# Vulnerability Assessment for Critical Natural Resources in Northwestern Connecticut

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# Table of Contents

# Introduction

The overall goal of this project is to create a vulnerability assessment for the Norfolk Conservation Commission which identifies key critical, sensitive, and threatened habitats and the species that inhabit them within the town of Norfolk, Connecticut. The assessment will provide an in-depth description of each critical habitat identified and where it is located. In addition, the project emphasizes the threat invasive plant species currently or will potentially pose on these specialized habitats and makes suggestions for their management. Threats identified from land use change and climate change are also addressed.

# Norfolk's Vulnerable Habitats

**Identifying Critical Habitats**

Norfolk is considered to be one of the most beautiful areas in Connecticut, known for its biological and ecological diversity. The landscape is created by geology, climate, and compatible plant species. The combination of rugged terrain, unfragmented landscape, and the presence of limestone allows for a variety of unique plant and animal species to thrive. Native plants in Norfolk endure the coldest climate in the state on top of the town's generally nutrient-poor, acidic soils. Within Norfolk, there are many areas of ecological importance, including rocky outcrops, seeps, wetlands, vernal pools, grasslands, ravines, and more.

Given this diverse and complex environment, it is important to identify and understand the critical habitats the contribute to Norfolk's biodiversity. The Connecticut Critical Habitats data layer depicts the classification and distribution of twenty-five rare and specialized habitats in the state, identified for their ecological significance and conservation needs. These habitats are classified and mapped based on extensive ecological data collected by state agencies, conservation organizations, and researchers. Connecticut Critical Habitats provides the identification and distribution of a subset of important wildlife habitats identified in the Connecticut Comprehensive Wildlife Conservation Strategy. This data set can be used to highlight ecologically significant areas and to target areas of species diversity for land and conservation protection within Norfolk.

Below is a map generated on ArcGIS using Connecticut Critical Habitat data pertaining to Norfolk sent from Staci Deming.

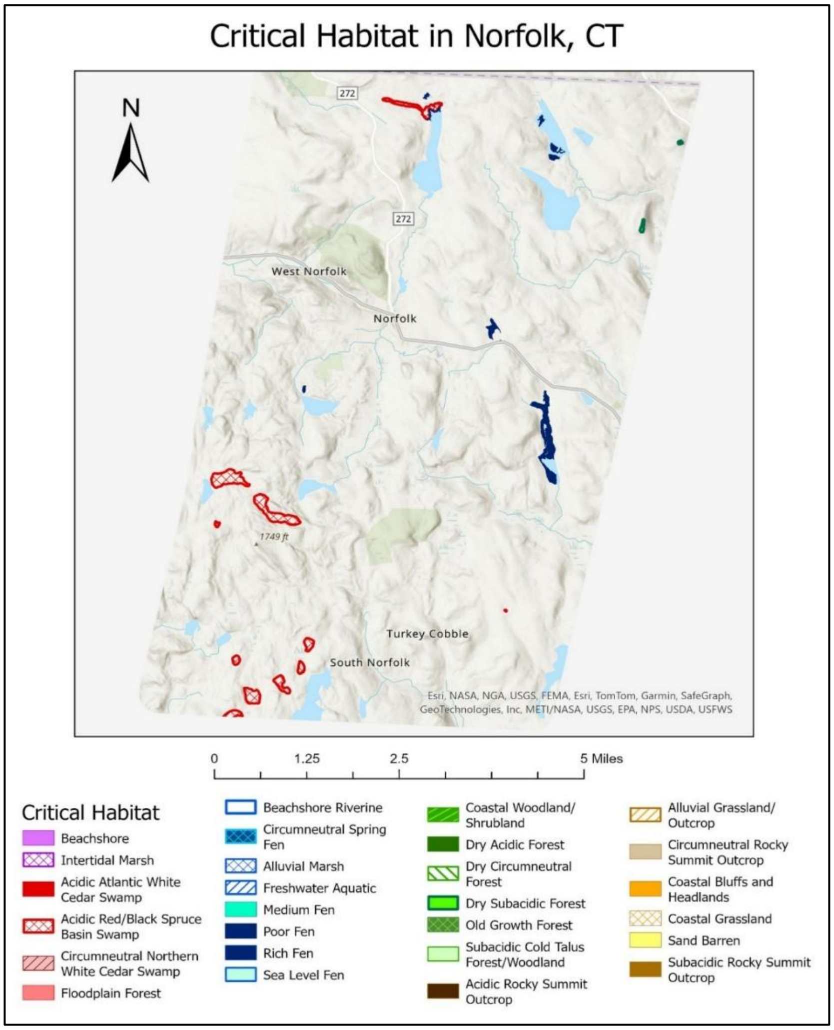



**Figure 1:** Critical Habitats in Norfolk CT – Made by Nicole Cretella with data from Stacy Deming

The Critical Habitats data from Stacy Deming was uploaded onto ArcGIS. Here, all layers such as "Water Courses" and "Natural Diversity Database" are turned off, besides the "Critical Habitats" layer to provide a visual of the critical habitat types and Norfolk and their locations. The key shows the kind of habitat present and clicking on the data points shows their location name.

The critical habitats in Norfolk, Connecticut that will be discussed in further detail are called *poor fen*, *acidic red/black spruce basin swamp*, and *dry sub-acidic forest*.

The following information regarding Norfolk's critical habitats comes from Norfolk's Natural Resource Inventory (NRI), Connecticut Critical Habitats dataset, CT Eco's Resource Guide, Norfolk's Plan of Conservation Development, and the 2015 Connecticut Wildlife Action Plan.

## Poor Fen

The first of Norfolk's Critical Habitats identified is called a poor fen. Fens are a type of peatland, which is an area that is confined to basins, influenced by groundwater, and develops on poorly decomposed peats. Fens are further classified according to pH, where poor fens have a pH of 4.5 to 5.5. As defined in the CT Eco Resource Guide on Critical Habitats, a poor fen is "a natural peatland occupying topographically defined basins; influenced by acidic ground water; on deep, poorly decomposed peats; dominated primarily by ericaceous shrubs."

Poor fens play a vital role in maintaining biodiversity. They support a unique variety of plant and animal species that are adapted to their nutrient-poor, acidic conditions. Mosses such as sphagnum moss are most common in poor fens. Additional vegetation includes shrubs such as leatherleaf and stunted trees like black spruce. Many species of conservation concern such as the southern bog lemming, eastern box turtle, and wood frog live in poor fens. Additionally, wetland ecosystems, such as poor fens, often act as effective carbon sinks on the planet. Poor fens aid in mitigating climate change by trapping carbon that would otherwise be released into the atmosphere.

The locations of poor fens in Norfolk, Connecticut include: Holleran Swamp, Benedict Pond, Pond Hill Pond, Beckley Bog, and Tobey Pond.

*Holleran Swamp*

Holleran Swamp is located north of Wood Creek Pond. This pond is state owned and open to the public, but Holleran Swamp is a forested bog owned by the Nature Conservancy. Residents can take their canoe or kayak to the state boat launch on Wood Creek Pond and paddle north to explore the swamp. Norfolk residents with a fishing license can also fish here, as large mouth bass and more occupy the pond.

Holleran Swamp contains both a poor fen and spruce basin swamp within the area. The nutrient-poor, acidic wetlands support a variety of species such as sphagnum mosses and pitcher plants. Poor fens also provide habitat for rare species like the Eastern ribbon snake and bog turtle.

*Benedict Pond*

Benedict Pond is one of the largest ponds in Norfolk, located off of Doolittle Drive. This area is privately owned by the Doolittle Lake Company. Although this pond is shallow, it is home to large populations of largemouth bass and sunfish. The vegetation found within Benedict Pond's poor fen includes yellow pond lilies, leatherleaf, and a black spruce community.

*Pond Hill Pond*

Pond Hill Pond is a 10-acre pond on private land, known for its scenic beauty and recreational opportunities. This area is popular for fishing and enjoying scenic walks around the pond. Native plants found in the poor fen here include black spruce, sheep laurel, white beak sedge, feathery bog moss, highbush blueberry, and swamp azalea.

*Beckley Bog*

Beckley Pond and the associate bog are well known in town. This habitat forms one of the oldest preserved natural areas and is owned by The Nature Conservancy, a global environmental nonprofit organization that aims to protect critical habitats and restore ecosystems. Beckley Bog was designated as a National Natural Landmark in 1977. Beckley Bog's poor fens are characterized by deep peat moss layers, supporting a variety of plant species such as black and red spruce, mountain holly, and highbush blueberry. Other unique, notable inhabitants include various carnivorous plants such as pitcher plants and sundews.

*Tobey Pong Bog*

Tobey Pond is an important deep cold-water pond with minimum development and the presence of a cold, acidic bog adjacent to it. This area is privately owned and located within the Great Mountain Forest Property. Additionally, Tobey Pond is the location of the town beach, providing recreation opportunities for residents. The beach is leased by the town from the Great Mountain Forest Company. Populations of largemouth bass, black crappie, yellow perch, sunfish, and chain pickerel live here.

## Acidic Black Red Spruce Basin

The second Critical Habitat identified in Norfolk is an acidic red/black spruce basin swamp. Swamps are one of the most common and well-known types of wetlands. Basin swamps, as mentioned in the Norfolk Natural Resource Inventory, are found in depressions that are characterized by slow moving water over peat and muck soils and are either acidic or circumneutral in pH. The CT Eco Resource Guide on Critical Habitats defines acidic red/black spruce basin swamps as, "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."

A swamp is typically wet throughout the growing season, and the dominant vegetation found will largely determine the diversity and types of wildlife in the area. Similar to poor fens, the acidic conditions support a unique variety of vegetation and animal communities. Both red and black spruce basin swamps are very rare. Red spruce dominated swamps are often mixed with hemlock, red maple, and yellow birch, along with a shrub layer that includes mountain holly, mountain laurel, high bush blueberry and common winterberry. An additional layer can be found with sphagnum moss sedges. Black spruce dominated swamps are mixed with tamarack, red spruce, and white pine, along with mountain holly, highbush blueberry, common winterberry, sheep laurel, leather leaf, pitcher plants, and sphagnum moss.

The location of acidic red/black spruce basin swamps in Norfolk, Connecticut include: Holleran Swamp, Great Mountain Forest, Wildcat Swamp, and Lake Winchester Brook Swamp.

*Holleran Swamp*

See the information on Holleran Swamp previously mentioned under the "poor fen" category. A red spruce basin swamp is located here. Vegetation found at the red spruce basin swamp includes red spruce, a genus of conifers including pine trees, creeping snowberry, coralroot orchid, dwarf mistletoe, 3-leafed Solomon seal, bog labrador tea, twinflower, boreal bod, and tall bog sedge, and dwarf huckleberry.

*Great Mountain Forest*

Great Mountain Forest is one of Norfolk's largest protected open spaces, consisting of over 6,000 acres that offer hiking, cycling, skiing, or snowshoeing. This area is actively managed for forest products. Additionally, wildlife habitat is extensively used for research and educational purposes. In the 1970s and 80s, wild turkeys and fishers were reintroduced into Connecticut at Great Mountain Forest. Within the Great Mountain Forest, there are 341 acres of swamps and wetlands, creating a home for a wide range of biodiversity. Wildcat Swamp is also found in this area.

## Dry Sub-Acidic Forest

The last critical habitat identified in Norfolk is called a dry sub-acidic forest. Unlike the two previous habitat types, this one is not a wetland, meaning there are key differences in vegetation and biodiversity here. The CT Eco Resource Guide to Critical Habitats defined a dry sub-acidic forest as, “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.”

Dry sub-acidic forests are also referred to as hickory woodlands, forming unique plant communities on upper slopes and summits in Norfolk. Hickory woodlands are comprised of an open understory with few shrubs and a groundcover layer comprised primarily of sedges with some grasses. These forests contribute to soil stabilization and prevent erosion on rocky slopes. The plant communities supported here thrive in the nutrient-poor soils and are not found in more fertile areas, adding to the overall ecological diversity of Norfolk.

The location of dry sub-acidic forests in Norfolk, Connecticut include: Aton Forest (including the Chimney Hill Site), Knapp Hill, and Bald Mountain.

*Aton Forest*

Aton Forest is a core forest habitat in Norfolk, owned by Aton Forest Inc. This is a nonprofit organization that aims to protect, study, and preserve essential natural ecosystems and vital habitats for wildlife in Northwest Connecticut. Aton Forest is a 1,500 acre private ecological research forest open by appointment for scientific and educational purposes. Notable trees in Norfolk such as striped maple, American hornbeam, white pine, and basswood are located here. Additional vegetation found within the dry sub-acidic forest includes ash, hickory, and hay scented fern.

*Knapp Hill and Bald Mountain*

Hickory woodlands are located on Knapp Hill and Bald Mountain. Knapp Hill is located within Aton Forest. Hickory woodlands are an unusual type of plant community that is not fully understood scientifically. They’re found on very shallow soils of summits and crests of open woodlands, containing dry-site species such as shagbark hickory, white ash, white oak, and hophornbeam. Spring ephemerals such as trout lily, dwarf ginseng, and Carolina Spring beauty are abundant here, along with wood ferns.

## Threats to the Critical Habitats

**Protected Open Space**

Many of Norfolk's critical habitats are located in areas labeled "protected open space," which refers to land that is bound by legal easement. The degree of protection present differs for each area. Protection through a conservation easement, ownership by a non-profit organization, or a deed restriction are among the most common forms of protection. These all limit development of a property. Forms of protection are crucial because many critical habitats are threatened by development. Some organizations that hold such easements and are responsible for their enforcement include federal government, the state of Connecticut, Aton Forest Inc., Great Mountain Forest Corporation, Housatonic Valley Association, and the Norfolk Land Trust.

**Threats**

Poor fens, acidic red/black spruce basin swamps, and dry sub-acidic forests face numerous threats. Understanding and addressing these threats are important for protecting these unique habitats, preserving their ecological functions, and ensuring the survival of the plant and animal species that depend on them.

*Loss, Degradation, or Fragmentation of Habitats from Development or Changes in Land Use*

Development and changes in land use can lead to the destruction or alteration of natural habitats. Converting forests, wetlands, and other natural areas into residential, commercial, or agricultural land all pose a potential threat to Norfolk's critical habitats. Habitat fragmentation occurs when large, continuous habitats are divided into smaller, isolated patches. This negatively impacts wildlife as it reduces their living space and ability to move and find resources. Development often involves the construction of roads, buildings, and other impervious surfaces that alter water flow patterns. These changes can lead to increased runoff, reduced groundwater recharge, and altered stream flows, which can degrade the poor fens and spruce basin swamps.

Runoff from agricultural, residential, and road areas can carry various pollutants including fertilizers, pesticides, oil, and heavy metals into natural habitats. This runoff can lead to nutrient loading in wetlands and water bodies, causing algal blooms and oxygen depletion. Sediment runoff can also cloud water, making it difficult for aquatic plants to thrive. Pollutants additionally poison wildlife and degrade the quality of the habitat.

*Recreational Overuse (Hiking, Swimming, Fishing, etc.)*

Many of Norfolk's critical habitats are located in areas open for public use. For example, Tobey Pond serves as a beach for residents while Great Mountain Forest offers hiking, skiing, cycling, and more. While these areas are protected and well maintained, recreational overuse still poses a threat, especially if users venture off the designated trails. Recreational activities can lead to habitat degradation through trampling, soil compaction, and pollution. High levels of foot traffic and use of water bodies can introduce pollutants and disturb wildlife. Managing these impacts involves balancing human use with conservation goals.

*Non-Native Invasive Species*

Non-native invasive species can outcompete native species for resources, leading to a decline in native biodiversity. The spread of invasives is often facilitated by human activities. A more in depth analysis on invasive plant species in Norfolk and the threats they pose is provided below.

## Norfolk's Invasive Plant Species

The following section discusses the invasive plants of concern listed on page 121 of the Norfolk Natural Resource Inventory. This section aims to understand what invasive plants would survive in each of the three habitat types. All information from this section is from the USDA Fire Effects Information System unless otherwise noted by an intext citation.

**Norway maple (*Acer platanoides*)**

Norway maple is a medium to large deciduous tree that can grow 40-90 feet tall. The tree is native to central and eastern Europe and western Asia. Norway maple was introduced to the United States in the 1700's as an ornamental plant. The tree can commonly be seen planted along urban streets and yards, and escapes into nearby forests. Norway maple is very commonly found with sugar maple (*Acer saccharum)*, and it is believed that they have a similar ecological distribution.

Norway maple's ideal environment is deep, fertile, moist soils with adequate drainage and a pH of ranging from 5.5-6.5. However, it is adaptable to infertile, acidic, and clay or sandy soils. Norway maple is commonly found in single stands and is tolerant to varying levels of shade. Distribution of the Norway maple in northern regions of the United States is limited by cold tolerance.

Norway maple is rare in habitats that are too moist and have a pH nearing 4.0. This makes it unlikely to survive in the Poor Fen and Acidic Black/Red Spruce Basin. However, Norway maple can adapt to various soil types, including compacted soils, and is tolerant to shade, varying levels of soil nutrients, and pollution. Norway maple is unlikely to grow in any of the three vulnerable habitat types due to inability to survive in overly saturated soils, and acidic conditions.

Norway maple's shade tolerance allows it to outcompete native trees and reduce light availability to understory organisms. Norway maple significantly reduces understory sapling density and species richness compared to native sugar maple (Martin, 1999). Its speed of regeneration outcompetes sugar maple in both frequency and abundance, allowing it to dominate forest composition. Norway maple also has roots that grow in shallow soil, which makes it difficult for other species of trees and plants to grow (Martin, 1999).


Picture of Norway maple. (UMD Extension, 2022).

**Bishop's goutweed (*Aegopodium podagraria)***

Bishop's goutweed is a perennial herb that can be identified by its erect hollow stems. It was introduced to North America from Europe as an ornamental plant, and became more abundant in the northeast in the 1960's. Goutweed typically grows between 4 and 12 inches, but in some cases can grow up to three feet tall. Bishop's goutweed has an extensive root system with both storage and feeding roots. Its horizontal rhizomes can grow up to 3 meters long and may become vertical shoots above ground. These rhizomatous roots allow it to grow aggressively away from the plant above and below ground. Goutweed also produces seeds, but seedling establishment is low and only plays a small role in its spread.

Goutweed can survive in varying habitats and thrive in areas that are disturbed. The herb can be found in wetland and non-wetlands and can tolerate moist soil but not over-saturated soils. In North America, goutweed is typically found in wildlands and upper hardwood forests. In its native range in Europe, goutweed can typically be found in deciduous woodlands and forests and plant communities dominated by tall herbs. Goutweed is known to be associated with boxelder, slippery elm, black walnut, black raspberry, bristly greenbrier, great ragweed, eastern waterleaf, and woodland lettuce. However, its ability to tolerate varying levels of shade, soil pH, moisture, and fertility allows it to grow in many habitats.

Bishop's goutweed can significantly impact ecosystems by altering soil chemistry, increasing humidity near the ground, and reducing light availability through its dense ground cover. These changes can disrupt native plant communities by modifying decomposition rates and nutrient cycling, leading to culminative impacts on forest communities.

Goutweed is unlikely to survive in the moist infertile wetland soils of the Poor Fen and Acidic Red/Black Spruce Basin. However, goutweed can tolerate soil pH ranging from three to nine allowing it to grow in the Dry Sub Acidic Forest. It is likely that goutweed would live on fragmented edges and disturbed portions of the dry sub acidic forests.

Picture of bishop's goutweed (EarthOne, 2024)

**Garlic mustard (*Alliaria petiolata*)**

Garlic mustard is an established herbaceous plant that typically behaves as a biennial with a taproot, sometimes growing as a winter annual. The taproot is a central root that grows straight down into the soil, and all other branches grow off. This allows it to access deep nutrients in soil and makes it difficult to remove. Garlic mustard is native to Europe and Asia. It was introduced to Long Island, New York in the 1800s, because it was believed to have medicinal properties.

In North America, garlic mustard is typically found in deciduous forests and disturbed woodlands. It is not associated with coniferous forests. Garlic mustard commonly invades upland and floodplain forests, savannas, roadsides, trail edges, and other disturbed areas. The plant thrives in areas with high soil pH and is not competitive in acidic soils. Garlic mustard prefers shaded, moist conditions caused by flooding, but can survive in various levels of sunlight. Flooding and natural disturbances facilitate its spread. Additionally, garlic mustard thrives in areas disturbed by humans such as hiking trails, railroad tracks, and road edges.

Garlic mustard is an invasive species with various ecological impacts in eastern deciduous forest understories, where it is particularly harmful to native spring ephemerals. It is possible for each plant to release up to 3,000 seeds, allowing it to spread rapidly and form dense monocultures. It blooms early which gives it a competitive advantage, as it establishes before many native species can emerge. Garlic mustard is shade-tolerant and produces large seeds. Additionally, garlic mustard's roots release allelopathic chemicals that disrupt mycorrhizal fungi, an essential underground network that facilitates nutrient exchange among native plants. This disturbance impacts forest regeneration, and biodiversity.

Garlic mustard does thrive in moist soils, but it is unlikely to survive in wetlands such as the Poor Fen and Acidic Black/Red Spruce Basin, since un-drained soils during the growing season of garlic mustard likely makes it intolerant to wetlands. Additionally, it is unlikely to survive in the Dry Sub-Acidic Forest due to its inability to tolerate dry and acidic soils. However, since garlic mustard thrives in disturbed sites, it is possible if any of these vulnerable habitats became disturbed or clear cut, garlic mustard may grow.

Picture of garlic mustard with flowers (King County, 2025).

**Porcelainberry (*Ampelopsis brevipedunculata*)**

Porcelainberry is a deciduous woody vine that can grow up to 20 feet tall. It is considered a liana, which is defined as a woody climbing or trailing plant that does not support its own weight. The woody vine often resembles native species of grapes. Porcelainberry was introduced to North America in the 1870s as an ornamental used for landscaping. The flowers of porcelainberry produce nectar that attract various pollinators such as bees and birds. Their berries are often attractive to birds who are the main source of seed dispersal. However, these berries offer no nutritional value to birds and other wildlife.

Porcelainberry is often associated with deciduous forest ecosystems, though it can also occur in coniferous or mixed forest types. It is frequently associated with disturbed or degraded forest communities, where gaps in the canopy and soil disturbances provide a competitive advantage over native species. In deciduous forests, porcelainberry is associated with the native species such as red oak, yellow poplar, red maple, American beech, white oak, ash, and sugar maple. In wetland environments, it is commonly associated with river birch, sycamore, blackberry, and willow. Porcelainberry can be found in wetlands, but thrives in well-drained soils, and is likely to have limited growth in consistently flooded soils. Porcelainberry favors full sun and soil pH near 7.0. However, the vine can also survive in varying levels of soil pH, and shade. In New England, porcelainberry is considered an early successional plant.

Porcelainberry grows over trees, shrubs, and understory plants, forming dense mats that outcompete native vegetation by blocking sunlight. This weight of these supporting vines can make species they grow on top of more vulnerable to wind and precipitation. Porcelainberry also can climb and grow on trees of large diameters, where it can ascend into their crowns by attaching to other vine species adapted to climbing large trees. The long vine structures of porcelainberry make it difficult to remove.

Porcelainberry may grow in these three habitats as it tolerates low pH. However, plant associations do not match any of the habitats. The nutrient poor, saturated soils of Poor Fen and Acidic Black/Red Spruce Basin make it unlikely that porcelainberry could survive in those habitats. Picture of porcelainberry with bright colorful berries (Olmsted Parks Conservancy, 2025).

**Mugwort (*Artemisia vulgaris* )**

Mugwort is a perennial rhizomatous weed. The plant can grow between two and five feet tall. It was introduced to North America over 400 years ago and was used for its medicinal properties. Mugwort forms extensive rhizome networks that allow it to extend far away from its original plant structure. The weed can also reproduce through seeds that are found in small oblong brown achenes.

Mugwort is commonly associated with roadways, crosswalks, and uncultivated areas. Disturbed habitats, meadows, and valleys are its main habitats. It thrives in dry to moist soils, but it does not persist in consistently moist soils as the weed is susceptible to root rot. Mugwort grows best in partial to full sun.

Mugwort grows rapidly and can outcompete native vegetation through its aggressive rhizomes. Studies have found that mugwort reduces understories species richness and diversity, especially early successional growth forests.

Mugwort would not survive in the Poor Fen and Red/Black Spruce Basin Swamp with the overly moist and acidic soils. The Dry-Sub Acidic Forest would be a more hospitable habitat, however mugwort is most associated with disturbed soils. It may survive in this vulnerable habitat if there is disturbance such as clearing for development. Picture of mugwort (The Spruce, 2024).

**Japananse barberry (*Berberis thunbergii*)**

Japanese barberry is a deciduous shrub that can grow three to six feet tall. The shrub has bright red fruit with dry skin that matures between August and September in New England. Japanese barberry was introduced to North America as an ornamental in the 1800's. It was originally native to Japan. Japanese barberry differs from native plants in North America because it takes up nutrients earlier and in greater amounts than native species. This difference in the timing and magnitude of nutrient uptake gives it a competitive advantage over native understory plants.

Japanese barberry can be found in a variety of habitats such as upland areas, riparian zones, wetlands, pastures, and meadows. Common plant associations include red maple forests with sweet birch, northern red oak, silver maple, green ash, sycamore, slippery elm, and Christmas fern. This shrub is typically found in second-growth forests that were previously cleared for agriculture, timber harvesting, or grazing. Japanese barberry can tolerate harsh environmental conditions such as high soil acidity, low fertility, and shallow soils. Its northern and western range limits are defined by its low tolerance to cold temperatures and drought. Japanese barberry prefers mesic conditions, and it is less common in extremely dry or very wet soil. The specific soil characteristics of Japanese barberry soil are hard to determine because it is believed that the shrub itself is altering soil chemistry. Japanese barberry contributes to increased soil acidity and higher nitrate levels, making it challenging to determine whether these conditions existed before the plant's invasion or are a result of its presence. Japanese barberry can be limited by extremes such as low soil nitrate availability, and low soil pH. However, it is not limited by sunlight availability and can tolerate varying levels of shade.

Japanese barberry can reproduce in multiple ways, which contribute to its aggressive spread and persistence. It reproduces through seeds, aboveground and below-ground shoots, and a process called layering. Layering occurs when stems that touch the ground can develop roots and form new plants. This allows it to form dense populations that are difficult to control. In mature Eastern Forest communities, Japanese barberry is particularly problematic. It forms dense thickets that outcompete native plants for light, space, and nutrients. It has been associated with increased soil acidity and elevated nitrate levels, which can be disadvantageous to native plant species that are adapted to habitat specific soil conditions.

Additionally, Japanese barberry plants are favorable habitats for deer ticks (*Ixodes scapularis*), which are known vectors of Lyme disease. An increase in the abundance of Japanese barberry increases the deer tick population, elevating the risk of Lyme disease transmission to humans (Elias et al. 2006). One study in Maine found that plots dominated by Japanese barberry had twice has many adult and nymph deer ticks compared to plots dominated by native plant species. These invasive dominated understory layers also create ideal environments for white-footed deer mice (*Peromyscus leucopus*) which are carriers of Borrelia burgdorferi, the bacteria responsible for Lyme disease, increasing the risk of Lyme disease infection among humans (Elias et al. 2006).

Japanese barberry is adaptable to many environments. However, it is unlikely it would be able to survive in the constantly wet and acidic soils of the Poor Fen and Acidic Black/Red Spruce Basin Swamp. The Dry Sub acidic forest is a more hospitable habitat for Japanese barberry with drier soils, and varying levels of light availability. Upon personal communication with John Anderson, we were informed that Japanese barberry may be present in some of the Dry Sub-Acidic Forest habitats in Norfolk. Picture of Japanese barberry invading forest understory (Connecticut Gardener, 2020).

**Oriental Bittersweet (*Celastrus orbiculatus*)**

Oriental bittersweet is a deciduous liana. A liana is a woody climbing or trailing plant that does not support its own weight. Oriental bittersweet can reach up to 66 feet tall and four inches wide. It can grow through climbing and sprawling. Oriental bittersweet reproduces through both sexual and vegetative reproduction, contributing to its rapid spread and persistence. Sexual reproduction occurs through the spread of seeds. This occurs because Oriental bittersweet produce clusters of round fruits that mature in late summer to fall. When the fruit ripens, they split open to reveal bright red seeds. These fruits are consumed by birds and small mammals, which aid in dispersing the seeds over long distances. The seeds can survive in varying soil and environmental conditions. Oriental bittersweet can also produce shoots from its extensive root system, allowing it to regenerate after physical damage or cutting. In Connecticut, oriental bittersweet flowers in May through June, and fruits and arils ripen in September.

Oriental bittersweet is most commonly associated with mesic forests, mixed hardwood forests, and forest edges. Coniferous forests, woodlands, shrubland, old field, duneland, coastal beaches, tidal saltwater, and saltmarsh are also common oriental bittersweet habitats. It does not tolerate saturated or dry soils. It can commonly be found in close proximity to roads. Oriental bittersweet thrives in disturbed areas and soils. Common plant associations include red oak, hickory, red maple, white ash, sycamore, Japanese barberry, multiflora rose, silver maple, and Japanese honeysuckles.

Oriental bittersweet has abundant seed production, high germination rates, and seedling establishment. It also has high light tolerance. These factors contribute to its ecological impacts and competitive advantage over native species. Oriental bittersweet causes ecological disturbance by outcompeting native plants for light, and nutrients, often forming dense thickets that suppress native plant regeneration. Its heavy, climbing vines can girdle and topple mature trees, disrupting forest structure and altering natural successional patterns.

Oriental bittersweet is not associated with wetlands, and unlikely to survive in the Poor Fen and Acidic Black/Red Spruce Basin. It has the potential to survive in the Dry-Sub Acidic Forest because it can tolerate acidic soils and has similar plant associations. However, it relies on disturbances and is intolerant of drought soils. It is possible if the Dry-Sub Acidic Forest experienced a wet season and disturbances occur, oriental bittersweet may invade. Picture of oriental bittersweet (The Spruce, 2024).

**Winged Euonymus (*Euonymus alatus*)**

Winged euonymus, also referred to as burning bush, is a deciduous shrub. In the fall, winged euonymus has bright red leaves that have earned it the nickname burning bush. Its stems have corky ridges that mimic the shape of wings. Winged euonymus can grow up to ten feet tall, and six feet wide. The shrub can form dense thickets that dominate forest understories and outcompete native plants. Winged euonymus is native to Japan, China, and Korea, and was introduced to North America in the 1800's as an ornamental. Winged euonymus flowers in late spring and produces small red fruits that are consumed by birds, which help disperse the plant's seeds. The shrub can also reproduce vegetatively through root suckers which produce new sprouts from roots.

Winged Euonymus can survive in a variety of habitats and tolerates varying site and soil conditions. Winged euonymus is invasive in pastures, glacial drift hill prairies, woodlands, and mature second-growth forests. It is commonly found in late successional oak-hickory, maple-beech, and mixed hardwood forests. In Connecticut, it is especially prevalent in mixed hardwood forests with high densities of white-tailed deer. Winged euonymus can tolerate high levels of methane in soil, and varying levels of sum. Studies show that it has the ability to invade undisturbed forests. Winged euonymus benefits from moist soils but can also survive and outcompete native vegetation in dry soils.

Winged euonymus is a significant ecological threat to habitats because it forms dense thickets that crowd out native understory plants and reduce biodiversity. It is highly resilient, and able to resprout from the root crown even after herbicide treatment. The shrub also tolerates pruning and other top-killing disturbances, making it difficult to control once established.


Winged euonymus is not a common wetland invader, meaning it is unlikely to be found in both the Poor Fen and Acidic Red/Black Spruce Basin. However, winged euonymus may be found in the Dry Sub-Acidic Forests due to its ability to tolerate full and near shade, as well as its presence in late successional oak-hickory systems where ash and hickory are common. Picture of winged euonymus showing wing like leaves, and bright red color (Vermont Invasives, 2025).

**Japanese Knotweed (*Fallopia japonica*)**

Japanese knotweed is a perennial geophyte. A geophyte is classified as a plant that has underground storage organs with buds that are able to reproduce vegetatively. These underground buds can withstand unfavorable or extreme environmental conditions by undergoing a period of dormancy (Sheikh et al., 2022). Japanese knotweed is native to Asia, and introduced in North America in the 1800's. It was used as an ornamental and promoted as a soil binder. Japanese knotweed has extensive underground rhizome systems. In New England, the plant flowers from August to September, seedlings emerge in late spring, and rhizomes begin to sprout from late spring to early summer. Vegetative regeneration in Japanese knotweed is possible from multiple plant parts, including rhizomes, aboveground stems, roots, and leaves. This makes it possible for the plant to regenerate from tissue no longer attached to the parent plant.

Japanese knotweed can survive in many habitats but is commonly associated with wetlands and riparian zones. Its ideal habitats include floodplain forests, forested and herbaceous wetlands, shrub wetlands, wet meadows, abandoned fields, early successional forests, edge habitats, woodland thickets, and ravines. It is commonly associated with plants such as red maple, black willow, northern spicebush, and southern arrowwood. Japanese knotweed can also easily establish in disturbed areas, including roadsides, railroad tracks, gravel pits, dumps, vacant lots, pastures, fields, and gardens. The geophyte is not limited by soil pH and survives in low nutrient soil.

Japanese knotweed's ability to regenerate from multiple different plant parts make it hard to compete with native plants. The leaf of the plant is also known to change leaf litter dynamics, create high soil nutrients, and harm frog populations.

Japanese knotweed is not limited by soil type or pH and often thrives in wetlands. The Poor Fen and Acidic Black/Red Spruce Basin likely are an ideal candidate for the growth of Japanese knotweed. If not already established, disturbance may push the plant to establish in these habitats. The Dry-Sub Acidic Forest is less likely to be impacted by Japanese knotweed, but disturbance could also play a role in spreading the plant into this vulnerable habitat type. Picture of Japanese knotweed with white flowers (Invasive Species Centre, 2025).

**Glossy Buckthorn (*Frangula alnus)***

Glossy buckthorn is a deciduous shrub that can grow up to 23 feet tall. It is native to Europe, northern Africa, and central Asia. Glossy buckthorn was introduced to North America as an ornamental in the late 1800's. It was originally used in New England for wildlife habitat improvement but quickly became invasive due to its competitive advantage over native plants. In the Northeast United States, glossy buckthorn sprouts from May to June. The shrub grows flowers that are pollinated, and fruits that are eaten by birds and small mammals. The fruit of glossy buckthorn is a large contributor to the spread of the plant. It can often outcompete native shrubs and trees as it sprouts earlier in the year, and its leaves take longer to fall off than other native plants.

Glossy buckthorn thrives in the moist soils of habitats such as bogs, fens, marshes, and riverbanks. In New England, it may be found in similar areas to its native habitats such as calcareous wetlands, alder thickets, heath-oak woodlands, and pine and spruce forests. Glossy buckthorn grows especially well in moist wetlands. In Massachusetts, glossy buckthorn has been shown to dominate the shrub layer in floodplain woodlands composed of red maple, silver maple, and swamp white oak. These woodlands typically have silty loam soils with a pH ranging from 4.5 to 5.5. Glossy buckthorn is also common in low-nutrient wetlands and fens. The shrub also thrives off disturbances. Sites that have been previously plowed are twice as likely to be invaded by glossy buckthorn. The plant can tolerate varying levels of sun, soil pH, and nutrient levels.

Glossy buckthorn reaches reproductive maturity earlier than most native vegetation, also aiding in its competitive advantage. This also makes it harder to kill, and it has been studied to still be able to produce fruit even after top kill herbicide was applied. Glossy buckthorn can alter forest succession patterns, food webs, and species richness. The plant is also an alternate host for the fungus that causes oat rust disease and alfalfa mosaic virus. These diseases could possibly harm nearby agricultural crops of oat or barley.

The Poor Fen and the Acidic Black Red Spruce Basin is an ideal environment for the glossy buckthorn. The acidic, nutrient-poor soil with varying levels of shade will likely support its growth. The moist soils of these habitats will promote their growth and seed germination. If glossy buckthorn is not present in these habitats at this time, land use changes and the spread of seeds by wildlife may impact its distribution. The Dry-Sub Acidic Forest would be unlikely to support the growth of glossy buckthorn with its dry conditions and increased survival of glossy buckthorn in wetlands, but disturbances, like clearing for construction, may risk the spread into those vulnerable habitats. Picture of glossy buckthorn with red berries (U.S.Department of the Interior, 2020).

**Shrub-like honeysuckles (Lonicera morrowii, L. tatarica, L. x bella)**
**Morrow's honeysuckle, Tatarian honeysuckle, Showy Fly Honeysuckle**

Shrub-like honeysuckles are deciduous semi-evergreen shrubs. These taxas typically grow three to ten feet tall. They were introduced to North America from China in the 1800’s. Morrow’s honeysuckles and tatarian honeysuckles can grow to be up to ten feet wide. Showy fly honeysuckles are often as wide as they are tall. These shrubs produce leaves earlier in the spring and retain their leaves later into fall than most native species, giving them a competitive advantage over native vegetation. They all have the ability to form dense thickets that shade out native understory plants, reduce biodiversity, and disrupt natural succession. Their abundant berries are spread by birds, aiding in outcompeting native plants. However, the fruit of these honeysuckles do not have any nutritional value for wildlife.

Honeysuckle species are highly shade-tolerant but also grow well in full sun, allowing them to establish in various habitats. They commonly occur in areas with some canopy cover, including open forests, floodplain forests, periodically disturbed floodplains, riparian zones, and scrub communities. Tatarian honeysuckle can tolerate soil with a pH as low as 5.0. Honeysuckles in general prefer well-drained soils and rarely survive in wet, poorly drained soil conditions. Showy honeysuckle is often found in oak forests. These species are not well adapted to drought or cold weather. They can most commonly be found in grazed or disturbed woodlands, lakeshores, forest edges, pastures, and upland areas. Honeysuckles create dense canopies that shade out understory plants, disrupt soil moisture and nutrient cycling.


These honeysuckles are unlikely to be found in the three vulnerable habitat types. The plant associations are not similar, and they would likely not tolerate the acidic soils well. However, there is always a chance that disturbances such as clear cutting would aid in their spread into these habitats. Picture of honeysuckles with bright pink flowers (Vermont Invasives, 2025).

**Purple Loosterife (L*ythrum salicaria*)**

Purple loosestrife is a perennial wetland shrub known for its bright purple flowers. The flowers are purple to magenta, and they bloom in mid to late summer when they form tall dense spikes. Purple loosestrife is native to Asia and has a wide range in North America but is limited by cold temperatures in the Arctic. It was introduced to North America in the 1800's from ship ballast soil. Purple loosestrife can be found from Maine to North Carolina on the Atlantic Coast. As purple loosestrife plants age, their stems become woody and can survive through winter, lasting up to two years. Mature plants can reach heights of up to 10 feet and spread as wide as 5 feet.

Purple loosestrife can reproduce asexually and sexually. One single plant can produce over 2.5 million seeds per year. Their seeds can spread through various methods such as wind and animals but are well suited for flowing downstream. Purple loosestrife can seed bank and have high germination rates. Asexually, purple loosestrife can reproduce through root fragments or pieces of stems that are broken off and re-established.

Purple loosestrife does not tolerate saltwater and is found exclusively in freshwater wetland habitats. It commonly grows in marshes, along streambanks and lakeshores, and in shallow impoundments, ditches, and canals. Purple loosestrife thrives in temperate climates with moist or seasonally saturated soils. It can grow in both calcareous and acidic soil conditions. The plant often spreads along interconnected waterways, as its seeds can float and disperse downstream. Purple loosestrife is commonly associated with native plants such as common cattail, broadleaf arrowhead, hardstem bulrush, and sandbar willow.

Purple loosestrife's dense growth outcompetes native vegetation, reducing plant diversity and altering the structure of ecosystems. This displacement of native species affects wildlife, especially bird populations by limiting food. Additionally, purple loosestrife can alter wetland hydrology and nutrient cycling, disrupting ecosystem functions such as water filtration and flood control.

Purple loosestrife can survive in a variety of wetland habitats including acidic infertile soils like that of the Poor Fen and Acidic Black Red Spruce Basin. Purple loosestrife does not thrive in non-wetland habitats. Picture of purple loosestrife showcasing bright purple flower stalks (Invasive Species Center, 2025).

**<u>Japanese Stiltgrass (*Microstegium vimineum)*</u>**

Japanese stiltgrass is an annual grass. It is native to Asia, and was introduced to North America as a packaging material for Chinese porcelain in the early 1900's. The grass has thin, pale green leaves with a distinctive silver rib and can grow up to three feet tall. The leaves may intertwine and form dense mats of grass. Japanese stiltgrass flowers in late summer and produces abundant seeds that can remain viable in the soil for several years. The grass can also spread vegetatively by rooting at stem nodes, giving it a competitive advantage over native plant species. Japanese stiltgrass is a C4 plant, meaning that it uses different pathways to photosynthesize. C4 plants use less water and thrive in warm sunny environments. However, Japanese stiltgrass is shade tolerant which is unusual for C4 plants.

Japanese stiltgrass is associated with forest edges, riparian zones, and disturbed areas in North America. Japanese stiltgrass thrives in shade, low elevation, and moist to mesic soils. In its native range, Japanese stiltgrass can be found in in riparian and mesic habitats. Japanese stiltgrass prefers neutral pH soils and can be found in mild basic and acidic soils.

Japanese stiltgrass causes ecological disturbances by forming dense mats that outcompete native vegetation and alter plant community structure. Its rapid growth and ability to thrive in both sun and shade allow it to outcompete native vegetation, reducing biodiversity. It can also change soil chemistry and nutrient cycling.

Japanese stiltgrass is unlikely to be found in any of the three vulnerable habitats. It does not grow well in acidic and/or extremely dry or wet soils. It thrives off disturbances and is likely to be found in areas impacted by land use change in Norfolk. Picture of Japanese stiltgrass stalks in forest understory (Invasive Species Center, 2023).

**Common Reed (*Phragmites australis)***

Common reed, commonly referred to as *Phragmites* is a perennial grass commonly associated with wetlands. It can grow up to 20 feet tall and creates dense stands that outcompete native species. In late summer, it produces feathery flower plumes that are purple when young and fade to tan. While some species of *Phragmites* are native to North America, the invasive type was introduced from Europe in the 1800's. It most likely was introduced through ship basalt water.

Common reed reproduces both sexually and asexually. It produces seeds in late summer from the large plume. The seeds are often spread by wind but are not as important to the success of invasive common reed as vegetative reproduction. Asexually, *Phragmites* reproduce through rhizomes that spread horizontally through soil and produce new shoots. The plant can also reproduce through stolons which are similar to rhizomes, but above ground.

Common reed can survive in a variety of wetland habitats. It can be found on every continent expect Antarctica. It tolerates both acidic and basic soils, and both nutrient-rich and nutrient-poor environments. However, tolerance may vary depending on the plant's developmental stage. In Vermont, common reed grew on highly acidic mine tailings with a pH of 2.9. Phragmites thrive in low salinity but can also grow in high salinity conditions. It also grows best in partial to full sun. Common reed is most commonly associated with disturbances and human activity, often occurring on old mine sites and clear-cut wetlands.

Common reed forms dense, tall stands that crowd out native plants, reducing plant biodiversity. The thick stands alter habitat structures, and make it harder for native animals like birds, fish, and amphibians to survive. Common reed changes soil chemistry by trapping sediments and increasing organic matter. It also lowers water flow and can dry out wetlands over time. Additionally, fire frequency and intensity may increase, because dry common reed stands are highly flammable.

Common reed is not associated with non-wetlands and would likely not be found in the Dry Sub-Acidic Forests but may survive on nearby riverbanks. The Acidic Black/Red Spruce Basin likely has too much shade, and acidic nutrient poor soil that would not be advantageous for its growth. The Poor Fen is a more suitable habitat as it has less shade, and increased water movement that can bring nutrients frequently. Picture of dense common reed thickets (Delaware Department of Natural Resources and Environmental Control, 2025).

**Black Locust (*Robinia pseudoacacia)***

Black locust is a deciduous tree that is native to the Appalachian and Ozark mountains. Black locust belongs to the Fabaceae family. This family includes a wide variety of plants such as trees, shrubs, herbs, and vines. The Fabaceae family also includes plants such as peanut, mesquite, mimosa, tamarind, and fenugreek. The tree can grow up to 82 feet tall, and 4 feet wide. Black locusts have flowers that are white, fragrant, and grow in clusters with a yellow spot on the upper petal. The fruits are dry legumes that split open to release seeds. In Connecticut, black locust typically blooms in late spring to early summer. Black locust can reproduce both sexually and asexually. Sexual reproduction occurs through flowers that are pollinated by wildlife resulting in pods that produce seeds. Asexual reproduction happens via root suckers, where new shoots grow from the tree's roots, creating genetically identical plants. Black locust’s ability to reproduce both by seeds and vegetatively enables black locusts to spread rapidly and invade new areas. The roots can grow up to one to two times longer than tree height.

Black locust is commonly found along roadsides, old pastures, and disturbed areas. It grows well in almost any soil type. It can grow on soils with a wide range of pH levels. However, it favors soils that are moderately fertile and have good drainage. Black locust is nitrogen-fixing, meaning it enriches the soil by converting atmospheric nitrogen into forms usable by plants. This allows it to grow in poor or disturbed soils, such as those found along roadsides or in old pastures. Black locust does not thrive in very moist, and water-logged soils.

Black locust's ability to fix nitrogen allows it to thrive in a variety of habitats and make the soil more favorable for itself. It can form dense thickets that outcompete and out shade native understory species. This disrupts local ecosystems by changing plant communities and reducing habitat diversity for wildlife. Black locust is not associated with wetlands and moist soils so would likely not be found in the Poor Fen and Acidic Black/Red Spruce Basin. Its ability to survive in a variety of environmental conditions makes it an ideal candidate to survive in the Dry Sub-Acidic Forest. If it has not already become invasive in the forest it may possibly invade with land-use change.

Picture of black locust with its white fragrant flowers (Cold Stream Farm, 2025).

**Multiflora Rose (*Rosa Multiflora*)**

Multiflora rose is a large, dense perennial shrub. It is known for its ability to produce large dense areas of vegetation that can reach up to 33ft wide. It is native to Japan, China, and Korea. Multiflora rose was introduced to the United States in the mid-1800s as an ornamental plant. In the 1950's, the U.S. Soil Conservation Service recommended multiflora rose for erosion control on slopes. The shrub can grow 6 to 10 feet tall. It spreads primarily by seeds, which are dispersed by birds and mammals that consume its small red fruits. In addition to sexual reproduction, it can reproduce vegetatively through rooting at the tips of arching canes that meet with soil. This asexual form of reproduction allows multiflora roses to rapidly colonize new areas and outcompete native species. The seeds of multiflora rose can have a lifespan of 10-20 years.

Multiflora rose grows slowly in its first 1-2 years of establishment and then begins to rapidly expand through layering and root expansion. It grows best in full sun, and well-drained, infertile soils. Multiflora roses can commonly be found in pastures, forest edges, and roadsides. Multiflora rose forms dense thickets with thorny stems that inhibit growth of native species. Additionally, it degrades forage and graze quality of pastures and fields.

Multiflora rose needs well-drained soil with full sun. It is unlikely that it will grow in any of the vulnerable habitats, but could if there is large clearing for development that creates forest edges and pastures that have full sun. Picture of multiflora rose with bright white flowers (U.S. Department of the Interior, 2025).

**Garden Heliotrope (*Valeriana officinalis*)**

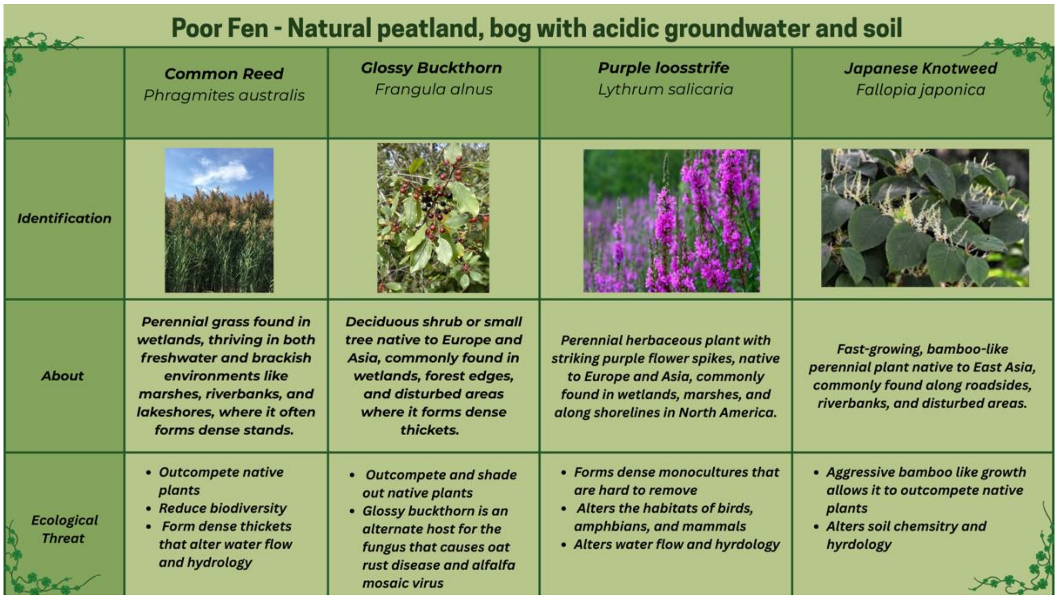
Garden heliotrope is a herbaceous perennial known for its medicinal properties (Center for Invasive Species and Ecosystem Health, 2018). It is considered a noxious weed in Connecticut, meaning it is a threat to ecosystems and crops within the state (NC State Extension, 2025). Garden heliotrope is native to Europe and eastern parts of Asia. The plant can grow up to four feet tall. Garden heliotrope has fragrant white and pale pink flowers that bloom between June and August. It also has small fruits, but seeds are mostly spread by wind (Center for Invasive Species and Ecosystem Health, 2018). Garden heliotrope produces valerian, which is a substance used in herbal medicine to treat anxiety, restlessness, and insomnia. Extracts are also used in perfumes, herbal teas, and as flavoring in various food products (NC State Extension, 2025).

Garden heliotrope grows well in full sun, and moist soils. It can tolerate light shade and dry soil, but not at the same time. Garden heliotrope is commonly planted in gardens and escape into nearby ecosystems. It can grow in a range of habitats, such as grassland and wooded sites. Specific site conditions regarding garden heliotrope are unavailable at this time (NC State Extension, 2025).

Research regarding garden heliotrope's invasive habitat range is limited. However, based on the limited available information it is unlikely to survive in any of the three vulnerable habitats. It needs moist, well-drained soils, and full to partial sun. Picture of garden heliotrope with bright multi-colored flowers (Cold Weather Gardening, 2013).

## Summary of Norfolk's Invasive Plants

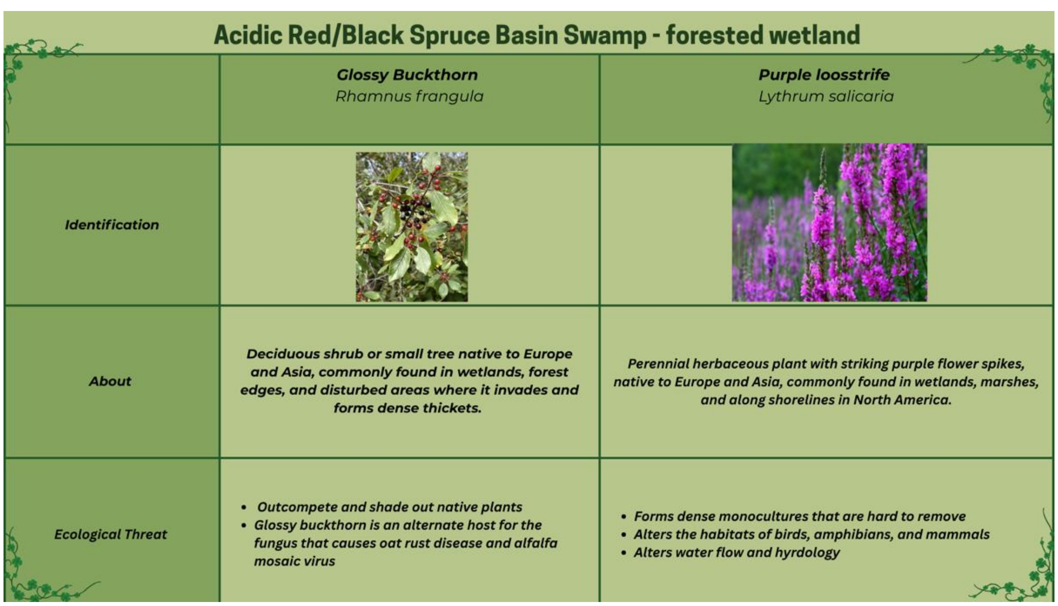
The four graphics below summarize the conclusions of the invasive plants of particular concern within Norfolk.



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<br>• Reduce biodiversity<br>• Form dense thickets that alter water flow and hydrology | • Outcompete and shade out native plants<br>• 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<br>• Alters the habitats of birds, amphibians, and mammals<br>• Alters water flow and hyrdology | • Aggressive bamboo like growth allows it to outcompete native plants<br>• Alters soil chemsitry and hyrdology |

Figure 2: Chart of invasive plants that are present (or may thrive well) in the Poor Fen. Made by Courtney McCann, all information is from the USDA Fire Effects Information System, and images from each section about the plants.



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<br>• 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<br>• Alters the habitats of birds, amphibians, and mammals<br>• Alters water flow and hyrdology |

Figure 3: Chart of the invasive plants that are present (or may thrive well) in the Acidic Red Black Spruce Basin Swamp. Made by Courtney McCann, all information is from the USDA Fire Effects Information System, and images from each section about the plants.

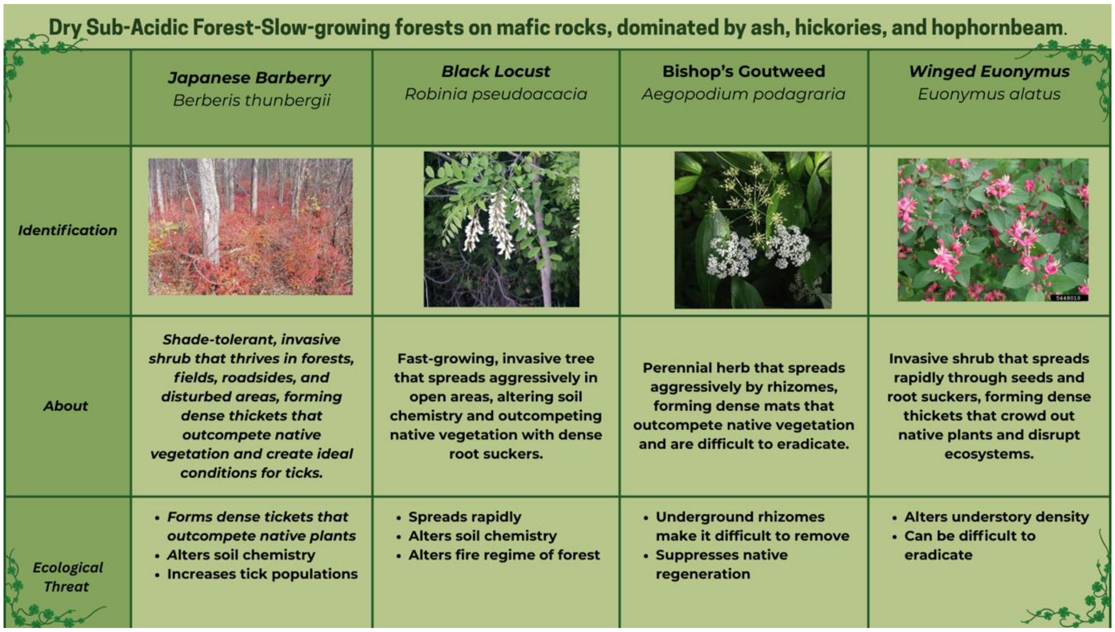



Figure 4: Chart of the invasive plants that are present (or may thrive well) in the Dry Sub-Acidic Forest. Made by Courtney McCann, all information is from the USDA Fire Effects Information System, and images from each section about the plants.

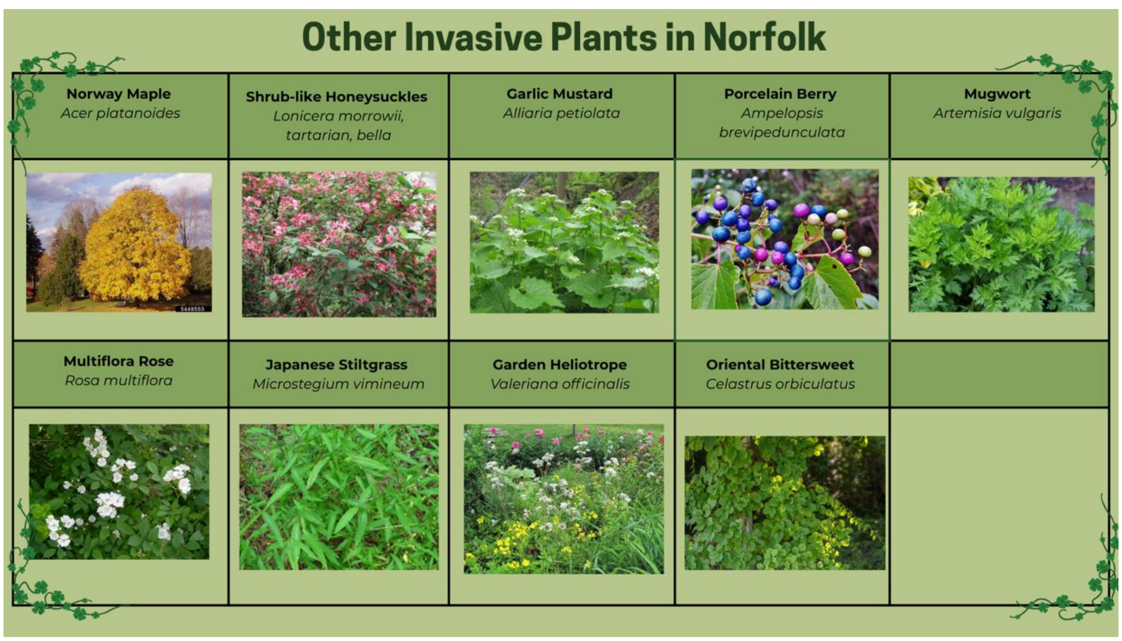



Figure 5: Chart of the invasive plants in Norfolk that are unlikely to be associated with the three vulnerable habitats. Made by Courtney McCann, all information is from the USDA Fire Effects Information System, and images from each section about the plants.

# Invasive Plants in a Changing World

## Climate Change

Climate change and land use change are a threat to all of Norfolk's vulnerable habitats and are also major causes of the spread of invasive plant species. Climate change can alter invasion success through environmental conditions and biotic interactions. Climate change will drive increased temperatures, extreme weather events like hurricanes, droughts, and wildfires. We will likely see the change in temperatures and in light and water availability in ecosystems. These changes can both cause species to survive in areas they previously could not, or species not to survive in habitats they previously were able to survive (Cho, 2024).

Under current warming predictions it is expected that 144 invasive plants in the eastern United States will shift their range northward by 213 km. Additionally, "sleeper" plants that were previously limited by temperature may "wake up" as the two-degree Celsius warmer planet is more suitable for them. Increased temperatures will not just force the range of plants northward but will extend growing seasons. This extended growing period often benefits invasive plants that have more time to grow and outcompete native species (Cho, 2024). Additionally, the increased frequency and intensity of storms like hurricanes will spread invasive plant species seeds across landscapes and introduce them to new habitats. Some invasive plant species will flourish under increased atmospheric carbon dioxide concentrations, especially those that are fast growing, like vines. Climate change not only will impact the spread and growth of invasive species but will also amplify their ecological disturbance. Woody plants like the common reed are flammable, and wildfire risk will increase with increased temperature and drought (Cho, 2024).

Eastern temperate forests have a large "invasion debt". This means that invasive species that may survive in these regions have not yet been introduced. Climate change will allow these species to be dispersed in these areas, especially in the north. Invasive plant species hotspots will be driven north, because previous environmental barriers like cold tolerance will have less occurrence (Merow et al., 2017). However, not all invasive plants will benefit from climate change. One study in New England found that garlic mustard will decrease in abundance as it survives better in colder climates. Japanese barberry however will benefit from climate change, increasing its abundance in New England, and moving north into Canada. Invasion risk is plant specific and regional specific. Norfolk is a colder microclimate that may allow garlic mustard to survive longer compared to other portions of Connecticut and New England (Merow et al. 2017).

## Land Use Change

Land use changes such as clearing for land development and agriculture are by far the greatest threats to the spread of invasive plants in Norfolk's vulnerable habitats. Invasive plant species thrive in disturbed areas where they gain a competitive advantage over native species. Invasive plants are generalist species that can thrive in a variety of habitats, which leads to establishment in areas like railroad tracks, hiking trails, clear cut forests, brownfields, abandoned fields, and roadsides. When natural habitats like forests are fragmented for the construction of roads, houses, and hiking trails, it creates edge effects. Along these edges is a habitat that is sunnier, warmer, and drier which many invasive plants thrive in (Wang et al., 2019). Additionally, human activity is often responsible for the spread of invasive species. Seeds can be introduced to new areas when they travel on vehicles, clothing, and pets.

# Best Management Practices

## Physical and Chemical

Mechanical control of invasive species involves physically removing the invasive plant. This method can be labor-intensive but is effective for small infestations and can be combined with other control methods. The most common techniques are cutting, mowing, and pulling. Cutting is effective in delaying and preventing seed production and depleting plant resources. However, follow up is often necessary because it does not fully remove the plant's roots. Mowing is often used with cutting to aid in preventing seed production. The combination of these methods is most effective for grasses and herbaceous plants. Pulling is effective for small infestation of herbaceous plants. This method removes seedlings and annuals, but the root must be fully removed to prevent regrowth.

Chemical control involves the use of herbicides to manage invasive plant species. An application method called foliar spraying is most used, where herbicides are sprayed directly onto the leaves of invasive plants. This method is effective at controlling large infestations of invasive plants but requires careful application to avoid harming non-target species and the environment. The most common herbicides used are glyphosate and triclopyr. In most cases, only use herbicides if mechanical removal is not possible.

"Connecticut's Invasive Plant Management Calendar" by Emmet Varricchio and CIPWG collaborators goes in depth on the best mechanical and chemical strategies for addressing the most common invasive plants in Connecticut. Different species require different management techniques.

## Prescribed burning

Prescribed burning of invasive species is the removal of invasive species through the use of fire, undertaken by well-trained individuals during specific weather conditions. Prescribed burns clear invasive plant biomass and allow for the natural regeneration of vegetation. In some cases, prescribed burning can stimulate fire-adapted species that can withstand burning and can aid seed germination (USDA, 2023). This method of invasive species control is often combined with physical control methods like cutting and mowing. Prescribed burning can be costly for small areas but is greatly used in large areas with large amounts of invasive species like dense common reed stands. Prescribed burning can control the following species; common reed, shrub-like honeysuckles, multiflora rose, garlic mustard, and mugwort (Conntecticuit Invasive Plant Working Group, n.d.).

## Hydrological Manipulation

Hydrological manipulation is the physical control of invasive plant species by raising or lowering water levels to stress or drown invasive species. This form of control works best for wetlands and has been used for control of Phragmites. This method of invasive species control can be costly as it requires dams and pumps to alter water levels. Additionally, it requires extensive planning. If hydrological manipulation is timed right, it can stimulate the growth of native wetland species (University of Florida Center for Aquatic and Invasive Plants, 2025).

## Native Seeding

Planting native species after physical or chemical removal of invasive plant species is an important management strategy to promote native forest regeneration patterns. Also called "priority effects management", seeding native plants can promote ecosystem restoration of invasion of exotic plants by manipulating the timing and sequence of species introduction. This practice will allow native species to outcompete invasive species for nutrients and space. Seeding native species will reduce the likelihood of invasive species future establishment (Young et al., 2016).

Seeding native plants is cost effective as removal practices such as cutting and mowing are already taking place in Norfolk. Seeds are low cost and can be scattered in the area after removal. There are some drawbacks of native seedling, as it relies on favorable environmental conditions for native species. In some cases, if the weather during the growing season was too dry or wet for the native plant species, it was out competed by the invasive species. Additionally, invasive plants can have a competitive advantage even when they are a late arriver during succession. However, the advantages outweigh the costs of native seeding after using chemical or mechanical invasive plant removal practices (Young et al., 2016).

## Biological Control

Biological control of invasive species is the introduction of a targeted predator. This predator can be an insect, parasite, pathogen, and in some cases mammals. This measure is often costly and requires a significant amount of labor and monitoring. However, biological control agents are well studied and must undergo an approval process by the United States government. There is always the risk that the introduced predator will become invasive in the chosen ecosystem (University of Florida Center for Aquatic and Invasive Plants, 2025).

Research into the control of Phragmites has been ongoing for decades, however no recommendation has been made yet (Tewksbury et al., 2002). Purple loosestrife, however, has been successfully managed with biological controls in Connecticut. *Galerucella calmariensis* and *G. pusilla* beetles have been released in Connecticut as part of a long-term study to control purple loosestrife. These leaf-eating beetles defoliate the plant, reducing its ability to photosynthesize, store energy for winter, and produce flowers. The beetles have caused significant damage at the release sites and are successfully overwintering and reproducing (Connecticut Invasive Plant Working Group, 2014). Another successful form of biological controls includes multiflora rose control by grazing of goats (Sundberg, 2019).

## Public Outreach & Education

Another practical and cost-effective invasive plant management technique includes public outreach and education initiatives in Norfolk. Raising awareness through workshops, community events, and informational materials will inform residents about the importance of the critical habitats in their town and the invasive plant species threatening them. Along with understanding the threats posed by invasive plants, residents can also learn about how to identify them and the best management practices to control them, even in their own yard. Because invasive plants can spread through hiking gear or pets, encouraging practices such as cleaning gear before hikes or monitoring dogs on a walk will help prevent the accidental spread of these species. Utilizing social media platforms and identification apps like Seek, Picture This, Google Lens, or Go Botany (website) can help community members recognize invasive plants and take action. Additionally, some plant stores continue to sell invasive species as ornamental garden plants. Ensuring local plant stores sell only native plants and educating Norfolk residents about the risks of planting invasive species will help prevent unintentional introductions.

Organizing volunteer events and activities, such as “pulling parties,” to remove invasive species is also an effective management practice. Volunteer efforts not only help remove invasive plants but also raise awareness about the importance of preserving native habitats. Organizations such as Great Mountain Forest often host educational information sessions and has organized invasive plant removal with volunteers in the past. The Norfolk Conservation Commission has also done the same.

# Conclusion

Ultimately, this assessment has identified three of Norfolk's critical habitats and their ecological importance in the town. Poor fens, acidic red/black spruce basin swamps, and dry sub-acidic forests have been located, defined, and assessed based on their presence in the town. Further research of invasive plants found in Norfolk was conducted to understand their current and future threats to these critical habitats. Land use change is the largest threat to these habitats and the leading cause of the spread of invasive plants. Continued monitoring of invasive plants as their distribution changes from climate change will be needed. Based on the management practices discussed in this analysis, a combination of physical and chemical controls with the secondary use of native planting is recommended to address the growing concerns of invasive plants in the town.

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