Adaptive Silviculture Experiment

Some progress, Some results, Some chipmunks

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CT DEEP

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RI DEM and Christopher Riely of URI

UCONN
COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

ASCC
Adaptive Silviculture for Climate Change

The University of Vermont · University of Minnesota · Michigan Technological University · Dartmouth · Forest and Rangeland Stewardship, Colorado State University · NIACS · USFS · The Jones Center at Ichauway · Mississippi Park Connection · Canada

Adaptive Silviculture Experiment
Some progress, Some results, Some chipmunks

Climate Change Impacts on Forests
In New England and Northern New York

- **More Variable Soil Moisture**
- **Increased Risk of Drought**
- **Stress from Forest Pests and Diseases**
- **Competition from Invasive Plants**
- **Changes in Suitable Habitat**
- **Changes in Tree Establishment**
- **Changes in Tree Growth**
- **Changes in Forest Composition**

https://usfs.maps.arcgis.com/apps/MapSeries/index.html?appid=a4babe8e2fe849739171e6824930459e

Adaptive silviculture:
or *adaptive forest management*

- forestry practices that are designed specifically to promote the resistance and resilience of the ecosystem to the impacts of climate change
- and foster adaptation to the projected future climate
- (Joyce et al., 2009; Bosworth et al., 2008)

Adaptive Silviculture: Frameworks and Research Networks

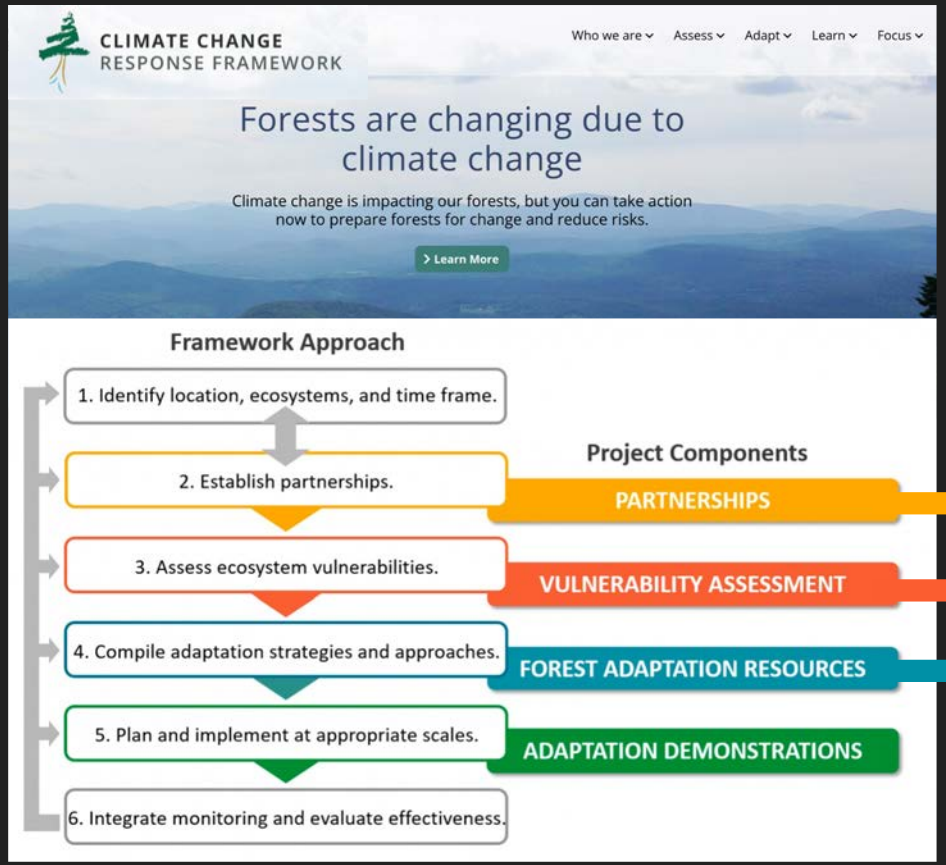
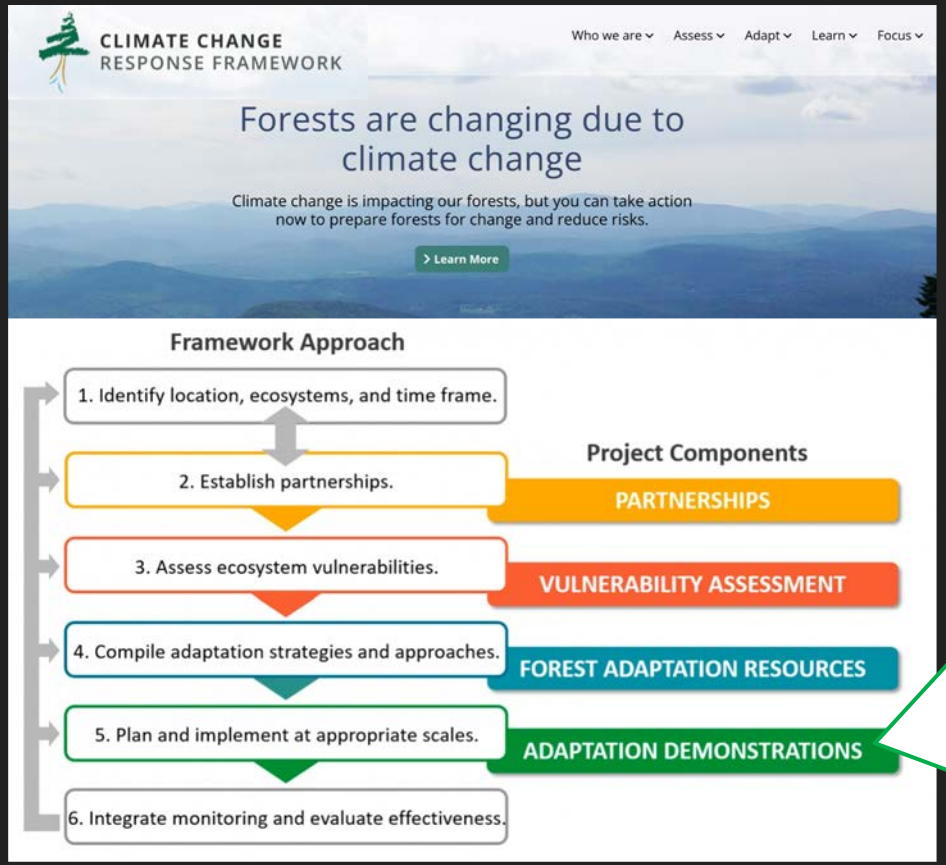


Fig. 2: The Climate Change Response Framework Approach. Reproduced from https://forestadaptation.org/who-we-are/our-approach (12/15/2022)

Adaptive Silviculture: Frameworks and Research Networks



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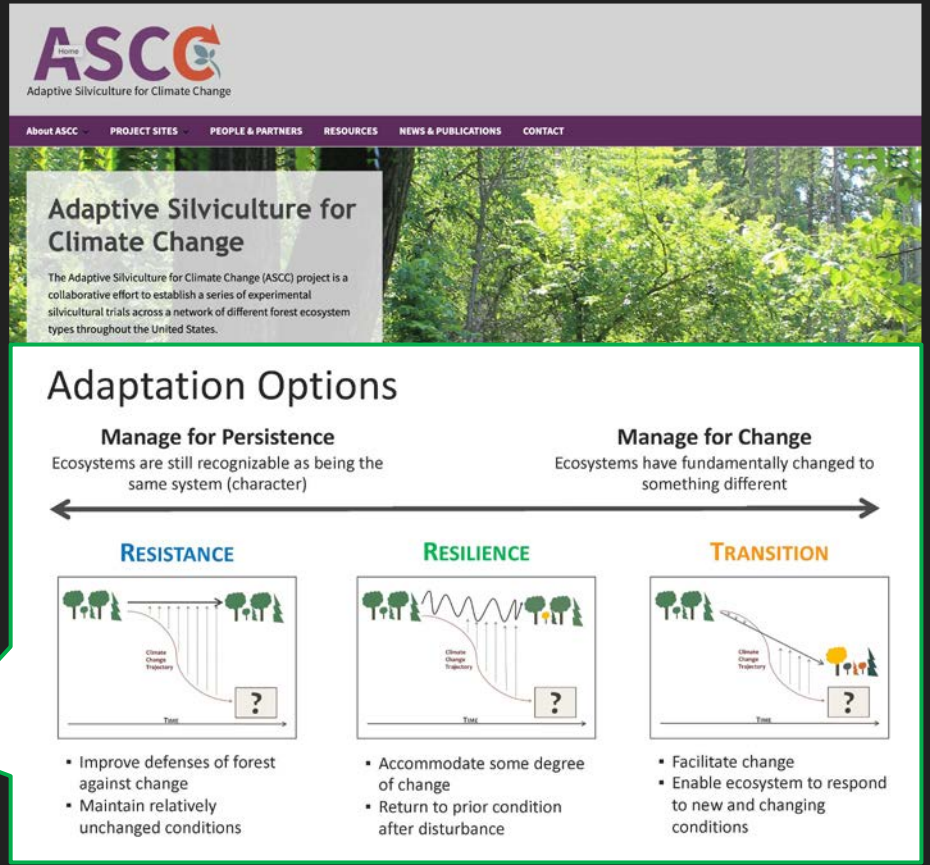
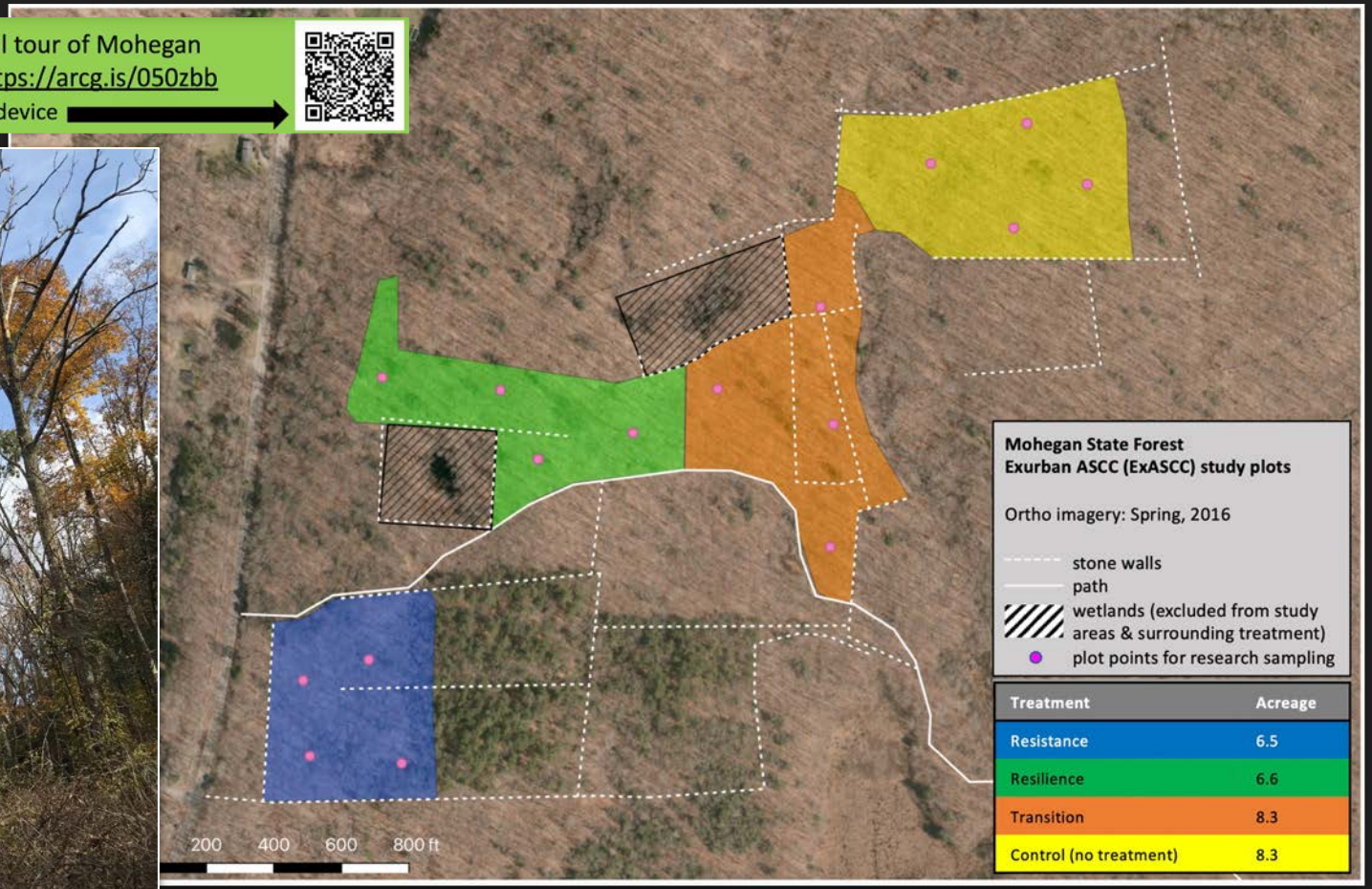


Fig. 1: The Resistance-Resilience-Transition treatment options. Figure Reproduced from https://www.adaptivesilviculture.org/silviculture-climate-adaptation (12/15/2022)

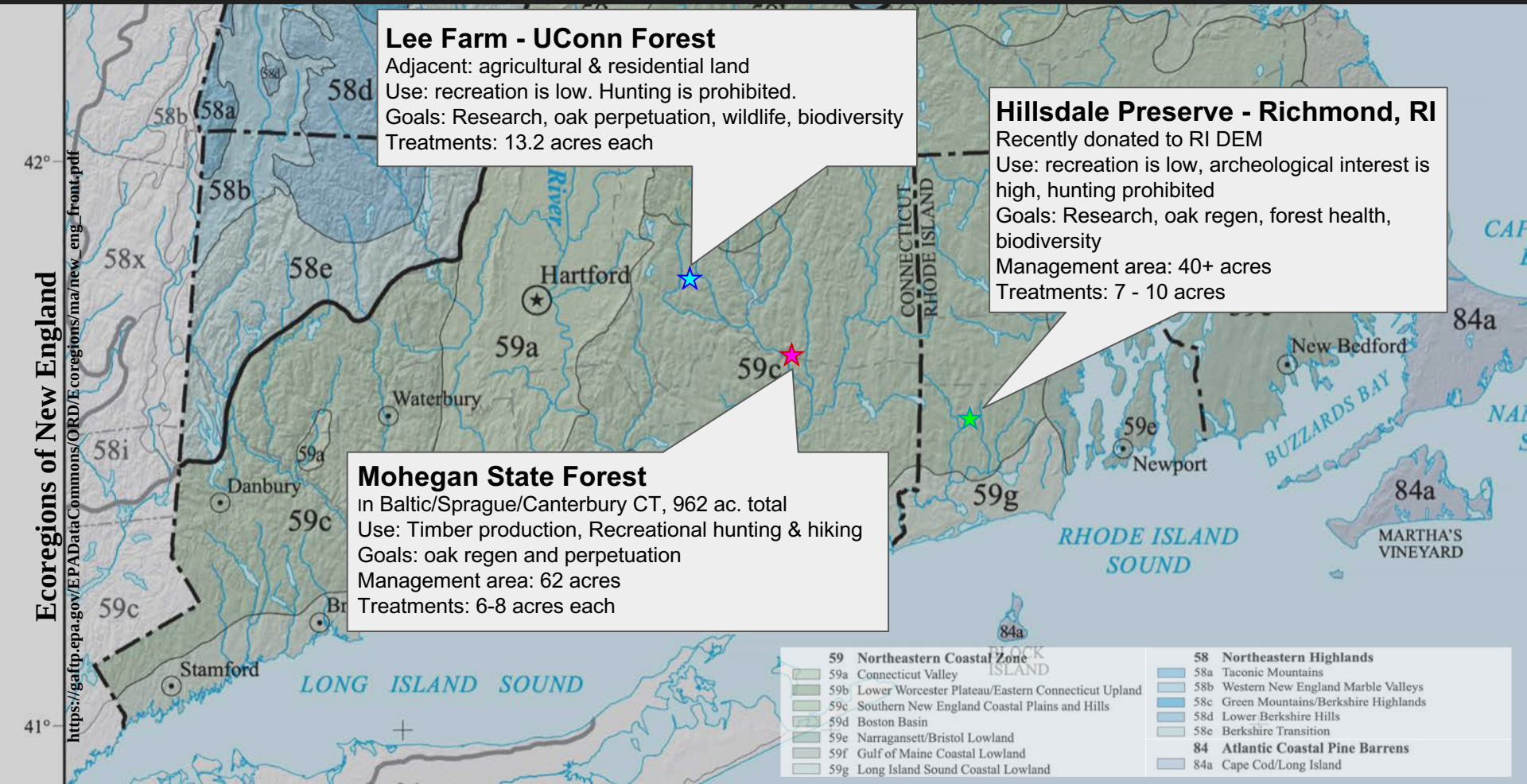
Southern New England Oak-Hickory site in Mohegan State Forest

For the workshop, we created a virtual tour of Mohegan State Forest, visit the Story Map @ https://arcg.is/050zbb

Or Scan this code with your smart device



Southern New England Oak-Hickory - 3 sites



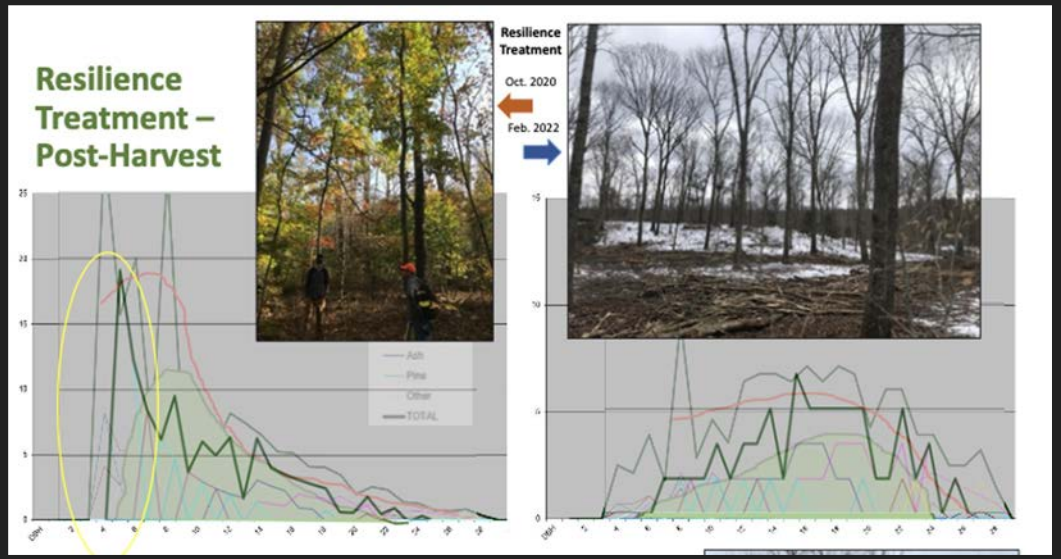
Lee Farm - UConn Forest
Adjacent: agricultural & residential land
Use: recreation is low. Hunting is prohibited.
Goals: Research, oak perpetuation, wildlife, biodiversity
Treatments: 13.2 acres each

Hillsdale Preserve - Richmond, RI
Recently donated to RI DEM
Use: recreation is low, archeological interest is high, hunting prohibited
Goals: Research, oak regen, forest health, biodiversity
Management area: 40+ acres
Treatments: 7 - 10 acres

Mohegan State Forest
In Baltic/Sprague/Canterbury CT, 962 ac. total
Use: Timber production, Recreational hunting & hiking
Goals: oak regen and perpetuation
Management area: 62 acres
Treatments: 6-8 acres each

Mohegan Site

- Workshop: Oct., 2020
- Pre-treatment Inventory: summer 2021
- Implementation: winter 2022
- Post-treatment Inventory: winter and summer 2022
- Tours: Summer 2022 and beyond!



Research on the workshop:

Investigation of proceedings using *Qualitative Content Analysis*

Seeking to answer 3 research questions

1) What are important considerations for implementing adaptive forestry practices in exurban forests?

1) What are feasible and effective silvicultural strategies to adapt exurban forests to climate change?

1) What are priorities and knowledge levels among exurban forest managers related to climate-adaptive management practices?

What are priorities and knowledge levels among exurban forest managers related to climate-adaptive management practices?

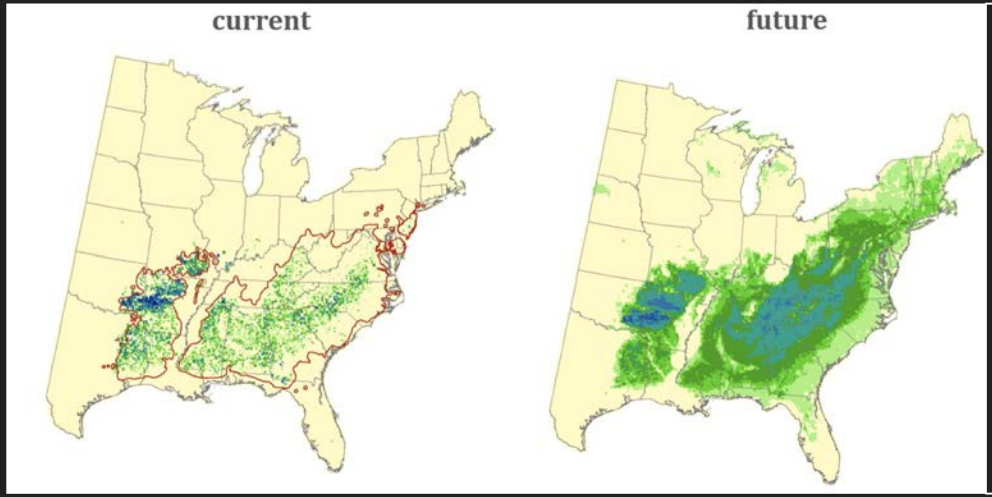
Priorities: So many! Multi-objective management.

Knowledge of climate change impacts on meeting management goals:

- Increased storm frequency/Intensity
  - Windthrow and flooding: threat to mature forests
  - Limits operations & challenges infrastructure
  - Lesser stocking targets to develop wind firmness
  - Upgrading infrastructure
- Increased frequency of drought
  - Impedes regeneration & threatens mature trees
  - Leaving shade behind for seedlings (irregular shelterwood & multiple entries)
  - Reduced stocking to reduce water stress & increase vigor

Knowledge of climate change impacts on meeting management goals:

- Shifting Ranges of tree species
  - Species-specific vulnerabilities
  - Future habitat suitability
  - Foster future adapted species, maybe using assisted migration?
    - Sourcing seedlings is tricky
  - Protect refuges for less-adaptable species and unique habitat
    - Topographically protected areas?



Climate Change Tree Atlas
https://www.fs.usda.gov/ccrc/tool/climate-change-tree-atlas

- Habitat suitability
- Distribution & Dispersal

- Several Models
- Several RCP Scenarios

Knowledge of climate change impacts on meeting management goals:

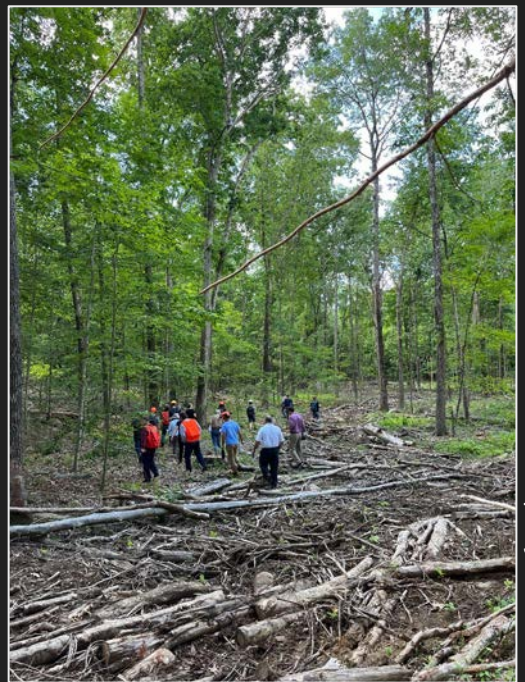
- Invasive plants
  - Respond well to climate change AND disturbance AND impede regeneration.
  - Vectored by recreation
  - Chemical and mechanical treatments before and after
  - Fast growing species to fill in canopy (Chestnut? American elm?)
- Pests and pathogens
  - HWA, EAB, Spongy moth, Oak wilt, Southern Pine Beetles, etc!
  - Compounding stressors
  - Lesser stocking targets to increase vigor
  - Insecticides
  - Biological controls
  - Salvage and sanitation cuts
- Fire
  - newly relevant to the region?
  - Maybe opportunities for controlled burning?

Knowledge of climate change impacts on meeting management goals:

- Carbon
  - a new priority, a feedback loop, and connected to public opinion
  - carbon/productivity objectives becoming prevalent
  - Balancing needs for carbon storage with regeneration (storage/sequestration)
- Loss of biodiversity
  - a feedback loop, both a result of change and a cause of it
  - Novel and compounding disturbances increase the threat
  - Biodiversity-focused objectives are prevalent
  - Irregular shelterwood for species and structural diversity
  - Old-growth characteristics
  - Pre-commercial tending
    - For regeneration, control of invasives and pests and pathogens
    - Expensive

Knowledge of climate change impacts on meeting management goals:

- Public Engagement
  - Public expectations mean challenges for planning & implementation
  - Protests
  - Maybe source of support?
  - Outreach and engagement



Tour with DEEP
June 2022

Knowledge of climate change impacts on meeting management goals:

- Uncertainty
  - Inherent in science, especially modeling the future
  - What don't we see coming? How bad will it be?
  - We have frameworks, research, but few examples of climate adaptive forestry
  - Embrace the non-traditional
  - Top strategy: Hedging Bets / insurance policies
    - introduction of novel species
    - fostering redundancy
    - increasing diversity in species and structure.

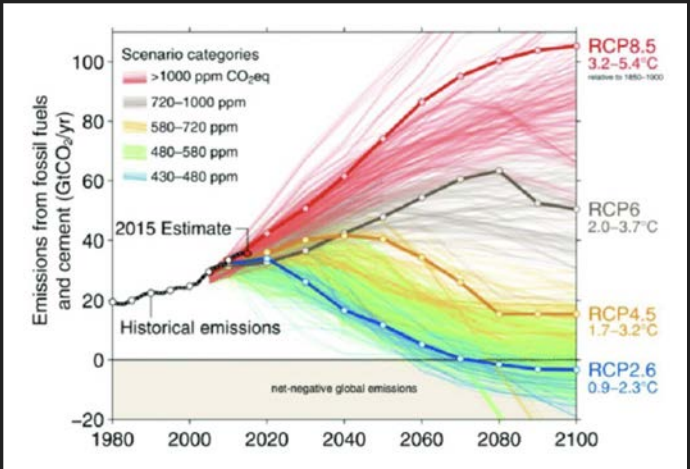


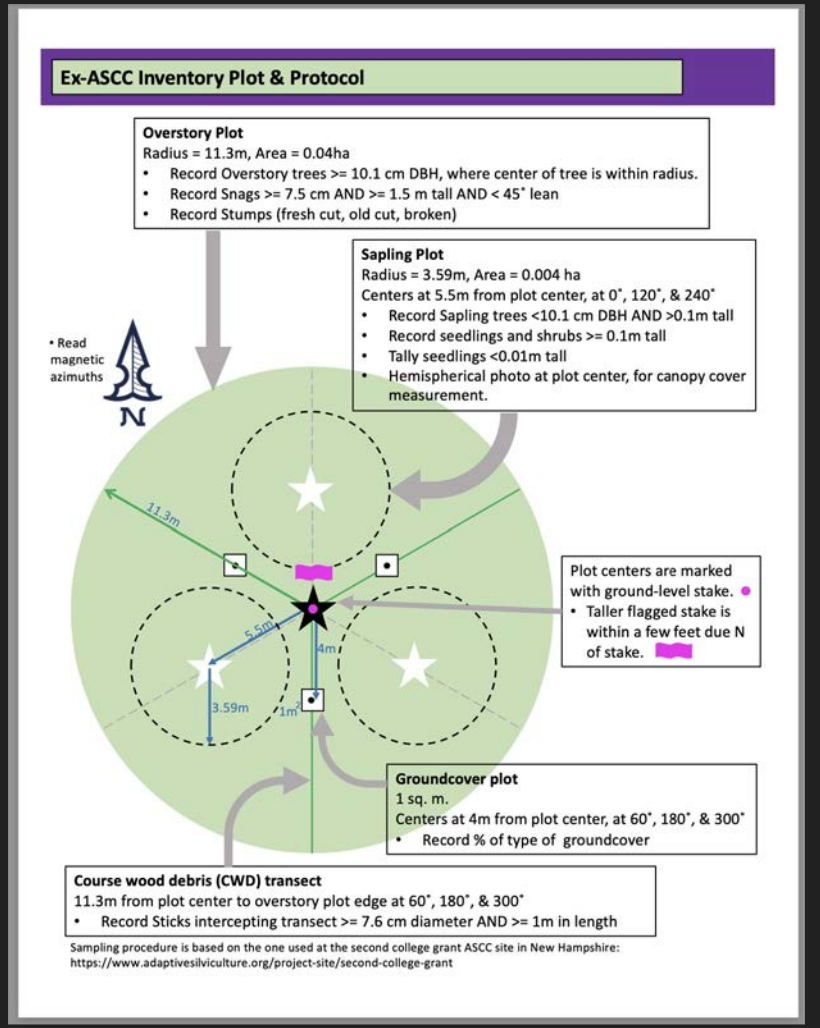
Image Credit: Neil Craik, University of Waterloo
https://climatenexus.org/climate-change-news/rcp-8-5-business-as-usual-or-a-worst-case-scenario/

The plans

Adaptive Strategy	Desired future conditions (goals) and plans derived from the workshop
Resistance	Fully-stocked stand density, deadwood, & current composition: oak and hickory dominance, shade tolerant species mixed in. Heterogeneity: unique habitats and varied structures Regeneration reflecting current species composition, reduced invasives & understory vegetation competing with desired tree seedlings
Resilience	Increased structural diversity, varied density & light conditions with small gaps (¼ - 2 acres) promoting spatial heterogeneity and multiple age classes Increased species diversity featuring species adapted to future climate conditions and increased climate variability (regeneration & planting) Reduced invasives & competing understory vegetation, potentially via controlled fire
Transition	Species composition: ak-hickory dominated, future-adapted species & genotypes with drought tolerance and wind firmness. Diverse canopy cover (including early successional) & gradient of light conditions with gaps of 2 acres with feathered edges. Oak-hickory regeneration & planted future-adapted species (chestnut, southern progeny oak), controlled invasives and competing understory vegetation.

Measuring Success

Metric	DFCs
Shannon Diversity Index	Heterogeneity/diversity in **species** and **structure**
Change in Stand density	Target stocking
Change in Canopy Cover	Regeneration
Seedling counts	Regeneration
Change in groundcover	Invasive species control, Regeneration
Seedling mortality and growth	Planting success



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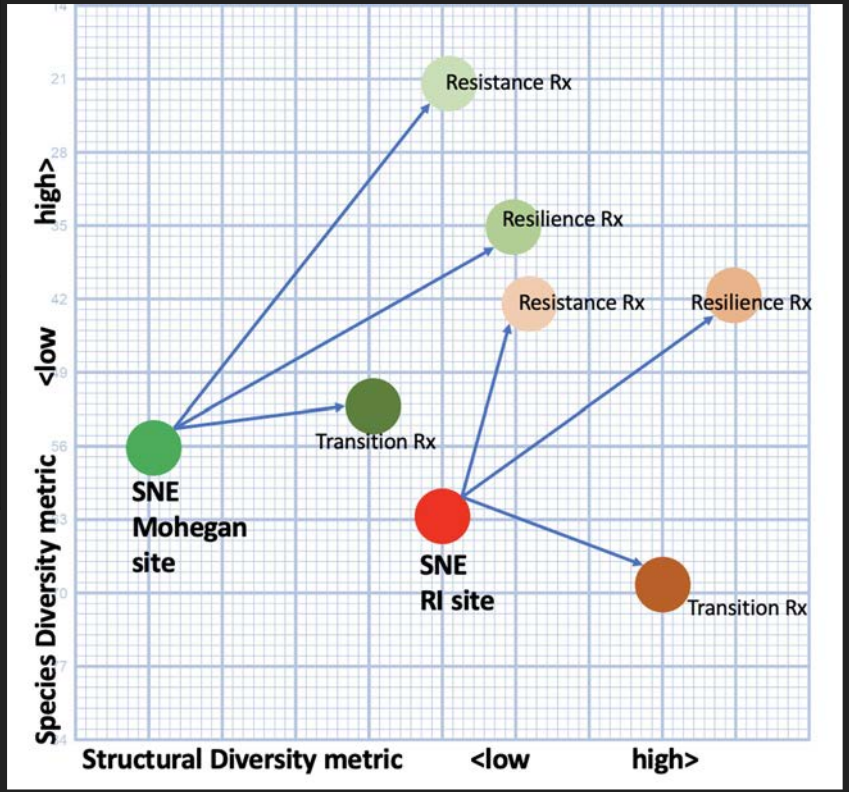
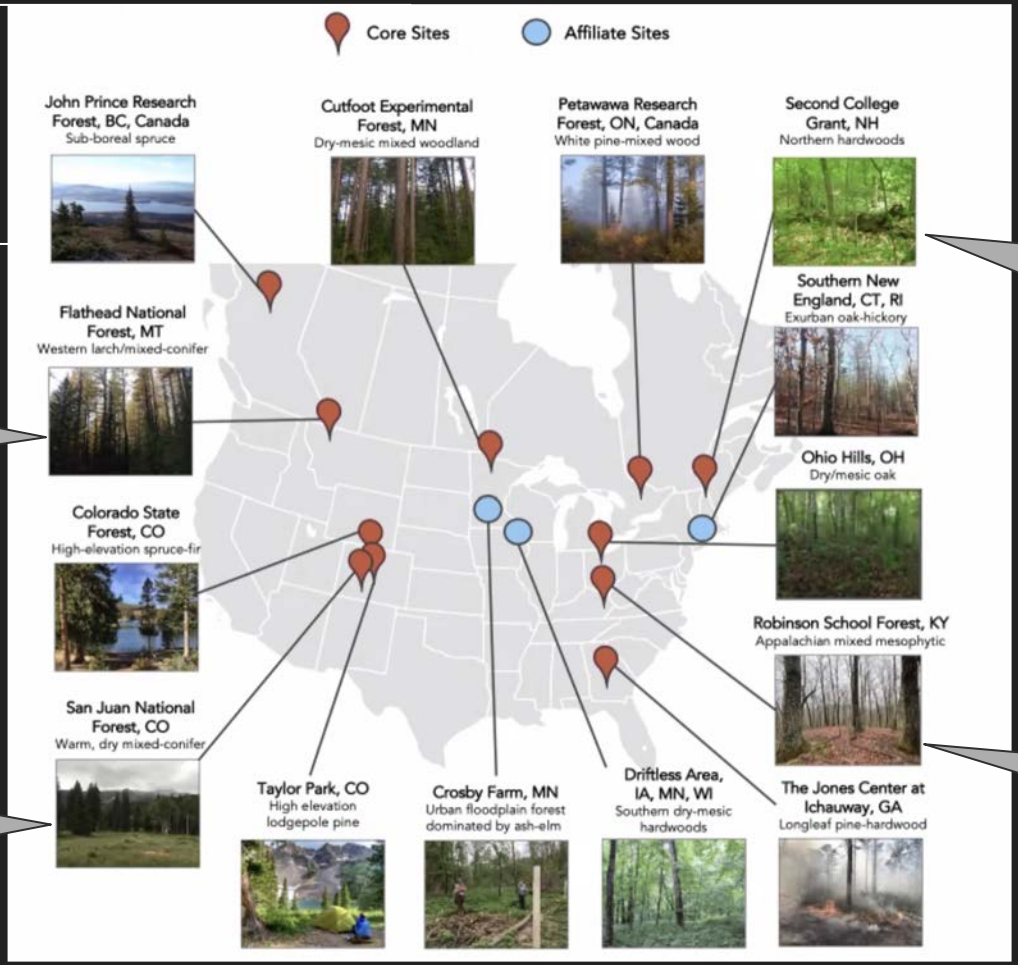


Fake graph ->
These are our intentions / expectations for diversity indices

Where we fit in the network

ASCC Network Site Locations as of 2023

Framework developed 2010/11
First site, Cutfoot, 2013



Measuring success: Diversity Indices

Resilience: group selection

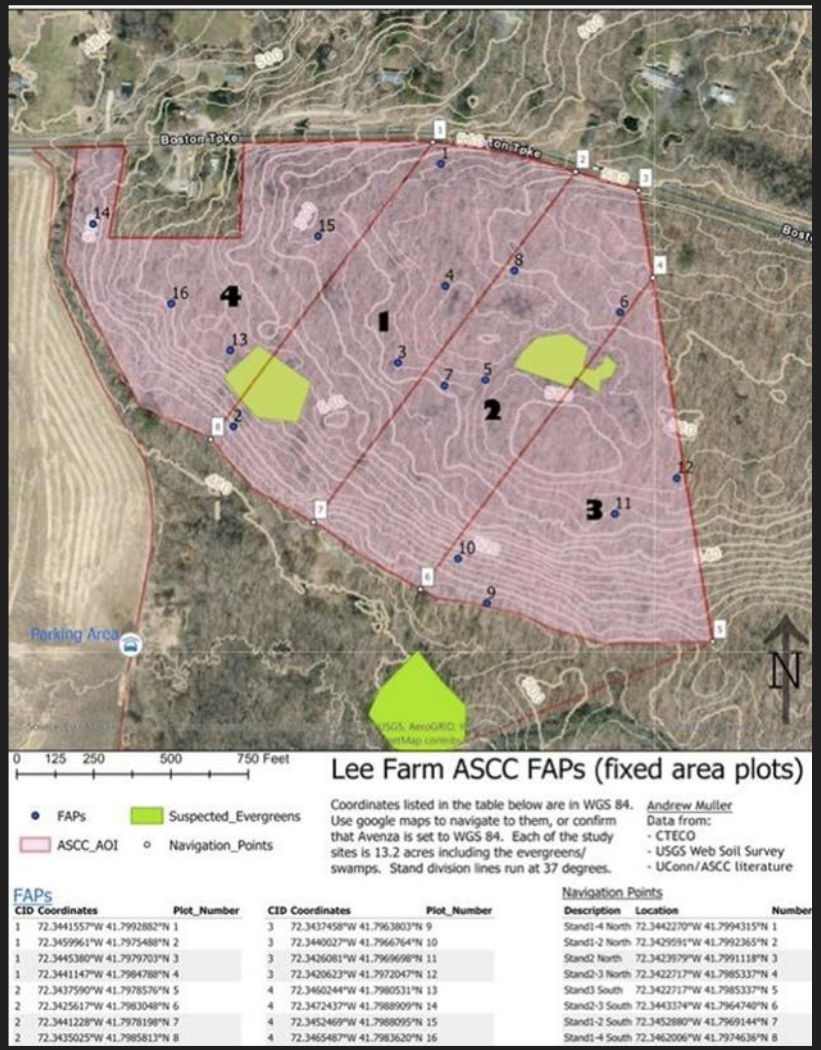
Transition: Patch Cuts

Resistance: Multi-entry shelterwood

Next Steps: Mini-workshop at Lee Farm

Pre-treatment inventory, summer 2022

Workshop planned for spring, 2023



0 125 250 500 750 Feet

FAPs
Suspected_Evergreens
ASCC_AOI
Navigation_Points

Lee Farm ASCC FAPs (fixed area plots)

Coordinates listed in the table below are in WGS 84. Use google maps to navigate to them, or confirm that Avenza is set to WGS 84. Each of the study sites is 13.2 acres including the evergreens/ swamps. Stand division lines run at 37 degrees.

Andrew Muller
Data from:
- CTECO
- USGS Web Soil Survey
- UConn/ASCC literature

FAPs

CID	Coordinates	Plot_Number
1	72.3441557°W 41.7992882°N	1
1	72.3459961°W 41.7975488°N	2
1	72.3445380°W 41.7979703°N	3
1	72.3441147°W 41.7984788°N	4
2	72.3437590°W 41.7978576°N	5
2	72.3425617°W 41.7983048°N	6
2	72.3441228°W 41.7978198°N	7
2	72.3435025°W 41.7985813°N	8

CID	Coordinates	Plot_Number
3	72.3437458°W 41.7963803°N	9
3	72.3440027°W 41.7966764°N	10
3	72.3426081°W 41.7969698°N	11
3	72.3420623°W 41.7972047°N	12
4	72.3460244°W 41.7980531°N	13
4	72.3472437°W 41.7988909°N	14
4	72.3452469°W 41.7988095°N	15
4	72.3465487°W 41.7983620°N	16

Navigation Points

Description	Location	Number
Stand1-4 North	72.3442270°W 41.7994315°N	1
Stand1-2 North	72.3429591°W 41.7992365°N	2
Stand2 North	72.3423979°W 41.7991118°N	3
Stand2-3 North	72.3422717°W 41.7985337°N	4
Stand3 South	72.3422717°W 41.7985337°N	5
Stand2-3 South	72.3443374°W 41.7964740°N	6
Stand1-2 South	72.3452880°W 41.7969144°N	7
Stand1-4 South	72.3462006°W 41.7974636°N	8

Next Steps: Implementation in Rhode Island

Workshop: April 2022
Pre-treatment inventory, summer 2022
Implementation, late summer 2023

Next Steps: Planting & Monitoring at Mohegan

UConn Forest Crew making deer-resistant cones for seedlings

Oak seedlings flagged under a “slash carpet”

Thank you!

Please don't hesitate to contact me with any questions!

Amanda Bunce
amanda.bunce@uconn.edu

The crew (plus Trixie) measuring in the transition area, post-treatment in Mohegan, Feb. 2022

Oak Seedlings at Mohegan, June 2022