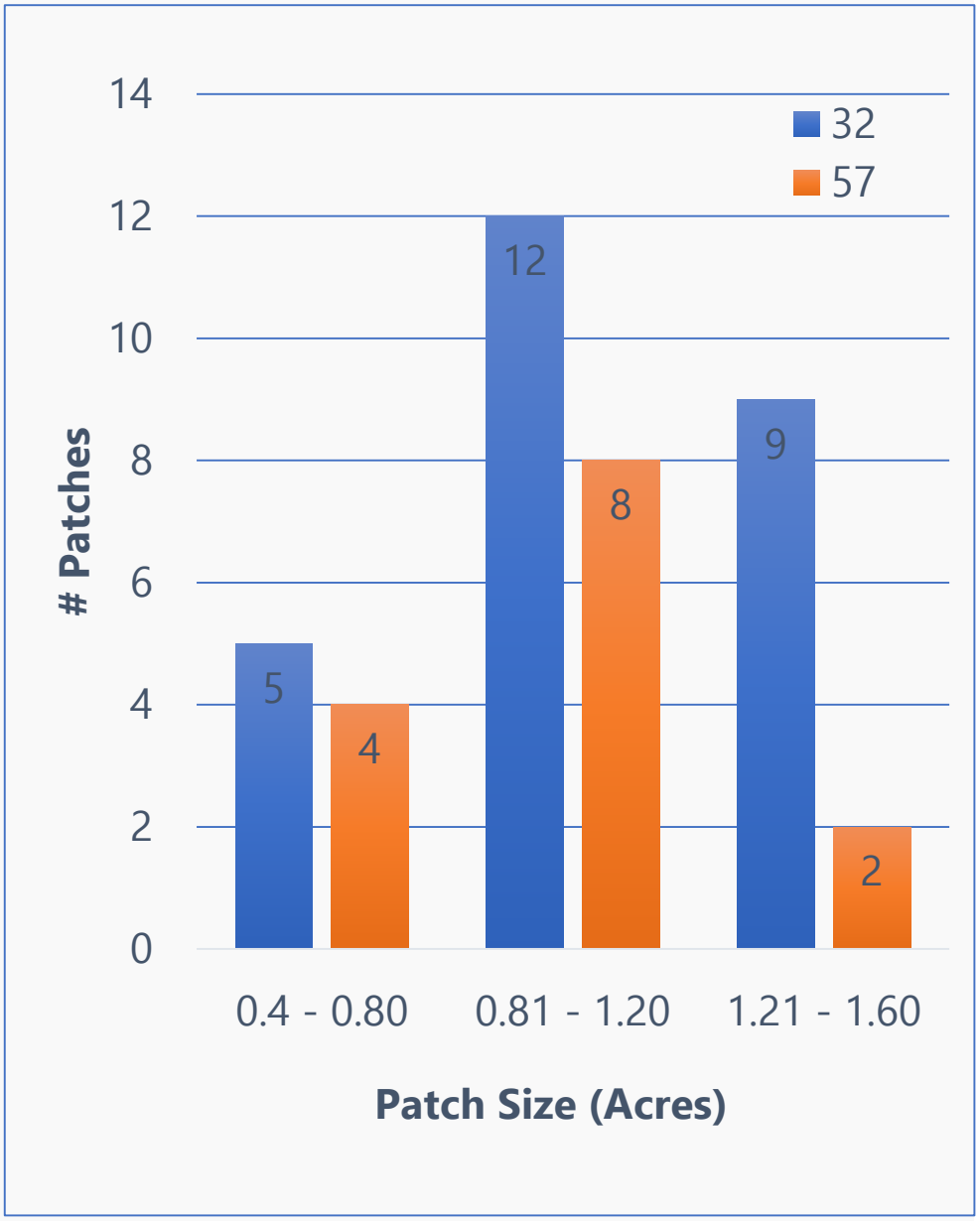
- Increase diversity of regeneration
- Shift composition toward potential climate winners
- Established multiple age classes
- Increase Coarse Woody Debris
- Increase snag density
- Reduce interfering vegetation

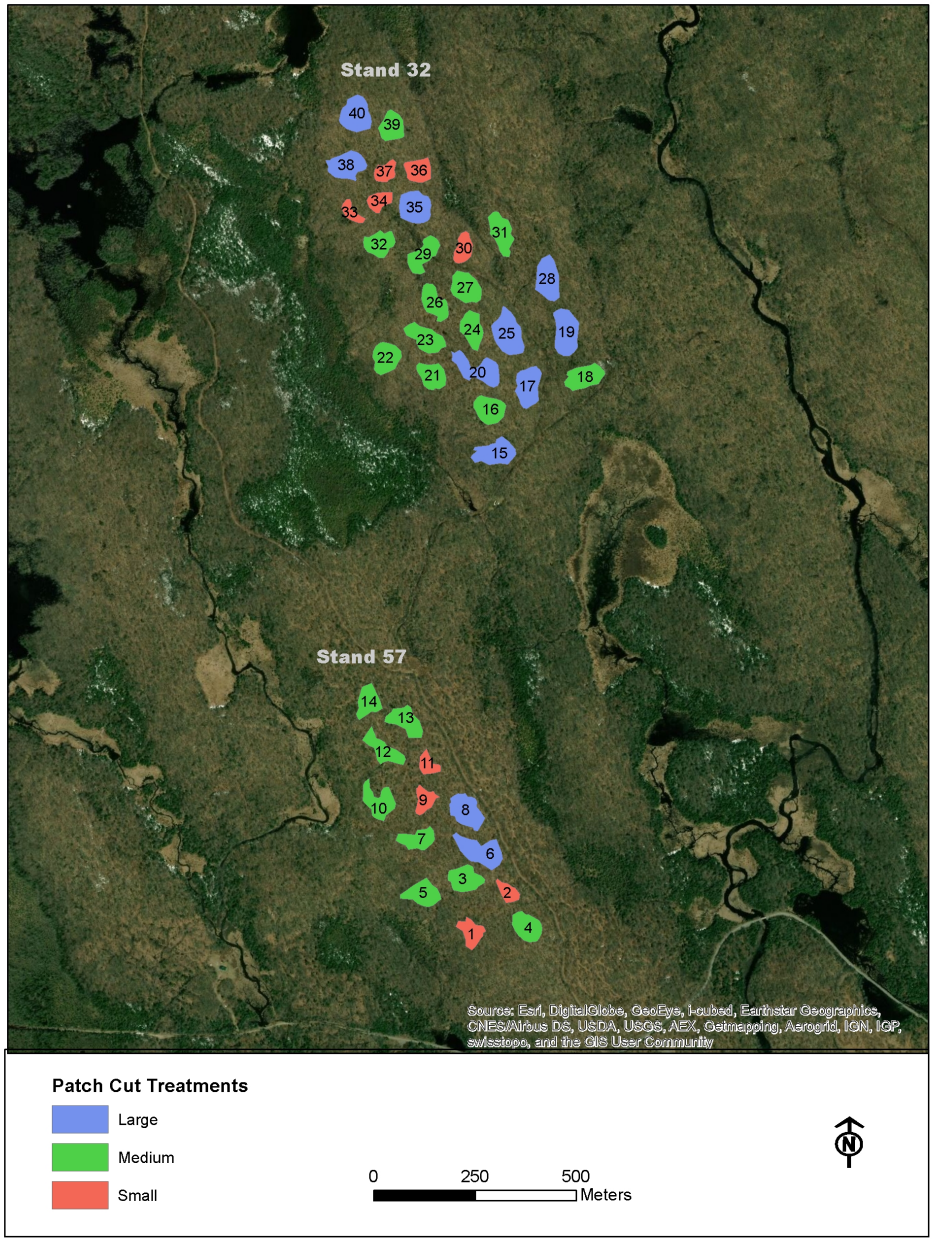
Forest Composition – Stand 32 and 57

Species	All TPA		All BA	
Red Maple	188.4	28%	44.0	32%
Sugar Maple	155.5	23%	28.0	20%
Beech	122.0	18%	27.7	20%
Yellow Birch	141.1	21%	23.7	17%
Black Cherry	16.1	2%	11.0	8%
Spruce	40.6	6%	2.7	2%
White Ash	4.0	1%	1.3	1%
Total	**667.6**	**100%**	**138.3**	**100%**

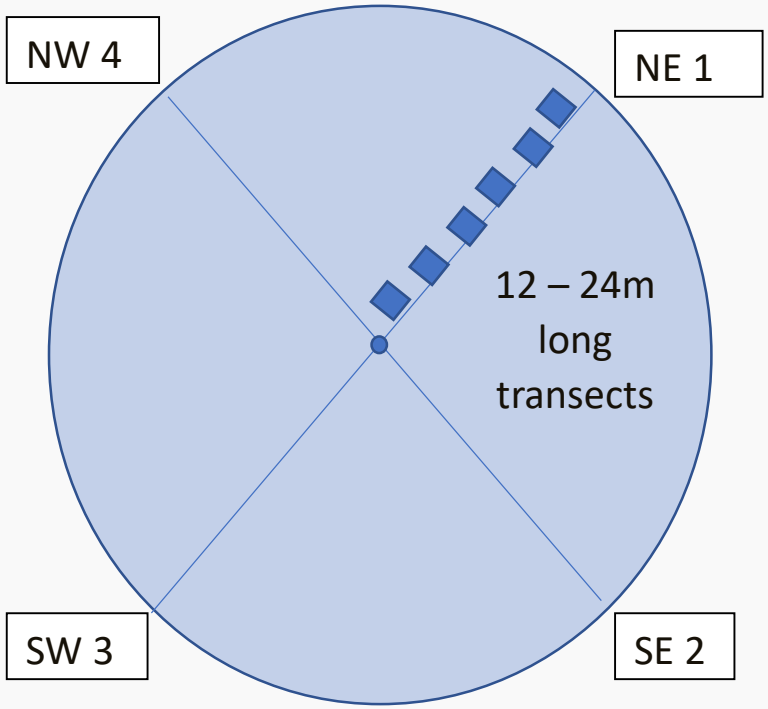
Species	All TPA		All BA	
Red Maple	202.1	23%	42.2	34%
Yellow Birch	234.8	27%	32.2	26%
Sugar Maple	60.6	7%	21.3	17%
Beech	330.3	38%	17.0	14%
Black Cherry	20.2	2%	7.0	6%
Spruce	29.7	3%	3.0	2%
Total	**877.7**	**100%**	**122.6**	**100%**

Prescription and Harvest


14
12
10
8
6
4
2
0
Patches
32
57
5
4
12
8
9
2
0.4 - 0.80
0.81 - 1.20
1.21 - 1.60
Patch Size (Acres)


Stand 32
Stand 57
Sources: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Patch Cut Treatments
Large
Medium
Small
0
250
500
Meters
N

Assessing Early Regeneration Response



Project Team

Project funded in part by the Wildlife Conservation Society Climate Adaptation Fund through the Doris Duke Charitable Foundation.

Project Team

- Cornell Cooperative Extension Onondaga County – emphasis on outreach
- SUNY ESF – with emphasis on the monitoring
- USFS – Northern Institute Applied Climate Science
- Cornell University – project design and outreach

Cornell Univeristy
Cooperative Extension
Agricultural Experiment Station

Cornell Cooperative Extension | Onondaga County

NIACS
Northern Institute of
Applied Climate Science

ESF

Questions?