Vulnerability Assessment for Critical Natural Resources in Northwestern Connecticut

Courtney McCann & Nicole Cretella

About Us

Source: https://today.uconn.edu/wp-content/uploads/2023/10/Fall_scenic_xxxxxx-1024x682.jpg

Courtney McCann

- From: New Jersey
- Major: Environmental Science
- Concentration: Global Change
- Year: Junior

Nicole Cretella

- From: Rhode Island
- Major: Environmental Science
- Concentration: Sustainable Systems
- Year: Junior

Current students at the University of Connecticut
This project was introduced to us through a course we took last semester called Climate Resilience and Adaptation

UConn Climate Corps Program

Climate Corps is an academic program at UConn focused on service learning and workforce development related to climate change adaptation at the local, community level.

The program includes:
- One-semester lecture course
- One-semester hands-on practicum semester where each student is paired with a local community partner

For more information, visit https://climate.uconn.edu/climate-corps/ or email renata.bertotti@uconn.edu and owen.placido@uconn.edu

Scope of the Project

Critical Habitat Identification

Addressing the types of critical habitats in Norfolk and their location

1

2

Invasive Plants

Researching invasive plant species present in Norfolk, Connecticut

3

Drawing connections between critical habitat traits and the conditions invasive species thrive in

Making Predictions

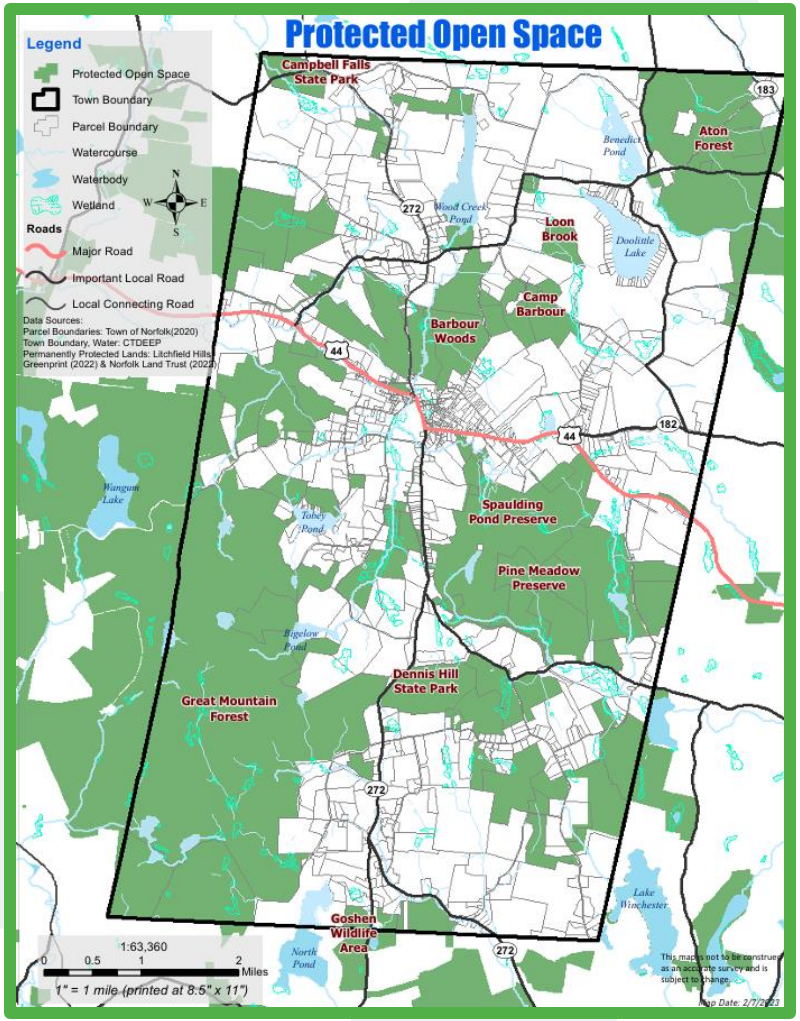
4

Analyzing the best management practices to remove invasive plants or prevent their spread

Management Strategies

Critical Habitats

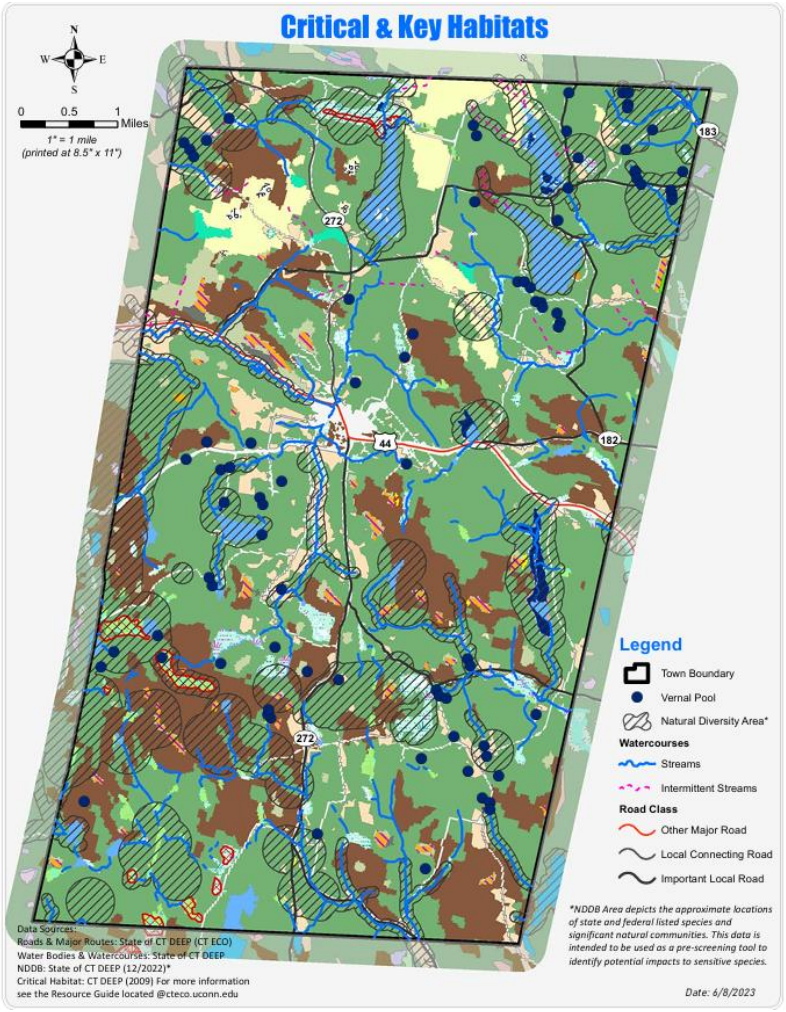
Identifying Norfolk's Critical Habitats



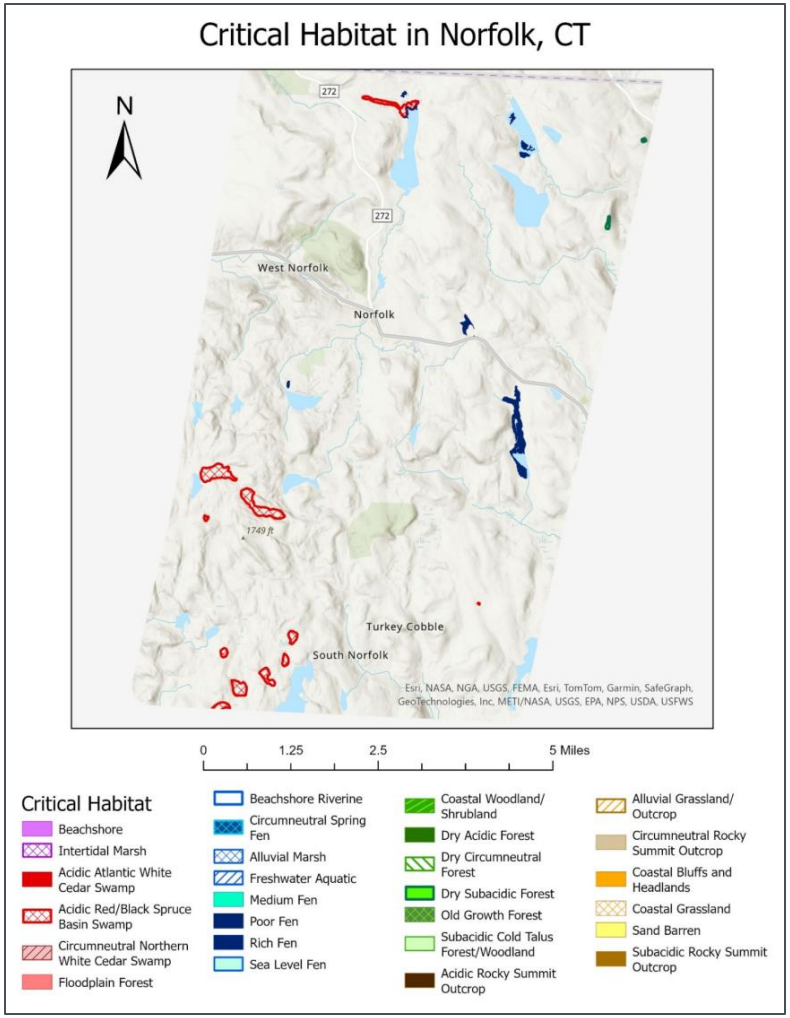
Pg. 52 of NRI

Protected Open Space

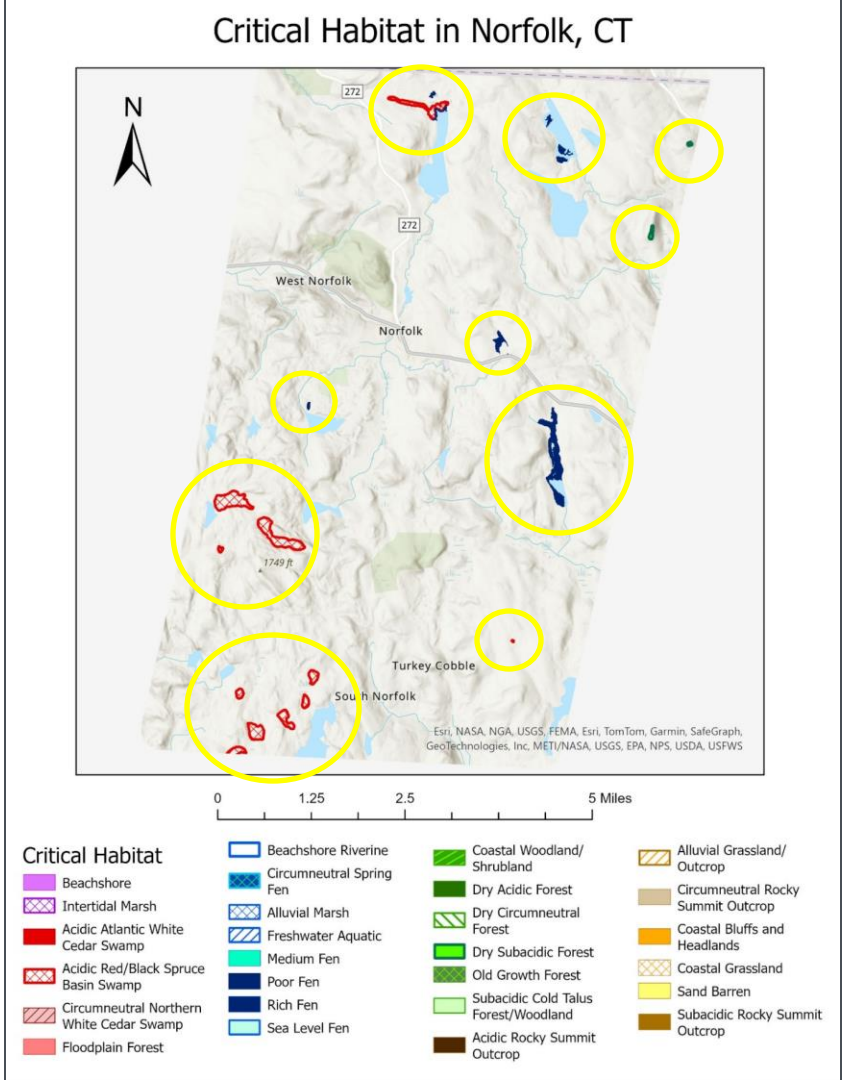
- Norfolk is considered one of the most beautiful areas in CT
- Biological & ecological diversity
- Protected Open Space
  - Land that is bound by legal easement
  - Significantly adds to and preserves the character of the community
  - Protects water quality
  - Conserves important natural resources
- Organizations that hold easements and are responsible for their enforcement: federal government, state of CT, Aton Forest Incorporated, Great Mountain Forest Corporation, Housatonic Valley Association, & the Norfolk Land Trust



Source: NRI, Pg. 44; https://norfolkct.org/wp-content/uploads/2023/04/NRI_2025_Final-2025_Web-View.pdf - Map created by: Stacy Deming, GISP Housatonic Valley Association



Map created by: Nicole Cretella, sourced from Stacy Demin's GIS data provided to us



Poor Fen

Holleran Swamp
Benedict Pond
Pond Hill Pond
Beckley Bog
Tobey Pond

Acidic Red/Black Spruce Basin Swamp

Holleran Swamp
Great Mountain Forest
Lake Winchester Brook Swamp
Wildcat Swamp

Dry Sub-acidic Forest

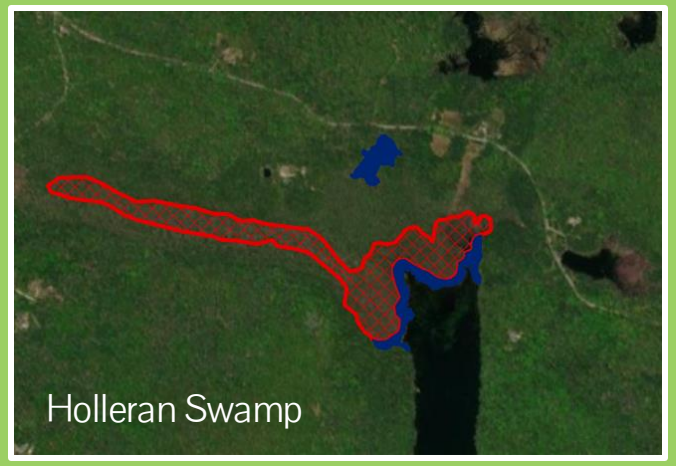
Aton Forest
Knapp Hill
Bald Mountain

Poor Fen

"Natural peatlands (bogs) occupying topographically defined basins; influenced by acidic ground water; on deep, poorly decomposed peats; dominated by sedges and/or shrubs. Subtypes include sedge, shrub thicket, and other/unique."

CT_ECO_Resource_Guide_Critical_Habitat.pdf

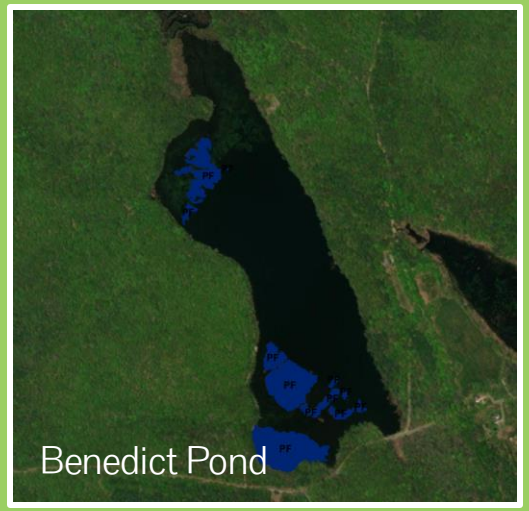
Beckley Bog: https://www.greenwichfilm.org/wp-content/uploads/2020/04/Nature-Conservancy-Blog-4-Beckley-Bog-Preserve-Norfolk-@TNC-scaled.jpg


Holleran Swamp


PF
PF
Tobey Pond Bog


Beckley Bog

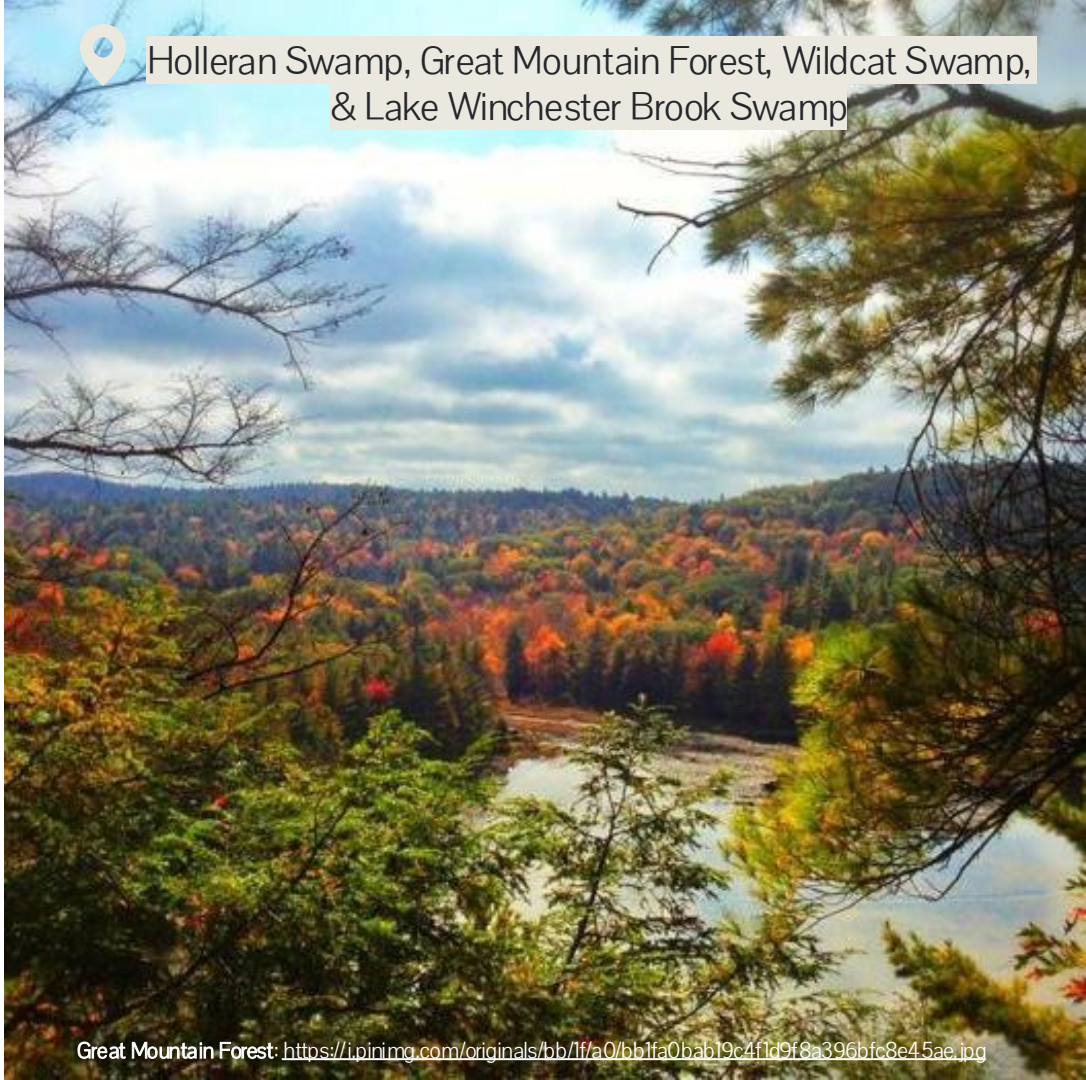

PF
Pond Hill Pond


Benedict Pond

Acidic Red/Black Spruce Basin Swamp

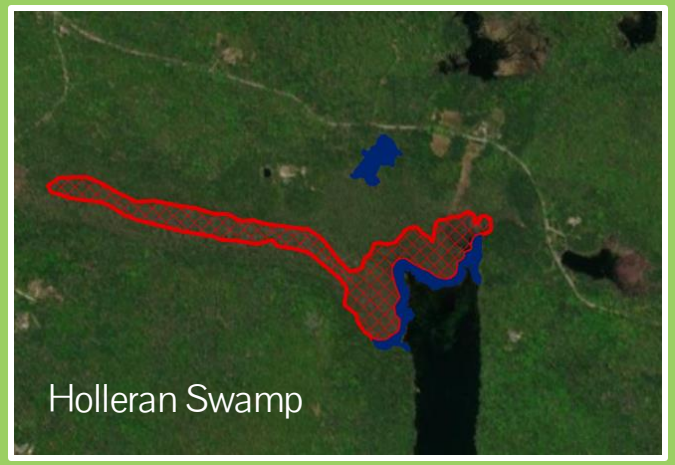
"Evergreen forested and/or shrub swamps dominated by red and/or black spruce with stagnant or slow-moving water; in topographically defined basins; on decomposed peats and mucks."

CT_ECO_Resource_Guide_Critical_Habitat.pdf



Great Mountain Forest: https://i.pinimg.com/originals/bb/1f/a0/bb1fa0bab19c4f1d9f8a396bfc8e45ae.jpg


Lake Winchester
Brook Swamp
ACR/BSS

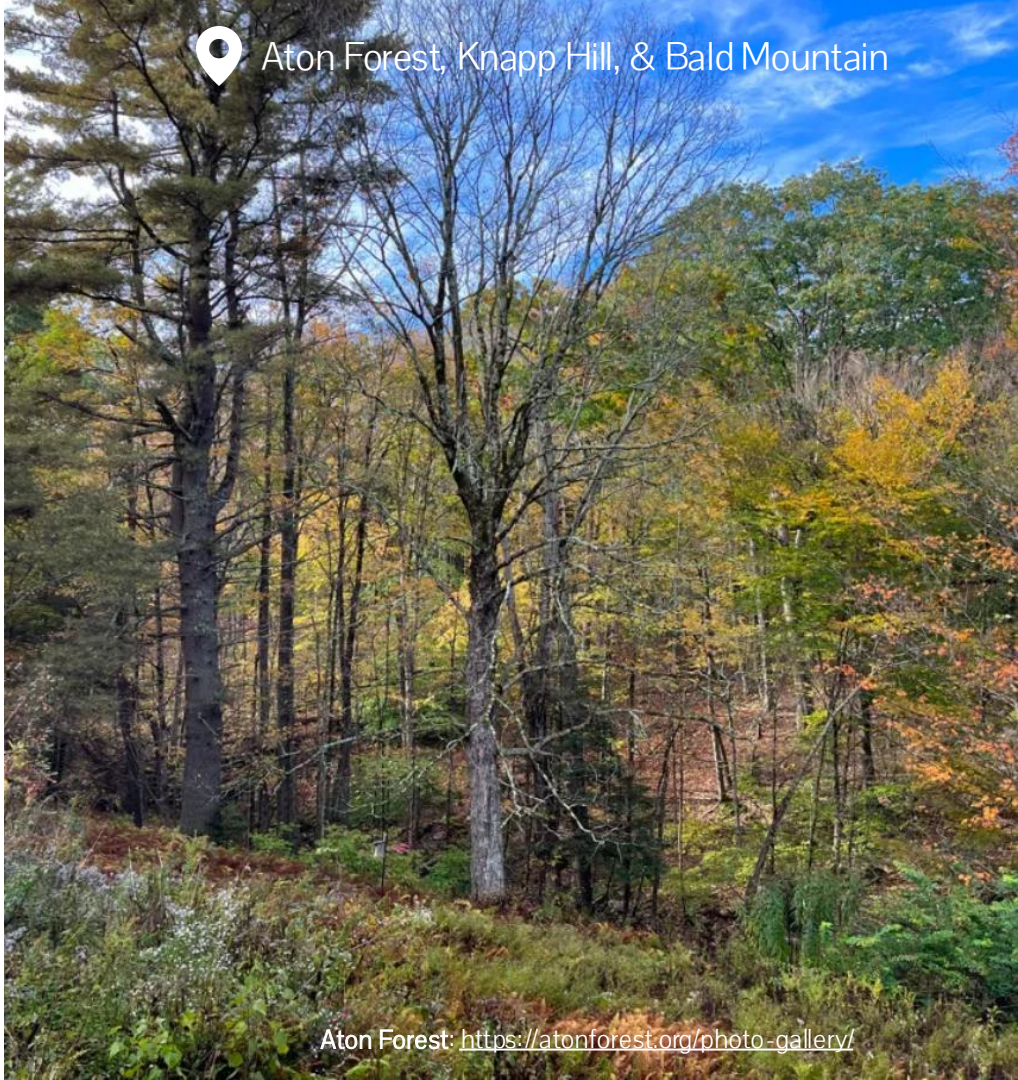

Holleran Swamp

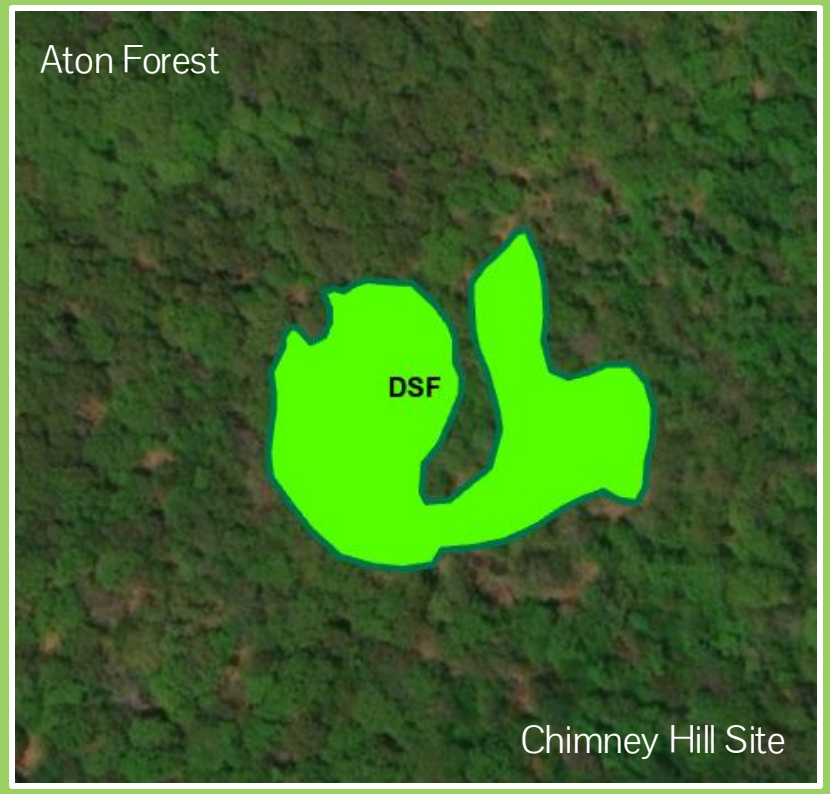

Great Mountain Forest
Wildcat Swamp

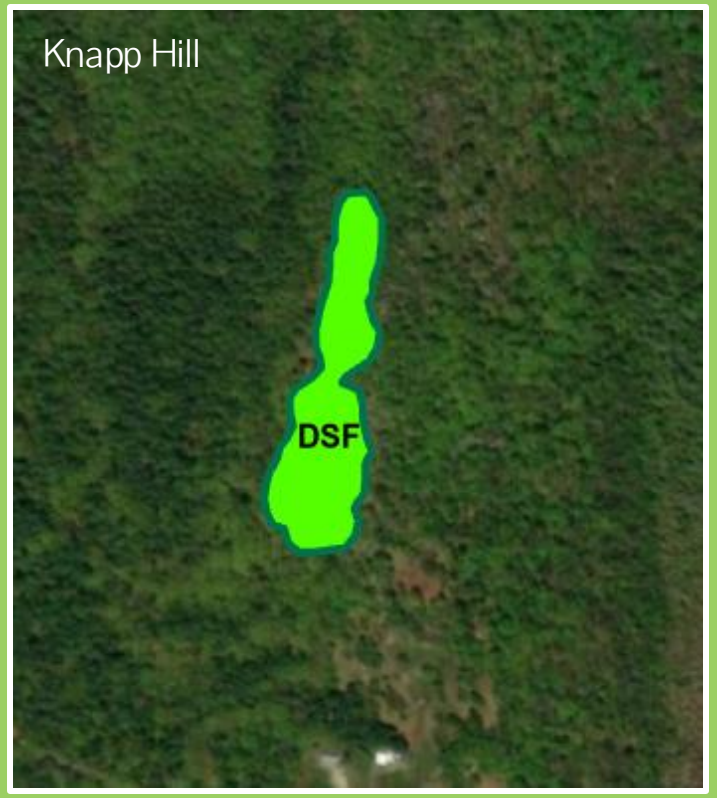
Dry Sub-Acidic Forest

"Slow-growing forests, primarily on or near the summit of basalt or other mafic rocks; often dominated by white ash, hickories and hophornbeam, with few shrubs and an open grassy ground cover. Subtypes include ash/hickory woodland and other/unique."

CT_ECO_Resource_Guide_Critical_Habitat.pdf







Not pictured: Bald Mountain

Critical Habitat Threats

- Loss, degradation, or fragmentation of habitats from development or changes in land use
- Threats from development and associated runoff (agricultural, residential, roads)
- Loss of habitat value due to hydrologic impacts from development, new roads, impervious surfaces, and culverts
- Insufficient scientific knowledge regarding wildlife species
- Degradation of forest habitat from over-browsing by deer
- * Degradation of habitats by non-native invasive species*

Invasive Plant Species

Identifying invasive plants that pose a threat to Norfolk's critical habitats

Poor Fen - Natural peatland, bog with acidic groundwater and soil

	Common Reed *Phragmites australis*	***Glossy Buckthorn*** *Frangula alnus*	***Purple loosstrife*** *Lythrum salicaria*	***Japanese Knotweed*** *Fallopia japonica*
Identification				
About	***Perennial grass found in wetlands, thriving in both freshwater and brackish environments like marshes, riverbanks, and lakeshores, where it often forms dense stands.***	***Deciduous shrub or small tree native to Europe and Asia, commonly found in wetlands, forest edges, and disturbed areas where it forms dense thickets.***	***Perennial herbaceous plant with striking purple flower spikes, native to Europe and Asia, commonly found in wetlands, marshes, and along shorelines in North America.***	***Fast-growing, bamboo-like perennial plant native to East Asia, commonly found along roadsides, riverbanks, and disturbed areas.***
Ecological Threat	• ***Outcompete native plants*** • ***Reduce biodiversity*** • ***Form dense thickets that alter water flow and hydrology***	• ***Outcompete and shade out native plants*** • ***Glossy buckthorn is an alternate host for the fungus that causes oat rust disease and alfalfa mosaic virus***	• ***Forms dense monocultures that are hard to remove*** • ***Alters the habitats of birds, amphbians, and mammals*** • ***Alters water flow and hyrdology***	• ***Aggressive bamboo like growth allows it to outcompete native plants*** • ***Alters soil chemsitry and hyrdology***

Common Reed

Phragmites australis

Japanese Knotweed

Fallopia japonica

Acidic Red/Black Spruce Basin Swamp - forested wetland

	Glossy Buckthorn *Rhamnus frangula*	***Purple loosstrife*** *Lythrum salicaria*
Identification	 	 
About	***Deciduous shrub or small tree native to Europe and Asia, commonly found in wetlands, forest edges, and disturbed areas where it invades and forms dense thickets.***	***Perennial herbaceous plant with striking purple flower spikes, native to Europe and Asia, commonly found in wetlands, marshes, and along shorelines in North America.***
Ecological Threat	• ***Outcompete and shade out native plants*** • ***Glossy buckthorn is an alternate host for the fungus that causes oat rust disease and alfalfa mosaic virus***	• ***Forms dense monocultures that are hard to remove*** • ***Alters the habitats of birds, amphibians, and mammals*** • ***Alters water flow and hyrdology***

Glossy Buckthorn

Frangula alnus

Purple Loosestrife

Lythrum salicaria

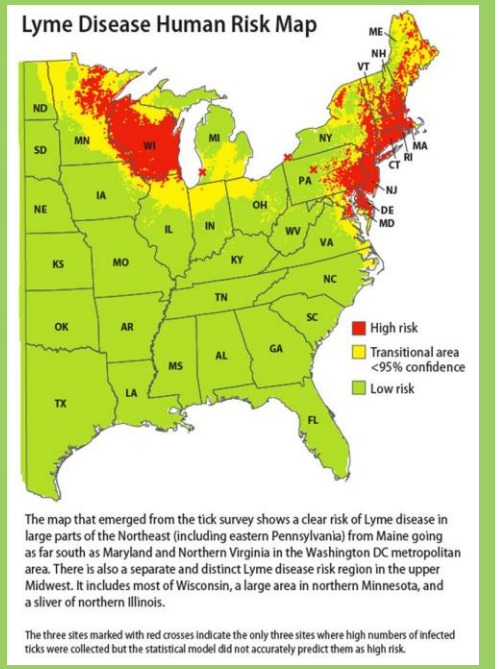
Dry Sub-Acidic Forest-Slow-growing forests on mafic rocks, dominated by ash, hickories, and hophornbeam.

	Japanese Barberry *Berberis thunbergii*	***Black Locust*** *Robinia pseudoacacia*	**Bishop's Goutweed** *Aegopodium podagraria*	***Winged Euonymus*** *Euonymus alatus*
Identification				
About	***Shade-tolerant, invasive shrub that thrives in forests, fields, roadsides, and disturbed areas, forming dense thickets that outcompete native vegetation and create ideal conditions for ticks.***	**Fast-growing, invasive tree that spreads aggressively in open areas, altering soil chemistry and outcompeting native vegetation with dense root suckers.**	**Perennial herb that spreads aggressively by rhizomes, forming dense mats that outcompete native vegetation and are difficult to eradicate.**	**Invasive shrub that spreads rapidly through seeds and root suckers, forming dense thickets that crowd out native plants and disrupt ecosystems.**
Ecological Threat	• ***Forms dense tickets that outcompete native plants*** • **Alters soil chemistry** • **Increases tick populations**	• **Spreads rapidly** • **Alters soil chemistry** • **Alters fire regime of forest**	• **Underground rhizomes make it difficult to remove** • **Suppresses native regeneration**	• **Alters understory density** • **Can be difficult to eradicate**

Japanese Barberry

Berberis thunbergii

Japanese barberry can facilitate the spread of Lyme disease



The map that emerged from the tick survey shows a clear risk of Lyme disease in large parts of the Northeast (including eastern Pennsylvania) from Maine going as far south as Maryland and Northern Virginia in the Washington DC metropolitan area. There is also a separate and distinct Lyme disease risk region in the upper Midwest. It includes most of Wisconsin, a large area in northern Minnesota, and a sliver of northern Illinois.

The three sites marked with red crosses indicate the only three sites where high numbers of infected ticks were collected but the statistical model did not accurately predict them as high risk.

(Williams et al., 2009)

Barberry Linked to Rising Rate of Lyme Disease

BY NICKI BELLEZZA

You could be more at risk of Lyme disease by having a particular plant growing in your yard. Japanese barberry (Berberis thunbergii) is thorny but a hardy, colorful, deer-resistant and inexpensive shrub — all reasons why it is popular in landscapes. It is an invasive species and an extremely popular shrub in home gardens and outside businesses as well. You see it at malls, gas stations and office complexes. However, it is also a haven for ticks.

The RA board banned Japanese barberry in Reston in 2008 due to its ability to spread from the landscape and invade the forested natural areas. Now, there is another reason to prevent residents from planting the shrub.

A bullseye rash is an indicator of Lyme disease infection in humans.

WHERE THERE IS JAPANESE BARBERRY THERE IS LIKELY TO BE HIGH NUMBERS OF LYME DISEASE-CARRYING TICKS.

According to Dr. Scott Williams, the lead researcher on Japanese barberry for the Connecticut Agricultural Experiment Station (CAES), one acre of forest with Japanese barberry averages 120 ticks, which is 12 times higher than forests without it. The spread of Lyme disease in barberry thickets is due to white-footed mice, common carriers of the bacteria that cause Lyme disease, which take shelter among the barberry's dense and thorny branches. One infected mouse passing through can transfer bacteria to any number of ticks, which then pass the infection to their next host. Japanese barberry thickets are also warmer and more humid than is normal, making it easier for ticks to survive.

Black locust

Robinia pseudoacacia

Bishop's Goutweed

Aegopogium podagraria

Winged Euonymus

Euonymus alatus

Other Invasive Plants in Norfolk

Norway Maple
Acer platanoides

Shrub-like Honeysuckles
Lonicera morrowii, tartarian, bella

Garlic Mustard
Alliaria petiolata

Porcelain Berry
Ampelopsis brevipedunculata

Mugwort
Artemisia vulgaris

Multiflora Rose
Rosa multiflora

Japanese Stiltgrass
Microstegium vimineum

Garden Heliotrope
Valeriana officinalis

Oriental Bittersweet
Celastrus orbiculatus

How will our changing world impact invasive plant growth?

How will climate change and land use change impact invasive plant growth in Norfolk in the coming years

Climate and Land Use Change Overview

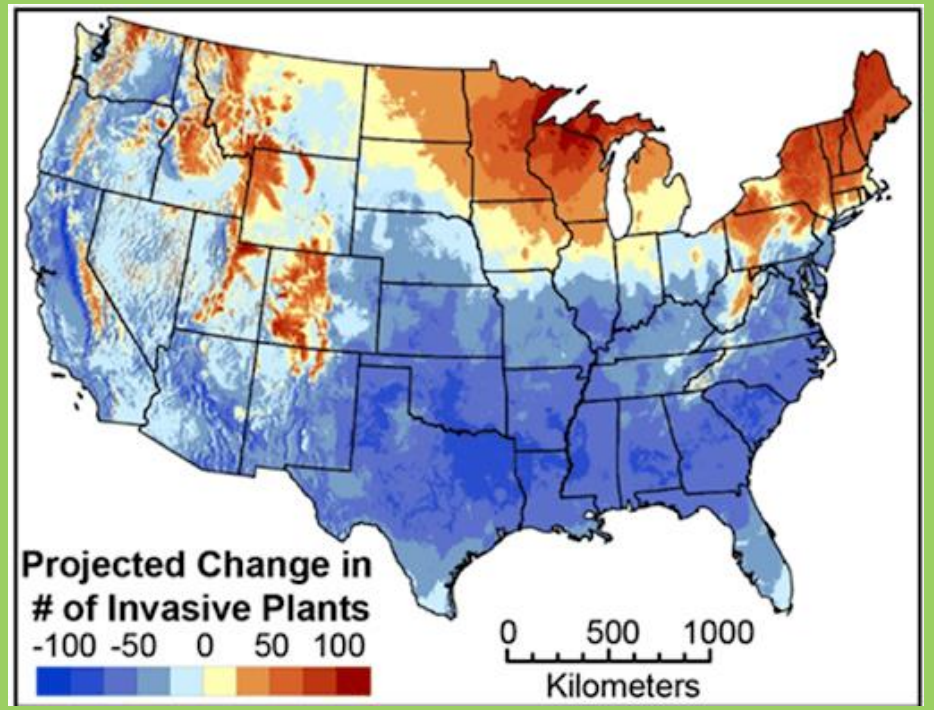
- Warmer temperatures allow southern invasive species to survive and expand into Norfolk.
- Longer growing seasons may give invasives more time to grow and outcompete native plants.
- Extreme weather events (storms, heavy rain) can spread invasive seeds and plant parts across the landscape.

Climate and Land Use Change Overview

- Land development and forest clearing creates disturbed areas where invasives can easily take hold.
- Fragmented natural areas (due to construction of roads, driveways, or trails) help invasives spread.
- Elevated CO_2 levels boost growth for fast-growing invasive plants, especially vines.
- Hiking and other human activities have the potential to spread invasives into new locations.

Changes in Temperature

- Eastern Temperate Forests has a large "invasion debt"
  - invasive plants that could thrive here haven't fully spread yet
  - 83% of species that could live here aren't here yet, but the climate is already suitable for them.
- Climate change may shift hotspots north.
- Warming winters reduce cold barriers that once kept some southern invasives out
- In the Northeast cold tolerance has been a natural form of invasive species control
- How does the colder microclimate of Norfolk impact this?

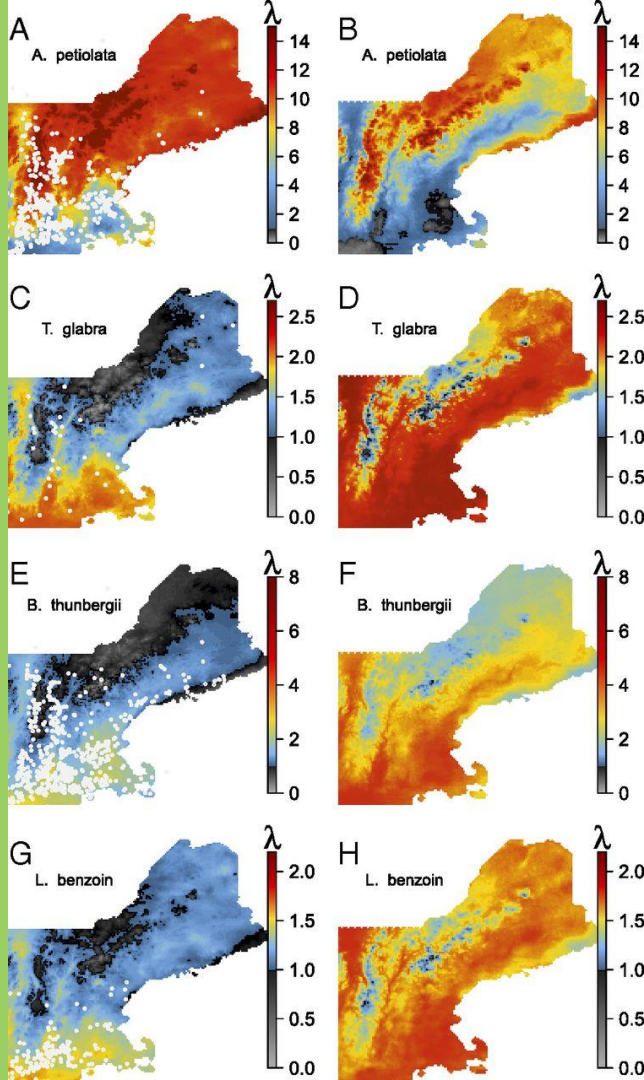


(Morrow et al., 2016)

Change in Temperature Cont.

- Garlic mustard may decline in southern New England with warming, but still threatens northern spread into cooler areas.
- Japanese barberry is likely to expand northward, thriving in warmer temperatures and shaded forest understories.
- Management should focus on early detection in northern regions before these species fully establish.

(Merrow et al., 2016)



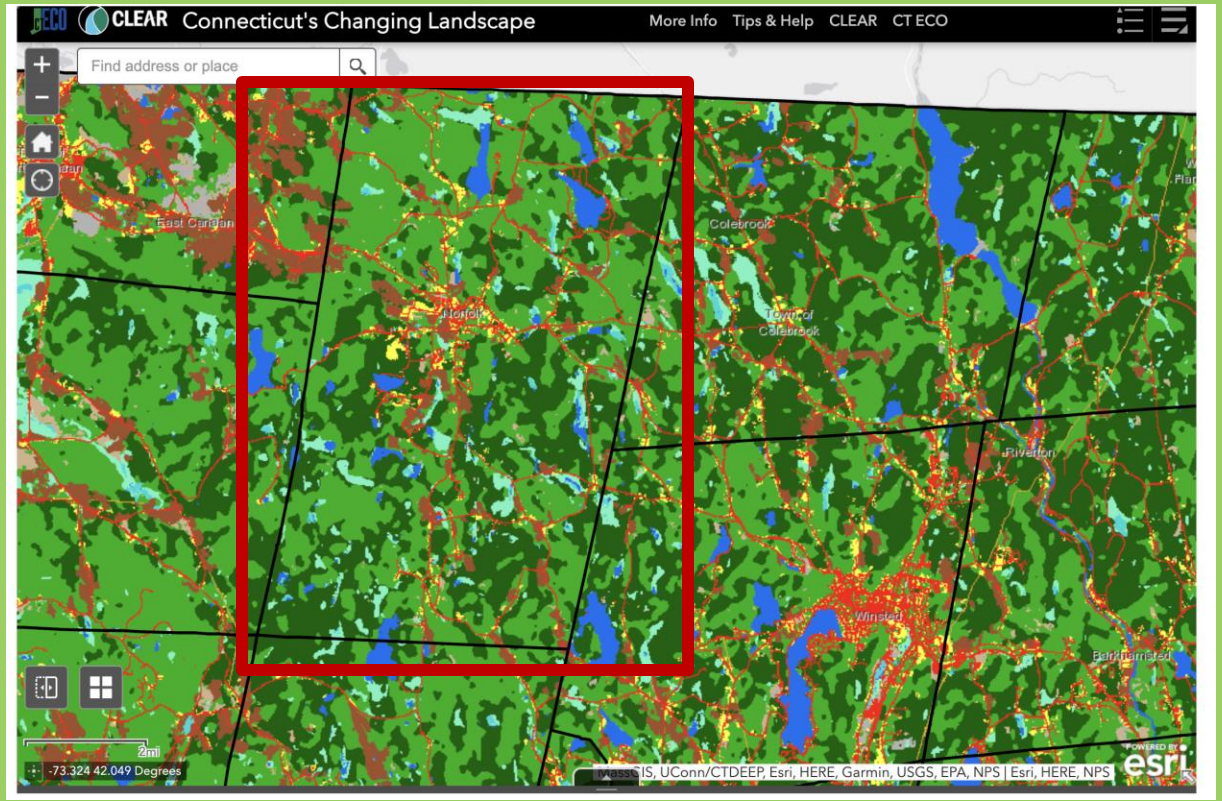
Land Use Change

- **Habitat disturbance**: Clearing land for development, roads, or agriculture creates open, disturbed areas
  - perfect conditions for invasive plants to move in and outcompete natives.
- **Edge effects**: When forests are fragmented (by roads, trails, or housing), they create more "edges".
  - Edges are warmer, sunnier, and drier.
- **Soil disruption**: Construction and soil disturbance can make it easier for invasive seeds (already in the seed bank or carried in) to germinate and spread.
- **Increased human movement**: Roads, trails, and landscaping introduce seeds through vehicles, shoes, and pets
- **Suppressed natural disturbances**: Fire suppression or altered flood regimes reduce natural ecosystem dynamics that help keep invasive species in check.

(Wang et al., 2016)

Norfolk's Land Use Change

https://clear.uconn.edu/projects/landscape/ct-landcoverviewer/



Norfolk

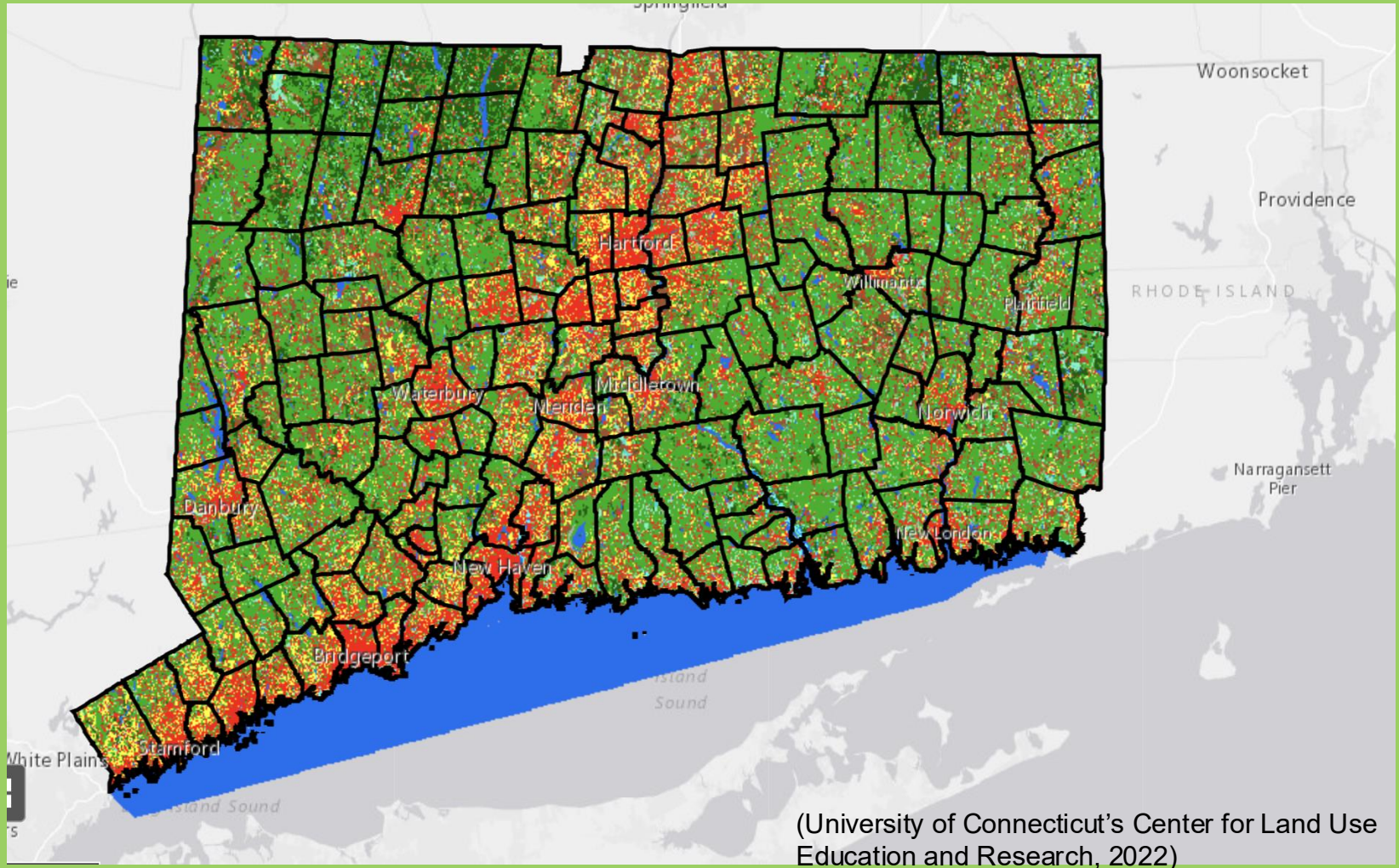
2015 Land Cover
Forest: 24858 acres, 83.8%
Ag. field: 1358 acres, 4.6%
Turf & grass: 581 acres, 2.0%
Developed: 1555 acres, 5.2%

1985 Land Cover
Forest: 25109 acres, 84.6%
Ag. field: 1219 acres, 4.1%
Turf & grass: 484 acres, 1.6%
Developed: 1473 acres, 5.0%

More Statistics
- in the Viewer Attribute Table (how?)
- interactively on the Numbers & Charts page

Zoom to

(University of Connecticut's Center for Land Use Education and Research, 2022)



(University of Connecticut's Center for Land Use Education and Research, 2022)

Best Management Practices

How to limit or prevent the spread of invasive plants in Norfolk

Mechanical & Chemical Strategies

Mechanical

- Cutting
- Pulling
- Mowing

Chemical

- Foliar Sprays (herbicides)
  - Glyphosate
  - Triclopyr

Link: Invasive Plant Management Calendar

Prescribed Burning

- Reduces invasive plant biomass and clears space for native regrowth
- Stimulates fire-adapted native species and improves seed germination
- Often combined with mowing or herbicide
- Costly for small areas but efficient for large areas
- Can be used for control of:
  - Phragmites australis (common reed)
  - Shrub-like honeysuckles
  - Rosa multiflora (multiflora rose)
  - Alliaria petiolata (garlic mustard)
  - Artemisia vulgaris (mugwort)

(USDA, 2023)

Hydrological Manipulation

- Raises or lowers water levels to stress or drown invasive species
- Works well for wetland invaders like *Phragmites australis*
- Requires control structures (like dams or pumps) and site-specific planning
- Can support native wetland restoration if timed and managed properly

(University of Florida Center For Aquatic And Invasive Plants, 2025)

Native Planting

What is native planting?

- restoration strategy to manage and suppress invasive plants by manipulating the timing and sequence of species introduction
- early-establishing native species to occupy space and resources
    - reducing the likelihood of invasive species establishing later (inhibitory priority)

(Young et al., 2016)
https://doi.org/10.1111/rec.12384

Native Planting

How cost effective is planting native species?

- Practices such as cutting, mowing, and plowing that are already used
- Seeds are low cost

Are there any negative consequences?

- Success dependent on weather and environmental conditions
- Possibility that plant species arriving later (invasives) may have a competitive advantage in some cases

(Young et al., 2016)
https://doi.org/10.1111/rec.12384

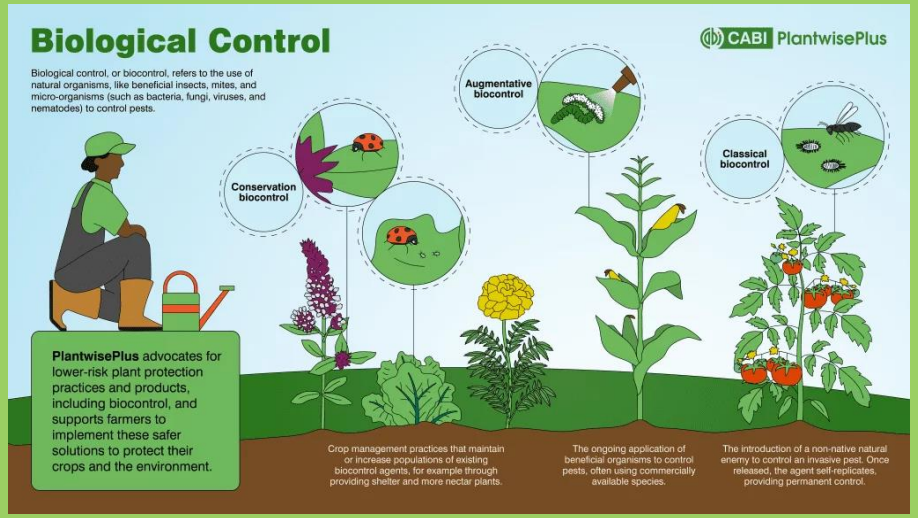
Biological Control

What is biological control?

- Introduction of targeted predators for invasive plants
  - Can be insects, parasites, or pathogens

How cost effective is biological control?

- Not cost effective.
- Would require scientist for placement and monitoring

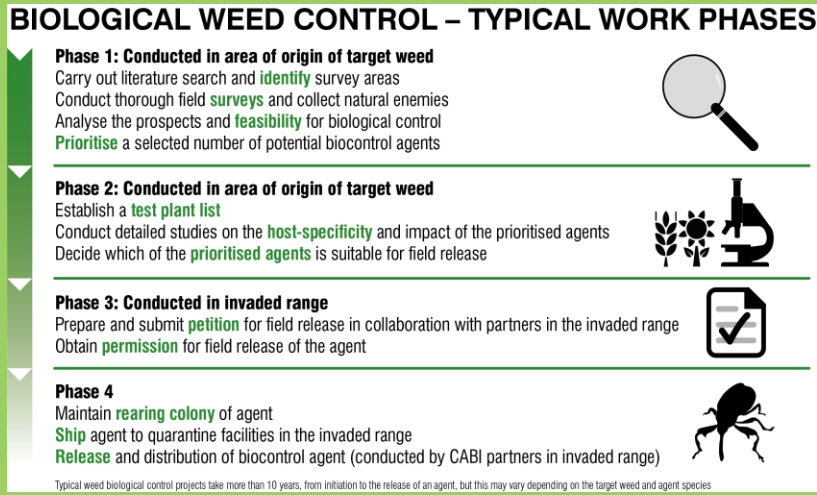


Are there any negative consequences?

- Not well studied on plants present in Norfolk
- Always a chance that introduced insect, parasite, or pathogen could become invasive itself
  - Parasite or pathogen may harm native vegetation

Success with managing purple loosestrife with biological controls

(Connecticut River Coastal Conservation District, 2016)

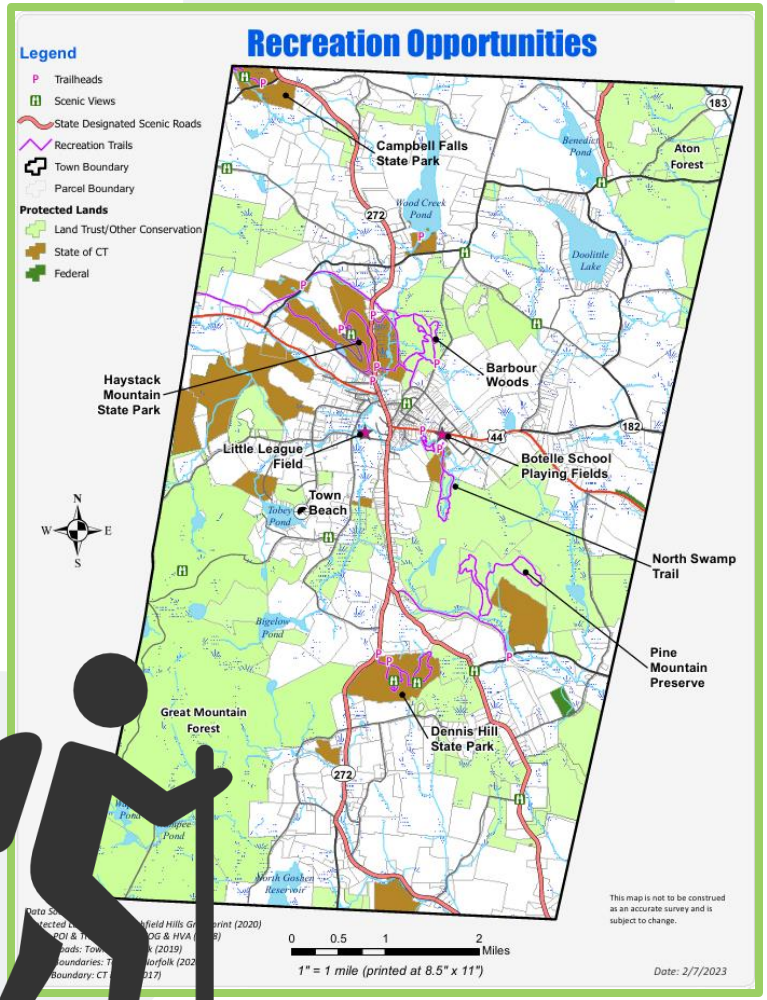


Potential for biological control of Phragmites australis in North America

https://doi.org/10.1006/bcon.2001.0994
(Tewksbury et al., 2002)

Potential for biological control of Multiflora Rose using goats

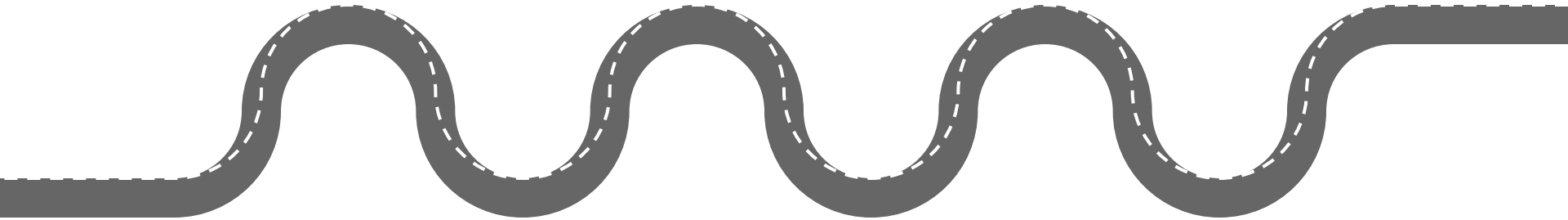
(Sundberg, 2019)



Public Outreach & Education

- Raising awareness through workshops, community events, & informational material
  - Threats
  - Identification
  - Spread
  - Best management practices
- Utilizing social media
  - Identification apps: Seek, Picture This, Google Lens, Go Botany (website)
- Engaging Volunteers
  - Aton Forest Incorporated & the Nature Conservancy volunteer opportunities
  - “Pulling Parties”

Concluding Thoughts



1. Norfolk's vulnerable habitats
2. Invasive plants in Norfolk's vulnerable habitats
3. Land-use change is the largest threat to vulnerable habitats
4. Climate change will drive invasives northward
5. Managment practices for invasive plants
6. Questions?

Thank you for your time!

Questions?

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