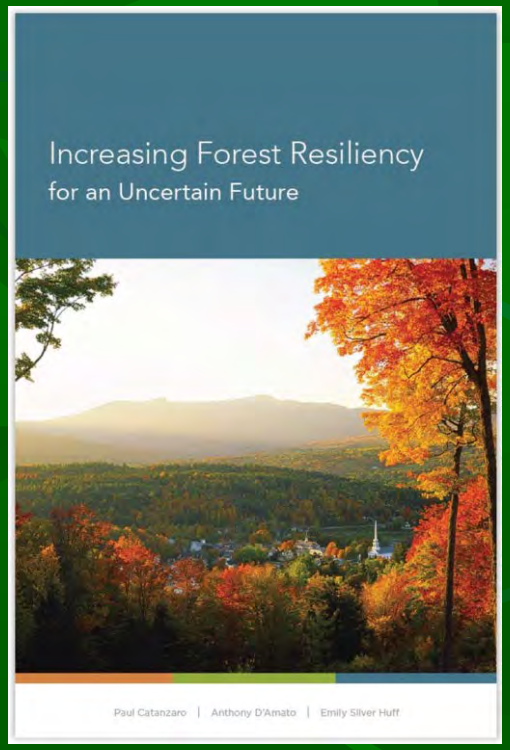
Increasing Forest Resiliency for an Uncertain Future



Paul Catanzaro – University of Massachusetts
Tony D'Amato – University of Vermont
Emily Silver Huff – Michigan State University

Past Forest Challenges

Chestnut trees

1938 Hurricane

Past land use history

Inherent Forest Resilience

- Will the future species composition and structure of our forests continue to provide the benefits we want/need?

Current Forest Stressors

Increasing in number and frequency

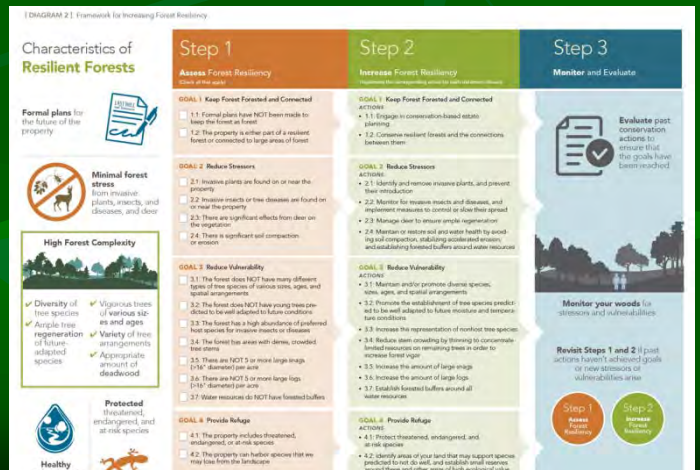
- Forest Conversion
- Invasive Plants
- Invasive Insects & Disease
- Deer Browse
- Climate Change

Stressor Interactions

- Stressors don't act in isolation, increasing their negative impact.
  - Early growing season > CO2 fertilization > more frequent, more intense storms = favor invasive plants
  - Deer preferentially browse native plants = favor invasive plants
  - Increased temps. = don't keep diseases/insects in check
  - Drought = predisposes trees to insects disease

Important to Address Stressors in an Integrated Way

- There are excellent resources that address most of these stressors individually.
- However, there is no framework to address them in an integrated way.
- Help critical decision makers increase forest resiliency in a way that is specific to their forest and mindful of their time energy and resources



Characteristics of Resilient Forests

Formal Plans for the Future of the Property

- Formal plans to pass the land on in order to maintain the greatest amount of forest cover and the biggest parcel as possible.

Minimal Forest Stress

- Each landscape has a unique combination of stressors and exposure to them

High Forest Complexity

At the Forest Scale

High Forest Complexity

- ✔ Diversity of tree species
- ✔ Ample tree regeneration of future-adapted species
- ✔ Vigorous trees of various sizes and ages
- ✔ Variety of tree arrangements
- ✔ Appropriate amount of deadwood

High Forest Complexity - Species

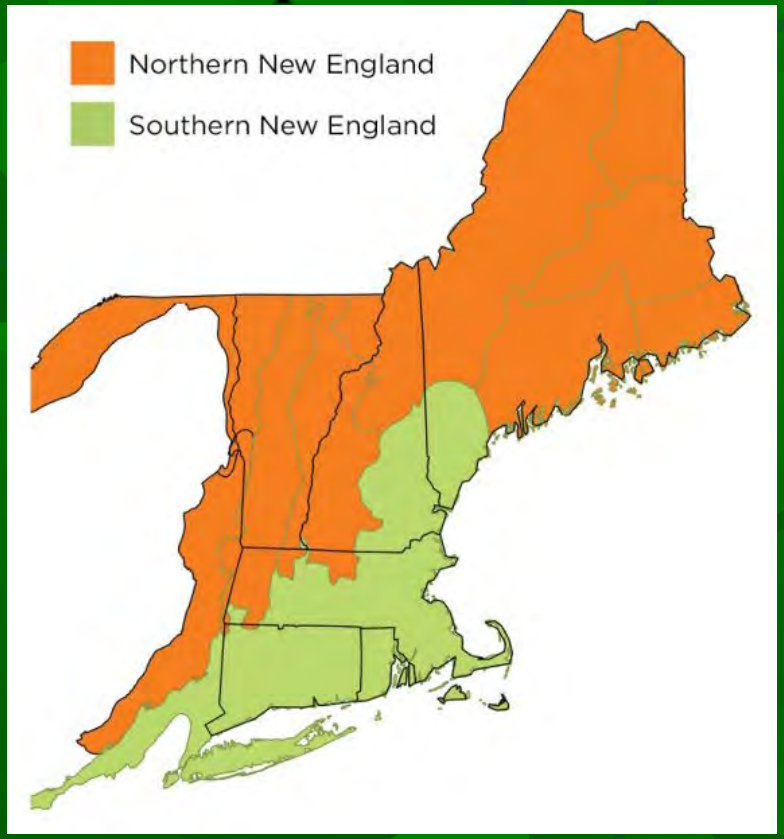
Predicted Change in Suitable Tree Species Habitat

[TABLE 1] Predicted Change in Suitable Habitat

The following table provides tree species and predictions of how competitive they will be in the future. The values following each species name indicate whether species-suitable habitats will increase (+), decrease (−), or stay the same (•) under projected climate change.

Northern New England (Ecological subsections M211A, B, C, and D, and M211E and J)			Southern New England (Ecological subsection M221A)		
Tree Species	Low Emissions (PCM B1)	High Emissions (GFDL A1FI)	Tree Species	Low Emissions (PCM B1)	High Emissions (GFDL A1FI)
Balsam Fir	−	−	Balsam Fir	−	−
Black Spruce	−	−	Black Spruce	−	−
Northern White Cedar	−	−	Eastern White Pine	−	−
Paper Birch	−	−	Northern White Cedar	−	−
Red Spruce	−	−	Paper Birch	−	−
Tamarack	−	−	Quaking Aspen	−	−
White Spruce	−	−	Red Spruce	−	−
			White Spruce	−	−
American Beech	•	−			
Quaking Aspen	•	−	Tamarack	−	•
Sugar Maple	•	−			
Yellow Birch	•	−	American Beech	•	−
			Northern Red Oak	•	−
Bear/Scrub Oak	•	•	Red Maple	•	−
Bigtooth Aspen	•	•	Yellow Birch	•	−
Eastern White Pine	•	•			
Red Maple	•	•	Bear/Scrub Oak	•	•
			Black Cherry	•	•
American Basswood	•	+	Sugar Maple	•	•
Bitternut Hickory	•	+			
Black Cherry	•	+	Bigtooth Aspen	+	•
			Pitch Pine	+	•
Pitch Pine	+	•			
			American Basswood	•	+
Black Birch	+	+			
Black Oak	+	+	Bitternut Hickory	+	+
Chestnut Oak	+	+	Black Oak	+	+
Northern Red Oak	+	+	Chestnut Oak	+	+
Shagbark Hickory	+	+	Shagbark Hickory	+	+
White Oak	+	+	White Oak	+	+
Threatened by Current Forest Health Issues (Do not target)			**Threatened by Current Forest Health Issues (Do not target)**		
Black Ash	−	−	Black Ash	−	−
Eastern Hemlock	•	•	Eastern Hemlock	•	•
White Ash	•	•	White Ash	•	•

Projected change in suitable habitat in the year 2100 based on Tree Atlas projections for a given ecological subsection. Prasad, A. M., L. R. Iverson, S. Matthews, M. Peters. 2007–ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. www.nrs.fs.fed.us/atlas/tree. Northern Research Station, USDA Forest Service, Delaware, Ohio.



High Forest Complexity - Structure

- Elements of a forest ecosystem and their spatial distribution (e.g., big trees, little trees, deadwood, understory plants)

High Forest Complexity

Simple Forest Example

High Forest Complexity

Complex Forest Examples

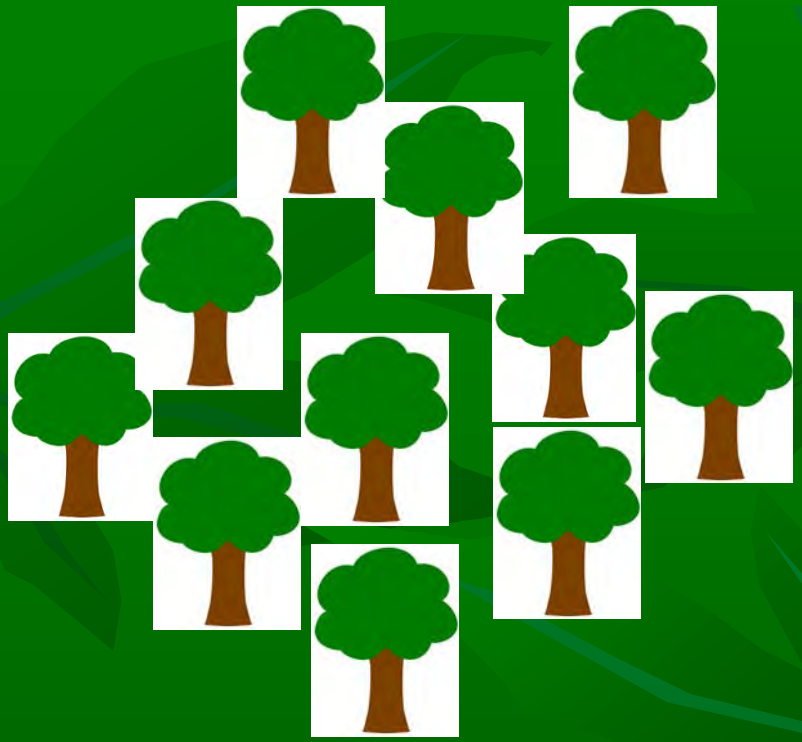


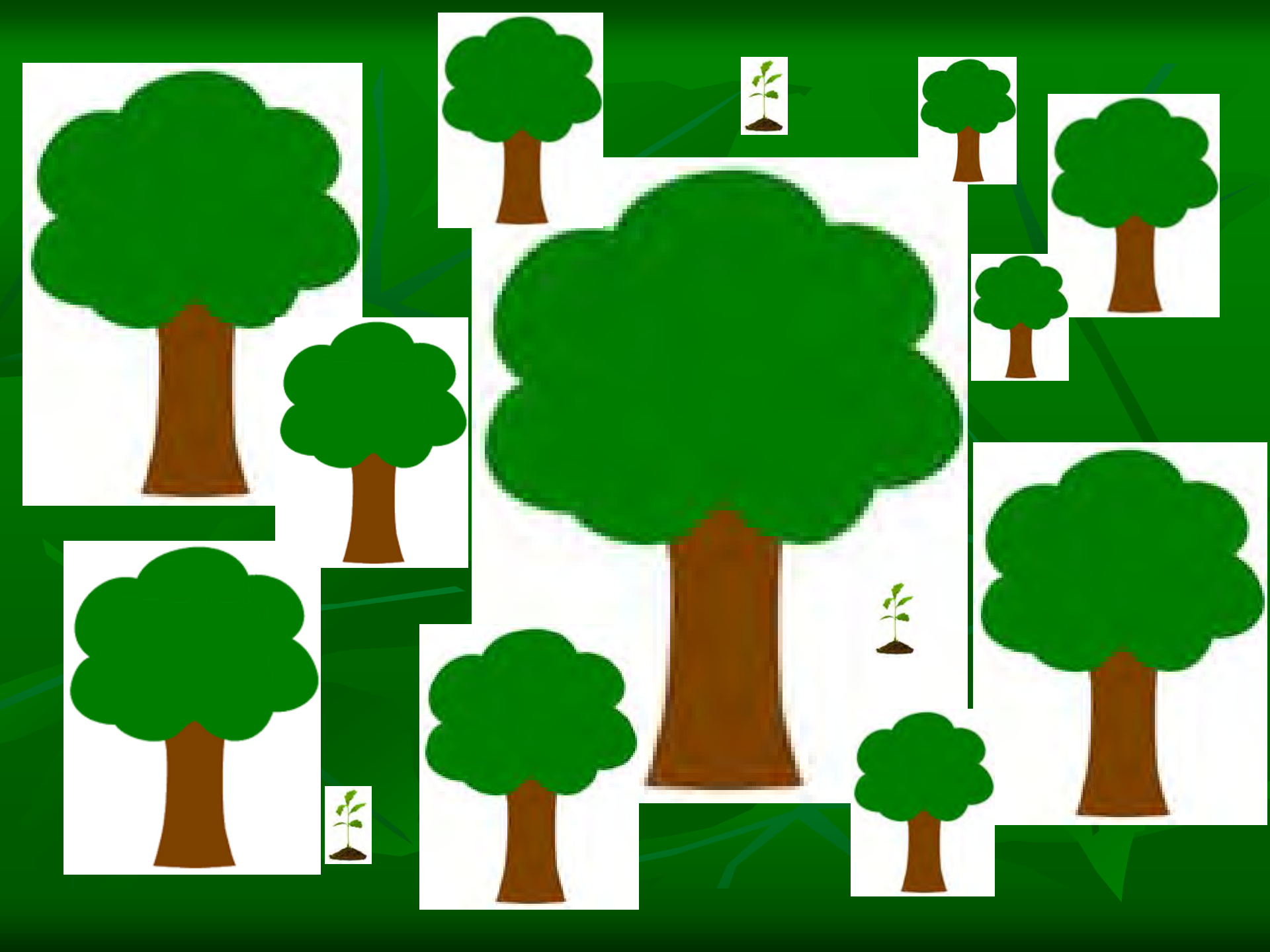












High Forest Complexity

- The components of the forest and their spatial arrangement matters !!!!

Healthy Soil and Water

- Soils with ample organic matter that is not compacted or eroding
- Forested buffers around resource areas

Protection for T&E and At-risk Species

- This includes, providing refuge for species predicted to be less competitive (e.g., red spruce).

Characteristics Resilient Forests

Landscape Scale

- Low conversion rates
- Large continuous areas of connected forest
- Diverse soil and growing conditions

Goals of Forest Resiliency

- Goal 1: Keep forest forested and connected
- Goal 2: Reduce stressors
- Goal 3: Reduce Vulnerability
- Goal 4: Provide Refuge

Gradient of Forest Resiliency

Where does your forest fall on the gradient of forest resiliency?

Which characteristics make it resilient?

Which characteristics make it vulnerable

Framework for Increasing Forest Resiliency

Step 1

Assess Forest Resiliency

Goal 1: Keep Forest Forested and Connected

Yes (Resiliency)	No (Vulnerability)	Don't Know (Need More Info)	
☐	☐	☐	1.1: Conservation-based estate planning has been implemented to ensure the continuation of this land as forest into the future.
☐	☐	☐	1.2: The property is part of a resilient forest or serves as a connection between large areas of forest (>250 acres in southern New England, >500 acres in northern New England).

Goal 2: Reduce Stressors

Yes (Resiliency)	No (Vulnerability)	Don't Know (Need More Info)	
☐	☐	☐	2.1: Invasive plants are NOT found on or near the property.
☐	☐	☐	2.2: Invasive insects and tree diseases are NOT found on or near the property.
☐	☐	☐	2.3: There are NO signs of significant deer impacts or an increasing deer population.
☐	☐	☐	2.4: The soils are NOT compacted or exhibiting evidence of significant erosion.

Framework for Increasing Forest Resiliency

Step 1

Assess Forest Resiliency Continued

Goal 3: Reduce Vulnerability

Yes (Resiliency)	No (Vulnerability)	Don't Know (Need More Info)	
☐	☐	☐	3.1: The forest has a diverse amount of species of various sizes, ages, and spatial arrangements.
☐	☐	☐	3.2: The forest is largely dominated by species predicted to be well adapted to future conditions.
☐	☐	☐	3.3: The forest contains a low abundance of preferred host species for invasive insects or diseases threatening the area (e.g., white ash: host of the emerald ash borer; eastern hemlock: host of the hemlock woolly adelgid; and red and sugar maple: host of the Asian long-horned beetle).
☐	☐	☐	3.4: There are NO areas of the forest with dense, crowded tree stems.
☐	☐	☐	3.5: There are 5 or more large snags (>16" diameter) per acre.
☐	☐	☐	3.6: There are 5 or more large logs (>16" diameter) per acre.
☐	☐	☐	3.7: Water resources have forested buffers.

Goal 4: Provide Refuge

Yes (Resiliency)	No (Vulnerability)	Don't Know (Need More Info)	
☐	☐	☐	4.1: The property is habitat for threatened, endangered, or at-risk species.
☐	☐	☐	4.2: The property can harbor species that we may lose from the landscape.

Step 2

Increase Forest Resiliency

- Step 1 gives you an understanding of the characteristics of your forest that make it resilient and those that make it vulnerable.
- Monitor those characteristics that make it resilient.
- Take action to reduce vulnerability and increase resiliency.

Critical Roles to Increasing Forest Resiliency

- Family forest owners dominate the landscape
- Many communities own land
- Increasing amounts of land trust owned land
- Foresters work with all of them!

Goal 3: Reduce Vulnerability

Goal 3: Reduce Vulnerability

3.1 Action: Promote diverse species of various sizes, ages and spatial arrangements.

Establish or maintain at least two age classes of trees by regenerating portions of your forest. Create gaps in the canopy to let sunlight reach the forest floor. The canopy gap size will depend on which species you are trying to regenerate. For example, sun-loving early-successional species need large gaps (>1/2 acre), whereas shade-tolerant late-successional species need gaps created by felling a single mature canopy tree.

Convert plantations to mixed woods with native tree species that are well adapted to the site.

Silviculture provides the opportunity to change forest structure and species composition.

Prioritizing Actions

- Maintain forest as forest
- Let resources, interests, and landowner goals guide actions
- Even single actions add up across the landscape!

Step 3

Monitor and Evaluate

- Forests are dynamic and constantly changing
- Stressors continue to advance and evolve
- Evaluate past stewardship actions to verify it was successful
- Great opportunity to engage neighbors and citizen scientists!

Framework for Increasing Forest Resiliency

[DIAGRAM 2] Framework for Increasing Forest Resiliency

Characteristics of Resilient Forests

Formal plans for the future of the property

Minimal forest stress from invasive plants, insects, and diseases, and deer

High Forest Complexity

- ✔ **Diversity** of tree species
- ✔ Ample tree **regeneration** of future-adapted species
- ✔ Vigorous trees of **various sizes and ages**
- ✔ **Variety** of tree arrangements
- ✔ Appropriate amount of **deadwood**

Healthy soil and water

Protected threatened, endangered, and at-risk species

Step 1

Assess Forest Resiliency

(Check all that apply)

GOAL 1 Keep Forest Forested and Connected

- ☐ 1.1: Formal plans have NOT been made to keep the forest as forest
- ☐ 1.2: The property is either part of a resilient forest or connected to large areas of forest

GOAL 2 Reduce Stressors

- ☐ 2.1: Invasive plants are found on or near the property
- ☐ 2.2: Invasive insects or tree diseases are found on or near the property
- ☐ 2.3: There are significant effects from deer on the vegetation
- ☐ 2.4: There is significant soil compaction or erosion

GOAL 3 Reduce Vulnerability

- ☐ 3.1: The forest does NOT have many different types of tree species of various sizes, ages, and spatial arrangements
- ☐ 3.2: The forest does NOT have young trees predicted to be well adapted to future conditions
- ☐ 3.3: The forest has a high abundance of preferred host species for invasive insects or diseases
- ☐ 3.4: The forest has areas with dense, crowded tree stems
- ☐ 3.5: There are NOT 5 or more large snags (>16" diameter) per acre
- ☐ 3.6: There are NOT 5 or more large logs (>16" diameter) per acre
- ☐ 3.7: Water resources do NOT have forested buffers

GOAL 4 Provide Refuge

- ☐ 4.1: The property includes threatened, endangered, or at-risk species
- ☐ 4.2: The property can harbor species that we may lose from the landscape

Step 2

Increase Forest Resiliency

(Implement the corresponding action for each statement chosen)

GOAL 1 Keep Forest Forested and Connected

ACTIONS

- 1.1: Engage in conservation-based estate planning
- 1.2: Conserve resilient forests and the connections between them

GOAL 2 Reduce Stressors

ACTIONS

- 2.1: Identify and remove invasive plants, and prevent their introduction
- 2.2: Monitor for invasive insects and diseases, and implement measures to control or slow their spread
- 2.3: Manage deer to ensure ample regeneration
- 2.4: Maintain or restore soil and water health by avoiding soil compaction, stabilizing accelerated erosion, and establishing forested buffers around water resources

GOAL 3 Reduce Vulnerability

ACTIONS

- 3.1: Maintain and/or promote diverse species, sizes, ages, and spatial arrangements
- 3.2: Promote the establishment of tree species predicted to be well adapted to future moisture and temperature conditions
- 3.3: Increase the representation of nonhost tree species
- 3.4: Reduce stem crowding by thinning to concentrate limited resources on remaining trees in order to increase forest vigor
- 3.5: Increase the amount of large snags
- 3.6: Increase the amount of large logs
- 3.7: Establish forested buffers around all water resources

GOAL 4 Provide Refuge

ACTIONS

- 4.1: Protect threatened, endangered, and at-risk species
- 4.2: Identify areas of your land that may support species predicted to not do well, and establish small reserves around these and other areas of high ecological value

Step 3

Monitor and Evaluate

Evaluate past conservation actions to ensure that the goals have been reached

Monitor your woods for stressors and vulnerabilities

Revisit Steps 1 and 2 if past actions haven't achieved goals or new stressors or vulnerabilities arise

Step 1 Assess Forest Resiliency

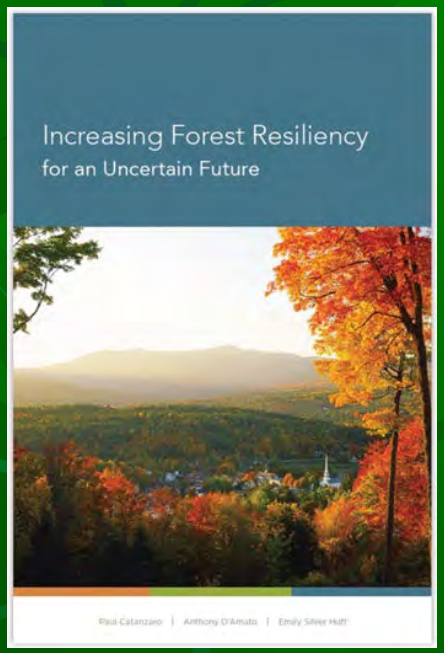
Step 2 Increase Forest Resiliency

Conclusions

- We must address our stressors in an integrated way
- Forest resiliency is a gradient
- Increasing a forest's resiliency leaves ample room for unique landowner goals.

Thank You

- To request copies: paulcat@umass.edu or download the PDF at www.MassWoods.net



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USDA

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NE CSC Northeast Climate Science Center

NIACS Northern Institute of Applied Climate Science