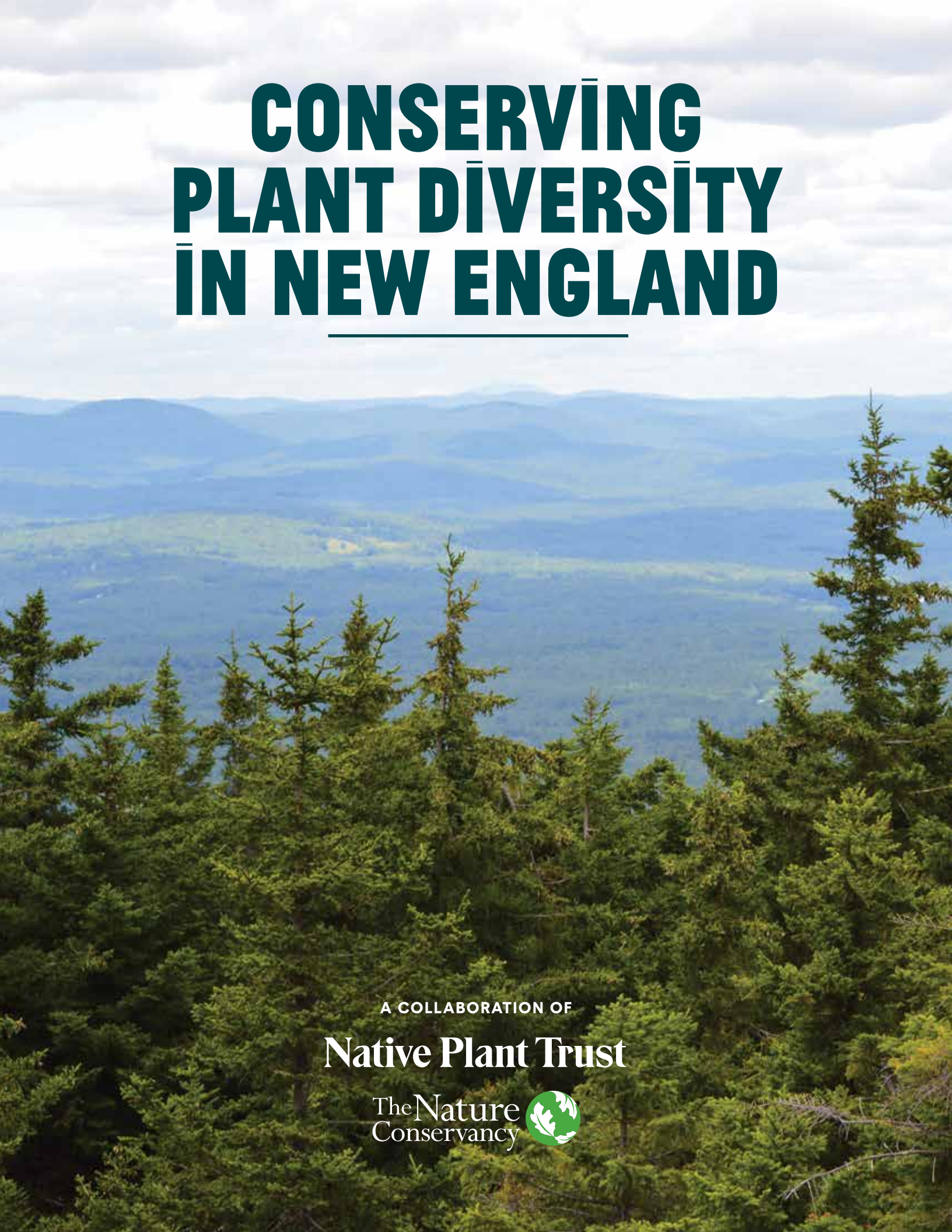
# CONSERVING PLANT DIVERSITY IN NEW ENGLAND



A COLLABORATION OF

Native Plant Trust

The Nature Conservancy

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# CONTENTS

# CONTENTS
**CONTINUED**



Canada rosebay
(*Rhododendron canadense*)
Dan Jaffe © Native Plant Trust

# EXECUTĪVE SUMMARY

# EXECUTIVE SUMMARY

## Overview

*Conserving Plant Diversity in New England* is a groundbreaking new report resulting from a two-year collaboration between Native Plant Trust and The Nature Conservancy. The report provides a scientific framework and detailed roadmap for conservation action and land protection at the species, habitat, and parcel scales that will effectively save plant diversity—and thus overall biodiversity—in New England as the climate changes.

Michael Piantedosi © Native Plant Trust

The genesis of the study was a desire to know whether a century or more of land conservation has protected enough land in the right places to save the region's plant diversity. Our goal was to assess the region's status in meeting targets in the Global Strategy for Plant Conservation, which is part of the United Nations' Convention on Biological Diversity (CBD). The CBD partners recently extended their targets to encompass goals recommended by the Global Deal for Nature (Dinerstein et al. 2019), and thus the 2021 update calls for protecting 30% of the world's ecosystems by 2030. To determine progress toward both the original and expanded goals, the team:

- delineated the regional distribution of 43 unique habitats
- identified 234 Important Plant Areas (IPAs)—climate-resilient areas with a relative abundance of rare and endangered plant species, containing 212 of our rarest species
- assessed the current protection status of those habitats and IPAs and likely losses to development by 2050
- evaluated their ability to effectively adapt to a changing climate.

Recently, the Biden administration announced its "Conserving and Restoring America the Beautiful" initiative, which calls for locally led campaigns to conserve and restore 30% of the nation's lands and waters by 2030 (Executive Order 14008). ***This report and the accompanying interactive mapping tool give policy makers, federal and state agencies, and land trusts in each state the detailed information needed to most effectively spend conservation dollars*** to achieve that goal by protecting resilient, biologically diverse landscapes across New England.

Finally, we want to acknowledge other important reports assessing habitat conservation in New England, including "Wildlands and Woodlands" (Foster 2012), "Losing Ground" (Lautzenheiser et al. 2014), "Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region" (Anderson et al. 2012), and "The vulnerabilities of fish and wildlife habitats in the Northeast to climate change" (Manomet 2012). To our knowledge, however, this is the first analysis to identify the specific sites throughout New England to protect to ensure the survival of plant assemblages and their inherent diversity.

## Targets and Approach

Plants are the basis for life on Earth. Plant communities translate the geophysical variation of the land, such as soil and topography, into the living habitats that sustain life. Conserving multiple intact examples of every habitat is a strategy for sustaining the natural benefits plants provide and maintaining the full diversity of species that depend on them (Beier et al. 2010). This report is thus the first to focus on regional plant diversity and resilience as the foundation for conservation policy and action.

*northern blazing star (Liatris novae-angliae)*
Liza Green © Native Plant Trust

Plants and plant communities face a host of immediate threats, from development to invasive species, as discussed in this report and more thoroughly in Native Plant Trust's "State of the Plants: Challenges and Opportunities for Conserving New England's Native Flora" (Farnsworth 2015). The altered temperature and precipitation patterns brought by a changing climate pose long-term challenges for ecosystems, as the composition and location of plants and plant communities shift in response. Thus, the research team took as a fundamental premise that the conservation targets must be grounded in an analysis of **resilience**—places where the land provides many microclimates or natural strongholds for current plant populations that will enable them to endure under different climate scenarios. Thus, for each habitat and Important Plant Area (IPA), we mapped the location of its most resilient land and measured the achievements of a century of collaborative conservation efforts toward permanently protecting those sites from conversion.

Our classification of conservation lands follows the U.S. Fish and Wildlife Service GAP program terminology (Crist et al. 1998), in which:

- "**Secured**" refers to land that is permanently secured against conversion to development through public or private fee ownership, easement, or other legal means.
- "**Protected**" refers to the subset of secured land explicitly dedicated to conserving nature and natural processes (GAP 1) or managed for a primarily natural state (GAP 2)
- "**Multiple Use**" refers to the subset of secured land that is open to many types of uses including recreation, resource extraction, and management (GAP 3)
- "**Unsecured**" refers to privately owned land or public land with no conservation restrictions.

With that data, we then determined how much of each resilient habitat or IPA needs protection to meet the goals of the two international benchmarks.

The Global Strategy for Plant Conservation (GSPC) has three targets relevant to this analysis:

- Target 4: At least 15% of each vegetation type secured through effective management or restoration (i.e., "protected")
- Target 5: At least 75% of the most important areas for plant diversity (IPAs) of each ecological region protected with effective management in place for conserving plants and their genetic diversity
- Target 7: At least 75% of known threatened plant species conserved in their natural place in the wild.

We tailored the area-based goals of the Global Deal for Nature (incorporated into Biden's "America the Beautiful" initiative) to the character of the New England landscape, the varieties of legal protection available here, and the impact of climate change. Thus, we set New England targets to parallel the GSPC targets, both with a timeframe of 2030:

- NE Target: At least 5-15% of each habitat protected and at least 30% secured against conversion. At least 75% of the securement on climate resilient land.
- NE Target: At least 30% of each climate-resilient area with the highest rare plant diversity (IPA) protected and at least 75% of each IPA secured against conversion across habitats and states.

The first NE target sets the protected level (conserved to protect nature and natural processes) needed based on habitat scale: dominant matrix forests 5%, wetlands 10%, patch-forming habitats 15%. Similarly, the resilience criterion is adjusted downward to 50% for wetlands to include some vulnerable but already protected examples of these critical habitats.

While this report focuses on protecting resilient and representative land, that approach is not always sufficient to sustain diversity. Protection of resilient land is most effective where the threat is habitat loss, conversion, or climate change; but other threats—like altered processes, trampling, overharvesting, and invasive species—need monitoring and management. Land protection also needs to go hand-in-hand with conservation strategies like seed banking, reintroduction, and assisted migration that ensure sources of biotic renewal are available and viable. The GSPC has a goal (Target 8 below) specifically related to ensuring that 75% of threatened plant species are in *ex situ* collections (seed banks and living collections at botanic gardens).


Eastern red cedar
(*Juniperus virginiana* var. *virginiana*)
Dan Jaffe © Native Plant Trust

# Results

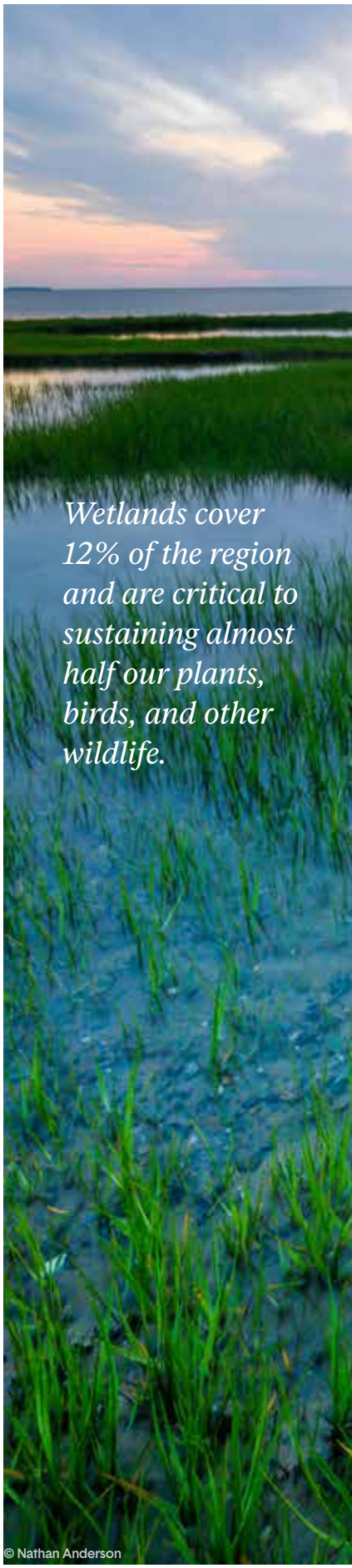
Conservation of New England's plant diversity under a changing climate is an achievable goal, but it requires significant increases in the securement and protection of resilient habitat. This will require securing large, multiple-use areas against conversion and managing them to retain essential functions, as well as protecting smaller areas for natural processes that ensure plant populations and communities thrive. As much as possible, securement should be focused on climate-resilient land. **To achieve the NE target of 30% secured will require the protection of 2.3 million acres of additional resilient land in specific habitats.** In addition, we must ensure the effective management of the existing 5.3 million acres of multiple-use forest land that is central to wildlife habitat and carbon storage but open to logging and mineral extraction.

- **Forests cover 86% of the natural landscape, but only one of New England's ten dominant forest types meets GSPC target 4 and only two meet the NE target.** Reaching the NE target will require securing an additional 2 million acres of climate-resilient forest. To reach the GSPC goal of 15% protection across all forest habitats requires investing in 3 million acres, including increasing the GAP level on land that is already secured. Urgently in need of conservation are resilient examples of oak-pine and coastal hardwood forests of southern New England that are already challenged by fragmentation and predicted to lose up to 18% of their current distribution to development by 2050.

- **Wetlands cover 12% of the region and are critical to sustaining almost half our plants, birds, and other wildlife, but are less conserved than we expected.** Of New England's eighteen types of bogs, swamps, floodplains, and marshes, only six meet the GSPC and three the NE targets, and these are predominantly small, unique bogs and peatlands. None of our five most common wetland types meet either target, although many unprotected examples occur on resilient land, and at least 20% of each habitat is secured against conversion. Reaching the NE target will require conservation of an additional 253,902 acres of resilient wetland and for the GSPC target 405,083 acres protected for nature.

- **Patch-forming terrestrial habitats are hotspots of plant diversity and often critical habitat for rare and endangered plant species.** Covering only 2% of New England's landscape, these summits, cliffs, barrens, and dunes sustain densities of rare species ten times higher than wetlands and forty times higher than upland forests. These unusual habitats are more often on secured land than their widespread counterparts, and seven out of fourteen types meet the GSPC target. However, only four meet the NE target because sites supporting sand-based habitats like pine barrens and coastal grasslands occur on flat and fragmented land that is vulnerable to climate change. Many of these habitats are also under high threat of conversion, with 15-18% of their current extent predicted to be lost by 2050. Meeting the 30% NE target requires securing only 17,726 acres, but it will take 88,620 acres of targeted resilient land to bring the silt- and sand-based systems to the standard for climate resilience.

- **Important Plant Areas (IPAs) are patches of resilient land that contain an exceptionally high density of rare plant species.** We identified 234 IPAs for New England that in aggregate cover 2.6 million acres and contain multiple examples of 212 rare plant species and resilient examples of 92% of the habitats. Each IPA's rare plant diversity ranges from 2 to 26 taxa depending on the site's size and location. By acreage, the IPAs are 29% protected, with another 23% secured on multiple-use lands. By site, 10 IPAs (4%) are more than 75% protected (GSPC target) and 32 (14%) have more than 75% securement in a combination of protected and multiple-use land. Conserving the unsecured IPAs (1.3 million acres) would go a long way toward sustaining the region's floristic and habitat diversity.



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- **New England has 388 globally and regionally rare taxa in need of conservation, as documented in Native Plant Trust's "*Flora Conservanda*: New England" (Brumback and Gerke 2013).** State Natural Heritage program inventories provide high-quality spatial records on 245 of them. Of those, 226 (92%) have occurrences on secured land (GAP 1-3), and of those 42% have more than 50% of their known locations are on secured land. However, only 16% of these occurrences are on protected land (GAP 1-2). The majority of the mapped locations are on resilient lands, although many taxa occur on a mix of resilient and vulnerable sites. Of the 245 well-mapped taxa, 19 have no permanent protection.

- **Conserving rare plants also requires *ex situ* strategies, as captured by GSPC Target 8**: "At least 75% of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs." In New England, Native Plant Trust manages the primary seed bank of rare and endangered species. Currently the seed bank holds collections of 43% of globally and regionally rare plant species. However, the collections are from only 7% of the populations.

# Recommendations

We recommend an approach to land conservation that focuses **on more proportional representation of the region's habitats across their ranges**, rather than on securing more acres of habitat types that are abundantly conserved already. While securing 30% of each habitat from conversion to another land use is important for maintaining resiliency and biodiversity in a changing climate, we also recommend each state aim for 15% of each habitat protected (conserved for nature and natural processes), with a minimum of 5% for dominant forest types. Prioritizing the IPAs will ensure that habitat protection also captures rare plant species.

sugar maple
*(Acer saccharum* var. *saccharum)*
Uli Lorimer © Native Plant Trust

The report's interactive maps and state-specific data will enable policy makers, federal and state agencies, and the land trusts in each state to effectively target the most significant areas for protecting New England's plant diversity and the biodiversity it supports. Examples include:

- Habitats that are rare within New England, such as coastal plain habitat primarily in Massachusetts and Rhode Island, warrant greater protection efforts, with a higher proportion secured for nature within the states where they occur.
- States with relatively large areas of a common habitat lacking conservation protection should also increase the amount of that habitat secured. For example, 90% of the regional habitat area of *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp* is found in Maine, yet 84% of this habitat is unsecured in the state.
- Habitats facing significant losses to development by 2050, such as the coastal hardwood forests of southern New England, are also high priority.

A recommended starting point is **conserving the IPAs in each state**, which saves rare species across multiple habitats. The two primary strategies are focusing on IPAs that are unsecured and increasing the amount of protection within IPAs that are partially secured, either by conserving more acres or raising the level of securement to GAP 1 or GAP 2, depending upon the density of rare species.

While most of the 43 habitats need additional securement, we highlight several, and their IPAs, that need urgent conservation action.

**Matrix Forests**

- Mid-elevation *Laurentian-Acadian Pine-Hemlock-Hardwood Forest* in Maine and Vermont has relatively high resilience but the lowest protection (2%) and securement (14%) of any forest type.
  - In Maine, there are eight unsecured IPAs within this habitat, totaling 22,980 acres.
  - New Hampshire has a single unsecured IPA of 5,537 acres.
  - Vermont has two unsecured IPAs totaling 3,515 acres.

- *North Atlantic Coastal Plain Hardwood Forest* (in all states but Vermont) meets the NE target of 5% protected, but less than half of that is on resilient land; it is also only 19% secured and highly threatened by development. All states should focus on this habitat, but Connecticut, Maine, and Rhode Island have the least securement.
  - In this habitat, there are twelve IPAs needing protection: six in Connecticut (6,402 acres), three in Massachusetts (2,085 acres), and three in Rhode Island (3,175 acres).
- *Northeastern Interior Dry-Mesic-Forest* and *Northeastern Coastal & Interior Pine-Oak Forest* have low securement, low resilience, fall short of the GSPC and NE targets, and are moderately threatened by development. The former needs securement in Connecticut, Massachusetts, and Rhode Island, and the latter is especially unsecured in southern Maine. The small IPAs will likely need to be embedded in a larger matrix of protected lands to remain viable.
  - In *Northeastern Interior Dry-Mesic Forest*, Connecticut has ten IPAs on a total of 7,754 acres, nine of which are unsecured. Massachusetts has two IPAs on 2,441 acres needing protection.
  - In *Northeastern Coastal & Interior Pine-Oak Forest*, Maine (9 acres), Massachusetts (468 acres), and New Hampshire (2,612 acres) each have a single IPA needing protection.

**Wetland Habitats**

- *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp* is well-secured in the southern part of its range, but it is predominantly in Maine, where it is largely unsecured. The habitat also needs conservation in Vermont, where only 14% of total acres and 21% of resilient acres are secured.
- *North-Central Interior Wet Flatwoods* is a rare habitat with only 25,306 acres across five states (all but Rhode Island), very little of which is protected, and most of the 16% total securement is not on resilient land. The habitat is also threatened by development. A single unsecured IPA in Massachusetts of only 67 acres should be a high priority for investigation.
- The 14,032 acres of *Glacial Marine & Wet Clayplain Forest* occur only in Vermont and are a high priority for conservation. Only 3% of total acreage is protected and 12% secured; only 14% of resilient acres are secured.
- *Laurentian-Acadian Large River Floodplain* is home to an exceptionally high density of regionally or globally rare plant species, with more than 30 rare taxa, many of which occur primarily in this habitat type. While 29% of the resilient acreage of this habitat (212,136 acres) is secured regionally, only 7% is protected (GAP 1-2). This habitat is predominantly found in Maine, where 71% of the 186,857 resilient acres are unsecured.

**Patch-forming Habitats**

- Four forest habitats are so restricted that they are included in the patch-forming habitat analysis, and two are high priority for conservation. The *North Atlantic Coastal Plain Maritime Forest* is only 15% secured in Maine, and only 18% of resilient acres are secured. Vermont's *Glacial Marine & Lake Mesic Clayplain Forest*, encompassing 32,066 acres, is only 7% secured.
  - Of the two IPAs in the maritime forest, a 500-acre site in Massachusetts needs protection.
- The coastal plain sand- and silt-based habitats are especially vulnerable to climate change. While the number of acres needed to reach targets is relatively small, it may be difficult to sustain these habitats over time. A clear focus should be saving the 36 rare plant species in the beach and dune habitats and the 8 in the coastal grassland.
  - Three *North Atlantic Coastal Plain Heathland & Grassland* IPAs in Massachusetts, encompassing 2,657 acres, are priorities; only one is protected.


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While this report focuses primarily on land conservation, we also examine and recommend additional conservation strategies, such as assisted migration, restoration and augmentation of sites and populations, and seed banking to preserve genetic diversity. What is certain in a changing climate is that we need multi-layered, science-based approaches to saving plant diversity and the life it sustains. We know that a rapidly changing climate will stress the ability of individual species and entire habitats to adapt, and thus recognize that some will migrate, some will die, and some will form new assemblages. With this report and its mapping tool, we aim to ensure that New England's native plants—the green foundation for functioning ecosystems—are at the forefront of conservation policy and action as climate plans develop.

American chaffseed
*(Schwalbea americana)*
Uli Lorimer © Native Plant Trust

PART ONE

# CONSERVĪNG PLANT DĪVERSĪTY

purple milkweed
(*Asclepias purpurascens* L.)

PART ONE

# CONSERVING PLANT DIVERSITY

## Background

### PLANT DIVERSITY AND RESILIENCE

In this report, we focus on the diversity and resilience of habitats rather than on plant diversity as the number of species. Plant communities translate the land's geophysical variation into living habitats that support many types of species. Conserving multiple intact examples of every habitat is a strategy for sustaining the natural benefits plants provide and for maintaining the full diversity of species that depend on them. In this section, we review the importance of habitat diversity, while in later sections we describe the habitats and rare species of the region. To account for the overarching effect of climate change on the distribution of plant species, we present an approach for identifying occurrences of each habitat that have the greatest resilience to climate change. Using The Nature Conservancy's map of site resilience and fine-scale maps of land securement, we assess the status of each habitat with respect to protection and resilience, and we set goals for conserving a resilient network of representative habitats.

*Gray's flatsedge (Cyperus grayi)*

Michael Piantedosi © Native Plant Trust

*For many conservation activities, plants are considered background, yet they furnish and cleanse the air we breathe and provide the basis for our medicines and food.*

For many conservation activities, plants are considered background, yet they furnish and cleanse the air we breathe and provide the basis for our medicines and food (Grifo and Rosenthal 1997). They are the basis for all life on planet Earth, and their role in forming and maintaining the ecosystems of the world has been valued at $125 trillion per year in tangible ecological services that benefit humans (Costanza et al. 2014). Plants also remove carbon dioxide from the atmosphere and store it as wood, leaves, roots, and soil. Plants process 123 billion metric tons of carbon each year across the globe (Beer et al. 2010), thus stemming the buildup of greenhouse gases. Half the weight of a tree consists of stored carbon, and since 80% of New England is forested, forests can help reduce the impact of climate change (Catanzaro and D'Amato 2019).

#### Species Diversity

Plant diversity is often measured as "richness," the number of species within a given area or the average number of species within a habitat. Diversity may also be represented as taxonomic diversity (the genetic relationships between different groups of species) and be quantified by the relative abundances of the species present. Further, plant diversity may be described in terms of functional diversity—those traits of the species present in an ecosystem that influence how an ecosystem operates or functions. The structure of a plant community (trees, shrubs, herbaceous plants) is part of the functional diversity of the community.

Ecologists have long held that a more diverse community tends to be more stable, and there is some evidence to support this. A classic study in the 1990s demonstrated that grassland plots with the most species, that is, those with greater diversity, were most resistant to the effects of drought and were most likely to have a growth rebound after the drought ended (Tilman 1999). A more recent study shows that vegetation, such as a patch of prairie or forest stand, is more productive in the long run when more plant species are present (Reich et al. 2012). Moreover, when biodiversity in the landscape is reduced, as in a cornfield, pine plantation, or suburban lawn, we fail to capitalize

on the natural services that biodiversity provides (Reich et al. 2012). Some studies show that high local and regional diversity enhances multiple ecosystem services over time in a changing world (Duffy 2008). Of course, many habitats (e.g., alpine areas, peat bogs) have been stable for millennia despite having relatively few species in the assemblage, suggesting that species counts are most meaningful within the context of a given region and the communities and habitats that characterize it.

## Habitat Diversity

*"What better expresses the land than the plants that originally grew on it?"* (Leopold 1949).
Habitat diversity refers to the extent and distribution of vegetated habitats within a region. Plants have evolved to exploit almost every terrestrial situation on Earth, and in each they must negotiate the challenges and limitations of the local conditions. Thus, habitat diversity conveys information about representation of the physical landscape and sets the context for a more nuanced understanding of richness and productivity. For example, tropical forests, with their ample warmth, moisture, and nutrients, represent almost the ideal condition for plants; as a result, they are rich in diversity. In contrast, a New England salt marsh is low in plant diversity because few species have the complex adaptations needed to tolerate cyclic exposure to air, freshwater, and saltwater, but those that do can utilize the rich sources of available nutrients. As a result, salt marshes are extraordinarily productive. These two habitats have evolved to fit different sets of physical conditions, and one cannot substitute for the other. Both habitats are necessary for sustaining the Earth's diversity; thus, the principle of representation—conserving examples of every habitat—is fundamental to maintaining the diversity of life.

The New England landscape is a study in variation. Set over a complicated layering of bedrock and stamped with thousands of wetlands and waterbodies during glaciation, the region's rocky terrain can stretch from coastal marsh to alpine tundra in a single state. As plants transform the abiotic variation into living biotic habitats, their forms and composition become the recognizable habitats that characterize the region. Gnarled wind-buffeted firs among compact cushions of tiny-flowered herbs immediately convey the underlying alpine conditions, where plants are designed to minimize exposure, conserve water, and trap heat. Wet depressions filled with huge-leaved herbs like skunk cabbage and false hellebore convey early spring near the coast and anticipate the deep shady oak-pine canopy to come. As the climate changes, we expect the compositional details of each habitat to adjust in response, but the underlying geophysical settings and terrain-driven processes to remain stable.

Habitats, as described by their characteristic plants and physical setting, are used in conservation as a coarse filter, or shorthand, for the full biotic communities they represent. Alpine habitats, for example, harbor more than 200 plant species, but the habitat's full diversity includes the 3,000 invertebrate species supported by those plants, as well as the 30+ birds, mammals, and herptiles that depend on them both as a food base (Jones et al. 2018). Interspecies relationships may be loose or highly intertwined, such as the blooming cycle of alpine flowers, which is tuned to the seasonal availability of pollinators. Relationships can get very specific; for example, the larva of the endangered White Mountain arctic butterfly (*Oeneis melissa semidea*) feeds on only two alpine sedges, including the rare Bigelow's sedge (*Carex bigelowii*). Evidence suggests that protecting enough habitat also conserves the associated species and relationships.

*"What better expresses the land than the plants that originally grew on it?"* ALDO LEOPOLD 1949

Habitat diversity goes beyond a count of associated organisms. It also includes the functional differences among a diversity of traits and the fulfillment of niche roles in an ecosystem. A diversity of functional traits is often correlated with a diversity of species in everything from phenological variation to biomass accumulation to root establishment. A study in a freshwater stream habitat found that variation in the role of plant functional diversity between seasons highlighted the importance of fluctuations in the relative abundances of leaf biomass on insect detritivore diversity and for ecosystem processes at various trophic levels (Frainer et al. 2014). Functional diversity can convey resilience by increasing the options available for recovery, as was found in a study on shortened intervals of climate-related wildfire, which showed that plants reliant on both soil seed banks and vegetative spread for growth were more resilient than those dependent on one strategy alone (Enright 2014). The associations between plant species richness and arthropod species richness has also been tied to the functional and structural diversity of plants in both grasslands and forests (Schuldt et al. 2019). In this study, there was a direct relationship between forest herbivores and plant species richness, a pattern that held for overall arthropod species richness because of the large proportion of herbivores.

To correctly use habitat diversity as a target for conservation, it is necessary to understand the different scales at which habitats occur and the intricate ways in which they nest. Matrix-forming forests reflect a region's dominant climate and soils, while wetland habitats respond to smaller scale hydrologic settings. Patch-forming habitats reflect very specific edaphic or disturbance factors (Poiani et al. 2000). Matrix forests define the character and fauna of the region, so in order to retain the full suite of services derived from them, they must be conserved at much larger scales than wetland or patch habitats (Anderson, 2008). One approach used by The Nature Conservancy (TNC) to identify areas for matrix forest conservation was to identify large 5,000- to 25,000-acre blocks of relatively unfragmented forest and then prioritize them for conservation action based on the number of embedded wetland and patch habitats (Anderson et al. 2006). Colloquially, this was referred to as prioritizing the chocolate chip cookie with the most chips. Similarly, the IPAs identified in this study are characterized by their dominant habitat but can be evaluated by the number of other habitats and the number of rare species contained within.

In summary, habitats make informative conservation targets because they reflect the region's geophysical variation, support thousands of associated species, convey resilience through functional diversity, and can form the basis of a representative conservation network appropriately configured and scaled to sustain diversity and services. We acknowledge, however, that habitats are messy entities. On the ground, distinctions between similar types can be subtle, and their boundaries are subject to interpretation. For this report, we use NatureServe's ecological system classification and TNC's terrestrial habitat map (Ferree and Anderson 2018). Although these are widely used tools, there is no agreed-upon scale of classification for habitats comparable to that for genus-species. Further, like all living systems, habitats are not static entities, and their composition is dynamic in both time and space. This makes it even more critical that we identify and conserve the most resilient examples of each habitat to ensure that the sites protected will continue to support diversity and ecological function into the future.

## Climate Resilience

Climate change is expected to alter species distributions, modify ecological processes, and exacerbate environmental degradation (Pachauri and Reisinger 2007). Assessments of past and projected future climates indicate that New England is already experiencing increased temperatures and altered precipitation patterns (Dupigny-Giroux 2018). In response, trees are shifting their ranges, creating potentially new species combinations (Fei et al. 2017). Although, conservationists have long prioritized land acquisitions based on habitats (Groves 2003), now they need a way to ensure

*cinnamon fern (Osmundastrum cinnamomeum)*
Liza Green © Native Plant Trust

that sites targeted for a specific habitat will continue to conserve biological diversity into the future, despite climate-driven changes in community composition. To address this issue, The Nature Conservancy has devised an approach for identifying climate-resilient areas based on enduring geophysical characteristics of the land (Anderson et al. 2014).

A climate resilient site is one that maintains species diversity and ecological function even as it changes in response to a changing climate (Anderson et al. 2014). Identifying resilient sites requires that we look beyond the composition and structure of the vegetation and assess the characteristics of the land itself. Plants experience climate at a very fine scale (inches to yards), such that a site with ample topographic and hydrologic variation is experienced by plants as a mix of microclimates. If well connected, areas of high topoclimate variation have the potential to buffer climate-change impacts by enabling local dispersal to more favorable microclimates and may also provide stepping-stones to facilitate longer distance range shifts (Suggitt et al. 2018). This "microclimatic buffering" (Willis and Bhagwat 2009) enables species to persist, even where the average background climate appears unsuitable.

Microclimate buffering was first reported in California's serpentine grasslands, where microtopographic thermal climates showed a 34 °F difference between maximum values on different slopes (Dobkin et al. 1987). Another study found areas of high local landscape diversity were important for long-term population persistence of butterfly species and their host plants under variable climatic conditions (Weiss et al. 1988). Many more studies of landscape-based climate variation have now shown how local climatic variation strongly influences species persistence, leading some scientists to suggest that microclimates not only slow the rate of transition, but also may act as long-term refugia (Morelli et al. 2018; Reside et al. 2013; Ashcroft 2010; DeFrenne et al. 2013; Dobrowski 2011). In the largest and most definitive study, Suggitt et al. (2018) examined five million distribution records for 316 plant species over 30+ years across England and found that microclimatic heterogeneity strongly buffered them against regional extirpations linked to recent climate change, reducing extirpation risk by 22%.

This is all good news for New England, where topography, aspect, moisture, and elevation modify local conditions and create microclimatic patterns that are relatively predictable at the site scale. TNC staff in Vermont measured the soil temperature at six points along Rattlesnake Ridge (a site mapped as having high resilience) and found differences up to 10 °F depending on aspect, elevation, and slope. Combined with moisture and bedrock differences, the small area supported seven distinct natural community types (Goodwin, personal communication, 2019). Even at finer scales there can be considerable climatic variation. A study of ten bogs in the Adirondacks (Langdon et al. 2018) found that while coarse-scale climate models predicted they would have a relatively long growing season averaging 128 days, temperature loggers at each bog found them to be much cooler and more variable, with an average growing season of only 73 days and a range from 22 to 128 days.

Moisture and hydrologic microrefugia are likely to prove essential for species persistence, especially plants (McLaughlin et al. 2017). At the site level, moisture is correlated with topography and aspect and can explain 40-72% of soil moisture variation (Yeakley et al. 1998). Mesic microenvironments are generated by a wide array of hydrologic processes and may be only loosely coupled to the regional climate. Thus, the presence of wetlands, riparian habitats, and groundwater-fed springs and seeps can be used to indicate relative differences in site resilience for areas with flatter topography. The extent and variety of wetlands can be a good indicator of microclimatic variation derived from subtle differences in topography and soils that are challenging to model.

*saltmarsh hay (Spartina patens)*
Michael Piantedosi © Native Plant Trust

TNC's spatially explicit model of **site resilience** is based on observations that intact sites with little fragmentation and a large variety of microclimates and wetlands enable species to persist longer under a changing climate (Anderson et al. 2014). In the model, every patch of land within an ecoregion is compared, and areas with more microclimates and less fragmentation are scored as having greater resilience than flatter and more fragmented areas of the same geophysical setting. The two measured factors used by TNC to map site resilience are: 1) landscape diversity, defined as microclimatic variation derived from topography and hydrology, and 2) local connectedness, derived from local fragmentation patterns. These factors underlie the map of climate resilience that forms the base data layer used in this report.

**Landscape diversity** refers to landscape-based climate variation defined as the variety of temperature and moisture environments created by an area's topography, wetlands, and elevation range. Landscape diversity is quantified by summarizing the variety of landforms, the elevation range, and the density of wetlands in a 0.4 sq km (100 acre) search area around every 30 m patch of land in the region.

**Local connectedness** is the degree to which a given landscape is conducive to the movement of organisms and the natural flow of ecological processes such as local dispersal (Meiklejohn et al. 2010). TNC's model of local connectedness uses 30 m data on land cover, roads, railroads, pipelines, energy infrastructure, and industrial forestry; and each element is assigned a "resistance weight" based on its theoretical resistance to population movements. The analysis measures the connectivity of a focal cell to its surrounding neighborhood when the cell is viewed as a source of movement radiating out in all directions to simulate dispersal through a medium of mixed resistance (Compton et al. 2007).

The **site resilience score** is an equally weighted combination of landscape diversity and local connectedness applied and scored for every cell in the region relative to the cell's geophysical setting and ecoregion (e.g., low-elevation sand in the North Atlantic Coast is compared to other low-elevation sand in the North Atlantic Coast, etc.). Full methods can be found in the published literature (Anderson et al. 2014; Anderson et al. 2012; Anderson et al. 2018). TNC uses the information to incorporate microclimate variation, local connectedness, and site resilience into conservation planning (see http://maps.tnc.org/resilientland/).

# GLOBAL STRATEGY FOR PLANT CONSERVATION AND GLOBAL DEAL FOR NATURE

The genesis of this report was an interest in assessing how well a century or more of conservation action is protecting plant diversity in New England, as measured against the Global Strategy for Plant Conservation, which is part of the United Nations' Convention on Biological Diversity (CBD). We extended the analysis to encompass goals of the Global Deal for Nature (Dinerstein et al. 2019), which calls for protecting 30% of the world's ecosystems by 2030. The 30 by 30 goals are being incorporated into the 2021 update to the CBD and were recently adopted by the current administration as part of its "Conserve and Restore America the Beautiful" initiative (Executive Order 14008).

## Global Strategy for Plant Conservation

The Global Strategy for Plant Conservation (GSPC) was first adopted by the Conference of the Parties to the Convention on Biological Diversity (CBD) in 2002. The GSPC considers plants in the terrestrial, inland water, and marine environments. Further, it applies to the three primary levels of biological diversity as recognized by the Convention, hence plant genetic diversity, plant species and communities, and their associated habitats and ecosystems. The GSPC originally included sixteen targets to be achieved by 2010. The targets were revised for a 2020 timeline and are being updated again in 2021 with a 2030 deadline.

The GSPC emphasizes that the outcome-oriented global targets are a flexible framework within which national and/or regional targets may be developed, according to national priorities and capacities, and taking into account differences in plant diversity between countries (Convention on Biological Diversity 2012).

For this study, we primarily focus on three targets for assessing the conservation of plant diversity in New England:

- Target 4: At least 15% of each vegetation type secured through effective management or restoration
- Target 5: At least 75% of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity
- Target 7: At least 75% of known threatened plant species conserved *in situ.*

The GSPC has a goal (Target 8) specifically related to ensuring that 75% of threatened plant species are in *ex situ* collections (seed banks and living collections at botanic gardens), which we address later in this report. In addition, prior work by Native Plant Trust achieved the first two targets: Go Botany satisfies Target 1, which is "an online flora of all known plants"; and "*Flora Conservanda:* New England" (Brumback and Gerke 2013) fulfills Target 2, "an assessment of the conservation status of all known plant species, as far as possible, to guide conservation action."


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## Global Deal for Nature

The Global Deal for Nature (Dinerstein et al. 2019) is a landmark paper authored by nineteen prominent scientists that advances a science-driven plan to save the diversity and abundance of life on Earth. The GDN targets 30% of Earth to be formally protected by 2030, plus an additional 20% designated as climate stabilization areas to ensure the temperature change stays below 1.5˚C. The authors argue that pairing the GDN and the Paris Climate Agreement would avoid catastrophic climate change, conserve species, and secure essential ecosystem services. The 30 by 30 target is derived from five fundamental goals of conservation science: (1) represent all native ecosystem types or "representation"; (2) maintain viable populations of all native species in natural patterns of abundance and distribution; (3) maintain ecological function and ecosystem services; (4) maximize carbon sequestration by natural ecosystems; and (5) address environmental change to maintain evolutionary processes and adapt to the impacts of climate change (Noss and Cooperrider 1994). Based on these axioms, and the area needed to fulfill them, the GDN argues for 30% of each of the Earth's ecoregions to be protected by 2030.

In this report, we give more detail in the form of a 2030 New England Target (NET), demonstrating how protection should be defined and distributed within ecoregions by translating the goal from 30% of the ecoregion to 30% of each habitat within ecoregions.

# SECURED LANDS AND GAP STATUS

Land and water permanently maintained in a natural state remains the most effective, long lasting, and essential tool for conserving species and habitats (Dudley 2008). Through land securement, conservationists aim to maintain the quality of land and water by regulating its use in specific places. In New England, conservation lands are far from uniform entities; instead, they have a wide range of management intents, are governed by a variety of public and private stakeholders, and represent an array of restrictions, designations, tenures, easements, interest holders, and ownership types.

The evolution of land and water protection to encompass a broader palette of securement is one of the important advances in conservation, because it offers a realistic chance to create conservation infrastructure at a larger scale and with a more diverse set of players. Protected reserves are still critical, but other strategies can inform responses to the increasingly complex nature of the environmental crisis.

**Secured Lands**: The Nature Conservancy's secured lands dataset (Prince et al. 2018) shows public and private lands that are permanently secured against conversion to development through fee ownership, easements, or permanent conservation restrictions. Each land parcel is tagged with acreage, ownership type, and GAP status.

**GAP Status**: GAP status was developed by the U.S. Fish and Wildlife Service (Crist et al. 1998) as a way of classifying all public and private conservation lands relative to the intent of the landowner or easement holder. It is widely used in the U.S. by public agencies, and it is included as part of the Protected Area Database maintained by the U.S. Geological Service.

GAP 1 and 2 lands are considered **protected**, and we adopt that language in this report.

- **GAP Status 1: Secured for Nature and Natural Processes**
  An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
  *Examples: nature reserves, Forever Wild easements, wilderness areas.*

- **GAP Status 2: Secured for Nature with Management**
  An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
  *Examples: national wildlife refuges, national parks.*

GAP 3 lands are considered multiple use. They are secured against conversion to development but open to many uses, including extraction and recreation.

- **GAP Status 3: Secured for Multiple Uses**
  An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining), or motorized recreation.
  It also confers protection on federally listed endangered and threatened species throughout the area. *Examples: state forests, forest management easements, conservation restrictions on working forest.*

**Unsecured lands** are not permanently secured against conversion; this includes most private land.

**Using GAP Status to Assess Progress**: In this report, we consider land in GAP status 1-3 to be "secured against conversion" but only land in GAP status 1 and 2 to be "protected." We consider GSPC target 4 ("secured through effective management and/or restoration") and GSPC target 5 ("secured with effective management in place for conserving plants and their genetic diversity") to be equivalent to GAP 1-2 protection, as multiple-use lands do not have a mandate for sustaining the habitats or natural features. In New England, there is an important conservation role for multiple-use lands (GAP 3) that enables us to maintain forest cover at large regional scales. Thus, for the primary (not IPA) NE target we explicitly aim for a mix of protected land (GAP 1-2) nested within a larger matrix of multiple-use land secured against conversion (GAP 3).

The secured land dataset (Prince et al. 2018) used for this study is compiled biannually by TNC from over sixty sources. For the most part, it is a combination of public land information maintained by each state and private conservation land information compiled by TNC's state field offices from land trusts and individuals. Staff in each state office compile the dataset for their state, assign the GAP status to each tract, and fill out the other standard fields. The completed state datasets are then compiled by the regional science office and quality checked for consistency and discrepancies.

For this study, we overlaid the secured land dataset on the habitat and climate resilience maps to identify the proportion of each that fall within each GAP status. Only parcels where the ownership duration is permanent are included in the mapped dataset. Although many volunteer, temporary, or non-permanent agreements may contribute to conservation, it is beyond our capacity to track and maintain information on non-permanent ownerships or activities at a regional scale.


Michael Piantedosi © Native Plant Trust

# NEW ENGLAND FLORA AND RARE TAXA

As one of the earliest colonized areas of the United States, the New England region has a long history of botanical interest and published science. Native Plant Trust's comprehensive flora of the native and naturalized higher vascular plants, *Flora Novae Angliae* (Haines 2011), is the primary reference for the region's plants. This manual has been converted into an interactive, online flora, Go Botany (Native Plant Trust 2012), that can be continuously updated to reflect taxonomic and nomenclatural changes to the flora, as well as actual changes in plant taxa of the region. This online flora for the region meets the criteria for Target 1 of the GSPC, "an online flora of all known plants" (Convention on Biological Diversity 2012).

The six states that make up New England cover more than 186,443 km$^2$, roughly the size of Washington State, with a comparable number of plant taxa (Farnsworth 2015). More than 3,500 species occur in the region, but almost a third of these are introduced (not native) (Haines 2011; Mehrhof 2000). Maine is the largest state in New England, covering almost half the region. Massachusetts has the most native taxa and also the most introduced taxa. TABLE 1 shows the breakout by state. An excellent summation of the history and development of the region's flora can be found in Native Plant Trust's "State of the Plants" (Farnsworth 2015).

**TABLE 1. Number of Taxa per New England State**

"Taxa" includes all species, varieties, and subspecies. Data also include taxa that are considered either native or naturalized but are no longer present in New England (historic). Source: Native Plant Trust's Go Botany database.

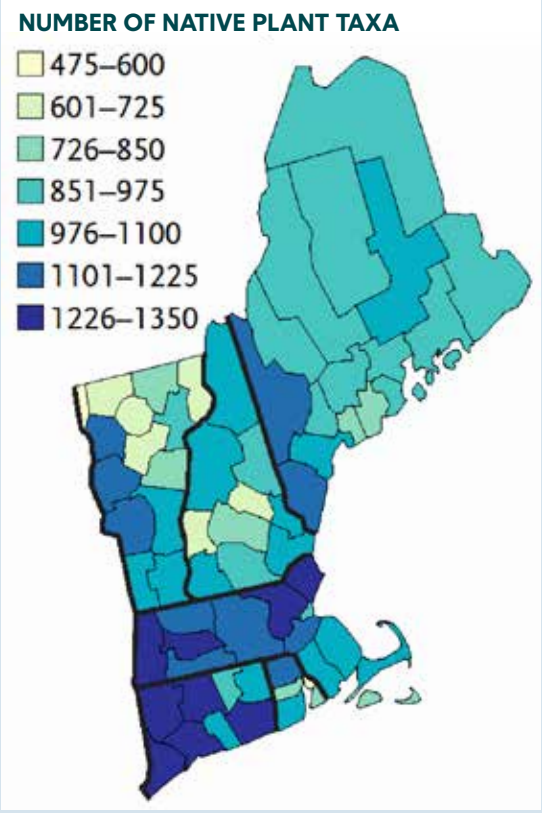
| STATE | NATIVE | NON-NATIVE | SUM* | TOTAL INDIVIDUAL TAXA** |
|---|---|---|---|---|
| MA | 1816 | 1487 | 3303 | 3275 |
| CT | 1731 | 1100 | 2831 | 2816 |
| ME | 1603 | 867 | 2470 | 2453 |
| VT | 1622 | 799 | 2451 | 2407 |
| NH | 1592 | 683 | 2275 | 2267 |
| RI | 1352 | 654 | 2006 | 1997 |

* Sum of native and non-native taxa. Taxa may be native in one county of a state, but may also be considered non-native in another county, and therefore counted under both categories.

** Total individual taxa counted only once per state, whether native or non-native.

**FIGURE 1. Native Plant Taxa in New England by County**

Source: Go Botany.



## Habitat and Plant Diversity

The varied physical features of New England's landscape—low coastal plains, rocky coasts, river floodplains, alluvial valleys, glacial lakes, forested mountains, and alpine peaks—in part account for the diversity of the region's flora. This following summary of the region's flora is based on Haines (2011) and Seymour (1969).

The region is home to part of the Appalachian Mountain chain, which is especially prominent in the northern states of ME, NH, and VT. Alpine habitats are also present in these states, and the highest peak in the region is Mt. Washington in NH at 1917 meters. The underlying bedrock of the region is primarily acidic (granite schist), but rock that is basic in nature (limestone, marble) is found mainly along the western border in CT, MA, and VT. Glaciers covered all but a tiny fraction of the region (part of the island of Martha's Vineyard), and before European settlement the region was primarily forests with a wide variety of coniferous and deciduous trees. New England is known for the extensive spruce fir-forests of NH and ME as well as several types of hardwood forest, the most renowned being the sugar maple hardwood forest, famous for its maple syrup and fall color.

All states in New England except VT border the Atlantic Ocean, and the seacoast has salt marshes and salt water species typical of eastern North America. Southeast MA and RI harbor numerous coastal plain species, many of which are typical of the mid-Atlantic states. The coastal plain pond shores of MA and RI, connected to and maintained by groundwater, are a globally rare habitat with a unique flora.

The Connecticut River, the largest in New England, flows the entire length of the region, from a small lake in NH near the Canadian border to Long Island Sound in CT. Several other large rivers in the region hold recognizable plant assemblage due to their underlying bedrock and climate. These include the St. John and Aroostook rivers in ME (ice-scoured Laurentian shorelines), the Housatonic River in western MA and CT (limestone and marble bedrock), and the lower Connecticut River, Merrimack River (MA), and Kennebec River (ME), which all contain fresh tidal and brackish tidal habitat.

There are several notable hotspots of rare plant diversity in New England; these are sites in which clusters of specialized plants co-occur on unusual substrates or in uncommon ecological community types. These hotspots include the marble valleys of western New England (CT, MA, VT), Connecticut River Valley (CT, MA, NH, VT), Cape Cod and the Islands (MA), southern RI, St. John River Valley (ME), and the Presidential Range (NH) (Farnsworth 2015).

© Wikimedia / Connecticut River

## Plant Rarity

From 1993 to 1996, Native Plant Trust (at that time New England Wild Flower Society) and its partners compiled data on the status of rare plants in the six New England states to formulate "*Flora Conservanda:* New England," a list of higher tracheophyte plant taxa to be prioritized for regional conservation" (Brumback and Mehrhoff et al. 1996). To account for nomenclatural and taxonomic changes since 1996 and to suggest updated priorities for protection at both the species and population level, *Flora Conservanda* was updated in 2012 by Native Plant Trust and its New England Flora Committee, which consists of representatives of each of the six New England state's Natural Heritage programs, or their equivalents, and other botanists familiar with the regional flora. Determination for listing was based on the global rank (per NatureServe 2013) of the species and the number of Element Occurrences (EOs *sensu* NatureServe 2013) known in New England. By applying strict definitions for the inclusion of a taxon within one of the five divisions, the group identified 593 taxa of high regional concern out of a total of approximately 2300 species indigenous to New England (Brumback and Gerke 2013).

*Flora Conservanda* focuses on taxa that are globally and regionally rare (Divisions 1 and 2). It also identifies taxa that may be declining throughout a significant portion of the region or that have occurrences of conservation importance owing to their biological, ecological, or (potential) genetic significance (Division 3). It further identifies taxa that are considered historic in the region (Division 4) as well as those that may be rare throughout New England, but for which taxonomic or distributional information is insufficient to determine status (Division IND). *Flora Conservanda* meets Target 2 of the GSPC, which calls for "an assessment of the conservation status of all known plant species, as far as possible, to guide conservation action" (Convention on Biological Diversity 2012).

*Flora Conservanda* indicates that 22% of the region's native plants are now considered rare or have populations in need of conservation (TABLE 2). Among them are 62 globally rare taxa and 10 endemic taxa, three of which are now considered extinct. An additional 96 taxa have been extirpated from their New England range and, in many cases, are imperiled in the remainder of their range (Farnsworth 2015). Since publication of *Flora Conservanda*, another globally rare species, American chaffseed (*Schwalbea americana*), has been rediscovered in Massachusetts, after last being seen in the 1960s.

**TABLE 2. Comparison of *Flora Conservanda* (1996 and 2012)**

| DIVISION | 1996 | 2021 |
|---|---|---|
| 1 – Globally Rare | 57 | 62 |
| 2 & 2(a) – Regionally Rare | 272 | 326 |
| 3 – Locally Rare | 76 | 57 |
| 4 – Historic in New England | 56 | 95 |
| IND – Status Indeterminate | 114 | 53 |
| **TOTAL** | **575** | **593** |

See Appendix 1 "Divisions of the List" for definitions of these divisions and Appendix 2 for definitions of global status.


American chaffseed
*(Schwalbea americana)*
Uli Lorimer © Native Plant Trust

# THREATS TO PLANT DIVERSITY IN NEW ENGLAND

As outlined in the "State of New England's Native Plants" (Farnsworth 2015), plant diversity in New England faces a variety of anthropogenic stressors. These include air pollution and trampling in the alpine zone; thousands of acres of forest cleared each year; more than 10,250 dams altering hydrology along rivers; fire suppression leading to succession of grassland habitats to forests; and a combination of ditching, draining, and overfishing, resulting in severe die-back of vegetation and erosion of substrate in estuarine marshes. Further, anthropogenic threats include those indirectly influenced by human activity, such as an overabundance of deer from having eliminated their predators. These threats have been exacerbated by the introduction of invasive plants, insects, and pathogens, which readily colonize habitats with significantly disturbed ecological processes. Each of these threats is altered or compounded by the effects of a changing climate, further pushing ecological systems out of balance.

## Habitat Loss and Fragmentation

Loss of habitat is the most significant driver of declines in plant diversity. Habitat loss in a landscape can fragment and isolate patches of suitable habitat for plant species, thereby reducing the potential for many organisms to move within a contiguous area.

Fragmentation of habitat as a result of road construction, residential and commercial development, altered hydrology (damming, locks, channeling), and associated infrastructure modifications has isolated blocks of forests, rivers, and wetlands, leading to isolated plant communities, disconnection of animal migration routes, and the breaking of intricate relationships based on connectivity that are critical to the survival of both.

With increased habitat fragmentation comes a compounding of associated threats to plant diversity through increased edge-effects. These include increased invasive species instances in native plant habitats, increased predation of interior forest birds and amphibians by edge-dwelling wildlife (and feral housecats), and alteration of microclimates by increased sunlight, wind, and soil erosion (Woolsey 2010).

Implications of fragmented habitats for plant life include a reduction of dispersal rates by seed or spore and reduced pollinator-visitation frequency, leading to declines in seed set. With habitat loss comes changes in abundance of species, affecting the network of interspecific interactions in a community. Syntheses published on plant-pollinator networks have found that many mutualistic networks, like plant-pollinator interactions, exhibit a relatively high degree of connectivity, especially when compared with networks of antagonistic interactions, such as food webs at various trophic levels. Literature suggests these general attributes of mutualistic networks are not only correlated with declines in habitat, but also that when maintained, impart significant stability and enable more species to persist in a community (Okuyama and Holland 2008; Bastolla et al. 2009; Thebault and Fontaine 2010).

In addition, residential, commercial, and industrial development has resulted in 1.1 million acres (21% of total land area) in Massachusetts alone being developed (Woolsey 2010), with adjacent habitats and plant communities degraded or disturbed by invasive species encroachment; light, air, and water pollution; excessive noise; and the compounded effects of each on shifting lands from carbon sinks to carbon sources.

downy rattlesnake-plaintain
*(Goodyera pubescens)*
Dan Jaffe © Native Plant Trust

## Invasive Species

Among the many threats to global biodiversity, the movement of species across historically distinct biogeographic borders remains one of the most intractable (Facon et al. 2006; Barney and Whitlow 2008; Moles et al. 2008). Introduction of invasive organisms, largely a result of human actions, has caused plant, animal, and pathogenic pests to transform many habitats in New England. While threats of invasive species on native habitats are well documented, they vary in level of severity depending on the habitat and the invasive species in question, and they tend to dominate in areas where disturbance events are consistent. Invasive species should generally be regarded as both a direct threat and a symptom of other, broader threats (e.g., climate change, development, fire suppression, etc.) to native plant communities.

In New England, the Invasive Plant Atlas of New England (IPANE) improved our understanding of the effects and distribution of invasive plant species in the region. At the time of IPANE's inception in 2001, 30-35% of the plant species known to New England were thought to be non-native and of those 3-5% were considered aggressive invaders. Since then, the number of non-native and invasive species in New England appears to have increased slightly, as the "State of the Plants" report notes that "31% of the 3,514 documented plants are not native, and 10% of those are invasive" (Farnsworth 2015).

*Introduction of invasive organisms, largely a result of human actions, has caused plant, animal, and pathogenic pests to transform many habitats in New England.*

Since its inception in 2005, EDDMaps (Early Detection & Distribution Mapping System) has become a primary repository for invasive species presence data, and the database contains nearly four million points documenting invasive species across North America. As described on its website, EDDMaps "aggregates data from other databases and organizations as well as volunteer observations to create a national network of invasive species and pest distribution data that is shared with educators, land managers, conservation biologists, and beyond." In addition to resources like IPANE and EDDMaps, local and regional CISMAs (Cooperative Invasive Species Management Areas) are active nationwide as a means of bringing together representatives from federal, state, tribal, and non-government organizations, as well as individuals, into organized groups working on invasive species management in a defined geographic area. Networks that cross political boundaries, such as IPANE, are critical for establishing early-detection systems and sharing consistent data with everyone from conservation land managers to the general public.

Plant communities already stressed by the effects of habitat loss and fragmentation are more susceptible to invasion from pests and pathogens. An example is the impact on plant diversity as a result of invasive earthworms. Research has shown that exotic earthworms in northern hardwood forests cause remarkable changes in soil structure, nutrient cycling, and plant communities. The most arresting of these findings is earthworm invasions turning these ecosystems from important global carbon sinks into carbon sources (Alban and Berry 1994; Bohlen et al. 2004a) through increased heterotrophic respiration (Li et al. 2002). In addition, earthworms shift the soil system from fungal dominated to bacteria dominated, resulting in a loss of important mycorrhizal-plant root relationships (Wardle 2002). Loss of mycorrhizae can lead to negative effects on plant root function (Lawrence et al. 2003), plant growth (Gundale 2002), and plant community assemblages (Holdsworth et al. 2007), ultimately affecting plant community diversity and every trophic level reliant on such diversity. In addition, an increase in earthworm diversity may cause a decrease in plant species diversity due to different earthworm species occupying multiple soil niches, such as those which live in the organic soil horizons and below in the organic-mineral horizons (Hopfensperger et al. 2011).

## Altered Hydrology (anthropogenic)

Throughout New England altered hydrology, most often a result of damming and channeling rivers, drastically affects both terrestrial and aquatic plant communities. The manmade modifications shift the seasonality, level, flow rate, and regularity of river flow. The result is decreased water and ice scour, altered patterns of sediment deposition, and reduced migration of plant propagules such as seeds and rhizomes along river shores, all of which affect the composition and viability of plant communities.

Further, as modifications to lands adjacent to coastal areas and wetlands increases (impervious surfaces, storm-wall construction, development, etc.) plant diversity in these hydric systems will likely decline. A 2014 study showed the influence of elevation and salinity on vegetation structure in tidal wetlands (when compared to estuarine hydrology and other variables) and found that global climate change may lead to changes in species distributions, altered floristic composition, and reduced plant species richness in estuarine wetlands. This conclusion largely shows the likelihood of near-term changes to plant diversity as coastal plant communities face several compounding threats, including sea-level rise, increased flood intensity, and exposure of freshwater wetland plant communities to salt water (Noto 2017, Janousek and Folger 2014).

## Fire Suppression

Fire suppression has removed an important disturbance event from the landscape and significantly altered New England's plant communities. Reduction of fire, primarily as a result of dense human habitation and the immediate threat of fire to infrastructure, has caused declines in fire-adapted plant communities, such as early-successional sandplains. In habitats such as sandplain grasslands and heathlands, a history of lightning-caused wildfires resulted in plant communities adapted to fire events. Without fire, much of New England's grassland habitats will over time become new-growth forests. In addition, with shortened fire intervals, species dependent on seedling recruitment (such as annuals) are more vulnerable to local extinction than are species that spread vegetatively (Enright 2014). In a changing climate, a projected reduction in post-fire rainfall in certain areas is likely to impact seedling recruitment, further altering plant diversity.

## Trampling

In plant communities less adapted to regular disturbance, such as in alpine, subalpine, and bog habitats, trampling by humans can have significant negative impact. Studies have shown varied impacts of trampling in alpine and subalpine plant communities (Chardon et al. 2018; Gremmen et al. 2003), as well as the degradation of bog systems as a result of deer trampling (Pettorelli 2006) – which will likely continue to increase as forest-edge habitat increases and with the absence of predatory megafauna (both anthropogenic impacts) keeping deer populations in control.

In incline- and elevation-driven habitats, some studies have shown that light to moderate disturbances can maintain high species diversity, while others emphasize that heavier disturbance reduces plant species richness and plant diversity. Highly disturbed and trampled alpine and subalpine systems could therefore be at greater risk for upward encroachment of lower-elevation species in a changing climate (Chardon et al. 2018).


Uli Lorimer © Native Plant Trust

# CONSERVATION ACTIONS TO COUNTER THREATS TO PLANT DIVERSITY

## Protect as Much Intact, Diverse, Complex Habitat as Possible

The focus of this report is land securement—whether through purchase or conservation easements—as the primary tool for sustaining plant diversity and the range of plant communities on the New England landscape. We argue that the goal is securing a proportional representation of habitats across the landscape and ensuring the sites conserved are resilient to climate change, as defined above.

There are other important conservation actions that have a prominent role in countering or mitigating threats to plant diversity.

## Monitor Plant Populations for Health and Threats

Monitoring of individual taxa and entire habitats to record baseline data is crucial for effective management of species, communities, and ecological systems. This baseline of what is "normal" for a species or a habitat is often a result of both biological and historical data gathered through consistent intervals of monitoring floristic health and changes to the system.

In New England, we are fortunate to have state-level Natural Heritage programs (or their equivalent), land trusts monitoring conservation lands they own or manage, and regional community-science monitoring programs, such as Native Plant Trust's New England Plant Conservation Program (NEPCoP) and Plant Conservation Volunteer (PCV) program. NEPCoP's primary goal is to address the questions of plant rarity at the population level, taking a regional perspective on endangerment, availability of resources, and likely benefits of species and habitat management (Parks 1993). For nearly thirty years, monitoring efforts through NEPCoP and the PCV program have gathered data on imperiled plant populations throughout New England to inform applied conservation actions. Data collected through regular monitoring of imperiled plant populations are fundamental to understanding trends occurring in an ecological system over time. For example, monitoring data can reveal the disproportionate decline of insect-pollinated plant species (Farnsworth and Ogurcak 2006; Farnsworth 2015), or the regional loss of dominant forests trees in the Northeast as a result of climate change (Clark 2014). Measuring and monitoring the results of management actions such as habitat restoration or species augmentation are critical to understanding the potential for species or ecosystems to adapt to the changes brought by climate change.

## Collect and Bank Seeds to Preserve the Genetic Diversity of Species and Habitats

Seed banking of wild species, one facet of *ex situ* conservation, is critical to integrated conservation measures seeking to protect plants in their native habitats (*in situ*), as seed banks provide a safety net against extinction in the wild and a source of local genotype seed for restoration projects (Havens et al. 1999). Unfortunately, there is a well-documented scarcity of seed for restoration; insufficient research in such areas as seed transfer zones, seed physiology, and longevity; and inefficient supply chains without clear documentation of seed origin and quality (Bischoff et al. 2010).

Effective seed banking collects from a range of geographically isolated species and populations and ensures intraspecific genetic diversity within each collection, often achieved through randomized sampling of a population. This approach has implications not only for individual taxa, but also for successful restoration of habitats. Several studies have shown genotypic diversity among plants may play a larger role in community and ecosystem processes than previously realized (Cook-Patton 2011; Kotowska 2009). In addition, a sufficient genotypic diversity of plants sown in habitat restorations may be "biological insurance" against fluctuations in ecosystem processes, thus increasing the reliability of restoration measures (Bischoff 2010).

In New England, Native Plant Trust banks the seeds of imperiled taxa at highest risk of extirpation from the wild, has engaged in a multi-year effort to collect and bank seeds of coastal habitats for restoration of public lands, many damaged by Hurricane Sandy in 2012, and participates in the collection of tissue of common orchids for long-term banking. Further, programs such as Seeds of Success, a partnership between the federal Bureau of Land Management and botanic gardens, zoos, and municipalities, aim to collect and bank seeds from common native taxa whose presence on the landscape are invaluable to maintaining habitat-scale function in ecosystems.

## Manage Habitats for Plant Diversity Where Necessary and Feasible

Ecological management of habitat is a complex and often challenging approach to maintaining plant diversity at the ecosystem scale. Its goal is sustaining or restoring composition, structure, and function (of individual taxa or entire habitats) and enhancing resistance and resilience under climate change. Highest priority for action is preserving exemplary, biodiverse habitats and areas important to their function and resiliency.

In New England, stewardship of terrestrial and aquatic ecosystems often requires controlling invasive species, using adaptive management techniques for species lost through succession (often a result of fire suppression, altered hydrology, or development of wild lands), and implementing species- or habitat-specific management practices. For example, prescribed burning is commonly used for managing successional growth of trees or some invasive species, which may compete with fire-adapted herbaceous plants in habitats traditionally kept open through wildfires. Similarly, tree-canopy thinning enables light to reach the forest floor for spring ephemerals or certain orchids requiring increased light levels to germinate and flourish. The common thread of these different approaches is a balanced interval and intensity of disturbance events (relative to each particular habitat and plant community) to support the greatest diversity of plant species. Habitat management may entail augmenting populations (see below) with plugs or small plants grown from locally-adapted, genotypic seed. Measuring success through consistent monitoring and data collection is critical to ensuring that information about techniques for preserving plant diversity can be shared with colleagues engaged in conservation and land management.

Jesup's milk-vetch
(*Astragalus robbinsii* var. *jesupii*)
Lisa Mattei © Native Plant Trust

## Augment and Introduce Plants

As plant communities are progressively degraded, invaded, or highly fragmented, ecological restoration becomes essential for maintaining imperiled taxa and overall plant diversity. Either augmentation (introducing plants or seeds to an extant site) or introduction (introducing plants or seeds at a new location within a species' known, historic range) of species is most effective when areas of appropriate habitat already exist. At both the species and habitat scales, augmentation or introduction with seed is typically undertaken only when other strategies to counter impacts to plant diversity have been deemed ineffective. Best practices include: establishing baseline data on species' populations, plant communities, and entire habitats (including historic and projected data when possible); comprehensive research into reproductive ecologies and seed germination; consistent and long-term monitoring of augmentation and introduction sites; and strategic partnerships with scientists and organizations with specialties in species conservation and ecological restoration (Havens, Guerrant, and Maunder 1999; Havens, Kramer, and Guerrant 2014).

## Conduct Assisted Migrations

With compelling evidence that climate change will be a significant driver of extinction (McCarthy et al. 2001; McLaughlin et al. 2002; Root 2003; Thomas et al. 2004), ecologists and land managers must consider the implications of using assisted migration (sometimes referred to as "managed relocation") to protect plant diversity. Assisted migration is one way of facilitating range shifts for plant species that may not be able to adapt in place and are restricted—by limits to propagule dispersal or significant barriers to migration routes—in their ability to move outside their historic range in response to climate or other environmental changes.

Over the past two decades, a healthy and often contentious debate has surfaced in the scientific community over the costs and benefits of assisted migration as a climate-adaptation strategy for plants and wildlife (Hulme 2005; Hunter 2007; McClanahan et al. 2008; Sax et al. 2009). This discussion has led to the development of multiple frameworks for weighing and evaluating ecological, legal, and ethical factors (Hoegh-Guldberg et al. 2008; Joly and Fuller 2009; Richardson et al. 2009; Sandler 2010).

Among the contentious issues is the lack of research into fundamental biological questions that could form the scientific basis for sound policies: Which species should be moved? What is the demographic threshold to initiate a need for assisted migration? How can populations be introduced while minimizing adverse ecological effects?

*goldenseal (Hydrastis canadensis)*
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Those against assisted migration assert that it is folly to assume ecologists are capable of determining when assisted migration will be effective and whether translocated species will do more harm than good (Ricciardi and Simberloff 2009; Seddon et al. 2009). They cite the unpredictable (and often negative) impacts of invasive species and a lack of comprehensive understanding into the function of ecological systems, particularly in a changing climate. Disconnected and fragmented lands further complicate the migration of species and habitats, and those areas with high connectivity may be otherwise degraded or their biodiversity configurations may be different from what a particular species has adapted to within a given historic range. Often the arguments made against assisted migration as a conservation strategy refer directly or indirectly to the precautionary principle; and thus, due to many unknown variables in the process of moving and introducing plants, assisted migration should be avoided. Opponents argue that the potential for invasive spread of a plant species that has been relocated to avoid extinction is too great a risk to overall ecological function, and that the data are not available to determine the invasive potential of many species (Simberloff 2009).

Those in favor of assisted migration also point to precautions, but focus on the unknown ecological impacts of allowing plants to become locally or regionally extirpated or driven to permanent extinction by rapidly changing climates (Sax et al. 2009). Further, those arguing for assisted migration rebuff the claims about the lack of knowledge on the invasion potential of native species beyond their historic ranges (as many examples of this are available, particularly for more common species) and disagree that assisted migration is or would be enacted haphazardly, without ecological context. Most proponents of assisted migration argue for a systematic and gradual approach to moving species beyond their historic ranges, and frequently the methods described for moving plants mimic the typical dispersal range of their propagules. This nuanced approach often focuses on predicted climate envelopes that could support the species.

With this report, we hope to further the discussion about assisted migration by delineating areas of high climate resilience where, if the sites are protected, plant species facing high extinction threats may find refuge, both within and beyond their historic ranges.

# Conservation of Habitats and Important Plant Areas

## INTRODUCTION

### Terminology

This report uses several terms that describe ecological units across a variety of scales. When describing a broad, ecologically-distinct area, we have chosen to use the terms (from broadest to finest scale): ecoregion, macrogroup, ecological system. When describing plant groups at a finer scale, we have chosen to use the terms (from broadest to finest scale): habitat, plant community, vegetation type, plant association. These terms, which denote particular groupings of plants, are used interchangeably, but are consistent throughout this report in reference to scale.

Each of these terms is defined as follows (NatureServe 2016; TNC 2020):

- **Ecoregion**: Part of a larger ecozone, ecoregions are large units of land and water that contain a geographically distinct combination of natural communities and species, share similar characteristics (such as climate and soils), and interact in ways that are critical for the long-term viability of the communities and species.
- **Macrogroup**: The fifth level in the U.S. National Vegetation Classification (NVC) natural vegetation hierarchy, in which each vegetation unit is defined by a group of plant communities with a common set of growth forms and many diagnostic plant taxa, including many characteristic taxa of the dominant growth forms, preferentially sharing a broadly similar geographic region and regional climate, and disturbance regime (cf. Pignatti et al. 1995, and Braun-Blanquet concept of "Class").
- **Ecological system** (synonymous with "habitat"): A terrestrial ecological system is defined as a mosaic of plant community types that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients, in a pattern that repeats itself across landscapes. Systems occur at various scales, from "matrix" forested systems of thousands of hectares to small patch systems, such as cliffs, basin wetlands, or barrens on a particular bedrock type, of a hectare or two.
- **Habitat** (synonymous with "ecological system"): A general term referring to the locality, site, and particular type of local environment occupied by an organism or community (adapted from Lincoln et al. 1998).
- **Plant community**: A group of plant species living together and linked together by their effects on one another and their responses to the environment they share (modified from Whittaker 1975). Typically the plant species that co-occur in a plant community show a definite association or affinity with each other (Kent and Coker 1992).
- **Vegetation type**: A named category of plant community or vegetation defined on the basis of shared floristic and/or physiognomic characteristics that distinguish it from other kinds of plant communities or vegetation (Tart et al. 2005a).
- **Plant association**: A vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy (Jennings et al. 2006).

Ecological system, habitat, ecosystem, natural community, and natural association refer to a variety of scales but are generally applied to ecological facilitation, which encompasses climate, hydrology, geological structure, soil, flora, and fauna.

Plant community, vegetation type, and plant associations refer to the floristic makeup of an area, primarily focused on the plants and plant interactions.

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## Overview and Methods

In this section we evaluate the conservation status of New England's habitats relative to global and regional targets, identify trends in securement and conversion, and make recommendations on where to focus conservation efforts. Additionally, we for the first time identify 234 Important Plant Areas, the conservation of which would move us a long way toward meeting both habitat and species goals.

We assess the conservation status of each habitat relative to well-developed international goals in the Global Strategy for Plant Conservation (GSPC; Convention on Biological Diversity 2012) and regional goals developed for New England based on the Global Deal for Nature (Dinerstein et al. 2019; see "Background" for details).

**GSPC Target 4**: At least 15% of each vegetation type secured through effective management and/or restoration (GAP 1-2 protection).

**NE Target**: At least 5-15% of each habitat protected (GAP 1-2) and at least 30% secured against conversion (GAP 1-3). At least 75% of the securement on climate-resilient land.

The Global Deal for Nature advocates for conserving representatives of all native habitats and viable populations of all native species by protecting 30% of the landscape by 2030. The New England target builds on this by adding criteria to ensure that sites are more resilient to climate change and by adding more detail to the types of securement.

**Why Focus on Climate Resilience?**

A key tenet of this document is that to succeed in sustaining plant diversity over the next century, we must focus protection on sites with the highest climate resilience. Site resilience is defined as the ability of a site to sustain diversity and ecological functions into the future, even as species move and vegetation types change in response to a changing climate (Anderson et al. 2014). To identify resilient sites, we use an approach known colloquially as "Conserving Nature's Stage" (Beier et al. 2015). This approach is based on the strong evidence and ample observations that although climate sets broad distribution limits and regulates the region's overall species pool, the places where species and communities are actually found, where they are persisting, and where they will be in the future are determined primarily by the properties of the land: soil, geology, topography, elevation (Anderson and Ferree 2010).

Our "Conserving Nature's Stage" approach asserts that rather than trying to protect biodiversity one species at a time, we should protect the ultimate drivers of biodiversity. The world has always experienced some measure of climate change, and species ranges are not fixed. Accordingly, we should seek to maintain the landscape features that ultimately control species richness. Plant distributions are coupled with moisture, light availability, and soil chemistry and texture, which in turn reflect geology and topography. This relationship is so tight that in New England, we can predict the total number of plant species present in every state (adj. $R2 = 0.94$) just by knowing the amount and types of geology present, the latitude, and the elevation range (Anderson and Ferree 2010). Studying how the current distribution of plant species and vegetation communities is coupled with the distribution of geophysical variables enables us to develop a conservation plan that protects diversity under both current and future climates.

The vegetation map used in this assessment (FIGURE 2, Ferree and Anderson 2013) provides a snapshot of how vegetation is currently distributed, and it illustrates how the current vegetation is correlated to landforms, geology, soils, and moisture patterns. The "random forest" models that underlie the distribution of each vegetation type integrate both climatic and geophysical variables. As the climate changes, the land's geophysical properties endure and can be used to predict where

habitats might be in the future or where the land is buffered from change due to topography. This is the principle behind the TNC climate resilience map used in this assessment (FIGURE 2, Anderson et al. 2014), which was created directly from the geophysical variables with the understanding that while the climate might change, the topography, soils and elevation gradients will not—at least not for the next several centuries. Using the two maps together enables us to create a conservation plan that starts with what is there now but incorporates a different future, while maintaining a high degree of certainty with respect to what places will be important under many scenarios.

The geophysical variables used in the climate resilience map (FIGURE 3, Anderson et al. 2014) were derived based on their importance to plant species and natural community distributions. That makes them useful as a basis for representation, because it gives us the tools to measure the distribution of secured lands across all the landscape properties needed to support the full spectrum of plant diversity.

**FIGURE 2. The Northeast Terrestrial Habitat Map**

This dataset (Ferree and Anderson 2015) maps the distribution of 140 types of forests, wetlands, unique communities, and tidal systems across the Northeast. To explore the map and view the legend, go to http://nature.ly/NEhabitat

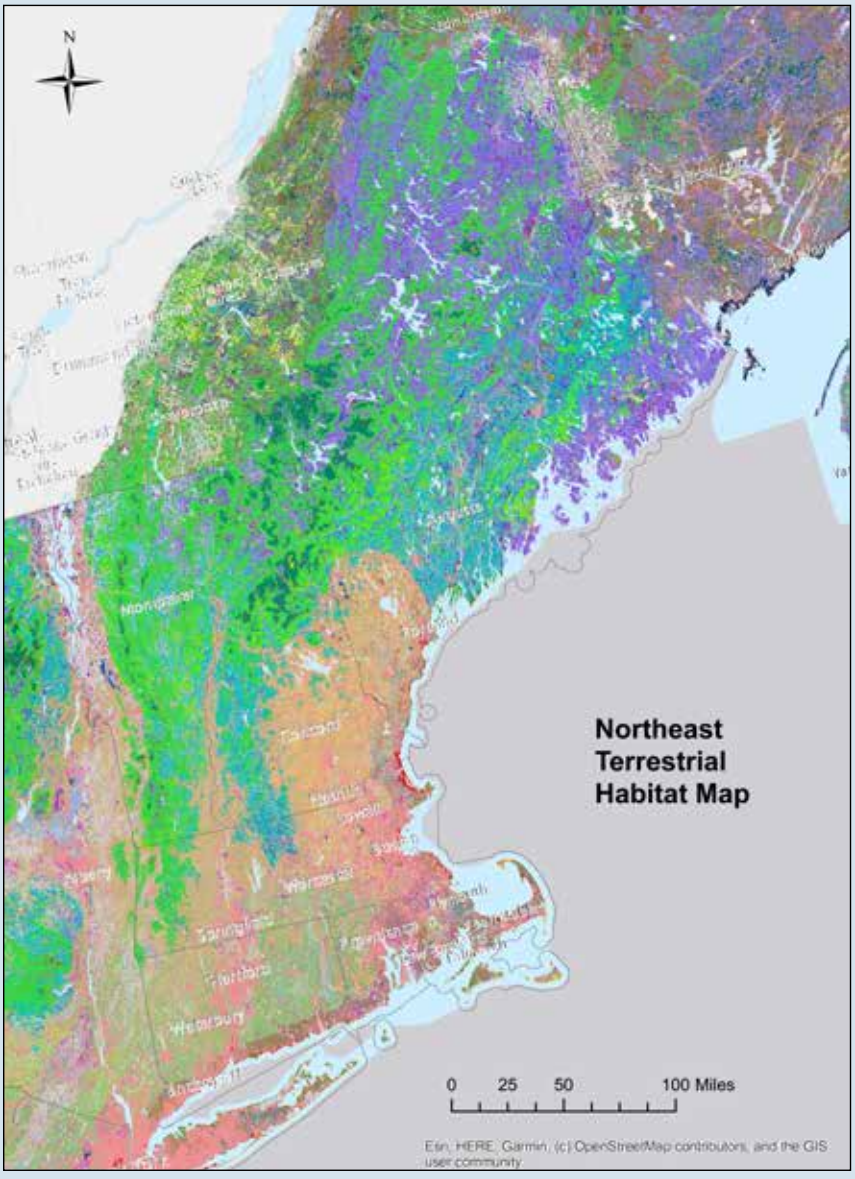
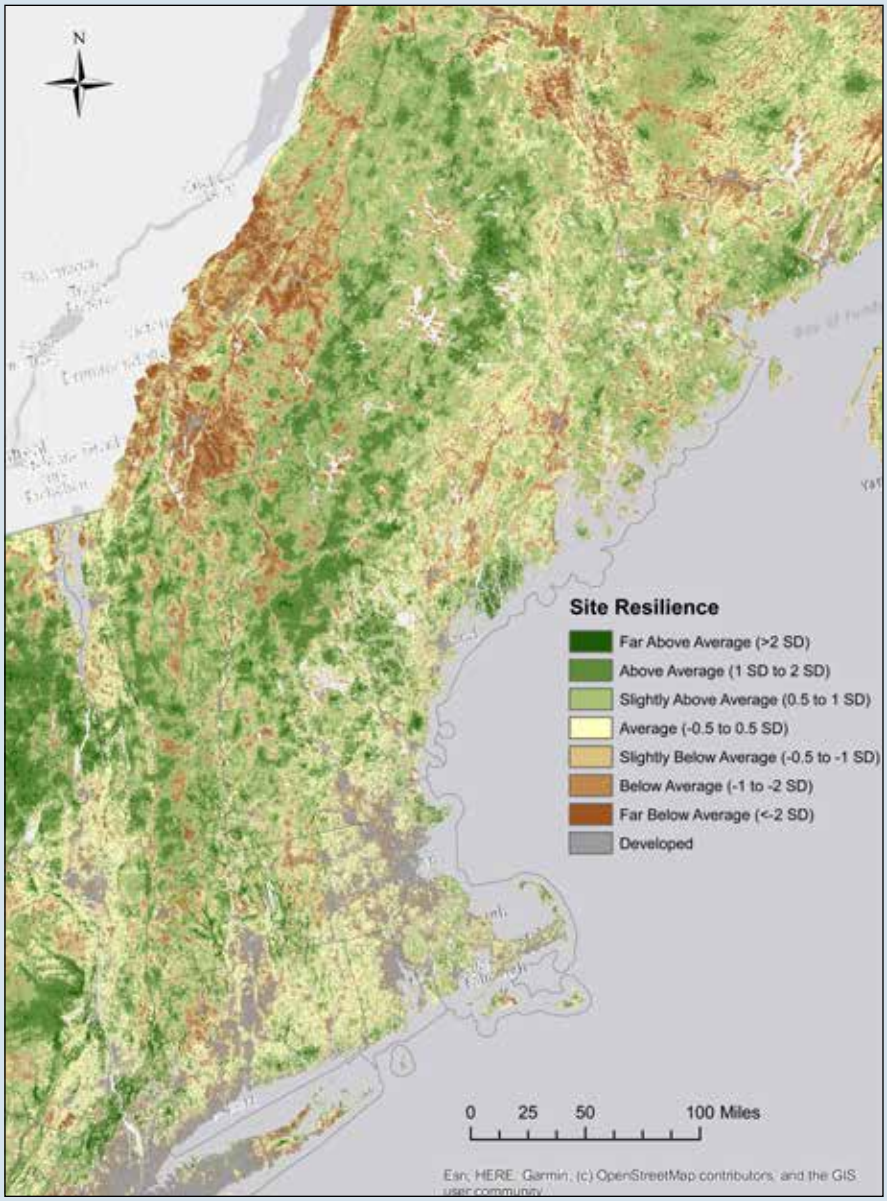


**FIGURE 3. The Northeast Terrestrial Resilience Map**

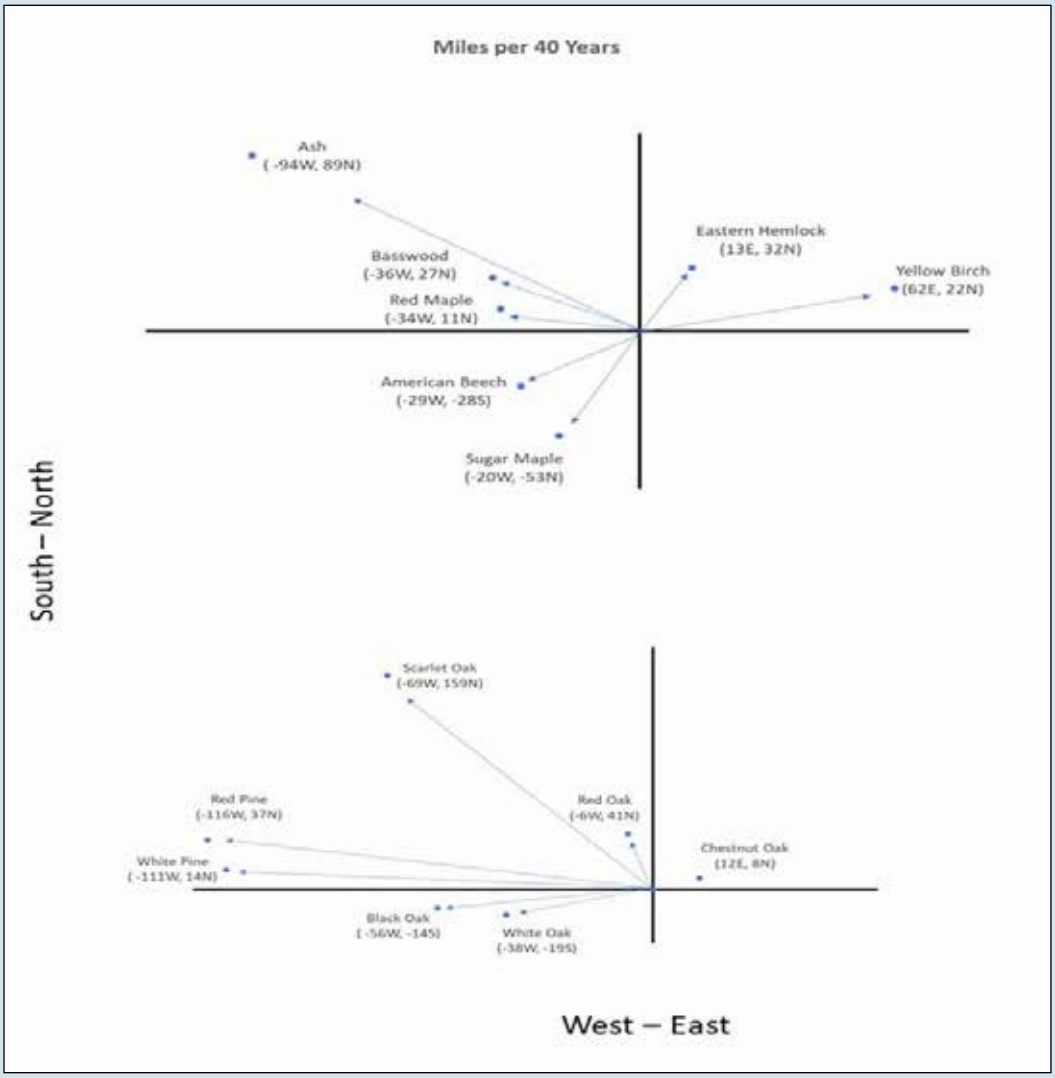
This map shows the areas with the most microclimates and the highest connectedness (i.e., highest resilience) relative to all the distinct geophysical settings within each ecoregion (Anderson et al. 2017). This map and underlying data can be explored using this web tool: http://maps.tnc.org/resilientland/




The habitats mapped in the Terrestrial Habitat Map have existed in New England for as far back as written records go, but they are always changing. American chestnut used to be a dominant component of Eastern forests but now persists as a shrubby understory species (Paillet 2002). Red maple has increased dramatically in response to current land use and forest management practices (Fei and Steiner 2007). Pollen records show dramatic range expansions and complete range shifts of oaks and pine during the retreat of the glaciers (Hunter et al. 1988). U.S. Forest Inventory and Analysis records for the last 40 years show substantial range shifts in 86 tree species (Fei et al. 2017). Moreover, tree species are not moving in concert, but are showing individual responses to changes in moisture and temperature (FIGURE 4). At some point New England's vegetation types will be very different from the familiar compositions we know today. This reinforces the need to focus on resilient places where plant species are likely to be most successful because of the properties of the land.

**FIGURE 4. Tree Range Shifts over the Last 40 Years**

These charts show the direction and distances that the distribution centers of Eastern trees have shifted over the last 40 years, based on U.S. Forest Inventory and Analysis data (Fei et al. 2017). The upper chart for Northern Hardwoods shows maple and beech moving west and south, likely following increases in moisture, while hemlock and yellow birch have moved north, likely following increases in temperature. The lower chart for Oak-Pine forests shows a similar pattern.



# CONSERVATION OF HABITATS: PROGRESS TOWARD GLOBAL AND REGIONAL GOALS

The global and regional goals we use to evaluate the conservation status of New England's habitats were fully described above. Below we compare each group of habitats to the GSPC targets and to a customized NE target that considers the scale of the habitat, the resilience of the land, and the relative amounts of securement and protection.

To create realistic ten-year NE targets, we divided the habitats into three groups:

- Matrix Forest: the ten dominant forest types that cover 86% of the natural landscape
- Wetland Habitats: the swamps, bogs, floodplains, and marshes that cover 12% of the natural landscape
- Patch-forming Habitats: the summits, cliffs, dune, and barrens that are embedded in the matrix of forests and wetlands. Although patch habitats make up only 2% of the natural landscape, they are hotspots of plant diversity.

Grouping the vegetation types this way enabled us to develop and assess New England-specific targets that reflect the natural distribution and resilience of these communities.

## Matrix Forest

**GSPC Target 4**: At least 15% of each forest type secured through effective management and/or restoration (i.e., GAP 1-2 protection).

**NE Target**: At least 5% of each forest type protected (GAP 1-2) and at least 30% of each secured against conversion (GAP 1-3). Resilient land makes up 75% of total securement.

New England's dominant vegetation is forest. The 28 million acres of forest create a connected matrix of natural cover composed of ten distinct habitats, each covering a half million to eight million acres. An additional four forest types are now so small and scattered that, with respect to goals, we treated them as patch-forming habitats (see section below).

Collectively, forests provide the region's primary ecosystem services, especially carbon sequestration. Climate regulation, water storage and filtering, pollution mitigation, and oxygen production. Economically, they support a century-long timber industry that harvests 8.2 million cords annually for building materials, fuel, fiber, and lumber (NEFF 2017) and support modest markets for maple syrup, holiday decorations, edibles, and medicinal plants as well. New England forest forms the natural backdrop for hunting, fishing, hiking, and camping, and the surrounding matrix in which high-diversity wetlands or patch-forming habitats are embedded. Intact forests have a marked vertical structure of canopy, understory, and herbaceous layer, and sustain moderate levels of plant diversity skewed toward shade-tolerant species.

Most of New England's forest is privately owned and managed for wood supply; and the majority of secured forest is multiple use and actively managed for recreation and timber harvest. To ensure that carbon continues to be removed from the atmosphere and naturally filtered clean water is available for New England citizens, advocates like Harvard's David Foster have argued for keeping 70% of New England forested (Foster et al. 2017). That means retaining 100% of the existing forest. Foster's Wildlands and Woodlands initiative (W&W) aims for 10% of natural lands protected as wildlands (i.e., protected as GAP 1-2) and 70% actively and sustainably managed for wood, food, and other values. The New England Forestry Foundation has endorsed the W&W vision and argues that not all of the 70% needs to be under securement because a healthy forest-based economy and strategic tax incentives could ensure that much of the land stays forested (private land enrollment in current use tax programs is 58%; Perschel et al. 2014).

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Currently, 21% of New England's forests are secured against conversion and 3% are protected. Securement is very unevenly distributed across forest types, with southern forests having less securement. Increasing securement to meet the NE target (30% and 5%) focused on resilient examples of every forest type would move us toward both the W&W 10% protection goal and the GSPC 15% protected target. The climate-resilience criteria in the NE target is critical if we are to ensure tangible, lasting results in the face of climate change.

**Results**: Only one forest habitat currently meets both the GSPC and NE targets: *Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest* (TABLE 3). This high-elevation forest forms the backdrop of New England's hiking and "peak-bagging" culture and is largely out of the range of practical timber management. *Laurentian-Acadian Northern Hardwood Forest*, the maple-beech-birch mix that gives New England its fall color and the dominant forest across the northern part of the region, also meets the NE target but not the GSPC target. This habitat is 30% secured against conversion, with 7% secured for nature; 96% of that is on resilient land. Because this forest covers 8.3 million acres, this is a relative success story, although we still need another 249,000 protected acres to reach the W&W 10% and another 415,000 protected acres beyond that to meet the GSPC target of 15%. Intelligently applied sustainable management practices on the secured multiple-use land might be able to sustain many of the functions of the forest type.

A few other habitats are close to meeting the NE target. Maine's *Acadian Sub-boreal Spruce Flats* are just 21,000 acres short, and both the *Acadian Lowland Spruce-Fir-Hardwood Forest* and *Laurentian-Acadian Red Oak-Northern Hardwood Forest* partially meet the target, with more than 5% protected and more than 85% on resilient lands, but less than 30% secured against conversion. In all, reaching the full NE target will require an additional to 2 million acres of forest conservation on resilient lands as well as effective management on the 5.3 million acres already in GAP 3 (TABLE 4). Reaching the GSPC goal of 15% protection across all matrix forest habitats will require investing in 3 million acres, through a combination of acquisition and increasing GAP levels on already secured land.

**TABLE 3. Goal Assessment for Matrix Forests**

Columns 2-5 show the % protected, resilient (R), and secured. Columns 6-7 indicates if it meets (Y) or partially meets (P) the GSPC and NE targets. Column 8 estimates the acreage of resilient land to be secured/protected to meet the NE target of 30%.

| MATRIX FORESTS | % PROTECTED (GAP 1-2) | % R | % SECURED FROM CONVERSION (GAP 1-3) | % R | GSPC | NET | RESILIENT ACRES FOR 30% |
|---|---|---|---|---|---|---|---|
| Montane Spruce-Fir-Hardwood Forest | 38% | 99% | 62% | 98% | Y | Y | |
| Northern Hardwood Forest | 7% | 96% | 30% | 89% | | Y | |
| Lowland Spruce-Fir-Hardwood Forest | 6% | 85% | 26% | 72% | | P | 196,801 |
| Sub-boreal Spruce Flat | 5% | 83% | 29% | 74% | | P | 20,806 |
| Coastal Plain Hardwood Forest | 5% | 46% | 19% | 44% | | P | 67,475 |
| Red Oak-Northern Hardwood Forest | 5% | 92% | 18% | 92% | | P | 131,907 |
| Interior Dry-Mesic Oak Forest | 4% | 46% | 18% | 42% | | | 166,952 |
| Hemlock-Northern Hardwood Forest | 3% | 70% | 18% | 67% | | | 463,408 |
| Coastal & Interior Pine-Oak Forest | 2% | 40% | 17% | 38% | | | 194,748 |
| Pine-Hemlock-Hardwood Forest | 2% | 74% | 14% | 67% | | | 735,828 |
| **TOTAL** | | | | | | | **1,977,926** |

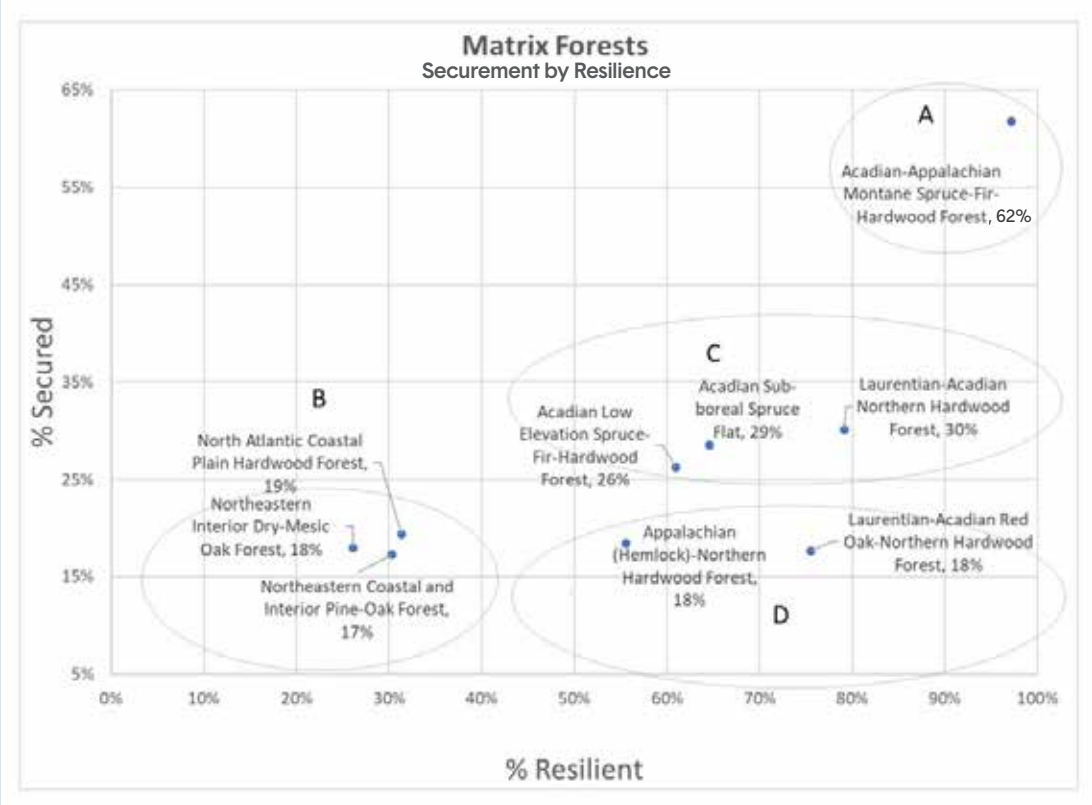
**TABLE 4. Improved Management**

Current and potential acres of multiple-use land (GAP 3) by forest type. These lands will need rigorous creation and enforcement of best management practices if they are to provide the expected benefits to people, plants, and wildlife.

| MATRIX FORESTS | % GAP | ACRES GAP 3 | % INCREASE IN RESILIENT LAND FOR 30% | RESILIENT ACRES FOR 30% |
|---|---|---|---|---|
| Montane Spruce-Fir-Hardwood Forest | 23% | 204,967 | 0% | 0 |
| Northern Hardwood Forest | 23% | 1,914,169 | 0% | 0 |
| Red Oak-Northern Hardwood Forest | 23% | 326,824 | 16% | 131,907 |
| Sub-boreal Spruce Flat | 20% | 1,063,434 | 2% | 20,806 |
| Lowland Spruce-Fir-Hardwood Forest | 15% | 620,338 | 6% | 196,801 |
| Hemlock-Northern Hardwood Forest | 13% | 137,930 | 21% | 463,408 |
| Pine-Hemlock-Hardwood Forest | 14% | 90,825 | 34% | 735,828 |
| Coastal Plain Hardwood Forest | 14% | 188,525 | 34% | 67,475 |
| Coastal & Interior Pine-Oak Forest | 15% | 227,828 | 42% | 194,748 |
| Interior Dry-Mesic Oak Forest | 11% | 508,535 | 46% | 166,952 |
| **TOTAL** | | **5,283,374** | | **1,977,926** |

**FIGURE 5. Matrix Forest Securement by Resilience**

This chart shows the average securement (GAP 1-3) and the average resilience score across all acres of each forest type. A = high securement, high resilience, B = low securement, low resilience, C = average securement, average resilience, and D = low securement, average resilience. Total securement (GAP 1-3) is listed after the forest name.




Some forest types are urgently in need of targeted conservation. The mid-elevation *Laurentian-Acadian Pine-Hemlock-Hardwood Forest* has relatively high resilience but the lowest protection (2%) and securement (14%) of any forest type. Our coastal and southern interior forests also have challenges with resilience. *North Atlantic Coastal Plain Hardwood Forest, Northeastern Interior Dry-Mesic Oak Forest,* and *Northeastern Coastal & Interior Pine-Oak Forest* have low securement, low resilience, and fall far short of the GSPC and NE targets (FIGURE 5, GROUP B). The lower resilience is due to these forests occurring on gentle lowland topography and being more fragmented by roads, powerlines, and development, reflecting the populated portion of New England where they are found. *North Atlantic Coastal Plain Hardwood Forest* does meet the NE target of 5% protected, but less than half of that is on resilient land. *Northeastern Interior Dry-Mesic Oak Forest* and *Northeastern Coastal & Interior Pine-Oak Forest* are both in high need of conservation, with less than 20% secured against conversion, less than 5% protected, and less than half of land already secured being resilient. The collective acreage needed to reach the NE 30% target for both forest types is relatively small (361,700 acres), and there is an ample amount of these forests on resilient land.

A large portion of our forests (5.3 million acres) are lands managed for multiple uses (TABLE 4). This could be an effective and cost-efficient strategy for conservation, but if the strategy is to succeed, these lands will need science-based and rigorously applied management aimed at producing the natural benefits and sustaining the diversity that we depend on. A discussion of the best forest management practices to sustain biological diversity and increase carbon is beyond the scope of this report, but suffice it to say improving forest management to maintain biodiversity, store carbon, and yield a sustainable harvest is an area of active research.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## Wetland Habitats

**GSPC Target 4**: At least 15% of each wetland type secured through effective management and/or restoration (i.e., GAP 1-2 protection).

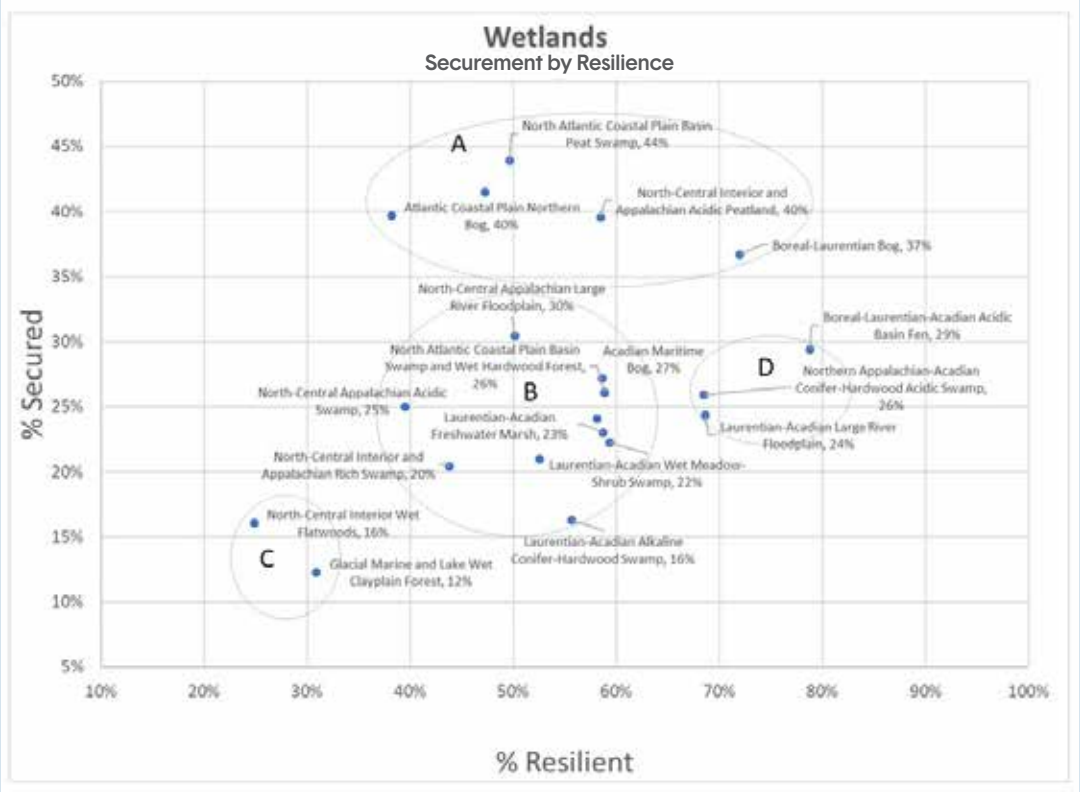
**NE Target**: At least 10% of each wetland habitat protected (GAP 1-2) and at least 30% of each secured against conversion (GAP 1-3). Resilient land makes up 50% of securement.

Wetlands are essential to sustaining New England's plant diversity. The four million acres of swamps, bogs, marshes, fens, and floodplains that punctuate the landscape contain four to five times the density of rare plant species of upland forests (based on an overlay of Natural Heritage program rare species locations on the vegetation map). Although wetlands make up only 12% of the natural lands, roughly 48% of the total vascular flora are legally considered to be obligate or facultative to wetlands (Lichvar et al. 2016).

The resilience approach targets larger unfragmented wetland complexes that are likely to persist over time. Small individual wetlands occurring in fragmented landscapes tend to score low for resilience, reflecting their vulnerability to the effects of climate change. As some kinds of wetlands occur predominantly in the latter context (FIGURE 6, GROUP B), resilience scores are intertwined with wetland type. For example, less than half of New England's freshwater marshes occur as large unfragmented complexes; most are scattered and small. Wet basins, moist depressions, ponds, and lakes help sustain the resilience of larger areas because they are cooler and moister than their surroundings, and this function will likely become more important as temperatures rise (McLaughlin et al. 2017; Simsek and Odul 2018). To account for the differences between wetlands and matrix forests in the NE target, we kept the criterion for base securement at 30%, increased the percentage of protection to 10% (GAP 1-2), and lowered the resilience criteria to 50% on the existing secured lands. The aim is to focus new acquisition on wetlands with the highest resilience, while acknowledging that vulnerable wetlands currently secured will remain important in the future due to their topographic setting, even if the structure and composition are compromised.

**FIGURE 6. Wetland Securement by Resilience**

This chart shows the average securement (GAP 1-3) and the average resilience score across all acres of each wetland type. A = high securement, moderate resilience, B = moderate securement, moderate resilience, C = low securement, low resilience, and D = moderate securement, high resilience. Total securement (GAP 1-3) is listed after the wetland name.




**Results:** New England's wetlands are 24% secured, but none of the region's five most common wetland types meet either GSPC or NE targets, although most do occur on resilient land, and most have more than 20% securement (TABLE 5). Six wetland habitats meet the GSPC target of 15% protection, but they are all unique small-acreage swamps or peat bogs (TABLE 5). Most of these also meet the NE target. *Acadian Maritime Bog* and *North Atlantic Coastal Plain Basin Swamp & Wet Hardwood Forest* are short in overall securement, and *Coastal Plain Basin Peat Swamp* falls short in resilience. Urgently in need of protection are *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp*, *North-Central Interior Wet Flatwoods*, and the *Glacial Marine & Lake Wet Clayplain Forest*, which have little protection or securement (FIGURE 6). Perhaps the protection of common wetlands is lower than expected because regulations are in place to prevent the destruction of wetlands; however, without targeted conservation action, it is unlikely the full diversity of wetlands will persist. Reaching the NE target will require securing an additional 253,902 acres of resilient wetland, while meeting the GSPC target would require 405,083 acres of newly protected wetlands.

Tidal wetlands are a special case. Despite relatively high levels of securement, we are still losing these wetlands due to inundation by sea-level rise. This phenomenon has been studied in detail by The Nature Conservancy (Anderson and Barnett 2017), which recommends conserving the "migration space" adjacent to each wetland to facilitate its migration landward and thus support its persistence. Not all existing wetlands have access to migration space, and much of the available migration space is not necessarily even in natural cover; but currently 33% of the migration space is secured against conversion, including 17% that is already protected. Most of that is associated with resilient sites.

**TABLE 5. Goal Assessment for Wetlands**

Columns 2-5 show the percent secured and percent of that which is on resilient land (%R). Columns 6-7 indicate if the wetland type meets (Y) or partially meets (P) the GSPC and NE targets. Column 8 gives the acreage of resilient land to be secured to meet the NET 30%. Superscript next to the name indicates the rank in total acreage of five most common types. Although tidal salt marsh protection is included in the table, the protection of existing salt marsh is not a useful indicator due to inundation by sea-level rise.

| WETLAND HABITATS | % PROTECTED (GAP1-2) | % R | % SECURED FROM CONVERSION (GAP 1-3) | % R | GSPC | NET TARGET | RESILIENT ACRES FOR 30% |
|---|---|---|---|---|---|---|---|
| Acadian Maritime Bog | 25% | 61% | 27% | 63% | Y | P | 149 |
| Boreal-Laurentian Bog | 23% | 71% | 37% | 74% | Y | Y | |
| Coastal Plain Basin Swamp/Hardwoods | 22% | 63% | 26% | 62% | Y | P | 24 |
| Coastal Plain Basin Peat Swamp | 17% | 49% | 44% | 48% | Y | P | |
| Tidal Salt Marsh | 17% | 56% | 42% | 52% | NA | NA | 12,863 |
| Tidal Marsh Migration Space | 17% | 94% | 33% | 91% | NA | NA | |
| Coastal Plain Northern Bog | 16% | 75% | 40% | 56% | Y | Y | |
| Interior/Appalachian Acidic Peatland | 15% | 33% | 40% | 52% | Y | Y | |
| Acadian Acidic Basin Fen | 10% | 80% | 29% | 85% | | P | 1,819 |
| Appalachian Large River Floodplain | 9% | 43% | 30% | 56% | | P | |
| Acadian Large River Floodplain | 7% | 73% | 24% | 81% | | | 17,434 |
| Freshwater Marsh[5] | 7% | 74% | 23% | 70% | | | 25,734 |
| N. Conifer-Hardwood Acidic Swamp[1] | 6% | 84% | 26% | 80% | | | 31,289 |
| Wet Meadow-Shrub Swamp[4] | 5% | 74% | 22% | 71% | | | 38,109 |
| Appalachian Acidic Swamp[2] | 5% | 51% | 25% | 46% | | | 30,464 |
| Interior/Appalachian Rich Swamp | 5% | 54% | 20% | 50% | | | 24,048 |
| Alkaline Conifer-Hardwood Swamp[3] | 4% | 71% | 16% | 75% | | | 78,818 |
| Wet Clayplain Forest | 3% | 71% | 12% | 37% | | | 2,489 |
| Interior Wet Flatwoods | 3% | 38% | 16% | 26% | | | 3,525 |
| **TOTAL** | | | | | | | **253,902** |


## Patch-forming Habitats

**GSPC Target 4**: At least 15% of each habitat type secured through effective management and/or restoration (i.e., GAP 1-2 protection).

**NE Target**: At least 15% of each patch-forming habitat protected (GAP 1-2) and at least 30% of each secured against conversion (GAP 1-3). Resilient land makes up 75% of securement.

Patch-forming habitats are terrestrial plant communities that occur in small patches on the landscape, nested within, and often contrasting with, the background matrix of forest and wetlands. Although patch habitats make up only 2% of New England's natural land, and none of them has more than 150,000 acres of total extent, they are hotspots of plant diversity. The summits, cliffs, barrens, dunes, grassy openings, and talus slopes have a density of rare species ten times higher than wetlands and forty times higher than upland forests, based on an overlay of species tracked by the state Natural Heritage programs. The overlay illustrates how important some of these communities are to rare plant species: alpine (66 species), acidic cliffs (38 species), calcareous cliffs (23), beach and dune (36), coastal grassland (8). The acreage of these communities may be dispersed as thousands of small patches (e.g., acidic cliffs) or clumped as in alpine tundra.

Patch-forming habitats are small in extent and concentrated in their biodiversity, and thus are more vulnerable to localized threats. Currently only 21% are secured against conversion. To recognize their high biodiversity value and small extent, we increased the NE protection target to 15%, which matches the GSPC target, while keeping the securement target at 30% and the climate resilience target high: 75% occurring on resilient land.

We included four forest types in this section (instead of the matrix forest section, where they appear in Part Two) because their current distributions are so restricted to small patches that the higher NE target for patch-forming habitat is more appropriate. These are: *North Atlantic Coastal Plain Pitch Pine Barrens*, *Northeastern Interior Pine Barrens*, *North Atlantic Coastal Plain Maritime Forest,* and *Glacial Marine & Lake Mesic Clayplain Forest*.

**Results:** Seven patch habitats meet the GSPC target, but only four of those also meet the NE target for area and resilience (TABLE 6). In general, the rocky landform-based habitats (e.g., cliff, summit) tend to have a high resilience score, reflecting the microclimates associated with their settings. Most of these habitats meet both targets. The coastal plain sand and silt communities occur mostly on climate-vulnerable land, with only 19-50% of the secured examples occurring on resilient sites. Two of these communities–*North Atlantic Coastal Plain Pitch Pine Barrens* and *North Atlantic*

*Coastal Plain Heathland & Grassland*—are also fire dependent. These habitats may be able to tolerate warming temperatures better than some, but their fragmented and developed settings could make burning difficult. The third, *North Atlantic Coastal Plain Beach & Dune*, is already experiencing a change in sea level. Unlike tidal salt marshes, which are literally migrating inland in response to sea-level rise, it is unclear what the future holds for the creation of new beaches to replace those drowned by inundation. Slightly elevated dune systems are more likely to persist through the next century, albeit as increasingly isolated islands.

The percent of the habitat that meets resilience goals differs dramatically between the bedrock-based communities, which are mostly above the 75% mark (FIGURE 7 A & D) and the sand/silt-based communities, which score much lower (FIGURE 7 B & C). Because patch habitats are small, only an additional 7,556 acres are needed to reach the GSPC 15% protected target and 17,726 to reach the NET 30% securement based on acres alone. But it would require an additional 88,620 acres of targeted resilient land to bring the sand/silt-based systems (pine barrens, dune, heathland) up to the target for climate resilience. Sustaining these habitats could be a challenge.

Two forest habitats are so restricted that they may be better thought of as patch-forming habitats need urgent conservation attention: *North Atlantic Coastal Plain Maritime Forest* and Vermont's *Glacial Marine & Lake Mesic Clayplain Forest*. The latter has very little protection or securement.

Two patch-forming habitats that just reach into New England are not included in the full assessment in Part Two but are shown in the tables and charts here for completeness. They are *Central Appalachian Dry Oak-Pine Forest* and *Central Appalachian Pine-Oak Rocky Woodland*.

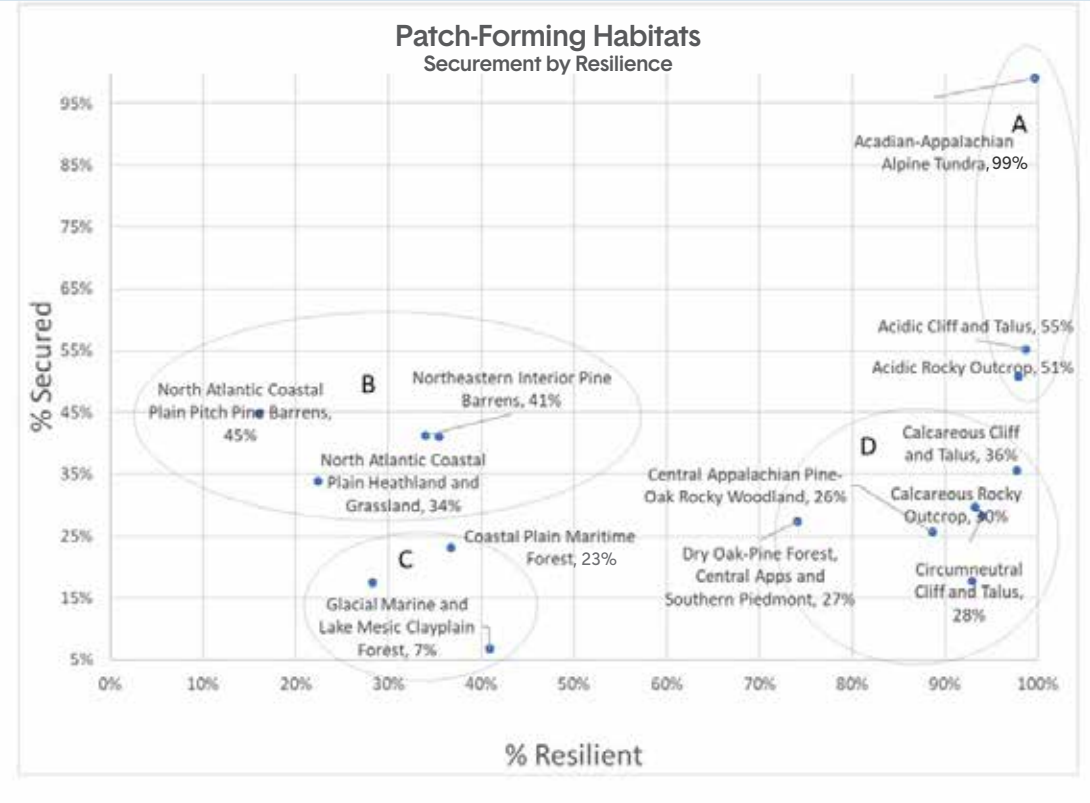
**TABLE 6. Goal Assessment for Patch-Forming Habitats**

Columns 2—5 show the percent secured and percent of that which is on resilient land. Columns 6–7 indicate if the habitat type meets (Y) or partially meets (P) the GSPC and NE targets. Column 8 gives the acreage of resilient land to be secured to meet the NET 30% and, in italics, *the additional resilient acres required to meet the 75% resilience criterion.*

| PATCH-FORMING TERRESTRIAL HABITATS | % PROTECTED (GAP1-2) | % R | % SECURED FROM CONVERSION (GAP 1-3) | % R | GSPC | NET TARGET | RESILIENT ACRES FOR 30% SECURED / 75% RESILIENT |
|---|---|---|---|---|---|---|---|
| Acadian-Appalachian Alpine Tundra | 85% | 100% | 99% | 100% | Y | Y | |
| Acidic Cliff & Talus | 36% | 99% | 55% | 99% | Y | Y | |
| Acidic Rocky Outcrop | 30% | 100% | 51% | 99% | Y | Y | |
| Coastal Plain Pitch Pine Barrens | 16% | 31% | 45% | 19% | Y | P | *58,431* |
| Northeastern Interior Pine Barrens | 9% | 49% | 41% | 33% | | | *8,403* |
| Coastal Plain Beach & Dune | 27% | 54% | 41% | 50% | Y | P | *9,140* |
| Calcareous Cliff & Talus | 15% | 99% | 36% | 99% | Y | Y | |
| Coastal Plain Heathland & Grassland | 21% | 23% | 34% | 25% | Y | P | *12,646* |
| Calcareous Rocky Outcrop | 11% | 100% | 30% | 99% | | | 118 |
| Circumneutral Cliff & Talus | 9% | 97% | 28% | 95% | | | 242 |
| Central Apps Dry Oak-Pine Forest | 7% | 87% | 27% | 80% | | | 3,146 |
| Central Apps Pine-Oak Rocky Woodland | 7% | 88% | 26% | 90% | | | 1,366 |
| Coastal Plain Maritime Forest | 12% | 51% | 23% | 47% | | | 5,400 |
| Mesic Clayplain Forest | 3% | 77% | 7% | 57% | | | 7,454 |
| **TOTAL** | | | | | | | **17,726 / *88,620*** |

**FIGURE 7. Patch-Forming Habitats by Resilience**

This chart shows the average securement (GAP 1-3) and the average resilience score across all acres of each patch habitat. A = high securement, high resilience, B = moderate securement, low resilience, C =low securement, low resilience, and D = moderate securement, high resilience. Total securement (GAP 1-3) is listed after the community name.



## Risk of Conversion

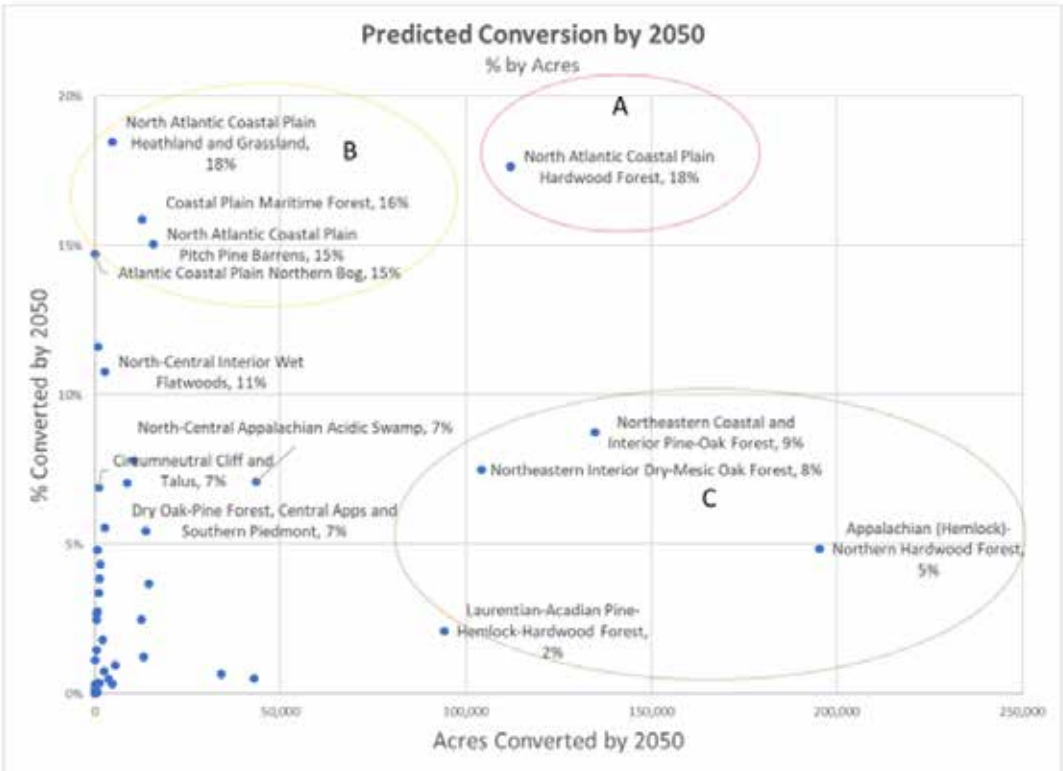
Throughout this report we note that securing land against conversion to development is often a first step toward protecting the land for nature and natural processes. In many parts of New England, the threat of habitat loss through direct conversion to development remains high and is estimated to total almost a million acres by 2050.

To understand how this is distributed across habitats, we used a Land Transformation Model developed by the Human-Environment Modeling and Analysis Laboratory at Purdue University (Tayyebi et al. 2012) to estimate the amount of each habitat predicted to be lost to development over the next 30 years. In this model, the quantity of urban growth at county and city scales is simulated using population, urban density, and nearest-neighbor-dependent attributes; areas near current development are the most likely to convert to development.

The results indicate large difference in the amount and percentage of likely development for each habitat. Several coastal plain patch-forming habitats are likely to lose a significant portion of their extent (15% to 18%), although because they are small, the total acres lost would be less than 75,000 (FIGURE 8, GROUP B). At the other end of the spectrum, three of southern New England's matrix forest types are predicted to lose more than 100,000 acres each (FIGURE 8, GROUP C), but because they are so dominant on the landscape, it is less than 10% of their respective extents. The most threatened habitat is *North Atlantic Coastal Plain Hardwood Forest*, which is predicted to lose more than 100,000 acres, equal to 18% of its current extent.

**FIGURE 8. Threat of Conversion**

The proportion of each habitat predicted to be developed is plotted against the total acreage predicted to be lost. A= high percent loss, high acreage loss. B = high percent loss, low acreage loss, C = low percentage loss, high acreage loss.



# CONSERVATION OF IMPORTANT PLANT AREAS

## Important Plant Areas for Diversity and Resilience

The GSPC calls for the identification and protection of Important Plant Areas (IPA) around the world, and several countries have completed IPA strategies as part of their national plans under the Convention on Biological Diversity. We therefore made identifying IPAs in New England a high priority, as securing these areas would be one of the most substantial approaches to land conservation for plant diversity.

In this section, we assess the resilience and habitat characteristics of the land on which rare species occur. The goal is to ensure that we conserve the areas of highest site resilience that also support a diversity of rare species, and, if possible, a diversity of habitats. Areas of high site resilience have the most topographic microclimates and the highest degree of connectedness relative to their geology, soil, and elevation zone, making them natural strongholds where species are likely to persist longer in the face of climate change.

## Definition and Location of IPAs

The GSPC sets three basic criteria for an Important Plant Area:

- Criteria A: threatened species
- Criteria B: exceptional botanical richness
- Criteria C: threatened habitats

A site can be identified as an IPA if it qualifies under **one or more** of these criteria (www.plantlife.com/criteria).

For this study, we defined an IPA as a contiguous patch of resilient land with a high diversity of rare plant species relative to its size. Rare plants were limited to globally and regionally rare species listed as division 1, 2 or 2a in *Flora Conservanda* (Brumback and Gerke 2013). Resilient land was defined as land with an above-average site resilience score based on the TNC resilience map (Anderson et al. 2014). We adopted the global GSPC goal and created a regional NE target as follows:

**GSPC Target 5**: At least 75% of the most important areas for plant diversity (IPA) of each ecological region protected, with effective management in place for conserving plants and their genetic diversity (i.e., GAP 1-2 protection).

**NE Target**: At least 30% of each resilient area with the highest rare plant diversity (IPA) protected and at least 75% of each IPA secured against conversion (GAP 1-3) across habitats and states.

To identify and map IPAs, we first created a dataset of contiguous resilient land in GIS by grouping adjacent cells of resilient land into larger aggregates and converting them to polygons, which we called "resilience patches." Next, we overlaid known locations of rare plants on the resilience patches and tabulated the size of the patch and the number of species and taxa per patch. To account for the size difference in the patches, we used a regression model to predict the average number of rare taxa based on the patch size ($R^2$= 0.11, P <0.0000) and then calculated the standardized residuals (the difference between the observed value and the predicted value) to identify sites that had more rare taxa than expected from their size. Note, the dataset and overlay are from 2014 and were used with permission; however, they do not reflect recent years of inventory (details in Anderson et al. 2014).

*golden-club (Orontium aquaticum)*
Liza Green © Native Plant Trust

The results identified 234 IPAs (FIGURE 9) spread across all six states. Collectively the IPAs cover 2.6 million acres and contain multiple populations of 212 Flora Conservanda species. Each site supports an average of three rare taxa, but diversity ranges from 2 to 26 taxa depending on the size of the site. Large IPAs over 100,000 acres average 11 taxa (range 5-26), small 100-acre sites average 6 taxa (range 5-6), and tiny 10-acre patches average 2 taxa (range 2-5). All sites scored high for climate resilience, but small sites will need to be assessed for their landscape context and likely nested within larger protected sites if they are to retain their species.

**FIGURE 9. Important Plant Areas (IPAs)**

These 234 sites are climate-resilient areas with multiple populations of *Flora Conservanda* Division 1 and 2 species. Very high diversity = 9 taxa, range 5-26; high diversity = 3 taxa, range 2-5.

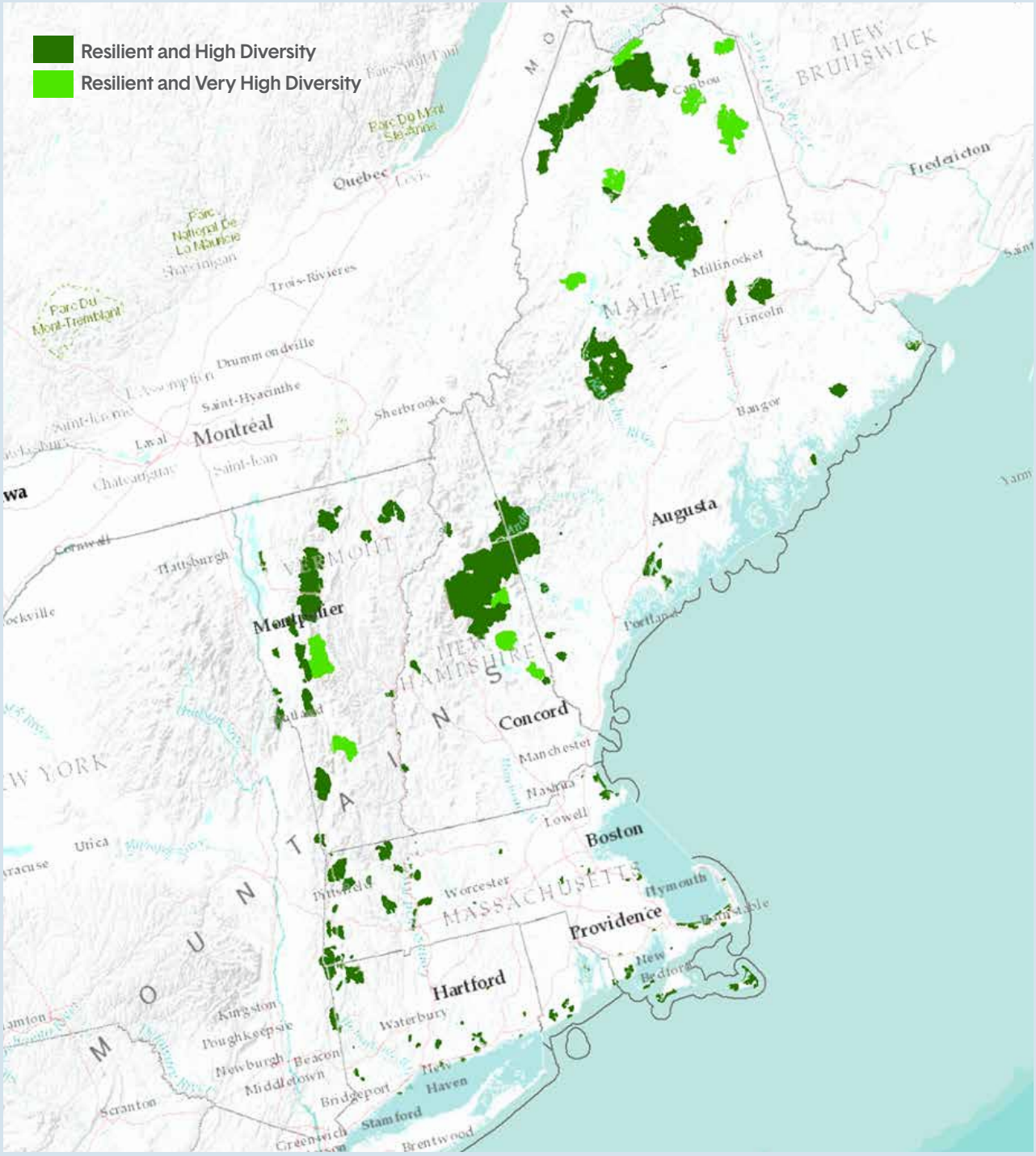
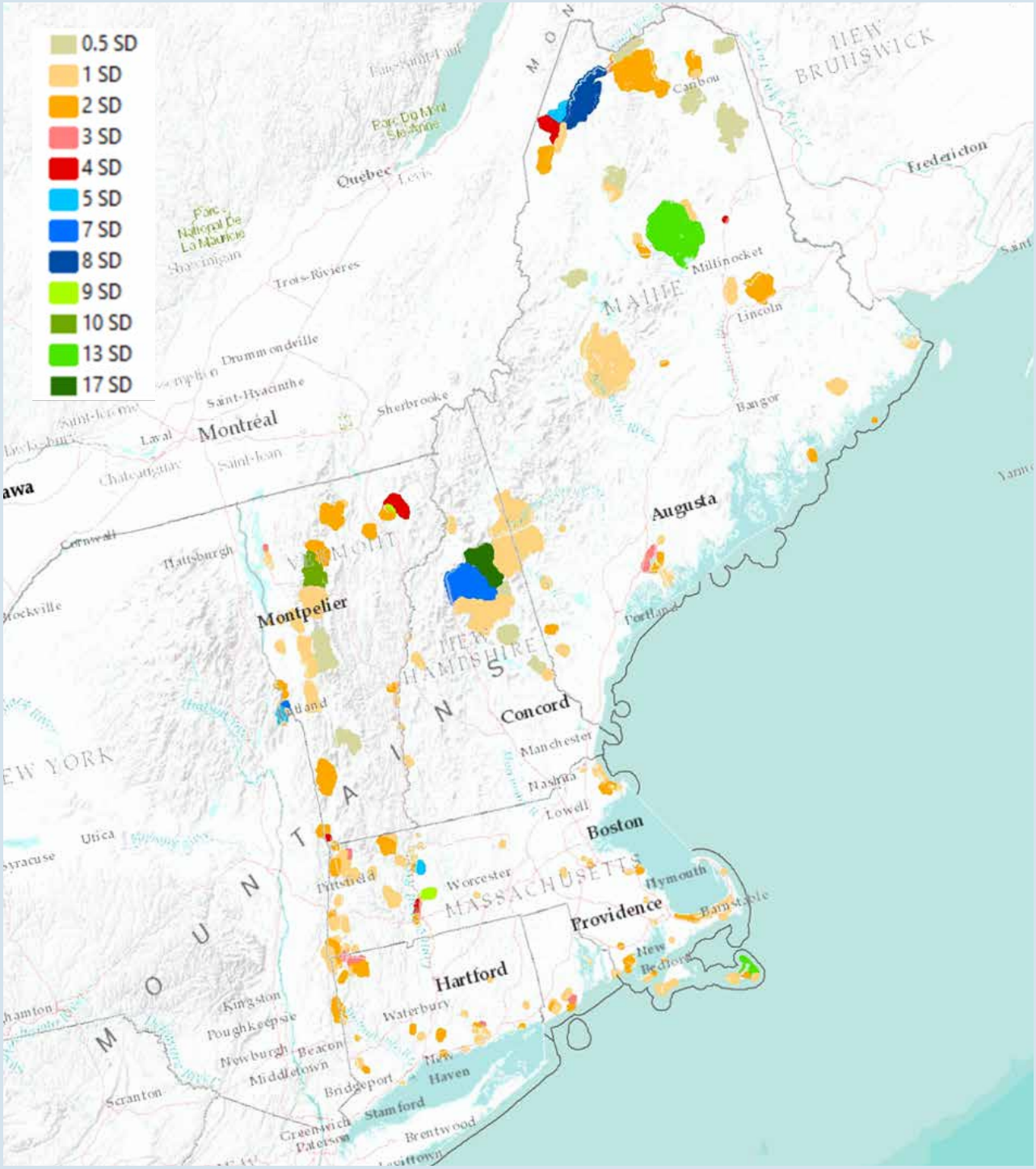


**FIGURE 10. IPAs by Diversity Status**

The average resilient site in New England has less than one rare species, but the IPAs have many more. The colors indicate the number of standard deviations above the mean each IPA has. The highest-scoring site (15 SD above the mean) is a 106,000-acre mountain site in NH with 26 rare plant taxa and 506 total rare species occurrences.



## Conservation Status and Progress Toward IPA Goals

To assess conservation goals, we labeled the IPAs with their primary state of occurrence, dominant habitat type, and degree of protection. Although all IPAs contain multiple habitats, tagging them with the dominant habitat enabled us to assess their ecological distribution across the region.

**Conservation Status of Sites**: GSPC Target 5 defines its IPA goal in terms of the number of sites protected. Here we define a protected IPA as one with 75% or more of its area in GAP status 1 or 2. Of the 234 IPAs, only 10 (4%) meet this criterion, and these are distributed relatively evenly across matrix, patch, and wetland habitats (TABLE 7). An additional 32 sites (14%) have 75% of their area secured (GAP 1-3) in a combination of protected and multiple-use land. These 32 sites are mostly forest dominated and occur on state lands or private lands with a conservation easement that permits management. A strategy for these places might be to raise the GAP status inside the IPA boundary by designating the area as a place of recognized biodiversity value or botanical concern. Of the remaining 192 IPAs, 155 have some level of securement, including 122 with GAP 1-2 in some portion of the site (although the securement does not add up to 75% of the area). These warrant further investigation, with a goal of either expanding the area protected or fee acquisition where possible and appropriate. The remaining 37 IPAs have no securement whatsoever and would benefit from on-the-ground investigation to establish both priority for and feasibility of conserving these sites.

**Conservation Status by Area**: The individual IPAs differ dramatically in size, so it is helpful to assess protection by total area rather than by counting the sites protected. This reveals a clearer picture of conservation progress. Of the 2.6 million acres included in the IPAs, 29% are protected (GAP 1-2) and another 23% are on multiple-use land (GAP 3); thus 52% of the IPA area is in some level of securement (TABLE 7).

Collectively, the set of IPAs dominated by the following habitats are all more than 30% protected, although only two are more than 75% secured (TABLE 7): *Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest, North Atlantic Coastal Plain Maritime Forest, North Atlantic Coastal Plain Pitch Pine Barrens, Laurentian-Acadian Northern Hardwood Forest, Boreal-Laurentian Bog, North-Central Appalachian Acidic Swamp,* and *Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp*. These results reflect the fact that the IPAs differ in size and that protection may be concentrated in a few sites.

Individually, 19 IPAs meet both the protection (30%) and securement (75%) of the NE target. These are mostly forest-dominated IPAs.

**Boreal Upland Forest**: *Acadian Low-Elevation Spruce-Fir-Hardwood Forest (3), Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (2)*

**Northern Hardwood & Conifer Forest**: *Appalachian (Hemlock)-Northern Hardwood Forest (3) Laurentian-Acadian Northern Hardwood Forest (7)*

**Central Oak-Pine Forest**: *North Atlantic Coastal Plain Maritime Forest (1), North Atlantic Coastal Plain Pitch Pine Barrens (1), Northeastern Interior Dry-Mesic Oak Forest (1)*

**Grassland & Shrubland**: *North Atlantic Coastal Plain Heathland & Grassland (1)*

Conversely, the set of IPAs dominated by the following habitats collectively have less than 10% protection: *Laurentian-Acadian Pine-Hemlock-Hardwood Forest, Northeastern Coastal & Interior Pine-Oak Forest, North-Central Interior Wet Flatwoods, Laurentian-Acadian Wet Meadow-Shrub Swamp, and North-Central Appalachian Large River Floodplain.*

See Appendix 3 for a complete list of IPAs by habitat and state, with acreage, GSPC protection status, and percent of area protected and secured.

**TABLE 7. Protection and Securement Status of the IPAs**

**#P** = the number of IPAs with more than 75% protection

**#S** = the number with more than 75% securement

**#U** includes 155 sites with some level of protection or securement but below 75% in total

| IMPORTANT PLANT AREAS BY DOMINANT HABITAT | BY COUNT | | | BY AREA | | |
|---|---|---|---|---|---|---|
| | #P | #S | #U | Protected (GAP 1-2) | Multiple Use (GAP 3) | Total Secured |
| **MATRIX FOREST HABITATS** | **9** | **26** | **145** | **29%** | **23%** | **52%** |
| **Boreal Upland Forest** | **3** | **5** | **13** | **35%** | **25%** | **60%** |
| Acadian Low-Elevation Spruce-Fir-Hardwood Forest | 3 | 3 | 13 | 10% | 22% | 32% |
| Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest | | 2 | | 68% | 29% | 97% |
| **Central Oak-Pine Forest** | **3** | **4** | **26** | **16%** | **12%** | **28%** |
| North Atlantic Coastal Plain Hardwood Forest | | 1 | 11 | 15% | 12% | 27% |
| North Atlantic Coastal Plain Maritime Forest | 1 | | 1 | 44% | 0% | 44% |
| North Atlantic Coastal Plain Pitch Pine Barrens | 1 | 2 | 4 | 55% | 34% | 89% |
| Northeastern Interior Dry-Mesic Oak Forest | 1 | 1 | 10 | 13% | 12% | 25% |
| **Northern Hardwood & Conifer Forest** | **3** | **17** | **106** | **27%** | **22%** | **49%** |
| Appalachian (Hemlock)-Northern Hardwood Forest | 2 | 5 | 59 | 12% | 19% | 31% |
| Laurentian-Acadian Northern Hardwood Forest | 1 | 11 | 35 | 30% | 22% | 52% |
| Laurentian-Acadian Pine-Hemlock-Hardwood Forest | | | 11 | 5% | 13% | 18% |
| Northeastern Coastal & Interior Pine-Oak Forest | | 1 | 1 | 5% | 27% | 32% |
| **PATCH-FORMING HABITATS** | **1** | **1** | **11** | **14%** | **16%** | **30%** |
| **Grassland & Shrubland** | **1** | **1** | **11** | **14%** | **16%** | **30%** |
| Agriculture | | | 7 | 15% | 5% | 20% |
| Atlantic Coastal Plain Beach & Dune | | | 3 | 16% | 8% | 24% |
| North Atlantic Coastal Plain Heathland & Grassland | 1 | 1 | 1 | 11% | 37% | 48% |
| **WETLAND HABITATS** | | **5** | **34** | **29%** | **24%** | **53%** |
| **Central Hardwood Swamp** | | | **1** | **0%** | **0%** | **0%** |
| North-Central Interior Wet Flatwoods | | | 1 | 0% | 0% | 0% |
| **Freshwater Marsh & Shrub Swamp** | | **1** | **7** | **25%** | **21%** | **46%** |
| Laurentian-Acadian Freshwater Marsh | | | 6 | 27% | 16% | 43% |
| Laurentian-Acadian Wet Meadow-Shrub Swamp | | 1 | 1 | 7% | 60% | 67% |
| **Large River Floodplain** | | **1** | **2** | **0%** | **47%** | **47%** |
| North-Central Appalachian Large River Floodplain | | 1 | 2 | 0% | 47% | 47% |
| **Northern Peatland** | | | **1** | **37%** | **1%** | **38%** |
| Boreal-Laurentian Bog | | | 1 | 37% | 1% | 38% |
| **Northern Swamp** | | **2** | **9** | **34%** | **24%** | **58%** |
| North-Central Appalachian Acidic Swamp | | 1 | 6 | 32% | 27% | 59% |
| North-Central Interior & Appalachian Rich Swamp | | 1 | 2 | 28% | 18% | 46% |
| Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp | | | 1 | 48% | 9% | 57% |
| **Tidal Marsh** | | **1** | **14** | **24%** | **35%** | **59%** |
| North Atlantic Coastal Plain Tidal Salt Marsh | | 1 | 14 | 24% | 35% | 59% |
| **Open Water / Lakeshore** | | | **2** | **0%** | **0%** | **0%** |
| **TOTAL** | **10** | **32** | **192** | **29%** | **23%** | **52%** |

## Representation of Habitats in the IPAs

The IPAs make a perfect starting point for conserving resilient sites that contain rare species and represent a range of habitats. An efficient strategy would be to prioritize IPAs whose dominant habitat is generally not well conserved, as discussed in a previous section. Toward that end, we assessed the representation of habitats within the 234 IPAs to see how much of each habitat would be protected if conservation efforts focused on the IPAs. This assessment goes much deeper into the IPA composition than did the dominant-habitat analysis above, as many habitats (for example, *Cliff & Talus*) never dominate an IPA but occur across many sites.

For matrix forest (FIGURE 11), most of the IPA acreage occurs in the more northern forest types, but it also occurs in types urgently in need of conservation, such as *North Atlantic Coastal Plain Hardwood Forest, Northeastern Coastal & Interior Pine-Oak Forest,* and *North Atlantic Coastal Plain Maritime Hardwood Forest.*

For wetlands, all the common habitats (FIGURE 12) have ample IPA acreage, including *Laurentian-Acadian Wet Meadow-Shrub Swamp, Laurentian-Acadian Freshwater Marsh,* and *Laurentian-Acadian Large River Floodplain*. The wetland habitats most urgently in need of protection all occur in IPAs also needing protection, especially *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp* and to a lesser extent *North-Central Interior Wet Flatwoods* and *Glacial Marine & Lake Wet Clayplain Forest.*

Patch habitats are well represented in the IPAs (FIGURE 13). Among the habitats with IPAs needing protection are *North Atlantic Coastal Plain Heathland & Grassland, Calcareous Rocky Outcrop,* and *Circumneutral Cliff & Talus.*

Elizabeth Farnsworth © Native Plant Trust

**FIGURE 11. IPA Representation of Matrix Forest Habitats**
Collectively the 234 IPAs encompass 2.6 million acres, most of which is forest.

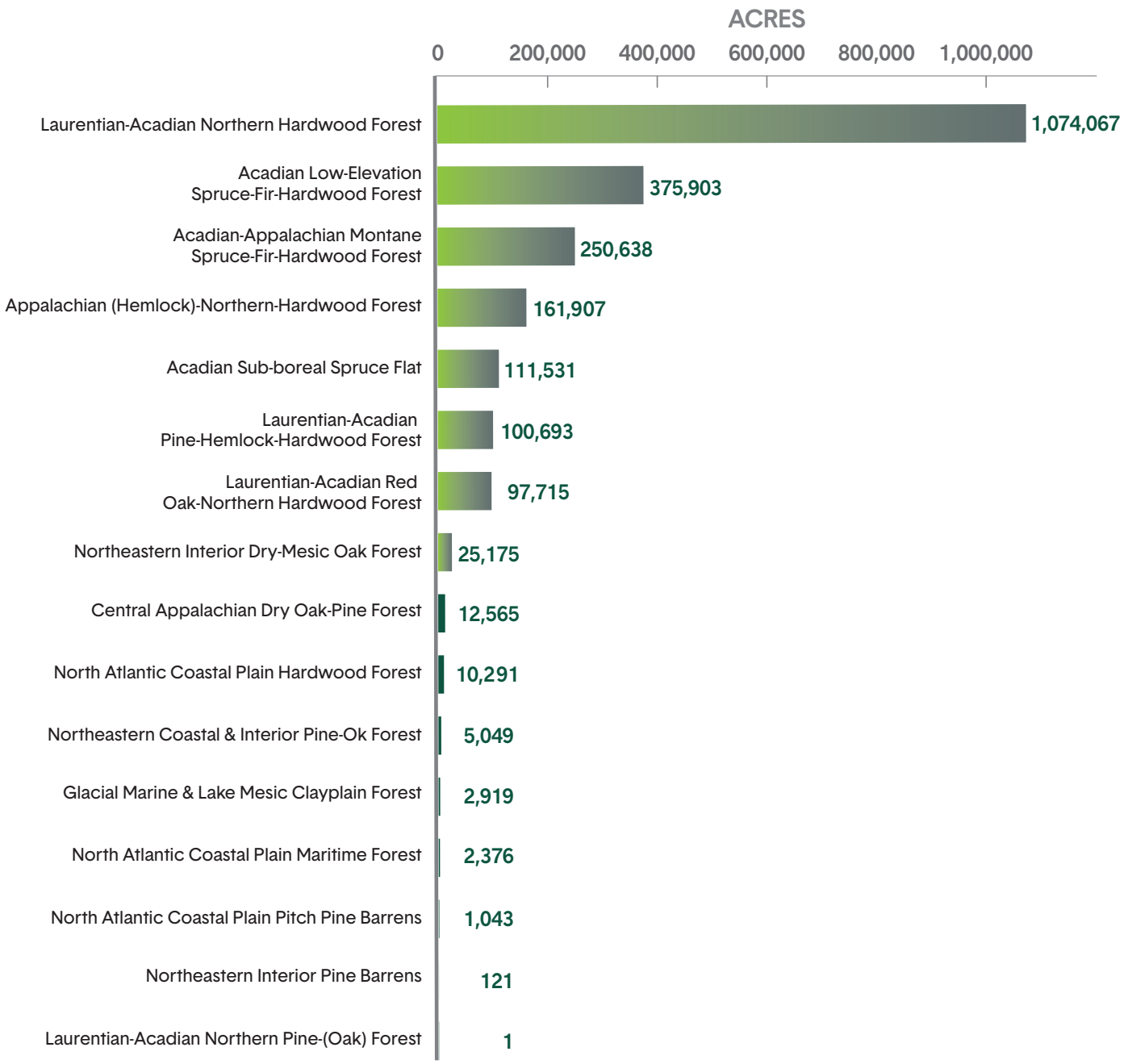


**FIGURE 12. IPA Representation of Wetland Habitats**

Collectively the 234 IPAs encompass 184,000 acres of wetland habitat.

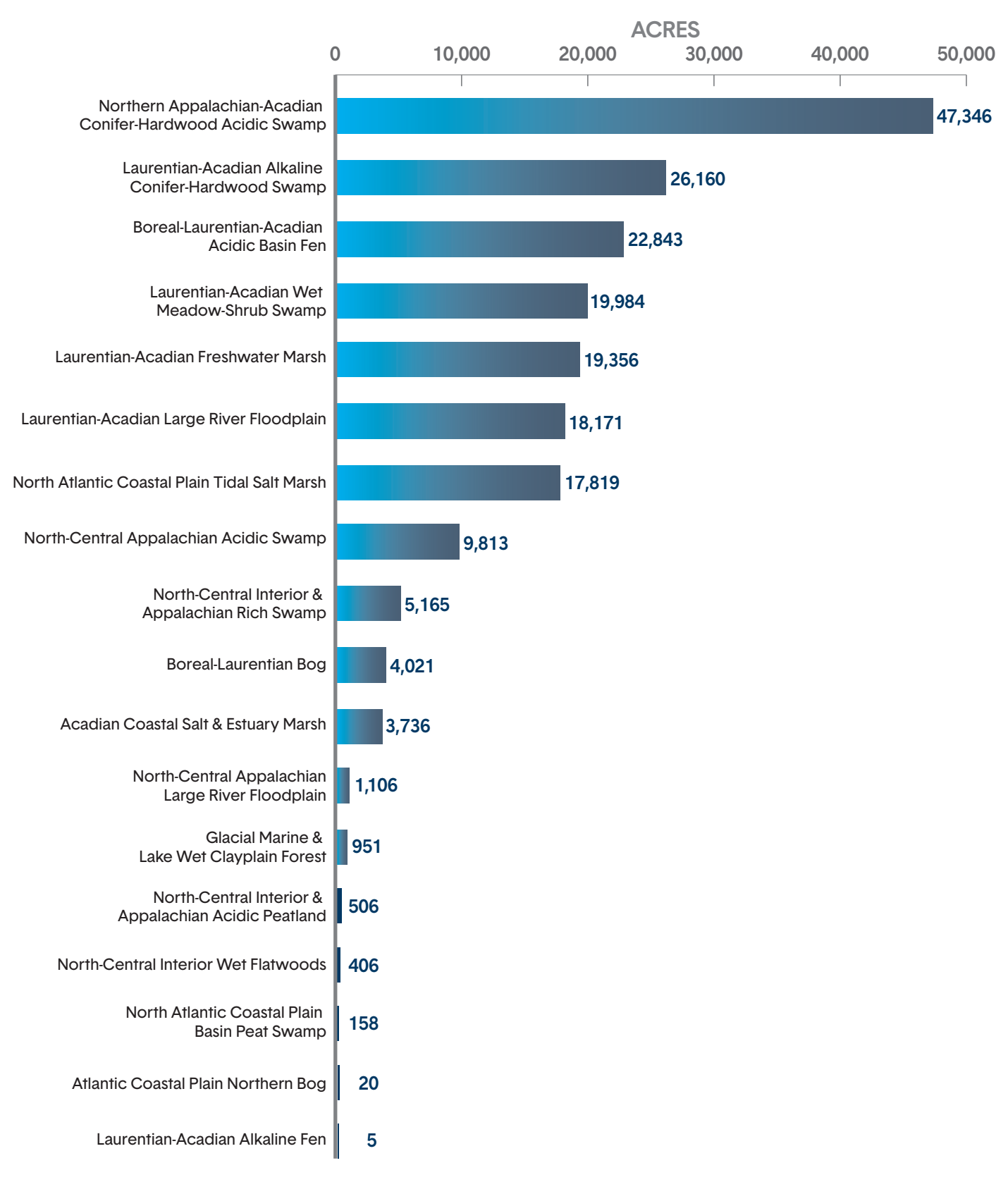
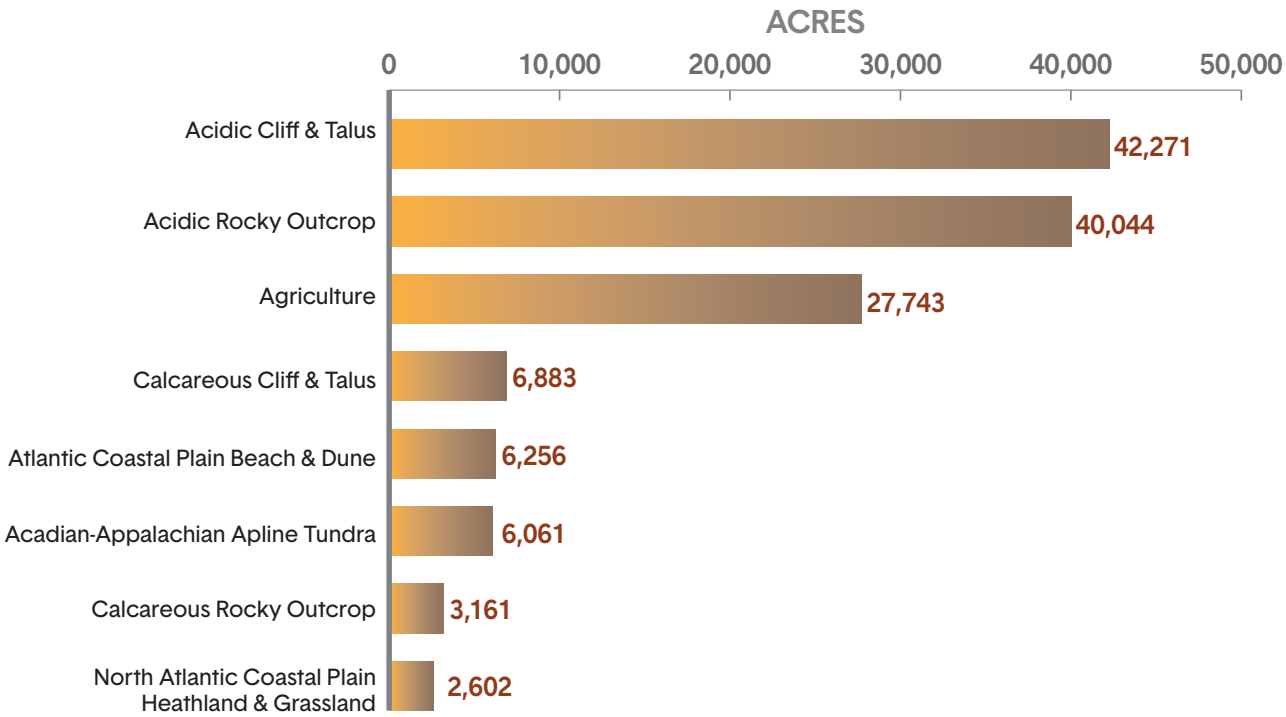


**FIGURE 13. IPA Representation of Patch-forming Habitats**

Collectively the 234 IPAs encompass 138,000 acres of patch-forming terrestrial habitat.




**Top Sites**: Another approach to prioritizing IPAs is simply by their diversity value. Of the 27 sites that scored far above average for diversity, only 1 is more than 75% protected (GSPC target), 9 are more than 30% protected (NE target), and 9 are less than 5% protected (TABLE 8). The sites with the highest diversity are generally the best protected, with the exception of a large site on the St. John River in Maine and a small site on Mount Pisgah in Vermont.

**Rare Plant Sites Outside IPAs**: In New England, rare plant sites are often found on resilient land. More than 60% of all occurrences of *Flora Conservanda* Division 1 and Division 2 taxa are in the IPAs (resilient areas with high diversity of rare plants), while 39% are on resilient areas not in an IPA (resilient area with low diversity of rare plants – usually just one occurrence ). Only 1% are on vulnerable areas (not resilient areas, FIGURE 14). This bodes well for conservation of rare species populations in New England, but increases the importance of protecting the IPAs. Since only 4% of the 234 IPAs are fully protected, many rare plant occurrences are not secure. Element occurrences of rare species not located on resilient land or in IPAs are immediate candidates for *ex situ* conservation, particularly seed banking (FIGURE 14).

**TABLE 8. Top Sites**

A list of sites scoring far above average for resilience AND diversity. GAP 1-2 is the percent of the site secured for nature and natural processes (i.e., protected).

| SITE ID | STATE | ACRES | SITE NAME | # *FLORA CONSERVANDA* TAXA | GAP 1-2 |
|---|---|---|---|---|---|
| 74690 | ME | 231,550 | Mt Katahdin | 22 | 86.3 |
| 177296 | NH | 142,457 | Mt Lincoln/Lafayette | 12 | 72.9 |
| 166592 | NH | 106,908 | Mt Eisenhower/Jackson/Crawford/ | 26 | 62.1 |
| 39751 | ME | 101,523 | St John River-Basford Rips-Blue Brook | 12 | 1.7 |
| 170730 | VT | 62,857 | Mount Mansfield | 14 | 22.8 |
| 52265 | ME | 25,411 | White Pond Acidic Fen, Northwest Lobe | 6 | 3.3 |
| 49094 | ME | 28,493 | St John River-Blue Brook | 8 | 2.3 |
| 167837 | ME | 10,134 | Abagadasset Point | 5 | 0.5 |
| 150311 | VT | 21,853 | Bald Mountain-Westmore | 7 | 0.0 |
| 245357 | VT/NY | 6,792 | Bald Mountain-West Haven | 8 | 50.1 |
| 309129 | MA | 6,734 | Mt Greylock/Ragged Mt/Saddleball Mt | 5 | 31.2 |
| 383349 | CT | 8,548 | Canaan Mountain | 5 | 20.1 |
| 382379 | MA | 4,675 | Nantucket  Harbor/Squam Head | 17 | 52.9 |
| 332418 | MA | 3,445 | Holyoke Range/Skinner State Park | 12 | 48.3 |
| 331473 | MA | 4,068 | Mt Norwottock/Devils Garden | 11 | 40.6 |
| 407472 | RI | 1,364 | Hot House Pond, Strange Pond | 5 | 30.8 |
| 168001 | VT | 1,315 | Eagle Mountain | 5 | 16.7 |
| 243370 | VT | 3,506 | Massachusetts Ledge | 9 | 12.7 |
| 422809 | CT | 1,163 | Eightmile River | 5 | 7.2 |
| 381217 | CT/MA | 1,488 | Toms Hill | 5 | 4.8 |
| 315708 | MA | 4,292 | No Name | 7 | 3.3 |
| 153805 | VT | 3,664 | Mount Pisgah | 13 | 0.0 |
| 391955 | MA | 404 | Nantucket/Shawkemo/Folgers Marsh | 5 | 30.4 |
| 300520 | VT | 339 | Pownal Hills-Quarry Hill | 6 | 28.0 |
| 77427 | ME | 194 | Crystal Bog | 6 | 15.7 |
| 38769 | ME | 286 | St John River, Wesley Brook | 5 | 0.0 |

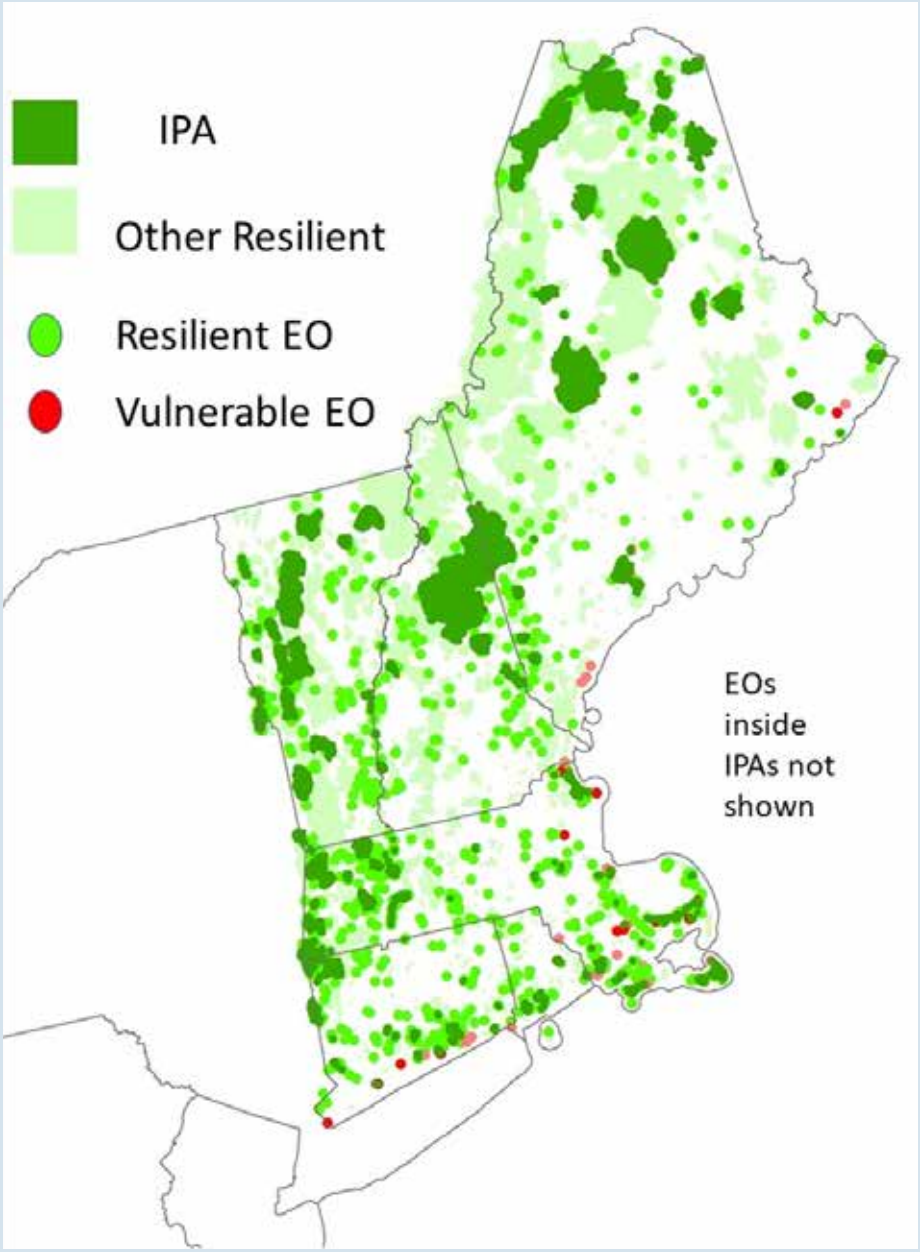



**FIGURE 14. Element Occurrences of Rare Plant Sites in IPAs and on Other Resilient Land**

Most occurrences of rare species are on resilient land, with only 24 on vulnerable land (red). Occurrences that are on resilient land but not in an IPA are shown in light green. The majority of occurrences are within the IPAs and hidden under the dark green areas on this map.

Plants are rooted organisms and thus sustaining plant diversity requires a long-term commitment to conserving places where they can thrive. The IPAs are a set of places where conservation is both critical and likely to succeed. Each site encompasses a diversity of habitats, contains a high density of rare plants, and has the highest possible site resilience relative to the geology and ecoregion in which they occur. Further, IPAs occur in every state across a range of sizes, habitats, and landscapes, making their conservation accessible to many scales of action. The sites and boundaries can be explored in detail on the accompanying web tool, and we encourage agencies and land trusts to ground check sites to assess their current condition.

# Conservation of Threatened Species

## Threatened Plants Conserved *in situ*

In 1996 and again in 2013, Native Plant Trust's *Flora Conservanda* (Brumback 1996; Brumback and Gerke 2013) designated the globally and regionally rare taxa in need of conservation. *In situ* protection is the primary method of conserving these species, and therefore knowing whether instances of rare taxa are located on protected land is important. Using 2015 data for numbers of plant occurrences (called an Element Occurrence or EO*) provided primarily by Natural Heritage programs in each New England state (or their equivalent), we were able to describe GAP securement levels for 245 of the 388 taxa in Divisions 1 and 2 (globally and regionally rare taxa) on the 2013 *Flora Conservanda* list. The list of 245 taxa with GAP status appears in Appendix 4.

The results indicate that 226 (92%) of the 245 well-mapped threatened plant species have some occurrences on secured land in New England, which is above the threshold set by the GSPC:

> **GSPC Target 7**: At least 75% of known threatened plant species conserved *in situ*. "Conserved *in situ*" is understood to mean that biologically viable populations of these species occur in at least one protected area or the species is effectively managed outside the protected area network, through other *in situ* management measures.

However, fewer than half the taxa (42%) have 50% or more of their total occurrences on secured land, and of these only 16% occur on GAP 1-2 land. Nineteen taxa (8%) have no occurrences on secured land. Thus, a large percentage of threatened species are in GAP 3 securement. Although secured against conversion, plants on these lands are not protected from other threats, such as those associated with logging or recreation (Farnsworth 2015 identifies up to five threats for many of these species). The securement status of the remaining 143 of the 388 Division 1 and 2 taxa was not available. Threatened plants in GAP 1-2 are covered in more detail in the Important Plant Areas section above.

The data show significant effort by public and private land conservation agencies and organizations in New England to protect rare plant habitat. Several caveats should be mentioned:

- The GSPC target does not specify a number or percentage of occurrences that should be in protected areas, only that "biologically viable populations occur in at least one protected area." Most biologists would not consider a species sufficiently secure if only one of its occurrences is on protected (GAP 1-2) land. In New England, the presence of endangered or threatened species has been one of the main drivers of land protection, and thus it is not surprising that a large percentage of threatened plants exist on secured land.

- The total number of EOs for each taxon in the GAP analysis is usually more than the number of EOs listed for each taxon in *Flora Conservanda* (Brumback and Gerke 2013). This is probably the result of all EOs of each taxon, including some historic locations for the taxa, being included in the GAP percentages. *Flora Conservanda* lists only EOs that are currently extant, defined as existing at a location within 20 to 25 years from present. Thus, the percentages of current occurrences on secured land may not be current.

*The term Element Occurrence was devised by The Nature Conservancy and is used in conservation as an alternative to "population." Populations of organisms often are difficult to delineate without intensive research, and use of the term "population" often implies that its limits are known. Somewhat broader in scope, an occurrence is defined as follows: the "area of land and/or water where a species is, or was, present and has practical conservation value"; it is the spatial representation of a species at a specific location (NatureServe 2012).

*White Mountain avens (Geum peckii)*
Liza Green © Native Plant Trust

- Based on the resilient-site analysis for the various ecological systems of New England (Part Two of this document), it seems likely that some current locations for a species may not be viable as climate change progresses. If this is the case, introduction to resilient sites within the historic range of a species or assisted migration to resilient sites outside its historic range may be necessary.

## Threatened Plants Conserved in *ex situ* Collections

*Ex situ* conservation is an indispensable component of integrated plant conservation, especially for imperiled species facing multiple threats on the landscape as the climate changes rapidly. Botanic gardens worldwide have long maintained rare plants in their living collections as a way to ensure their survival, and one recent study estimates that 41% of known threatened plant species are in such collections, primarily holding species from temperate regions (Mounce et al. 2017).

In recent decades, seed banking has become the predominant tool for maintaining rare plant diversity (and increasingly for common species essential for habitat restoration). Seed banking has several distinct advantages over living collections, including the ability to store large quantities of plant material for long periods of time at relatively low cost. Seed banking enables the preservation of genetic diversity within a population as it was collected on the landscape, at a specific moment in time. Maintaining genetic diversity in *ex situ* living collections is logistically complicated, as plantings are more vulnerable to genetic drift, artificial selection, and active problems with pests and pathogens (Guerrant et al. 2004).

The value of seed bank collections with representative genetic diversity cannot be overstated as species and habitats shift ranges as the climate changes. Seed collections give conservationists the option to augment, introduce, or assist in the migration of imperiled plant species to prevent local extirpation or extinction.

Native Plant Trust established its seed bank in 1985 and has spent decades refining protocols to maximize potential viability of seeds and to ensure representative genetic diversity in each seed collection. Recently, Native Plant Trust has focused on achieving goals set by the GSPC; for seed banking, it is Target 8:

**GSPC Target 8**: At least 75% of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs.

The GSPC sets a target for species conservation but lacks a target for the percentage of element occurrences collected of any individual species. To ensure genetic diversity, which safeguards adaptive abilities inherent in each occurrence of the species, research suggests collecting from at least two-thirds of the occurrences. The focus of such collection is on occurrences that are large in number of individual plants and representative of the geographic and ecological distribution of the species in New England.

Native Plant Trust has made significant strides in banking the rare flora of our region. In New England, there are 388 globally and regionally rare species (defined as Div. 1, 2, and 2[a] in *Flora Conservanda*) with approximately 3,300 element occurrences. The seed bank currently has ~800 collections, representating 244 occurrences of 167 globally or regionally rare species, plus ~500 collections of 20 locally rare and historic taxa (Div. 3, 3(a), 4). These represent 73 rare plant families and just under a tenth of the known occurrences of the most imperiled plants in New England.

*seaside threeawn (Aristida tuberculosa)*
Michael Piantedosi © Native Plant Trust

Among our highest priorities is to collect viable representatives of all globally and regionally rare species and to have sufficient quantities of each for research, augmentation, or other conservation initiatives. We are also focusing on acquiring seed from regional endemics, where New England is host to the majority of occurrences of a rare species. As we learn more about the presence of globally rare or endemic species on areas designated as "low resiliency" to climate change, or those with range strongholds in precarious positions on unsecured lands, we will focus collection targets more heavily on occurrences in those vulnerable locations.

Despite decades of effort to bank seeds of the region's imperiled species, work remains to bank those taxa which either do not produce true seeds (typically producing spores or vegetative propagules) or otherwise produce recalcitrant and unorthodox seeds. Among rare New England taxa, "unorthodox" plant groups—such as ferns and fern allies, many orchids (Orchidaceae), adder's tongues (Ophioglossaceae), and willows (Salicaceae)—will need continued research and expanded infrastructure for effective *ex situ* storage.

Shared knowledge has become a crucial research utility in applied *ex situ* conservation and often informs protocols and best practices for effective long-term storage of seed (and increasingly spore and gemmae). As of 2018 the number of botanical institutions that collect and bank seed of wild species has grown to 370 in 74 countries (Sharrock et al. 2018). Many, like Native Plant Trust, have partnered with the Millennium Seed Bank at the Royal Botanic Gardens, Kew, or with umbrella organizations, such Botanic Gardens Conservation International and the Center for Plant Conservation, which is a network of conservation partners that collectively work to save the imperiled plants of the United States and Canada.

## NATIVE PLANT TRUST SEED BANK STATISTICS

- Total collections (cleaned, frozen): 1,639
- Total unique taxa: 419
  - Div.1, 2, 2[a] (globally and regionally rare) taxa: 167
  - Div. 3(a), 3(b), (taxa declining in a large portion of the region 3(a) or common taxa with strongly disjunct occurrences 3(b)): 20
- Total rare plant families: 73
- Of the 388 Div. 1, 2, and 2a (globally and regionally rare) taxa: 167 collected and banked, 43%
- Of the ~309 Div. 1, 2, and 2a (globally and regionally rare) taxa that are considered orthodox seed producers (excludes most ferns and orchids): 167 collected and banked, 54%
- Of the ~3,300 occurrences of the 388 taxa, 244 occurrences collected and banked, 7%
- Of the ~3,000 occurrences of ~309 taxa, 244 occurrences collected and banked, 8%

*beaked spikesedge (Eleocharis rostellata)*
Michael Piantedosi © Native Plant Trust

CASE STUDIES

# Conservation of Rare Plants and Resilient Habitats: Two Case Studies

While this report focuses on resilient habitat, there is value in considering individual species that will likely benefit from an abundance of resilient habitat or be negatively affected by its scarcity. The discussion here examines two taxa that are rare or endangered across the New England states, the potential loss or security of habitats for these taxa in a changing climate, and the conservation measures (such as *ex situ* seed banking) that may prevent their extirpation from the landscape. The locations of rare taxa included here have been obscured for protection of the plants and are based on data collected by the New England Plant Conservation Program (NEPCoP) and Natural Heritage programs in each New England state.

These case studies of two species of conservation concern in New England—purple milkweed (*Asclepias purpurascens* L.) and American ginseng (*Panax quinquefolius*)—demonstrate that the impacts of climate change will not be consistent across macrogroup habitats nor on individual plant species, and will require evaluation over time. Shifts and changes in plant assemblages, plant communities, and overall plant diversity will require integrative and adaptive conservation measures, including *in situ* protection of habitats and *ex situ* seed banking, as well as continued analysis and applied research.

Purple milkweed
(*Asclepias purpurascens* L.)

## *Asclepias purpurascens* – Purple milkweed

Purple milkweed (*Asclepias purpurascens* L., Asclepiadaceae) is a rare but widely distributed species currently recorded from twenty-five Eastern and Midwestern states and Ontario, with historic records from another four states. All extant New England populations are restricted to Connecticut and Massachusetts; the species is considered historic in Rhode Island and New Hampshire. Only 11 occurrences have been seen since 1980, of 82 collected before that time (Table 11 includes all occurrences documented in the last 25 years). Of these, only 6 have been observed recently and 1 remains to be confirmed as purple milkweed. Both confirmed populations are small (with fewer than 30 plants) and appear precarious.

Exhibiting a broad ecological amplitude, purple milkweed typically inhabits semi-open margins of woodlands (often with oak-pine associations), roadsides, utility corridors, and old fields on soil substrates ranging from dry to quite moist. Many of its populations in North America occur on calcium-rich parent material, indicating a loose affinity for richer soils with high cation exchange capacity. Although succession to forest, road maintenance, and development has negatively impacted these habitats, there is still ample area available to support the taxon range-wide. However, existing populations rarely produce fruit; therefore, population growth and range expansion proceed very slowly. Reasons for the decline of purple milkweed may include major intrinsic limits to reproduction (including self-incompatibility), competition with other plant species, and other environmental factors that have yet to be identified (Farnsworth and Gregorio 2001).

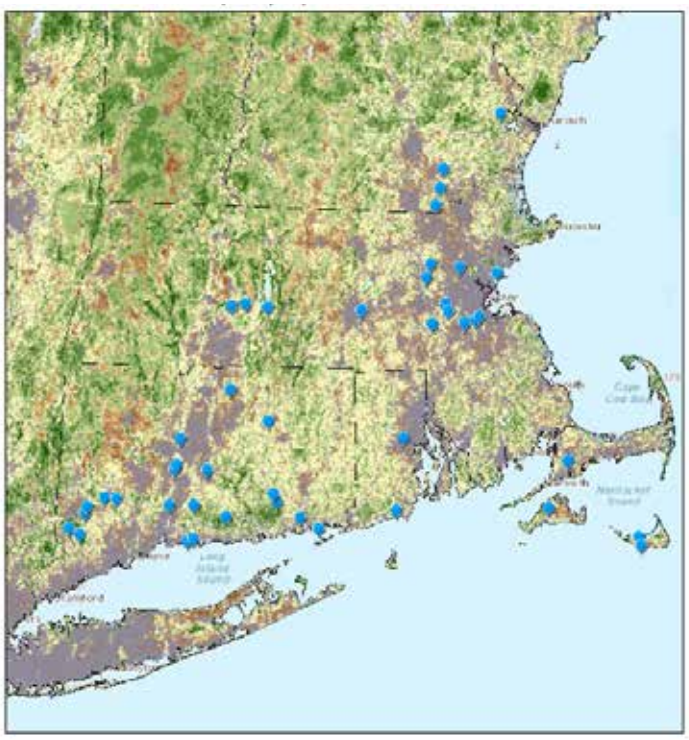
Purple milkweed
(*Asclepias purpurascens* L.)


**TABLE 9. Conservation Status of *Asclepias purpurascens* L. (purple milkweed), *Flora Conservanda* Div. 2, G4G5**

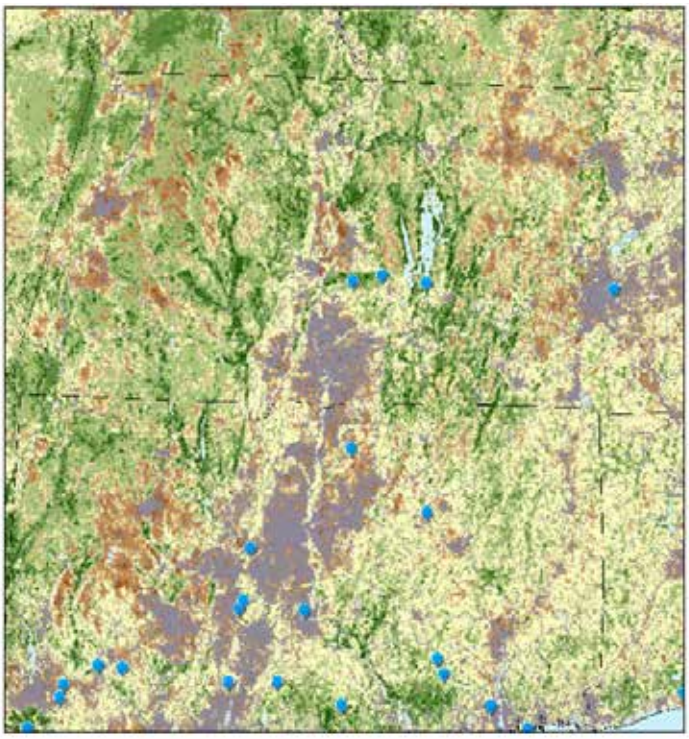
| STATE | CONSERVATION STATUS |
|---|---|
| CT | rare to uncommon (S-rank: S2S3), special concern (code: SC) |
| MA | extremely rare (S-rank: S1), endangered (code: E) |
| NH | historical (S-rank: SH), endangered (code: E) |
| RI | historical (S-rank: SH), state endangered (code: SE) |

**FIGURE 15. Resilience**

These maps depict areas of resiliency (highest in dark green to green; lowest in gray-brown and brown) overlaid with generalized population areas of purple milkweed (*Asclepias purpurascens* L.) in the New England states. Most extant populations of purple milkweed are located in low-resiliency areas.



15A. ME, VT, MA, RI, CT



15B. VT, MA, CT, small section of RI

**TABLE 10. Resilience Status of Land on which *Asclepias purpurascens* L. Occurs**

| ***ASCLEPIAS PURPURASCENS* L. (PURPLE MILKWEED)** | **CONTEXT** | | **SITE RESILIENCE** | | |
|---|---|---|---|---|---|
| **HABITAT OR MACROGROUP** | **OCCURENCES** | **% HABITAT** | **RESILIENT** | **AVERAGE** | **VULNERABLE** |
| Central Oak-Pine Forest | 14 | 31% | 28% | 21% | 50% |
| Urban/Suburban Built | 13 | 29% | 8% | 8% | 85% |
| Northern Hardwood & Conifer Forest | 12 | 27% | 16% | 42% | 41% |
| Agricultural Grassland | 2 | 4% | 0% | 50% | 50% |
| Water | 2 | 4% | 0% | 0% | 0% |
| Northern Swamp | 1 | 2% | 0% | 0% | 100% |
| Ruderal Shrubland & Grassland | 1 | 2% | 0% | 100% | 0% |
| **Total** | **45** | **100%** | **16%** | **24%** | **55%** |

As described in the conservation plan authored by Farnsworth and Gregorio (2001), the primary conservation objectives for purple milkweed in New England are to locate, protect, maintain, or establish at least twenty separate occurrences in Massachusetts and Connecticut. They recommend that the majority of these populations occur on protected land, and we would add that, in addition to protected land, purple milkweed element occurrences located on land areas of high-resilience to climate change should be given greater priority for protection and management. Consistent, quantitative monitoring of all known element occurrences of purple milkweed is taking place through Native Plant Trust's New England Plant Conservation Program, and with targeted monitoring by state Natural Heritage programs. Among the most critical research needs for purple milkweed are improved understanding of the reproductive biology of this species and the protocols for augmenting or establishing new populations from seed.

Based on the distribution of most purple milkweed across *Central-Oak Pine* (31%), *Urban/Suburban Built* (29%), and *Northern Hardwood & Conifer* (27%) macrogroups (total 87%), and with individual element occurrences largely located outside resilient habitat areas (66%), it is likely that purple milkweed will face significant losses as climate change alters temperature and precipitation. This is particularly concerning for locations of this species on islands (Nantucket, Martha's Vineyard), where remnants of isolated genetic diversity in this species are likely to be negatively impacted. With many of the populations of purple milkweed considered historic in New Hampshire and historic or lacking recent observational data in eastern and northeastern Massachusetts, many of the exemplary occurrences are located in areas of central Massachusetts and southern Connecticut where habitats are likely to degrade with climate change. The 16% of purple milkweed occurrences located in resilient areas are largely concentrated in south-central Connecticut and near the Quabbin Reservoir in Worcester County, Massachusetts. Occurrences of purple milkweed outside these resilient areas, particularly those located in *Urban/Suburban Built* environments where development pressures remain high, should be the immediate focus of monitoring and seed banking efforts, if sizeable and reproductive populations are observed. Large occurrences in resilient habitat areas should also be monitored and seed banked, but also considered as introduction or augmentation sites for ensuring the survival of this species in the New England portion of its range. Areas of high resilience within the *Central Oak-Pine* macrogroup habitats, largely in south-central and north-coastal Massachusetts, coastal New Hampshire, and southwestern Maine, may also be areas of value for assisted migration of this species from seed bank resources.

As outlined in Farnsworth and Gregorio (2001) and several other sources (USDA 2003; NHESP 2015), this species is self-incompatible and has high potential for inbreeding depression; as a result, it rarely produces fruits (NHESP 2015). Given its small population numbers, further hindrance to production of follicles and seeds will likely slow the increase in individuals in both resilient and non-resilient areas and will likely cause losses and significant declines in the genetic diversity of this species. Although cross-fertilization may be tried as a means of conservation, seed banking from large occurrences of purple milkweed is an immediate priority.

## *Panax quinquefolius* – American ginseng

American ginseng (*Panax quinuefolius* L., Apiaceae) is distributed over the eastern half of North America and is present in all New England states, though rare and protected in most.

Based on the New England distribution of American ginseng across *Northern Hardwood & Conifer Forest* (78%), *Cliff & Talus* (10%), *Central Oak-Pine Forest* (6%), and *Outcrop, Summit & Alpine* (5%) macrogroups, and with individual plant populations primarily located within resilient areas (84% in far above average, above average, and slightly above average), it is likely that many of the American ginseng occurrences will not be significantly impacted by changing temperature and precipitation. Further, threats from development in these primary macrogroup areas is quite low, with only 4% of the key habitat areas for this species facing any development. Highest areas for resilience include parts of the White Mountain National Forest of New Hampshire and Maine, northwestern Vermont, and smaller areas near the Quabbin Reservoir in central Massachusetts.

Given the likelihood of American ginseng's primary habitat areas persisting under climate change, other more numerous and severe threats should be a major focus of conservation plans for the species. Impacts from fragmentation of unsecured habitat areas within these macrogroups (see detailed maps of each macrogroup for GAP 1–3 status) could cause dislocation of important genetic variation among what are often small populations. This potential habitat-scale threat is compounded by immediate anthropogenic threats, such as over-harvesting in the wild for medicinal components, proliferation of invasive species (such as exotic earthworms and pathogens affecting dominant tree species), and impacts to insect and avian wildlife populations that contribute to fruit development and dispersal. Perhaps the most important conservation action in the case of American ginseng is protection *in situ*, where parcels of unprotected land (lacking GAP 1–3 status) should be managed to retain connectivity and above-average resiliency. Other strategies include augmentation and restoration to ensure the persistence of minimum viable populations throughout American ginseng's New England range (USFS Eastern Reg. 2003). A minimum viable population is defined as a population size likely to give a population a 95% probability of surviving over a 100-year period (Nantel 1996). Maintaining or increasing the size of the existing populations of American ginseng will also ensure that local seed sources are available for future reintroductions of the species.

American ginseng
(*Panax quinquefolius* L.)
Dan Jaffe © Native Plant Trust

TABLE 11. Conservation status of *Panax quinquefolius* L. (American ginseng), *Flora Conservanda* Div. 1, G3

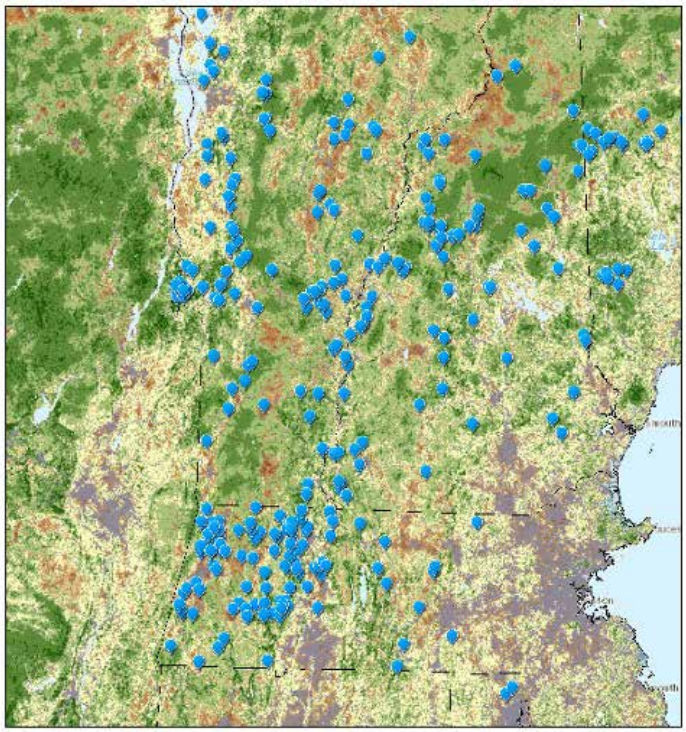
| STATE | CONSERVATION STATUS |
|---|---|
| CT | rare (S-rank: S2), special concern (code: SC) |
| MA | uncommon (S-rank: S3), special concern (code: SC) |
| ME | uncommon (S-rank: S3), endangered (code: E) |
| NH | rare (S-rank: S2), threatened (code: T) |
| RI | extremely rare (S-rank: S1), state endangered (code: SE) |
| VT | uncommon (S-rank: S3) |

TABLE 12. Resilience Status of Land on which *Panax quinquefolius* L. Occurs

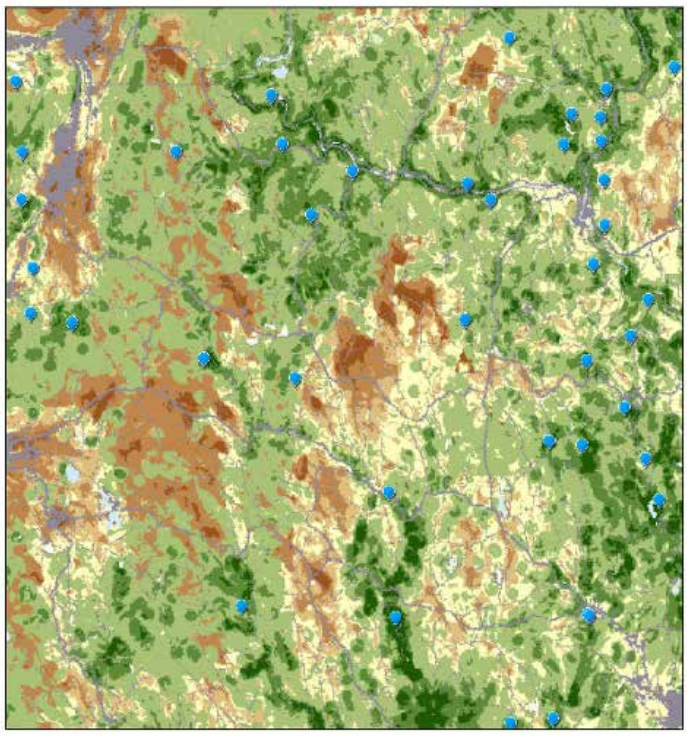
| *PANAX QUINQUEFOLIUS* L. (AMERICAN GINSENG) | CONTEXT | | SITE RESILIENCE | | |
|---|---|---|---|---|---|
| HABITAT OR MACROGROUP | OCCURENCES | % HABITAT | RESILIENT | AVERAGE | VULNERABLE |
| Northern Hardwood & Conifer Forest | 251 | 78% | 85% | 8% | 7% |
| Cliff & Talus | 32 | 10% | 94% | 0% | 6% |
| Central Oak-Pine Forest | 18 | 6% | 83% | 11% | 6% |
| Outcrop, Summit & Alpine | 6 | 2% | 100% | 0% | 0% |
| Water | 4 | 1% | 0% | 0% | 0% |
| Agricultural Grassland | 3 | 1% | 33% | 0% | 66% |
| Northern Swamp | 3 | 1% | 66% | 33% | 0% |
| Urban/Suburban Built | 2 | 1% | 50% | 0% | 50% |
| Central Hardwood Swamp | 1 | 0% | 100% | 0% | 0% |
| Freshwater Marsh & Shrub Swamp | 1 | 0% | 0% | 100% | 0% |
| **Total** | **321** | **100%** | **84%** | **7%** | **8%** |

**FIGURE 16. Resilience**

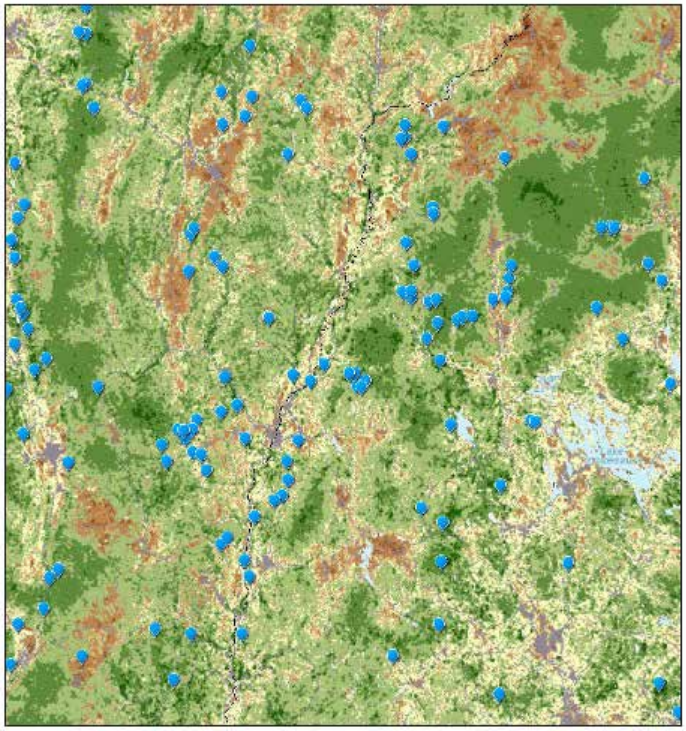
These maps depict areas of resiliency (highest in dark green to green; lowest in gray-brown and brown) overlaid with generalized population areas of American ginseng (*Panax quinquefolius)* in the New England states. Most extant populations of American ginseng are located within above-average to high-resiliency areas.



16A. ME, VT, NH, MA, northern CT, northern RI



16B. Berkshire County, MA



16C. VT, NH, northern MA


Liza Green © Native Plant Trust

# Results and Recommendations

## INTRODUCTION

In this study, we analyzed whether a century or more of land conservation in New England has protected enough land in the right places to save the region's plant diversity. While government agencies, land trusts, and private landowners have together made significant progress toward conserving natural environments, there are large biases in the distribution of conserved lands that need to be corrected if we are to sustain the full spectrum of plant and habitat diversity.

Of the 36 million acres of natural lands in New England, approximately 8.3 million acres (22%) are secured against conversion, with 2.1 million protected for nature and natural processes (GAP 1-2) and 6.2 million secured and managed for multiple uses (GAP 3). To achieve the goal of 30% of the region's lands conserved by 2030—a goal incorporated into both international and national initiatives—will require securing another 2.3 million acres against conversion and protecting at least 419,000 acres of that for nature.

Identifying which specific acres to preserve, especially in the context of a changing climate and thus a changing flora, is a goal of this report. As explained earlier, we used habitat diversity and scale, rather than species richness, as a metric for plant diversity. We then analyzed securement levels for 43 habitats and 234 newly identified Important Plant Areas (IPAs) in their distribution across the region and set conservation targets based on scientifically defined benchmarks. In addition, we assessed the climate resilience of the land that is currently conserved and factored site resilience into the recommendations for future conservation.

The data in this report coupled with the interactive mapping tool provide a robust framework for conservation action that effectively directs limited funding to habitats, areas, and specific sites that will help sustain plant diversity—and indeed biodiversity—in New England as the climate changes.

# MAJOR FINDINGS

Our analysis is framed by two sets of benchmarks: the Global Strategy for Plant Conservation (GSPC) in the United Nations' Convention on Biological Diversity and the Global Deal for Nature (Dinerstein et al. 2019). The New England targets (NET) derived from the latter are tailored to the scale and diversity of habitats in New England and explicitly include climate resilience. To recap, the primary land conservation goals by 2030 are:

**Global Strategy for Plant Conservation Targets**

- **Target 4**: At least 15% of each vegetation type secured through effective management or restoration (GAP 1-2 protection)
- **Target 5**: At least 75% of the most important areas for plant diversity (IPAs) of each ecological region protected with effective management in place for conserving plants and their genetic diversity. We defined IPAs in New England as habitats with exceptionally high rare plant diversity (>1 rare species per 10,000 acres), with the Target 5 goal attained through at least 75% of the areas with high resilience conserved with GAP 1-2.
- **Target 7**: At least 75% of known threatened plant species conserved *in situ* (in their natural place in the wild).

**New England Targets**

- At least 5-15% of each habitat protected and at least 30% secured against conversion, with at least 50-75% securement on climate-resilient land, depending upon habitat type. The target sets the protected level (conserved to protect nature and natural processes) needed based on habitat scale: dominant matrix forests 5%, wetlands 10%, patch-forming habitats 15%. Similarly, the resilience criteria are adjusted downward to 50% for wetlands to include some vulnerable but already protected examples of these critical habitats.
- At least 30% of each climate resilient area with the highest rare plant diversity (IPA) protected, and at least 75% of each IPA secured against conversion across habitats and states.

*Reaching the NE target of 30% secured by 2030 will require conserving an additional 2.3 million acres focused on specific habitats and climate-resilient sites.*

## Results

**Matrix forests cover 86% of the natural landscape and provide essential benefits to people and wildlife, but of New England's ten dominant forest types only one meets the GSPC target and only two meet the NE target.**

- Reaching the NET 30% will require adding 2 million acres of new conservation land targeted toward climate-resilient areas.
- Increasing GAP 1-2 protection to 15% across resilient land for the other nine matrix forest types to meet the GSPC target would require an investment in three million acres of land, including increasing the GAP level on land that is already secured.
- Existing conservation is concentrated in the northern and high-elevation forest types. Urgently in need of securement and protection are the oak-pine and coastal hardwood forests of southern New England that have limited climate resilience and are predicted to lose up to 18% of their current distribution to development by 2050.
- Saving plant diversity will also require improved and science-based management of the 5.3 million acres already secured against conversion but open to multiple uses.

**Wetlands are less conserved than we expected.** Of the eighteen types of bogs, swamps, floodplains, and marshes that are critical to sustaining almost half our plants, birds, and other wildlife, only six meet the GSPC and three the NE targets.

- Wetlands cover 12% of the region, but the types that meet the targets are largely small unique bogs and peatlands covering less than 1% of land area. None of the five most common wetland types meet either the GSPC or NE targets, although all of them have more than 20% securement and most meet the goals for climate resilience.
- Reaching the NE target will require conservation of an additional 253,902 acres of resilient wetland, including 151,901 acres protected explicitly for nature.
- Meeting the NE target also steps nearly 40% of the way toward the GSPC goal of protecting 405,083 more acres for nature.

**Patch-forming terrestrial habitats are hotspots of plant diversity and of particular importance as habitats of rare and endangered plant species.** Covering only 2% of the landscape, these summits, cliffs, barrens, and dunes sustain densities of rare species ten times higher than wetlands and forty times higher than upland forests, according to an overlay of Natural Heritage program rare species locations. Results indicate that seven of the fourteen habitats meet the GSPC goal, but when resilience is factored in, only four of these also meet the NE target. These are all bedrock-based habitats like cliffs and summits.

- Large conservation challenges are apparent in the low-elevation sand- and silt-based patch habitats such as pine barrens and coastal grasslands. These habitats are under high threat of conversion (15%-18% of current extent by 2050), and much of the current protection is on flat and fragmented land that is vulnerable to climate change.
- An additional 7,556 acres are needed to reach the GSPC 15% protected target.
- Meeting the NE target requires only 17,726 acres to reach 30% securement based on acres alone, but it would require an additional 88,620 acres of targeted resilient land to bring the silt- and sand-based systems up to the standard for climate resilience.

**Important Plant Areas (IPAs) are patches of resilient land that contain a high density of rare plant species.** We identified 234 IPAs for New England that cover 2.6 million acres, contain multiple occurrences of 212 globally and regionally rare taxa, and have resilient examples of 92% of the habitats. Each IPA's rare plant diversity ranges from 2 to 26 taxa depending on the site's size and location.

- For the GSPC target, 10 IPAs (4%) are more than 75% protected, and 32 (14%) have more than 75% securement by a combination of protected and multiple-use land.
- Of the remaining 192 IPAs, 155 have some level of securement, including 122 with GAP 1-2 in some portion of the site (although securement does not add up to 75% of the area). The remaining 37 IPAs have no securement.
- By acreage, the IPAs are 29% protected, with another 23% secured against conversion on multiple-use land.

Elizabeth Farnsworth © Native Plant Trust


We also examined two additional GSPC targets that are critical to saving plant diversity.

- **Target 7**: "At least 75% of known threatened plant species conserved *in situ*." Of the 245 rare taxa for which we have securement status, 226 (92%) have at least one occurrence on secured land (GAP 1-3), leaving 19 taxa with no permanent protection. For most taxa, more than 50% of their known locations are on secured land. However, only 16% of the occurrences of these threatened species are on GAP 1-2 land, and the securement status of the remainder of the 388 globally and regionally rare taxa was not available.

- **Target 8**: "At least 75% of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs." In New England, Native Plant Trust manages the primary seed bank of rare and endangered species. Currently the seed bank holds collections of 43% of globally and regionally rare taxa. However, the collections are from only 7% of the populations.

# RECOMMENDATIONS

We recommend an approach to land conservation that focuses on more proportional representation of the region's habitats across their ranges, rather than on securing more acres of habitat types that are abundantly conserved already. Our findings show the conservation of New England's habitat and plant diversity is an achievable goal, yet one which requires significant increases in resilient habitat areas effectively secured against conversion (30%), with a smaller proportion protected for nature (5-15% depending on the habitat type). To achieve these percentages, 2.3 million acres of additional resilient land targeted toward specific habitats must be secured against conversion, with at least 419,000 acres of that protected for nature. Conserving the unsecured IPAs (1.3 million acres) is an important focus, as it would save rare plant species and would go a long way toward sustaining the region's floristic and habitat diversity. In addition, we must ensure the effective management of 5.3 million acres of existing GAP 3 forest land, which is open to multiple uses.

By increasing the amount of area targeted for habitat conservation and incorporating effectively managed multiple-use land (GAP 3) as part of the solution, meeting the New England target will also maintain critical carbon resources and source water areas needed for people. Of course, there is no substitute for permanent GAP 1-2 protection, which is an essential measure for the health and longevity of trees and plants, many of which have multi-century life spans and develop complex co-evolutions and intertwined ecological networks. The New England target addresses this by targeting at least 5% GAP 1-2 protection in every forest type, and higher amounts for wetlands and patch habitats. We hope this target will help spur conservation of the more southern and low-elevation forests, which are vastly under-protected compared with their northern and high-elevation counterparts. Additionally, by increasing the area goal for securement and focusing on resilient land, we keep the options open for more protection, which can be achieved through redesignation of existing secured land (GAP 3) into a higher protection status (GAP 1-2).

The report's interactive maps and state-specific data will enable policy makers, federal and state agencies, and land trusts in each state to effectively target the most significant areas for protecting New England's plant diversity and the biodiversity it supports. For example:

- Habitats that are rare within New England, such as coastal plain habitats primarily in Massachusetts and Rhode Island, warrant greater protection efforts, with a higher proportion protected within the states where they occur.
- States with relatively large areas of a common habitat lacking conservation protection should also increase the amount of that habitat secured in their state. For example, 90% of the regional habitat area of *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp* is found in Maine, yet 84% of this habitat is unsecured in the state.
- Habitats facing significant losses to development by 2050, such as the *North Atlantic Coastal Plain Hardwood Forest* of southern New England, are also high priority.

A recommended starting point is **conserving the IPAs in each state**, which saves rare species across multiple habitats. The two primary strategies are focusing on IPAs that are unsecured and increasing the amount of protection within IPAs that are partially secured, either by conserving more acres or raising the level of securement to GAP 1 or GAP 2, depending upon the density of rare species. The table in Appendix 3 lists all 234 IPAs by dominant habitat and primary state (some cross boundaries), with acreage, number of rare species, and protection status. Using that table with the mapping tool, conservationists can also see the range of habitats within each IPA.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The securement and resilience data in the report's tables and on the mapping tool provide a regional, state, and ultimately parcel view of both conservation achievements and the path to either GSPC or New England targets by 2030. While most of the 43 habitats need additional securement, we highlight several, and their IPAs, that need urgent conservation action. See the state summaries for more detail.

**Matrix Forests**

- Mid-elevation *Laurentian-Acadian Pine-Hemlock-Hardwood Forest* in Maine and Vermont has relatively high resilience but the lowest protection (2%) and securement (14%) of any forest type.
  - In Maine, there are eight unsecured IPAs within this habitat, totaling 22,980 acres.
  - New Hampshire has a single unsecured IPA of 5,537 acres.
  - Vermont has two unsecured IPAs totaling 3,515 acres.
- *North Atlantic Coastal Plain Hardwood Forest* (in all states but Vermont) meets the NE target of 5% protected, but less than half of that is on resilient land; it is also only 19% secured and highly threatened by development. All states should focus on this habitat, but Connecticut, Maine, and Rhode Island have the least securement.
  - In this habitat, there are twelve IPAs needing protection: six in Connecticut (6,402 acres), three in Massachusetts (2,085 acres), and three in Rhode Island (3,175 acres).
- *Northeastern Interior Dry-Mesic-Forest* and *Northeastern Coastal & Interior Pine-Oak Forest* have low securement, low resilience, fall short of the GSPC and NE targets, and are moderately threatened by development. The former needs securement in Connecticut, Massachusetts, and Rhode Island, and the latter is especially unsecured in southern Maine. The small IPAs will likely need to be embedded in a larger matrix of protected lands to remain viable.
  - In *Northeastern Interior Dry-Mesic Forest*, Connecticut has ten IPAs on a total of 7,754 acres, nine of which are unsecured. Massachusetts has two IPAs on 2,441 acres needing protection.
  - In *Northeastern Coastal & Interior Pine-Oak Forest*, Maine (9 acres), Massachusetts (468 acres), and New Hampshire (2,612 acres) each have a single IPA needing protection.

**Wetland Habitats**

- *Laurentian-Acadian Alkaline Conifer-Hardwood Swamp* is well-secured in the southern part of its range, but it is predominantly in Maine, where it is largely unsecured. The habitat also needs conservation in Vermont, where only 14% of total acres and 21% of resilient acres are secured.
- *North-Central Interior Wet Flatwoods* is a rare habitat with only 25,306 acres across five states (all but Rhode Island), very little of which is protected, and most of the 16% total securement is not on resilient land. The habitat is also threatened by development. A single unsecured IPA in Massachusetts of only 67 acres should be a high priority for investigation.
- The 14,032 acres of *Glacial Marine & Wet Clayplain Forest* occur only in Vermont and are a high priority for conservation. Only 3% of total acreage is protected and 12% secured; only 14% of resilient acres are secured.
- *Laurentian-Acadian Large River Floodplain* is home to an exceptionally high density of regionally or globally rare plant species, with more than 30 rare taxa, many of which occur primarily in this habitat type. While 29% of the resilient acreage of this habitat (212,136 acres) is secured regionally, only 7% is protected (GAP 1-2). This habitat is predominantly found in Maine, where 71% of the 186,857 resilient acres are unsecured.


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**Patch-forming Habitats**

- Four forest habitats are so restricted that they are included in the patch-forming habitat analysis, and two are high priority for conservation. The *North Atlantic Coastal Plain Maritime Forest* is only 15% secured in Maine, and only 18% of resilient acres are secured. Vermont's *Glacial Marine & Lake Mesic Clayplain Forest*, encompassing 32,066 acres, is only 7% secured.
  - Of the two IPAs in the maritime forest, a 500-acre site in Massachusetts needs protection.
- The coastal plain sand- and silt-based habitats are especially vulnerable to climate change. While the number of acres needed to reach targets is relatively small, it may be difficult to sustain these habitats over time. A clear focus should be saving the 36 rare plant species in the beach and dune habitats and the 8 in the coastal grassland.
  - Three *North Atlantic Coastal Plain Heathland & Grassland* IPAs in Massachusetts, encompassing 2,657 acres, are priorities; only one is protected.

While this report focuses primarily on land conservation, we also examine and recommend additional conservation strategies, such as assisted migration, restoration and augmentation of sites and populations, and seed banking to preserve genetic diversity. What is certain in a changing climate is that we need multi-layered, science-based approaches to saving plant diversity and the life it sustains. We know that a rapidly changing climate will stress the ability of individual species and entire habitats to adapt, and thus recognize that some will migrate, some will die, and some will form new assemblages. With this report and its mapping tool, we aim to ensure that New England's native plants—the green foundation for functioning ecosystems—are at the forefront of conservation policy and action as climate plans develop.

PART TWO

# STATUS REPORT AND MAPS

Elizabeth Farnsworth © Native Plant Trust

# CONTENTS

Cushion plant *(Diapensia lapponica)* and Lapland rosebay *(Rhododendron lapponicum)*
Liza Green © Native Plant Trust

# OVERVIEW

## Approach

Plants have evolved to exploit almost every terrestrial situation on Earth, and in each they negotiate the challenges and limitations of the local conditions. Thus, plant communities translate the land's geophysical variation into living habitats that support many types of species. In this report, we focus on the diversity and resilience of habitats as an embodiment of plant diversity, rather than on plant diversity defined more simply as "richness," the number of species within a given area or the average number of species within a habitat. Conserving multiple intact examples of every habitat across its range within a region is a strategy for preserving plant diversity, sustaining the natural benefits plants provide, and maintaining the full diversity of species that depend on them. As the climate changes, we expect the compositional details of each habitat to adjust in response, but the underlying geophysical settings and terrain-driven processes to remain stable.

This section describes 43 of New England's terrestrial habitats and analyzes them with respect to distribution, resilience, securement, associated species, and threat of conversion. Our ability to understand the trends and spatial relationships among habitats was made possible by the recent development of several key datasets, which are described in the main body of the report. Here we briefly review the data sources and provide more detail on the Northeast Terrestrial Habitat Map. Synthetic analysis comparing habitats to one another is also provided in the main body of the report, but we realize that readers may not be familiar with the full range of habitats found throughout the region. In this section, we profile each habitat individually; provide information on its distribution, composition, and associated species; and assess its level of securement and resilience to climate change.

## Data Sources

The method of mapping terrestrial habitat types is described below. To assess the status of each habitat, we relied on three key datasets described in detail in the main report.

**Climate Resilient Land**

As climate change drives shifts in species and ecosystems, conservation plans based on current biodiversity patterns will become less effective at sustaining species and natural processes over the long term (Pressey et al. 2007). Thus, conservationists need a way to ensure that sites targeted for protection will continue to conserve biological diversity and ecological functions into the future. To address this issue, The Nature Conservancy (TNC) devised an approach for assessing climate resilience based on enduring geophysical characteristics of the land (Anderson et al. 2014; see nature.org/climateresilience).

Plants experience climate at a very fine scale (inches to yards), such that a site with ample topographic and hydrologic variation is experienced by plants as a mix of microclimates. If well connected, areas of high topoclimate variation have the potential to buffer climate-change impacts by enabling local dispersal to more favorable microclimates and may also provide stepping-stones to facilitate longer-distance range shifts (Suggitt et al. 2018).

In New England, topography, landforms, and elevation modify local conditions and create microclimatic patterns that are relatively predictable at the site scale. These factors can be used in combination with moisture models to estimate the variety of climatic environments available to resident species. The TNC dataset (Anderson et al. 2014) evaluates and scores every pixel of land with respect to the diversity of microclimates and degree of connectedness. Scores are calculated relative to the land's geophysical setting (geology and soil) and ecoregion. Scores are expressed as standard deviations above or below the average values for the setting.

**Securement**

Measures of land securement are based on The Nature Conservancy's Secured Land dataset (Prince et al. 2018), which is developed and maintained by each state office and aggregated by the regional science office. The dataset contains the boundaries of all land that is permanently secured against conversion to development, including public and private land held in fee or easement by state agencies, federal agencies, land trusts, and private conservation holders. The land is classified by GAP status (Crist et al. 1998) into three categories:

- **GAP Status 1**: Secured for nature and natural processes

  An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management. *Examples:* nature reserves, Forever Wild easements, wilderness areas.

- **GAP Status 2**: Secured for nature with management

  An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance. *Examples*: national wildlife refuges, national parks.

- **GAP Status 3**: Secured for multiple uses

  An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining), or motorized recreation. It also confers protection on federally listed endangered and threatened species throughout the area. *Examples*: state forests, forest management easements, conservation restrictions on working forest.

- **Unsecured**: Land that is not permanently secured against conversion; this includes most private land.

GAP 1 and 2 lands are considered **protected**, which is the term we use in this report, and are the only lands that satisfy the GSPC targets. The New England targets include GAP 1-3 lands in the benchmark of 30% secured and use GAP 1-2 for the 5-15% that should be "secured for nature."

**Predicted Loss to Development**

To estimate the threat of conversion, we used a Land Transformation Model developed by the Human-Environment Modeling and Analysis Laboratory at Purdue University (Tayyebi et al. 2013). In this model the quantity of urban growth at county and city scales is simulated using population, urban density, and nearest-neighbor-dependent attributes. Future land use predictions were created for every 30-m pixel in the region in five-year increments from 2010 to 2060 and used NLCD 2001 version 2 as the basis for projections. To estimate loss, we calculated acres of each habitat present in 2020 that are predicted to be developed by 2050.

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# NEW ENGLAND'S TERRESTRIAL HABITATS

The terrestrial habitats defined and described in this report follow the Northeast Terrestrial Wildlife Habitat Classification (Gawler et al. 2008) with modifications as necessary to enable consistent mapping in the Northeast Terrestrial Habitat Map (Ferree and Anderson 2014) – our key data source. The latter is a comprehensive and standardized representation of natural habitats across fourteen states and four Canadian provinces (FIGURE 1. US PORTION). The habitats are equivalent in scale and concept to the NatureServe ecological system (Comer 2010), which was developed to provide a common base for characterizing vegetation habitats across states. The map was developed to promote an understanding of terrestrial and aquatic biodiversity patterns across the region, and is not intended to replace state classifications, which often have more detail and nuance.

## Concepts and Terminology

NatureServe's ecological system classification presents units that are readily identifiable by conservation and resource managers in the field (Comer 2010). Although based on dominant vegetation, they are defined as recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. Each ecological system type is named based on biogeographic region, dominant cover type, and ecological setting such as an elevation zone, moisture regime, or disturbance process (e.g., Acadian Low-Elevation Spruce-Fir-Hardwood Forest). The classification includes all upland, wetland, and estuarine habitats. It does not include aquatic freshwater or marine habitats.

In this report, as in Gawler et al. (2008), we use the term "terrestrial habitat" as synonymous with "ecological system" and roughly equivalent to "vegetation type" or "plant community." Although ecological systems are tied to the U.S. National Vegetation Classification (USNVC, FGDC 2008), they are not a formally recognized level of the USNVS hierarchy, which is based on physiognomy, not on a common ecological setting. Users should also realize that within a single terrestrial habitat, such as Acadian Low-Elevation Spruce-Fir-Hardwood Forest, there may be variation related to local conditions that may be described at a finer "plant association" level.

The classification system describes terrestrial habitats in relation to ecological setting, but these may occur on the land at fundamentally different scales. To account for this, each habitat has been assigned to one of three landscape patterns:

- **matrix forest**: dominant forest types that occupy large contiguous areas (generally >5,000 acres under natural conditions) and form the background matrix of a geographic region. Other habitats tend to nest within the matrix where local conditions differ in moisture, soil depth, or disturbance regimes. An example of a matrix forest is the Acadian Low-Elevation Spruce-Fir-Hardwood Forest, which dominates at low elevations in northern Maine.

- **wetland**: swamps, bogs, marshes, floodplains, and fens that form in annually flooded or permanently saturated conditions where water collects. These habitats are smaller than the matrix-forming forests and generally occupy 10 acres to 5,000 acres under natural conditions. An example is the North Atlantic Coastal Plain Basin Peat Swamp, which is a peat-accumulating forested wetland common to the coastal plain.

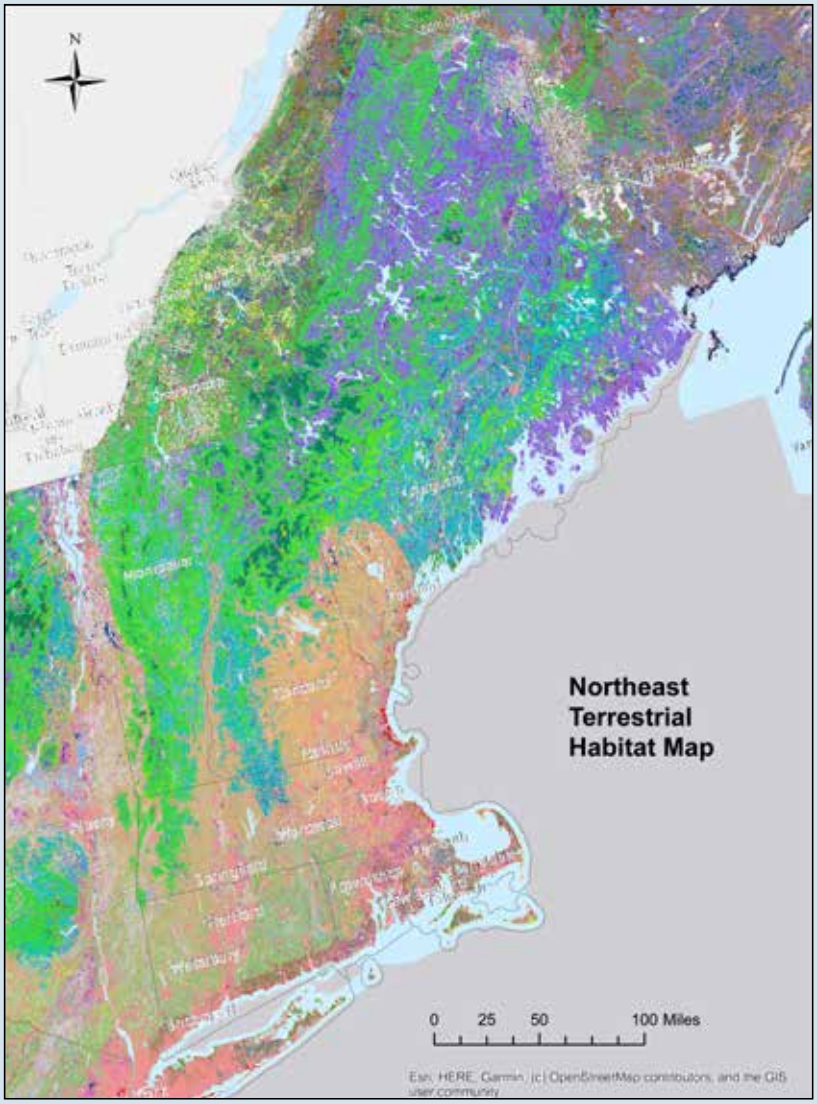
- **patch-forming habitats**: these habitats occur under very localized environmental conditions that are distinctly different from the surrounding landscape (e.g., Acidic Rocky Outcrop). The habitat often reflects extreme conditions in soil (bedrock or shifting sand), exposure (alpine winds, steep slopes), or disturbance regime (fire, mowing). Patch habitats tend to have high plant diversity and host some of New England's rarest species.

In addition, newly identified Important Plant Areas (IPAs) occur within all three landscape patterns in New England. Based on criteria in the Global Strategy for Plant Conservation (GSPC), here an IPA is defined as a contiguous patch of resilient land with a diversity of rare plant species relative to its size. The IPAs are characterized by their dominant habitat but can be evaluated by the number of other habitats and the number of rare species contained within. Collectively they contain multiple occurrences of 212 of our rarest species and resilient examples of 92% of the habitats.

Attention to these scales is an important part of understanding the distribution, securement, and resilience patterns of plant diversity.

**FIGURE 1. The Northeast Terrestrial Habitat Map**

This dataset (Ferree and Anderson 2015) maps the distribution of 140 types of forests, wetlands, unique communities, and tidal systems across the Northeast. To explore the map and view the legend, go to http://nature.ly/NEhabitat



## Geography

The map used for this study covers the six New England states as well as PA, NJ, MD, DE, WV, VA and the Canadian provinces of New Brunswick, Novia Scotia, Prince Edward Island, and Quebec. All statistics in this report are for New England only: CT, MA, ME, NH, RI, VT.

## Naming Conventions

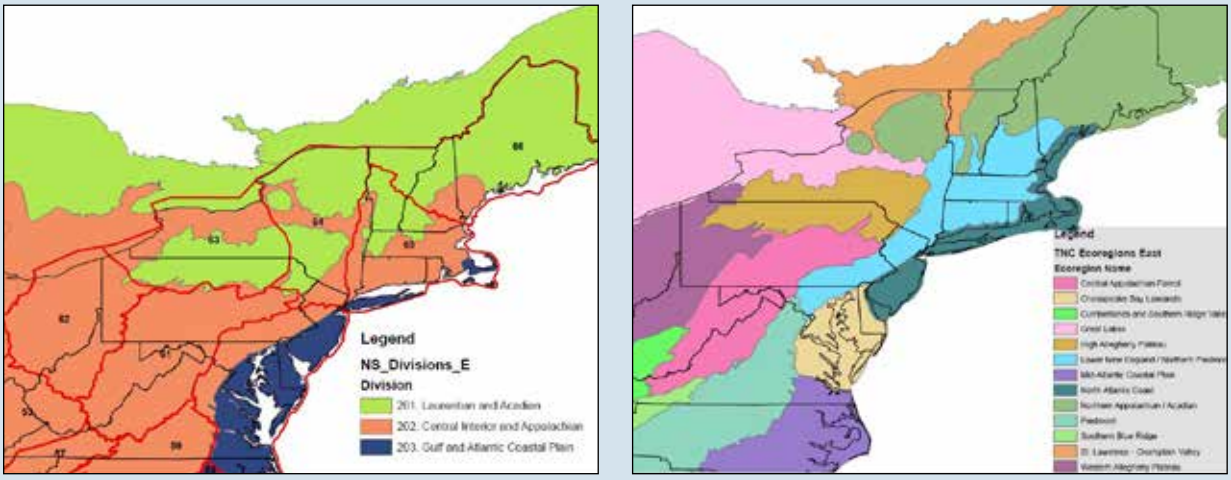
The names of ecological systems incorporate a biogeographic reference, and the ecological systems classification for the continental United States uses major geographic divisions as an upper-scale descriptor (Comer et al. 2003). Those divisions were adapted from Bailey (1995 and 1998), with division lines modified according to ecoregion lines developed by The Nature Conservancy (Groves et al. 2002) and World Wildlife Fund (Olson et al. 2001). These divisions (FIGURE 2) are sub-continental landscapes reflecting similar climate and biogeography. Three divisions cover the Northeast:

- Laurentian-Acadian (Div. 201)
- Central Interior and Appalachian (Div. 202)
- Gulf and Atlantic Coastal Plain (Div. 203).

Each ecological system has a "home" division with which it is most closely allied ecologically, and the Northeast terrestrial habitat classification uses the three divisions as one of the grouping variables. An ecological system name may use its "home" division in its name (e.g., Laurentian–Acadian) or, depending upon the system range, a narrower biogeographic reference such as "Central Appalachian" (part of Div. 202).

**FIGURE 2. Biogeographic Divisions Used in the Classification**

The map on the left shows the major divisions used in naming the ecological system types. The map on the right shows the TNC ecoregions, which are occasionally used to add further limits to the distribution of a system type.



## Mapping Methods

The methods used to create the Terrestrial Habitat map are relatively detailed and summarized in a methods document with further detail on the classification system (Ferree and Anderson 2013).

The mapping process was intensely data-driven, relying on comprehensive datasets of ecological variables (geology, landforms, precipitation, etc.) and more than 70,000 ecological community samples. Whenever possible, we used field-collected data combined with national datasets. Very briefly, the basic mapping steps were as follows:

- Compile foundation datasets for the entire region (landforms, geology, climate, land cover, etc.).
- Develop a list of ecological systems, and meet with appropriate state, federal, and NGO staff to understand the distribution, scale, and landscape pattern of ecological systems.
- Compile plot samples for ecological systems using State Natural Heritage data, forest inventory and analysis points, and other sources. Tag each sample with the appropriate ecological system.
- Develop models for the dominant matrix-forming forest types using regression tree analysis of tagged plot samples on the data sets of ecological information.
- Map the dominant forest types onto the landscape using landform-based units.
- Develop models for the wetland systems (swamps, marshes, bogs, etc.) and the patch-forming upland systems (barrens, glades, summits, cliffs, etc.).
- Assemble models into one region-wide map and develop legend.

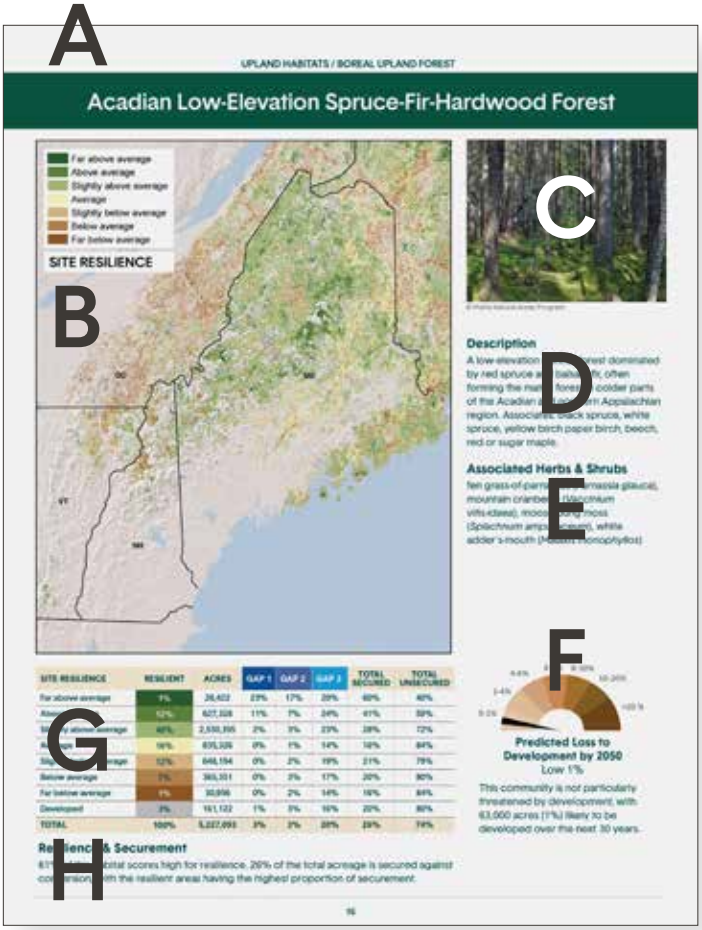
TABLE 1. Terrestrial Habitats and Level of Securement

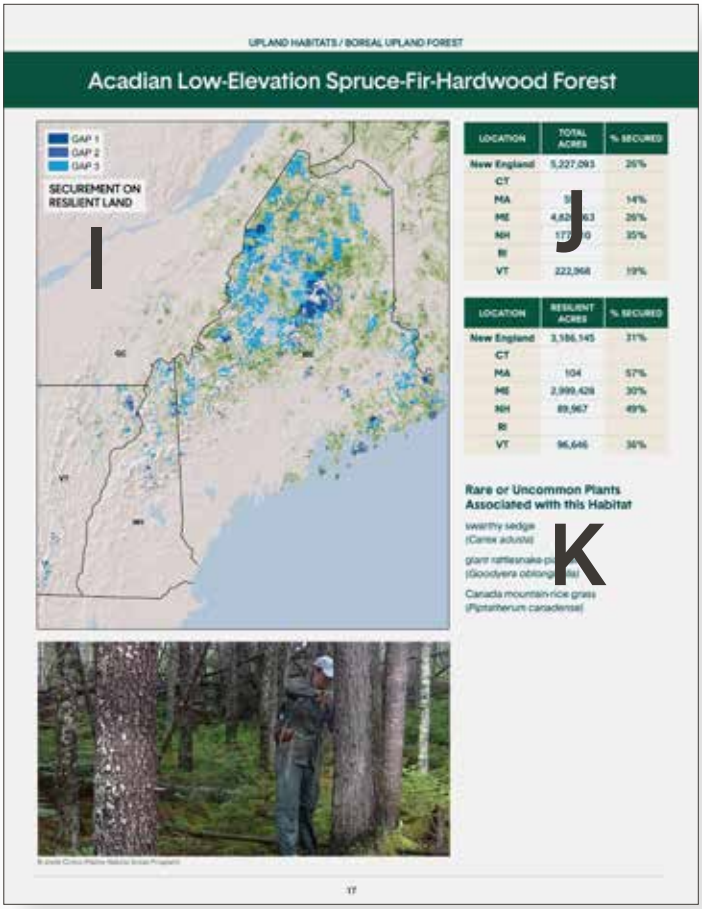
| UPLAND HABITATS | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED |
|---|---|---|---|---|---|
| **MATRIX FOREST HABITATS** | **29,141,876** | **4%** | **5%** | **18%** | **74%** |
| **Boreal Upland Forest** | **7,520,051** | **8%** | **8%** | **22%** | **61%** |
| Acadian Low-Elevation Spruce-Fir-Hardwood Forest | 5,227,093 | 3% | 3% | 20% | 74% |
| Acadian Sub-boreal Spruce Flat | 1,418,525 | 2% | 3% | 23% | 71% |
| Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest | 874,432 | 19% | 19% | 23% | 38% |
| **Central Oak-Pine Forest** | **2,257,390** | **3%** | **5%** | **17%** | **74%** |
| North Atlantic Coastal Plain Hardwood Forest | 634,467 | 2% | 4% | 14% | 81% |
| North Atlantic Coastal Plain Maritime Forest | 79,051 | 1% | 10% | 12% | 77% |
| North Atlantic Coastal Plain Pitch Pine Barrens | 104,801 | 8% | 7% | 29% | 55% |
| Northeastern Interior Pine Barrens | 19,829 | 6% | 3% | 32% | 59% |
| Northeastern Interior Dry-Mesic Oak Forest | 1,387,176 | 1% | 3% | 14% | 82% |
| Glacial Marine & Lake Mesic Clayplain Forest | 32,066 | 3% | 1% | 4% | 93% |
| **Northern Hardwood & Conifer Forest** | **19,364,435** | **2%** | **2%** | **16%** | **81%** |
| Laurentian-Acadian Northern Hardwood Forest | 8,280,091 | 4% | 3% | 23% | 70% |
| Laurentian-Acadian Pine-Hemlock-Hardwood Forest | 4,460,233 | 1% | 1% | 11% | 86% |
| Laurentian-Acadian Red Oak-Northern Hardwood Forest | 1,071,860 | 2% | 3% | 13% | 82% |
| Appalachian (Hemlock)-Northern Hardwood Forest | 4,016,594 | 1% | 2% | 15% | 82% |
| Northeastern Coastal & Interior Pine-Oak Forest | 1,535,658 | 1% | 2% | 15% | 83% |
| **PATCH-FORMING HABITATS** | | | | | |
| **Cliff & Talus** | **156,190** | **11%** | **10%** | **20%** | **60%** |
| Acidic Cliff & Talus | 113,213 | 19% | 17% | 19% | 45% |
| Calcareous Cliff & Talus | 29,225 | 8% | 7% | 21% | 64% |
| Circumneutral Cliff & Talus | 13,752 | 5% | 4% | 19% | 72% |
| **Outcrop, Summit & Alpine** | **191,618** | **32%** | **10%** | **18%** | **40%** |
| Acadian-Appalachian Alpine Tundra | 7,900 | 76% | 9% | 14% | 1% |
| Acidic Rocky Outcrop | 152,972 | 15% | 15% | 21% | 49% |
| Calcareous Rocky Outcrop | 30,746 | 5% | 6% | 19% | 70% |
| **Grassland & Shrubland** | | | | | |
| Atlantic Coastal Plain Beach & Dune | 36,484 | 1% | 26% | 14% | 59% |
| North Atlantic Coastal Plain Heathland & Grassland | 25,219 | 2% | 18% | 13% | 66% |
| Ruderal Grassland & Shrubland | 53,047 | 1% | 1% | 13% | 85% |
| Agricultural Grassland | 2,571,409 | 0% | 0% | 3% | 97% |

TABLE 2. Palustrine Habitats and Level of Securement

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED |
|---|---|---|---|---|---|
| **WETLAND HABITATS** | **3,947,104** | **3%** | **7%** | **18%** | **72%** |
| **Northern Swamp** | **2,195,240** | **2%** | **3%** | **17%** | **78%** |
| Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp | 761,511 | 4% | 3% | 20% | 74% |
| Laurentian-Acadian Alkaline Conifer-Hardwood Swamp | 573,968 | 1% | 3% | 13% | 84% |
| North-Central Appalachian Acidic Swamp | 608,230 | 2% | 4% | 20% | 75% |
| North-Central Interior & Appalachian Rich Swamp | 251,531 | 2% | 3% | 16% | 80% |
| **Northern Peatland** | **381,256** | **4%** | **11%** | **18%** | **67%** |
| Boreal-Laurentian-Acadian Acidic Basin Fen | 323,874 | 5% | 5% | 19% | 71% |
| Boreal-Laurentian Bog | 37,537 | 9% | 14% | 14% | 63% |
| Acadian Maritime Bog | 5,223 | 4% | 21% | 3% | 73% |
| Laurentian-Acadian Alkaline Fen | 217 | 2% | 0% | 29% | 69% |
| North-Central Interior & Appalachian Acidic Peatland | 14,406 | 2% | 13% | 24% | 60% |
| **Coastal Plain Swamp & Peatland** | **18,628** | **7%** | **10%** | **25%** | **58%** |
| North Atlantic Coastal Plain Basin Peat Swamp | 17,783 | 11% | 7% | 27% | 56% |
| Atlantic Coastal Plain Northern Bog | 845 | 3% | 13% | 24% | 60% |
| **Central Hardwood Swamp** | **39,338** | **2%** | **2%** | **11%** | **86%** |
| North-Central Interior Wet Flatwoods | 25,306 | 0% | 3% | 13% | 84% |
| Glacial Marine & Lake Wet Clayplain Forest | 14,032 | 3% | 0% | 9% | 88% |
| **Large River Floodplain** | **340,645** | **2%** | **5%** | **19%** | **73%** |
| Laurentian-Acadian Large River Floodplain | 309,055 | 3% | 5% | 17% | 76% |
| North-Central Appalachian Large River Floodplain | 31,590 | 2% | 6% | 22% | 70% |
| **Freshwater Marsh & Shrub Swamp** | 860,248 | 2% | 4% | 16% | 77% |
| Laurentian-Acadian Freshwater Marsh | 367,506 | 3% | 4% | 16% | 77% |
| Laurentian-Acadian Wet Meadow-Shrub Swamp | 492,741 | 2% | 3% | 17% | 78% |
| **Tidal Marsh** | 111,748 | 2% | 14% | 22% | 62% |
| Acadian Coastal Salt & Estuary Marsh | 23,350 | 1% | 11% | 19% | 69% |
| North Atlantic Coastal Plain Tidal Salt Marsh | 88,398 | 2% | 16% | 25% | 56% |

# PAGE LAYOUT




**A.** Habitat Name

**B.** Map of Relative Climate Resilience of the Habitat

**C.** Photo

**D.** Description

**E.** Associated Herbs and Shrubs

**F.** Predicted Loss to Development by 2050

**G.** Resilience by Securement Table

**H.** Resilience and Securement

**I.** Map of Resilient Areas and Securement

**J.** State Statistics on Resilience and Securement

**K.** Associated Rare Plant Species

Click on any map to go to the mapping tool.

## A. Habitat Name

The standardized name or macrogroup based on NatureServe ecological systems. More detail can be found on the terrestrial habitats here.

## B. Map of Relative Climate Resilience of the Habitat

The boundaries of the habitat come directly from the Northeast Terrestrial Habitat map, but the information displayed is the climate resilience score for each pixel of land. Climate resilience is scored on a relative scale adjusted to the average score of the underlying physical habitat on which this habitat/vegetation type occurs. The legend is:

- Far above average (> 2 standard deviations) Most Resilient
- Above average (1 to 2 standard deviations) More Resilient
- Slightly above average (0.5 to 1 standard deviation) Somewhat Resilient
- Average (-0.5 to 0.5 standard deviations) Average
- Slightly below average (-0.5 to -1 standard deviation) Somewhat Vulnerable
- Below average (-1 to -2 standard deviations) More Vulnerable
- Far below average (<-2 standard deviations) Most Vulnerable

More detail can be found on TNC's climate resilience map here.

## C. Photo

Photos were provided by the state Natural Heritage Programs or TNC staff and are intended to convey the look and structure of the habitat.

## D. Description

The text for this field was taken directly from the Northeastern Terrestrial Wildlife Habitat Classification (Gawler et al. 2008) with editing to shorten the description. The original document is here.

When a description was not provided in Gawler (2008), we modified a description of the habitat from one of the state natural community classification documents, usually from the state with the majority of the habitat. The state classifications provide much more detail on the habitat and a more localized description of environmental setting and associated species. We encourage readers to check out these terrific documents, which contain a body of information not readily found in any other source.

## E. Associated Herbs and Shrubs

This section includes species that are tracked by the state Natural Heritage programs and that occur in statistically higher numbers in this habitat than any other (chi-squared test). These species were determined by an overlay of 117,000 species locations obtained from the Natural Heritage programs and used with permission. Lists were not corrected for current range, so if a habitat occurs from CT to ME and a plant species is common in the habitat only in CT, it will still show up in the list.

## F. Predicted Loss to Development by 2050

This chart shows the percent of the habitat projected to be converted to development by 2050, if development keeps the same pace as the last two decades. The estimate was made using a Land Transformation Model developed by Amin Tayyebias and others at Purdue University (Tayyebi et al. 2013). When combined with the habitat grid, the model predicts the amount of habitat lost to development in future decades based on the past decade (1990–2000 data and validated using change in the 2001 and 2006 National Land Cover Databases).

## G. Resilience by Securement Table

This table lists the acres and percentages of each resilience category by its GAP status. With respect to the global diversity targets 4 and 5, the securement status of the entire habitat is given in the top row. For the New England Target, the area and securement status of the most resilient land is equal to the sum of the three highest resilience categories shaded in green (>0.5 SD, i.e., slightly above average or higher).

On the macrogroup pages, this table is securement by state and includes the number of Important Plant Areas (IPAs) and the number that meet the GSPC target of 75% protected (GAP 1-2), have 75% of their area secured (GAP 1-3) in a combination of protected and multiple-use land, or are unsecured, although many have some level of securement below the 75% threshold. IPAs are assigned to their dominant habitat, although they include a variety of habitats. Two unsecured open-water IPAs in Maine and Vermont are not included here.

## H. Resilience and Securement

This text summarizes proportion of resilience land and the degree of securements (GAP 1-3) for the habitat across all of New England.

## I. Map of Resilient Areas and Securement

This map shows only the resilient portion of the habitat (areas with a resilience score >0.5 SD, i.e., slightly above average, or better). Blue colors indicate that the resilient areas are already under some sort of securement (GAP 1, 2, or 3). The accompanying web map lets users explore these areas in detail.

## J. State Statistics on Resilience and Securement

This box includes relevant statistics on the distribution, resilience, and securement by state.

**UPPER BOX**: Total areas of the habitat in each state, and proportion that is secured (GAP 1-3)

**LOWER BOX**: Total resilient acres of the habitat (>0.5 SD) in the state and the proportion that is secured (GAP 1-3)

## K. Associated Rare Plant Species

This list comes from expert knowledge of rare species distributions in the habitats described here.

## Variations: Macrogroups and Tidal Systems

The habitats are organized by NatureServe Macrogroups. Each macrogroup page shows the distribution and securement of the group, a table showing GAP status by state, and a chart of predicted loss to development. The page is followed by maps and photos of each individual habitat within the macrogroup that occurs in New England.

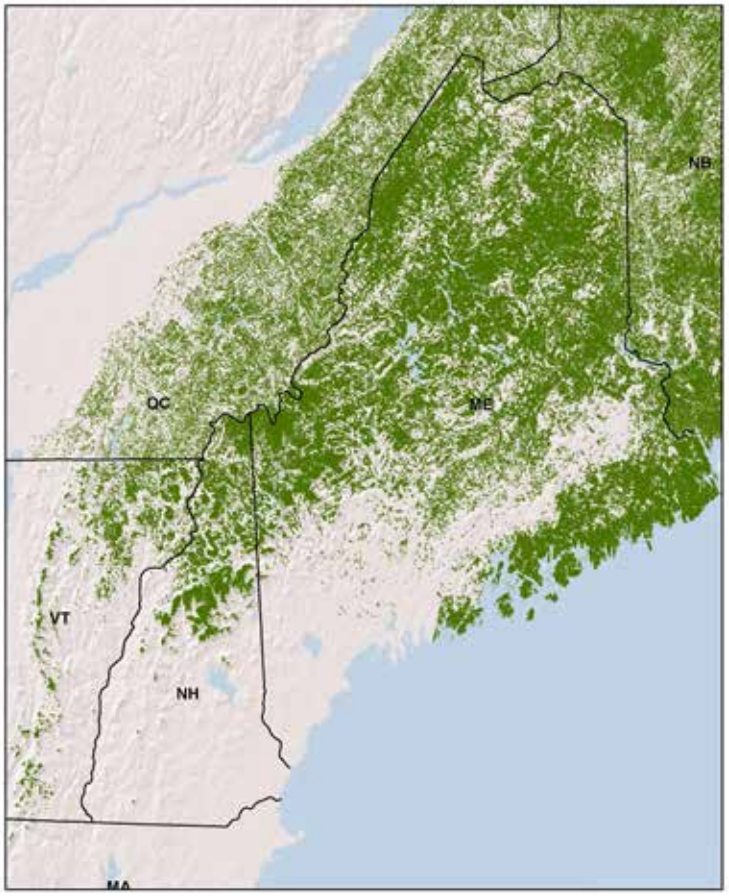
Tidal systems are treated differently, as they are subject to the unique threat of sea-level rise, which is analyzed differently from the climate-resilient land.

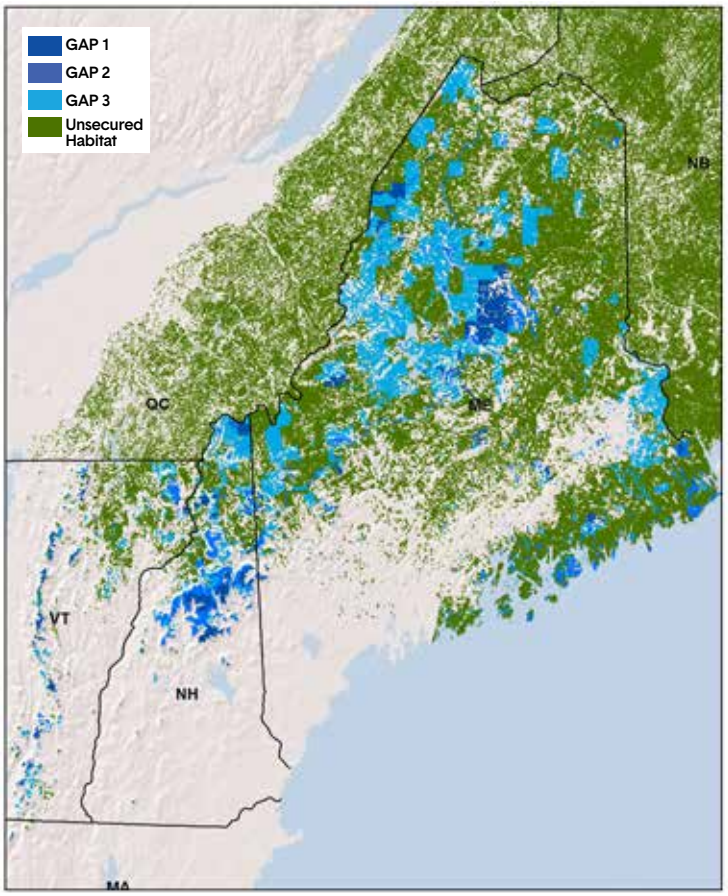
# UPLAND HABĪTATS
## MATRĪX FOREST

© Martin Sanchez

MACROGROUP

# BOREAL UPLAND FOREST

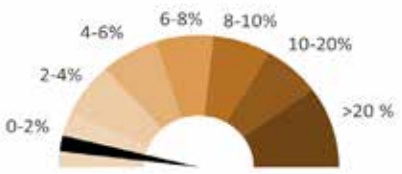



**Boreal Upland Forest**
Conifer-dominated forests of cold northern climates characterized by spruce and fir.

**Acres in New England**
7.5 million

**Percent Secured**
GAP 1 = 5%
GAP 2 = 5%
GAP 3 = 21%

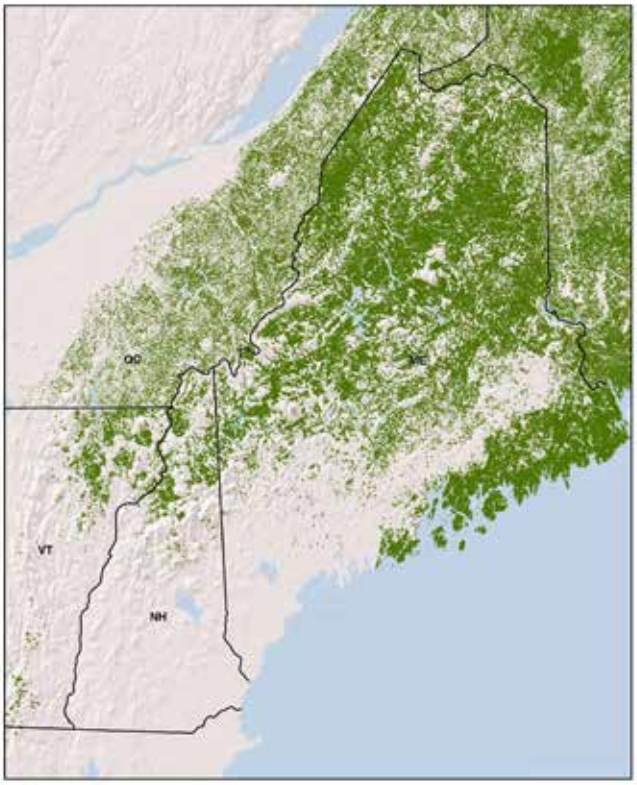



**Predicted Loss to Development by 2050**
38,731 acres (<1%)

| | | | | | | IMPORTANT PLANT AREAS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | TOTAL | P | S | U |
| **Boreal Upland Forest** | **7,520,051** | **5%** | **5%** | **21%** | **69%** | **21** | **3** | **5** | **13** |
| Massachusetts | 1,248 | 26% | 0% | 29% | 45% | | | | |
| Maine | 6,574,320 | 3% | 3% | 21% | 72% | 19 | 3 | 3 | 13 |
| New Hampshire | 573,597 | 18% | 27% | 23% | 32% | 2 | | 2 | |
| Vermont | 370,886 | 10% | 5% | 16% | 69% | | | | |
| **New England** | **7,520,051** | **348,045** | **373,204** | **1,595,224** | **5,203,578** | | | | |

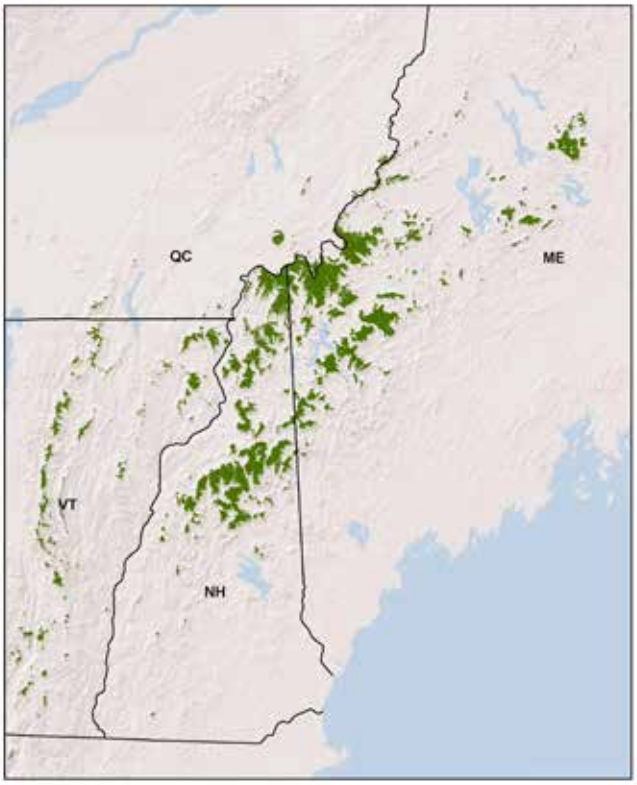
P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS



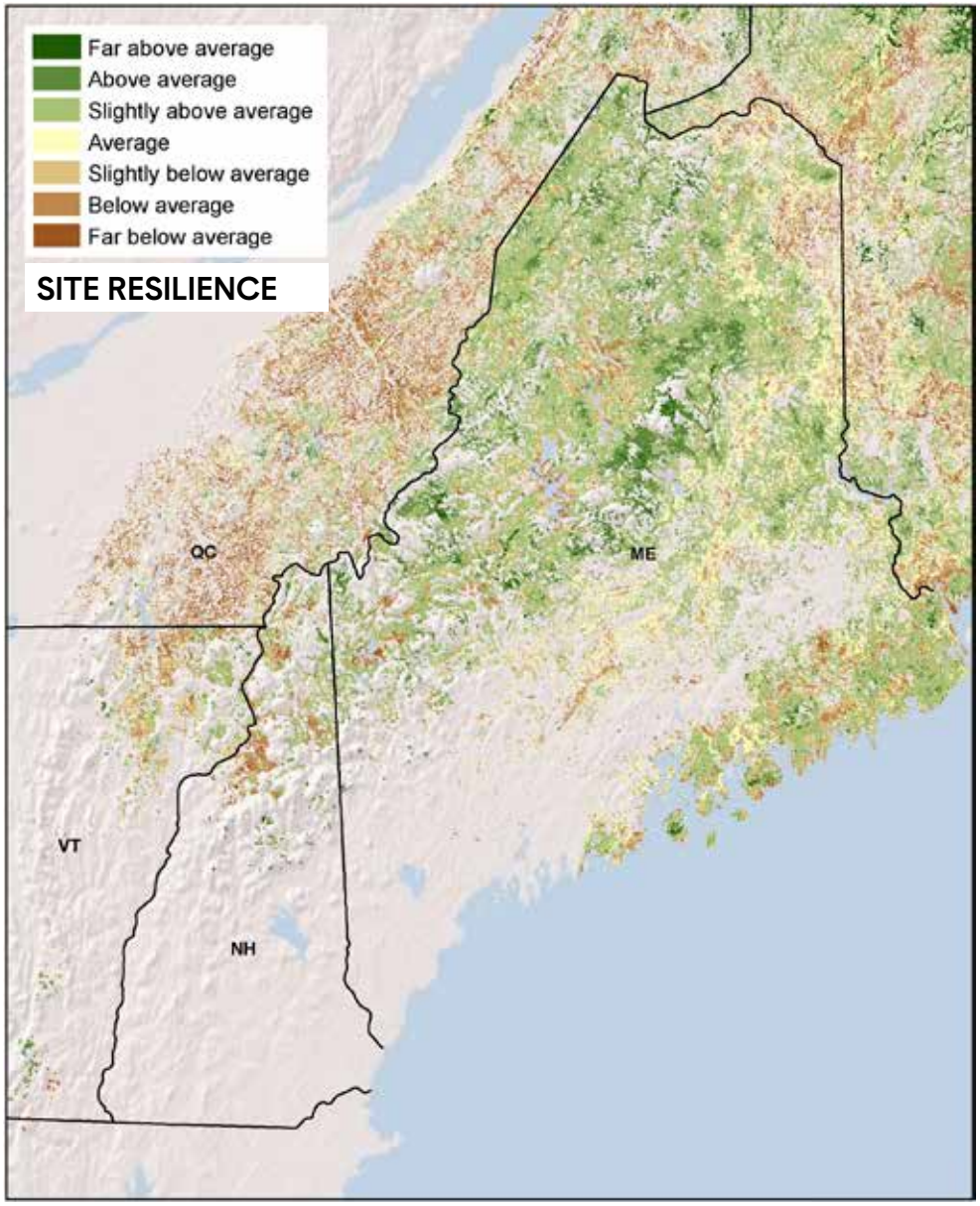

**Acadian Low-Elevation Spruce-Fir-Hardwood Forest**


**Acadian Sub-boreal Spruce Flat**




**Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest**

# Acadian Low-Elevation Spruce-Fir-Hardwood Forest




© Maine Natural Areas Program

## Description

A low-elevation conifer forest dominated by red spruce and balsam fir, often forming the matrix forest in colder parts of the Acadian and northern Appalachian region. Associates: black spruce, white spruce, yellow birch paper birch, beech, red or sugar maple.

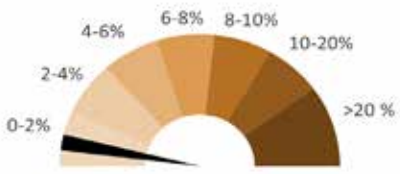
## Associated Herbs & Shrubs

fen grass-of-parnassus (*Parnassia glauca*), mountain cranberry (*Vaccinium vitis-idaea*), moose dung moss (*Splachnum ampullaceum*), white adder's-mouth (*Malaxis monophyllos*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 28,422 | 23% | 17% | 20% | 60% | 40% |
| Above average | 12% | 627,328 | 11% | 7% | 24% | 41% | 59% |
| Slightly above average | 48% | 2,530,395 | 2% | 3% | 23% | 28% | 72% |
| Average | 16% | 835,326 | 0% | 1% | 14% | 16% | 84% |
| Slightly below average | 12% | 648,194 | 0% | 2% | 19% | 21% | 79% |
| Below average | 7% | 365,351 | 0% | 3% | 17% | 20% | 80% |
| Far below average | 1% | 30,956 | 0% | 2% | 14% | 16% | 84% |
| Developed | 3% | 161,122 | 1% | 3% | 16% | 20% | 80% |
| TOTAL | 100% | 5,227,093 | 3% | 3% | 20% | 26% | 74% |

## Resilience & Securement

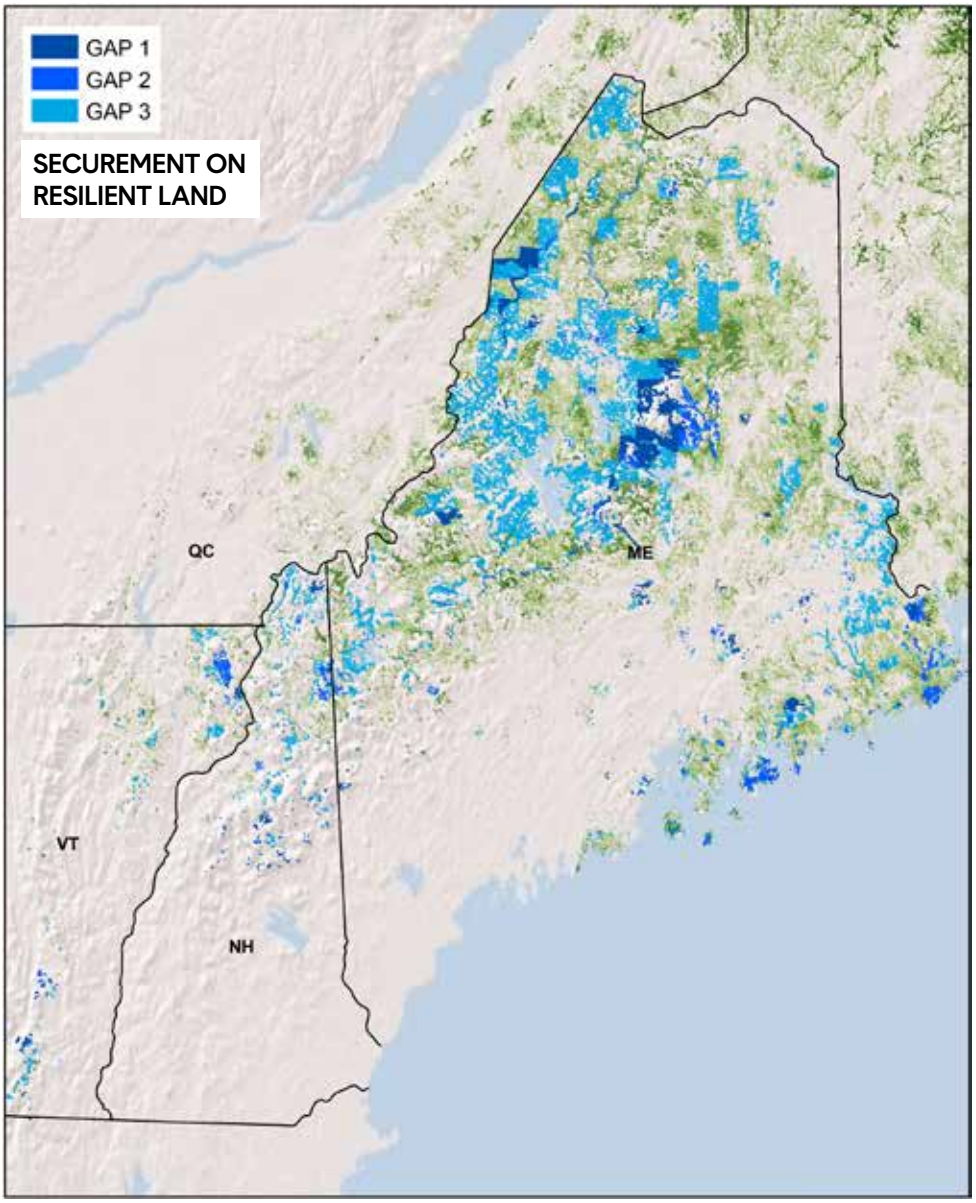
61% of this habitat scores high for resilience, and 26% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.




**Predicted Loss to Development by 2050**
Very low 1%

This community is not particularly threatened by development, with 34,136 acres (<1%) likely to be lost over the next 30 years.

# Acadian Low-Elevation Spruce-Fir-Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 5,227,093 | 26% |
| CT | | |
| MA | 553 | 14% |
| ME | 4,826,063 | 26% |
| NH | 177,510 | 35% |
| RI | | |
| VT | 222,968 | 19% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 3,186,145 | 31% |
| CT | | |
| MA | 104 | 57% |
| ME | 2,999,428 | 30% |
| NH | 89,967 | 49% |
| RI | | |
| VT | 96,646 | 36% |

## Rare or Uncommon Plants Associated with this Habitat

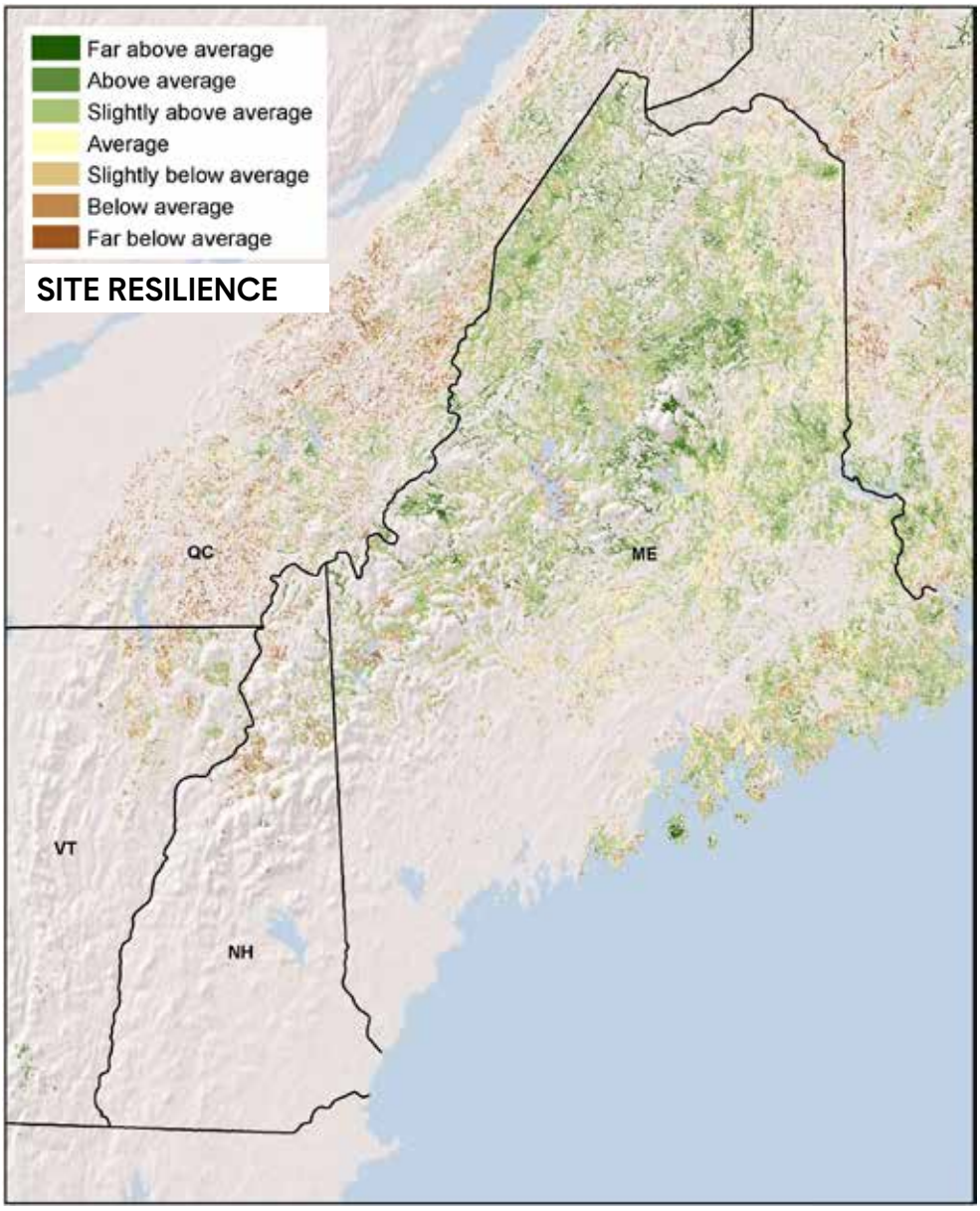
swarthy sedge
(*Carex adusta*)

giant rattlesnake-plantain
(*Goodyera oblongifolia)*

Canada mountain-rice grass
(*Piptatherum canadense*)

© Andy Cutco (Maine Natural Areas Program)

# Acadian Sub-boreal Spruce Flat




© Maine Natural Areas Program

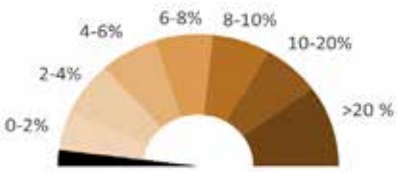
## Description

A conifer or mixed forest forming extensive flats on areas of imperfectly drained soils. Black spruce, red spruce, and balsam fir dominate a mostly closed canopy; yellow birch, hemlock, black cherry, and red maple are sometimes present in smaller numbers. Bryophytes and low herbs are abundant.

## Associated Herbs & Shrubs

mountain fly-honeysuckle (*Lonicera villosa*), fen grass-of-parnassus (*Parnassia glauca*), sheathed sedge (*Carex vaginata)*

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 3,121 | 27% | 13% | 19% | 58% | 42% |
| Above average | 11% | 149,814 | 9% | 5% | 25% | 39% | 61% |
| Slightly above average | 54% | 762,799 | 2% | 3% | 26% | 31% | 69% |
| Average | 17% | 234,211 | 1% | 1% | 16% | 18% | 82% |
| Slightly below average | 10% | 148,563 | 1% | 2% | 21% | 24% | 76% |
| Below average | 6% | 83,053 | 0% | 3% | 19% | 23% | 77% |
| Far below average | 0% | 6,491 | 0% | 3% | 20% | 23% | 77% |
| Developed | 2% | 30,473 | 1% | 3% | 20% | 24% | 76% |
| TOTAL | 100% | 1,418,525 | 2% | 3% | 23% | 28% | 72% |



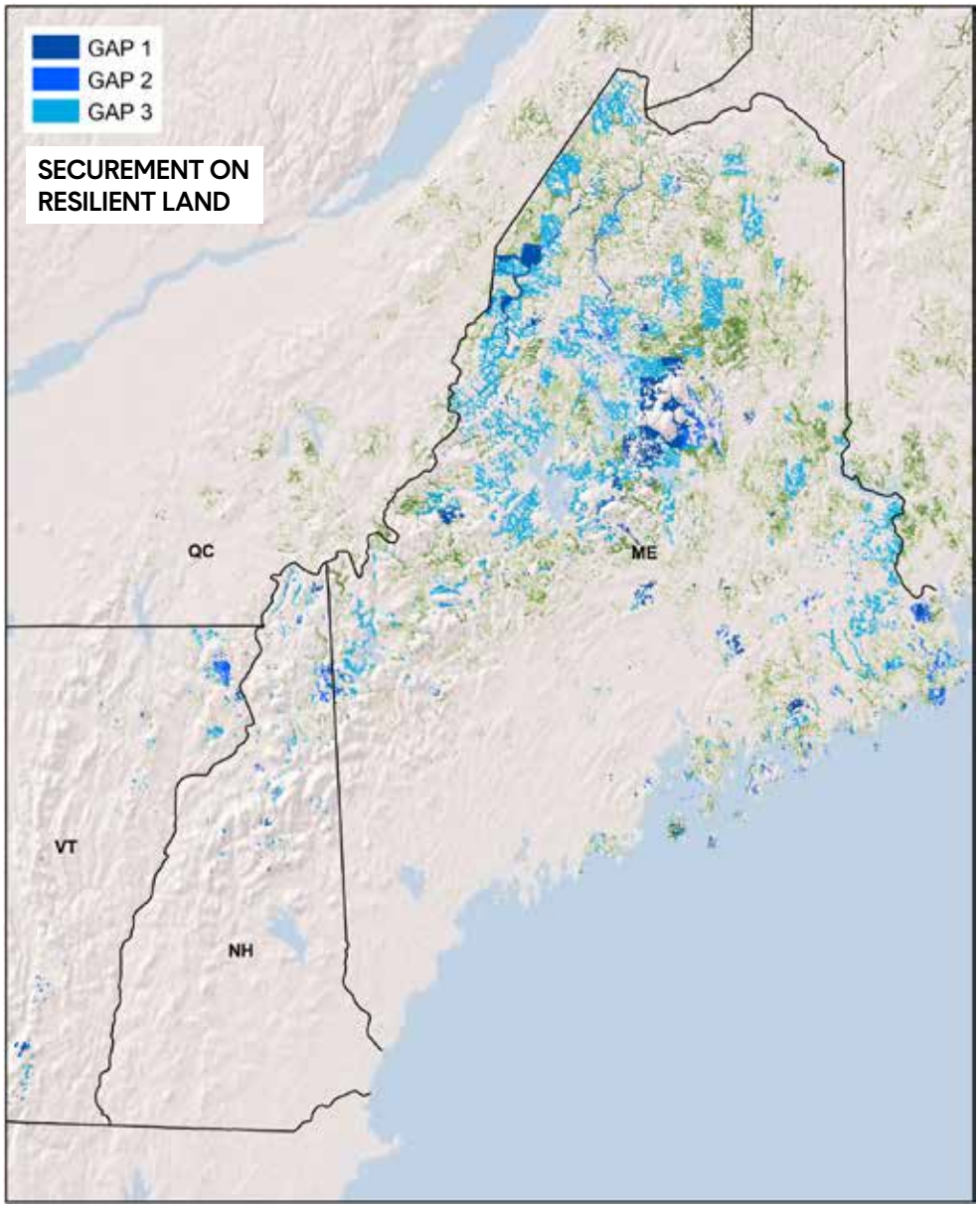

**Predicted Loss to Development by 2050**
Very low 1%

This community is not threatened by development. Only 4,169 acres (<1%) are likely to be lost over the next 30 years.

## Resilience & Securement

66% of this habitat scores high for resilience, and 28% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Acadian Sub-boreal Spruce Flat




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 1,418,525 | 29% |
| CT | | |
| MA | 91 | 3% |
| ME | 1,328,319 | 28% |
| NH | 43,952 | 35% |
| RI | | |
| VT | 46,164 | 27% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 915,734 | 33% |
| CT | | |
| MA | 3 | 100% |
| ME | 875,583 | 32% |
| NH | 21,296 | 48% |
| RI | | |
| VT | 18,852 | 53% |

## Rare or Uncommon Plants Associated with this Habitat

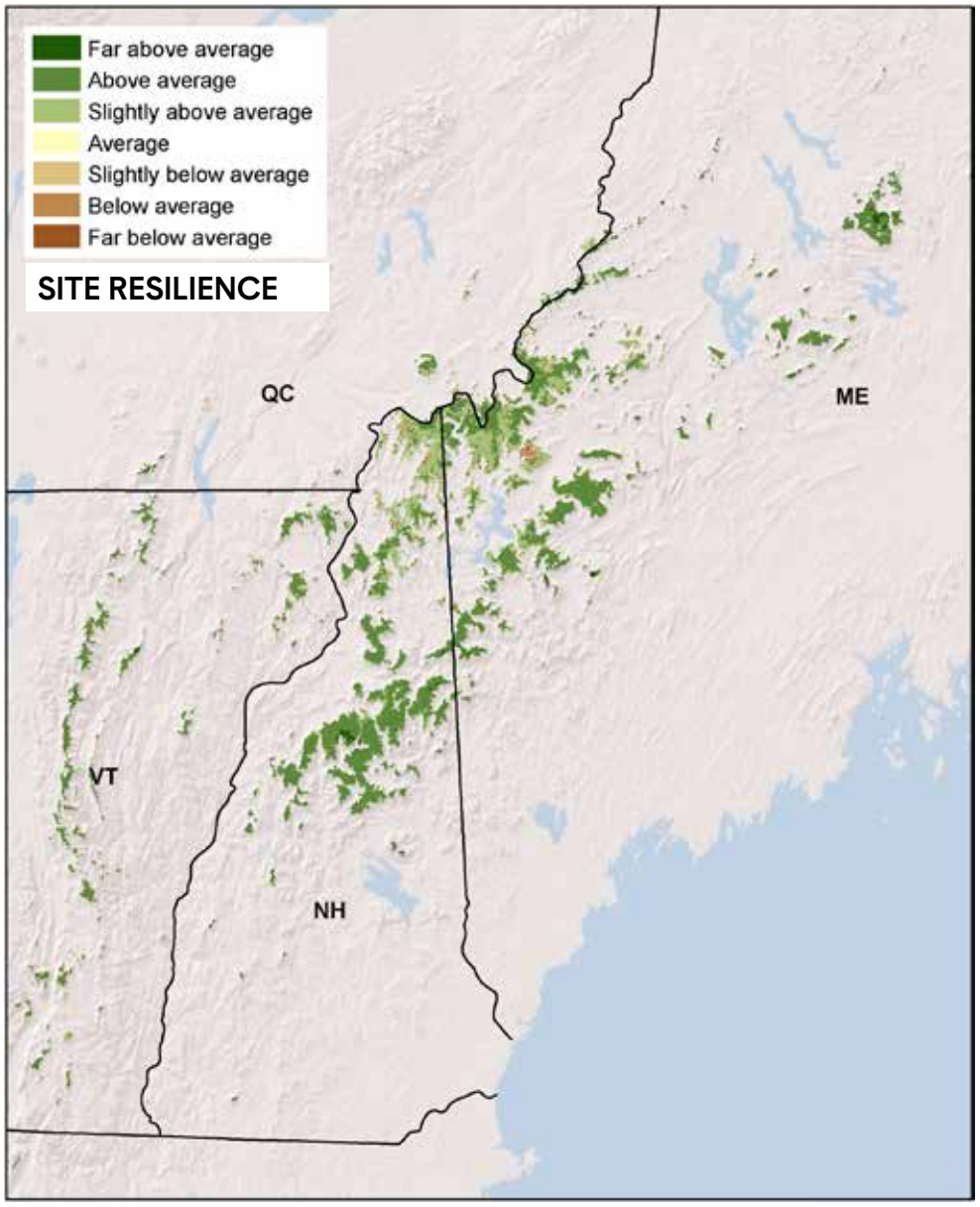
mountain cranberry (*Vaccinium vitis-idaea*)

Lapland-crowfoot (*Coptidium lapponicum*)

swamp thistle (*Cirsium muticum*)

lance-leaved violet (*Viola lanceolata*)

# Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest




© Maine Natural Areas Program

## Description

A high-elevation conifer forest dominated by red spruce and balsam fir and forming small to very large patches on the highest peaks of the Northern Appalachian mountains. Heart-leaved birch is a characteristic tree, along with yellow birch, white birch, mountain maple, striped maple, mountain ash, and occasionally black spruce.

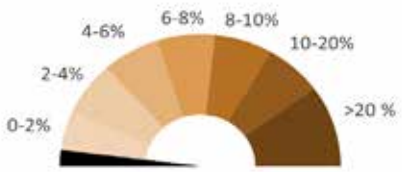
## Associated Herbs & Shrubs

boreal bedstraw (*Galium kamtschaticum*), Bartram shadbush (*Amelanchier bartramiana*), Hornemann's willow-herb (*Epilobium hornemannii*), purple crowberry (*Empetrum atropurpureum*), northern bentgrass (*Agrostis mertensii*), cushion-plant (*Diapensia lapponica*), small-flowered wood rush (*Luzula parviflora*), squashberry (*Viburnum edule*), bearberry willow (*Salix uva-ursi*), little shinleaf (*Pyrola minor*), false toadflax (*Geocaulon lividum*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 19,013 | 52% | 17% | 9% | 77% | 23% |
| Above average | 70% | 609,688 | 24% | 24% | 19% | 67% | 33% |
| Slightly above average | 25% | 221,127 | 5% | 7% | 37% | 49% | 51% |
| Average | 0% | 0 | 0% | 0% | 0% | 0% | 0% |
| Slightly below average | 0% | 13 | 0% | 0% | 67% | 67% | 33% |
| Below average | 1% | 13,038 | 3% | 7% | 41% | 51% | 49% |
| Far below average | 0% | 3,626 | 2% | 1% | 32% | 36% | 64% |
| Developed | 1% | 7,926 | 4% | 4% | 37% | 45% | 55% |
| TOTAL | 100% | 874,432 | 19% | 19% | 23% | 62% | 38% |

## Resilience & Securement

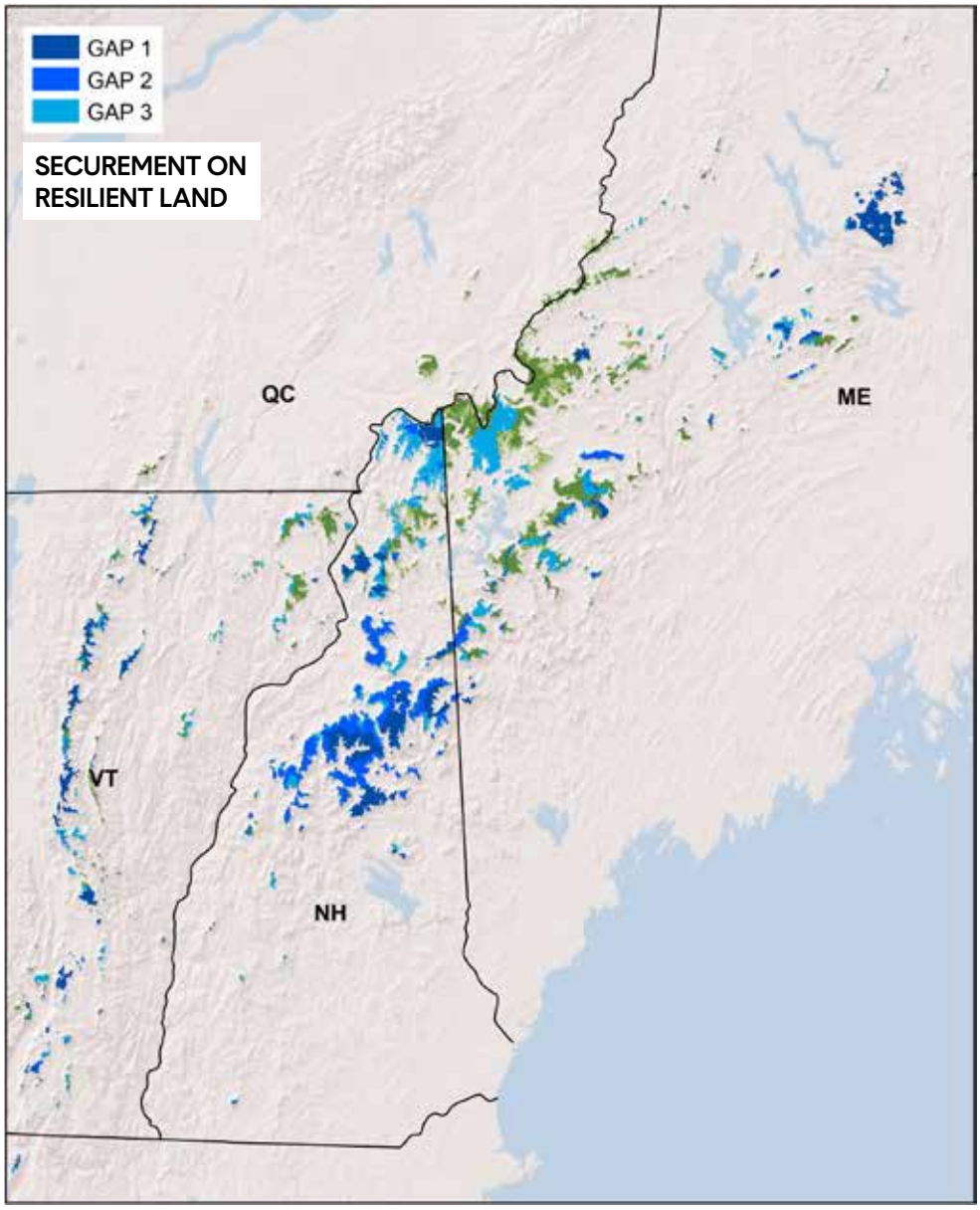
97% of this habitat scores high for resilience, and 62% of the total acreage is secured against conversion, and 38% is protected.




**Predicted Loss to Development by 2050**
Very low 0%

This community is not threatened by development. Only 434 acres (<1%) are likely to be lost over the next 30 years.

# Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 874,432 | 62% |
| CT | | |
| MA | 605 | 100% |
| ME | 419,938 | 40% |
| NH | 352,135 | 89% |
| RI | | |
| VT | 101,753 | 60% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 849,828 | 62% |
| CT | | |
| MA | 584 | 100% |
| ME | 406,177 | 40% |
| NH | 342,263 | 89% |
| RI | | |
| VT | 100,804 | 60% |

## Rare or Uncommon Plants Associated with this Habitat

lance-leaved arnica (*Arnica lanceolata*)

open field sedge (*Carex conoidea*)

russet sedge (*Carex saxatilis*)

heart-leaved twayblade (*Neottia cordata*)

spiked wood rush (*Luzula spicata*)

woodland arctic-cudweed (*Omalotheca sylvatica*)

silvery whitlow-wort (*Paronychia argyrocoma*)

little yellow-rattle (*Rhinanthus minor* ssp. *groenlandicus*)

purple crowberry (*Empetrum atropurpureum*)

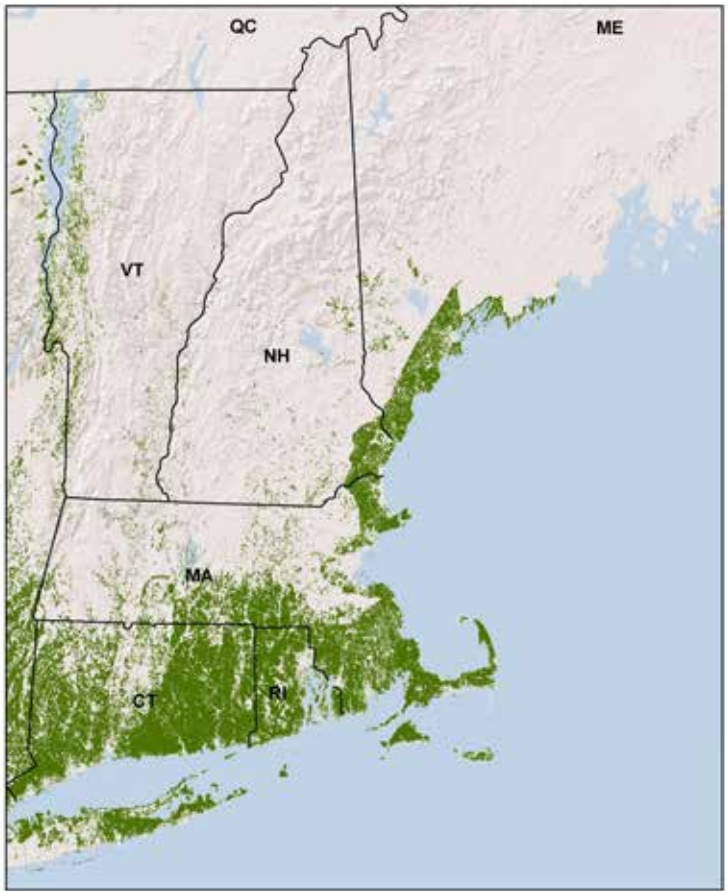
Hornemann's willow-herb (*Epilobium hornemannii*)

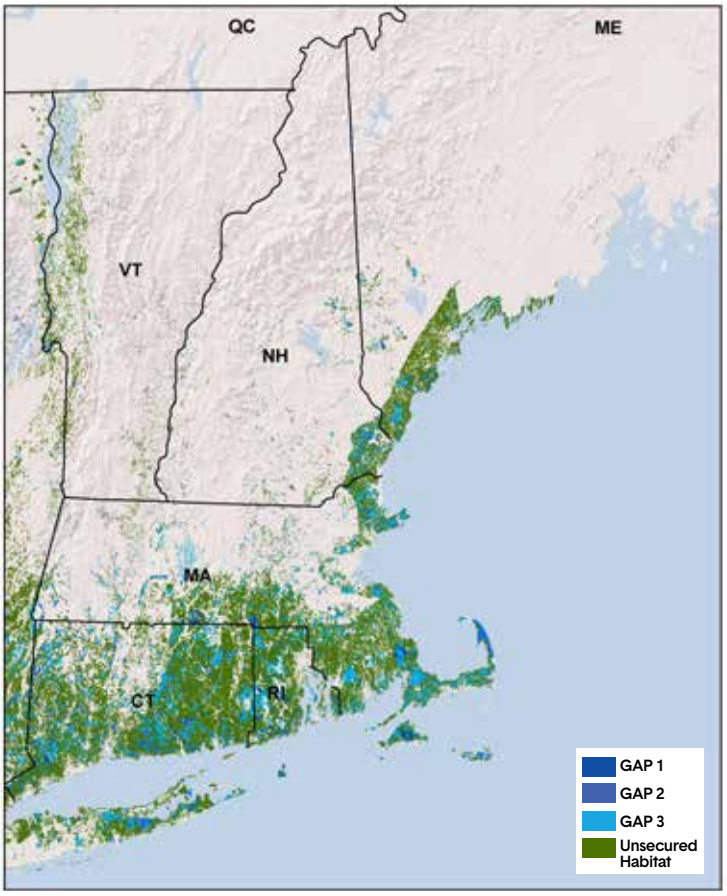
boreal bedstraw (*Galium kamtschaticum*)

northern willow (*Salix arctophila*)

MACROGROUP

# CENTRAL OAK-PINE FOREST

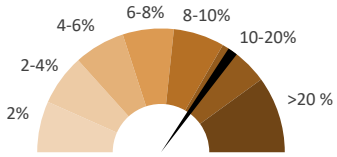



**Central Oak-Pine Forest**
Mixed hardwood-conifer forest of southern New England dominated by oaks (red, black, scarlet, chestnut) and pine (white, pitch).

**Acres in New England**
2.4 million

**Percent Secured**
GAP 1 = 2%
GAP 2 = 4%
GAP 3 = 14%




**Predicted Loss to Development by 2050**
246,497 acres (11%)

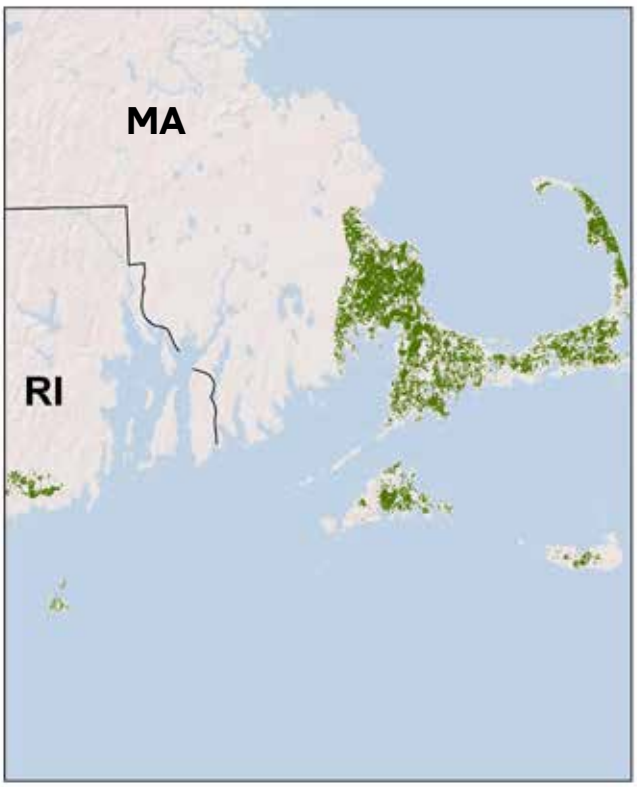
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Central Oak-Pine Forest** | **2,257,390** | **2%** | **4%** | **14%** | **80%** | **33** | **3** | **4** | **26** |
| Connecticut | 1,164,346 | 1% | 4% | 12% | 83% | 17 | 2 | | 15 |
| Massachusetts | 642,197 | 4% | 3% | 19% | 74% | 13 | 1 | 4 | 8 |
| Maine | 117,372 | 1% | 5% | 10% | 85% | | | | |
| New Hampshire | 42,310 | 3% | 4% | 16% | 77% | | | | |
| Rhode Island | 258,565 | 2% | 4% | 15% | 79% | 3 | | | 3 |
| Vermont | 32,599 | 2% | 1% | 4% | 93% | | | | |
| **New England** | **2,257,390** | **41,892** | **79,149** | **326,660** | **1,809,688** | | | | |

P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS

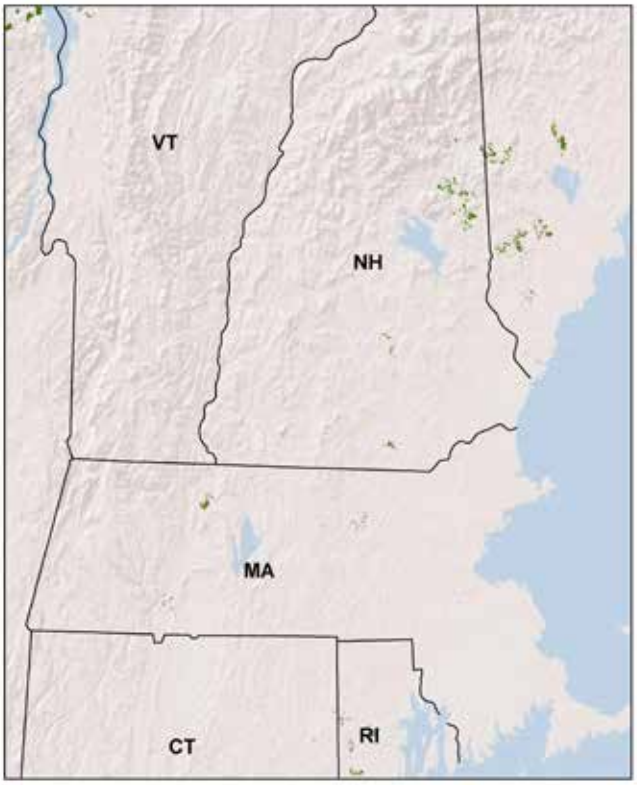

COASTAL | **North Atlantic Coastal Plain Hardwood Forest**


COASTAL | **North Atlantic Coastal Plain Maritime Forest**

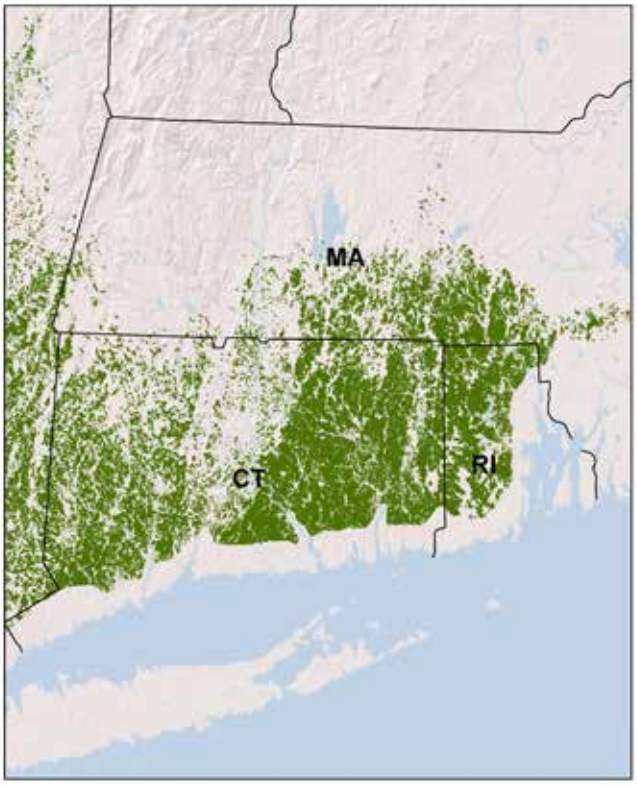



COASTAL | **North Atlantic Coastal Plain Pitch Pine Barrens**

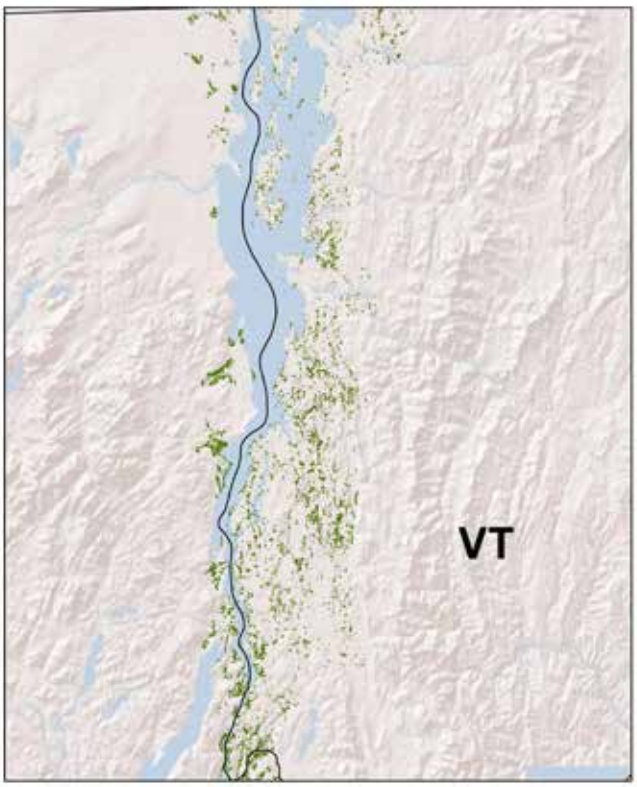
# DISTRIBUTION OF HABITATS




INTERIOR | **Northeastern Interior Pine Barrens**

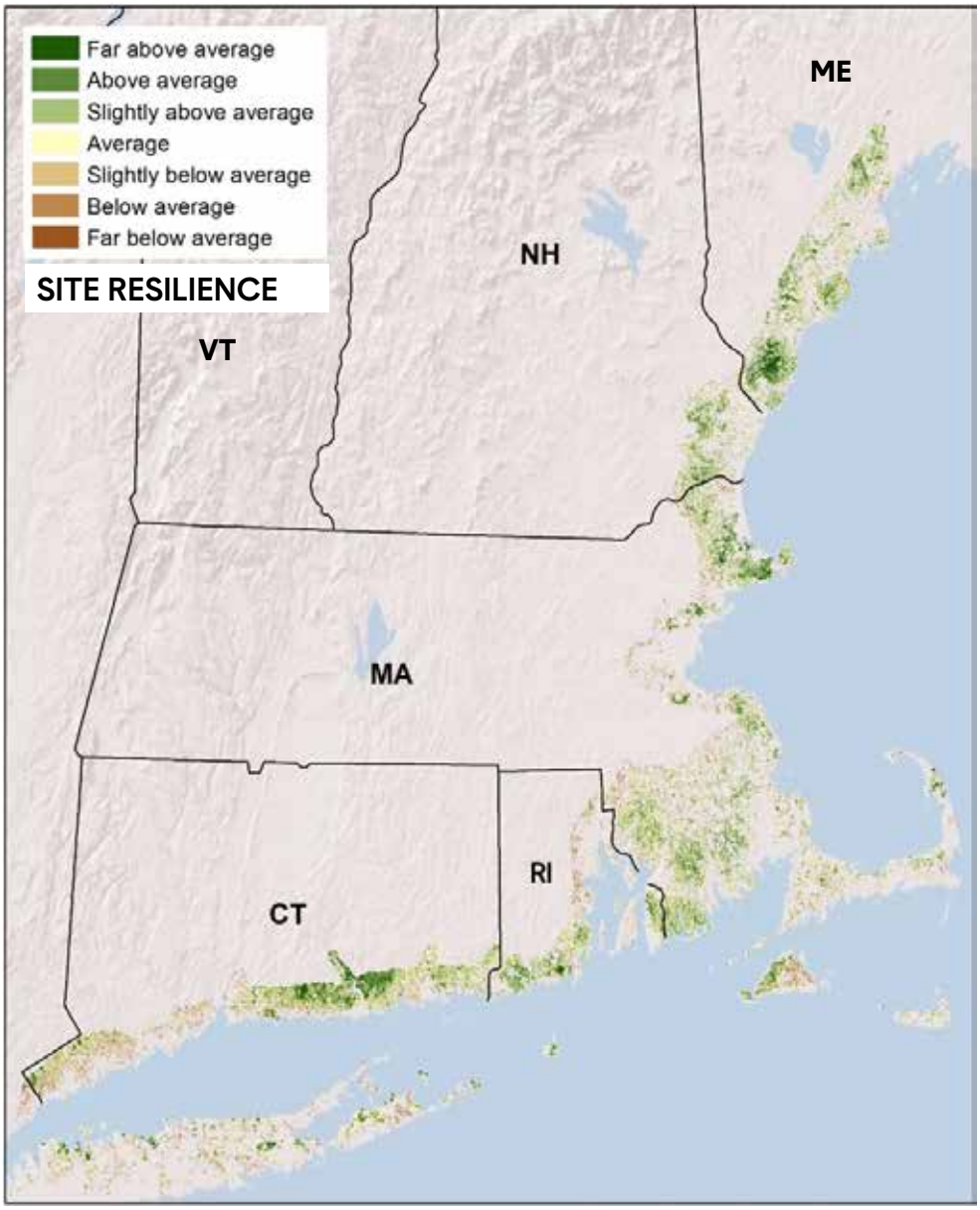



INTERIOR | **Northeastern Interior Dry-Mesic Oak Forest**




INTERIOR | **Glacial Marine & Lake Clayplain Forest**

# North Atlantic Coastal Plain Hardwood Forest




© Robert Coxe (Delaware Species Conservation & Research Program)

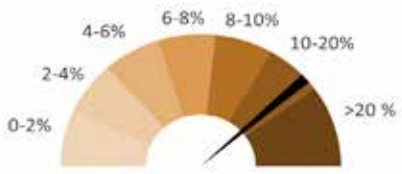
## Description

A hardwood forest largely dominated by oaks, often mixed with pine. White, red, chestnut, black, and scarlet oaks are typical, and American holly is sometimes present. Sassafras, birch, aspen, and hazelnut are common.

## Associated Herbs & Shrubs

lion's-foot rattlesnake-root (*Nabalus serpentarius*), northern blazingstar (*Liatris novae-angliae*), arrow-feather threeawn (*Aristida purpurascens*), northern tubercled bog-orchid (*Platanthera flava* var. *herbiola*), large whorled pogonia (*Isotria verticillata*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 11,865 | 3% | 11% | 30% | 44% | 56% |
| Above average | 12% | 75,212 | 2% | 6% | 23% | 31% | 69% |
| Slightly above average | 18% | 111,672 | 2% | 4% | 17% | 22% | 78% |
| Average | 38% | 241,398 | 1% | 4% | 14% | 19% | 81% |
| Slightly below average | 11% | 66,978 | 2% | 2% | 12% | 15% | 85% |
| Below average | 7% | 45,680 | 2% | 2% | 10% | 14% | 86% |
| Far below average | 1% | 9,290 | 1% | 1% | 7% | 10% | 90% |
| Developed | 11% | 72,373 | 1% | 1% | 7% | 8% | 92% |
| TOTAL | 100% | 634,467 | 2% | 4% | 14% | 20% | 80% |



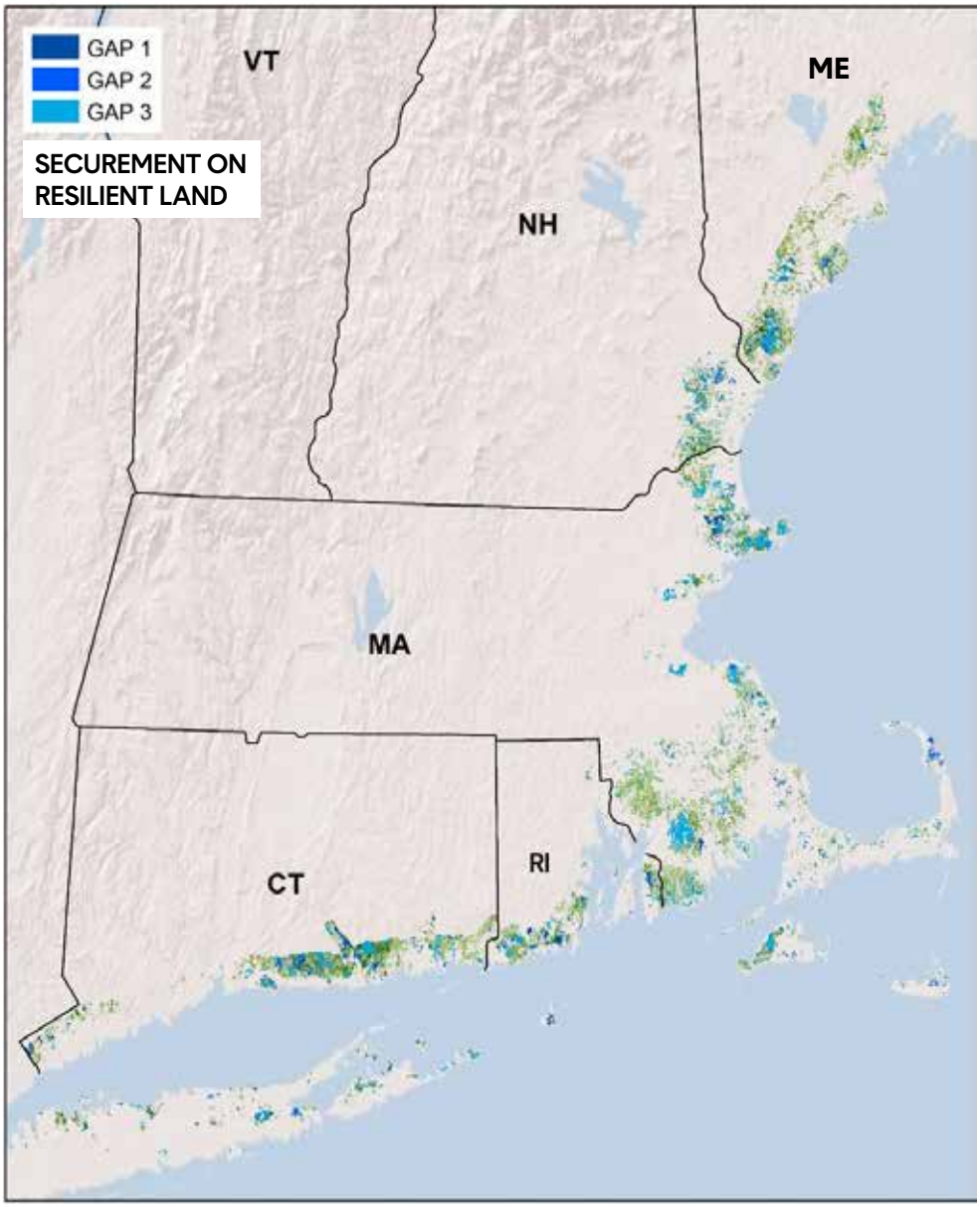

**Predicted Loss to Development by 2050**
High 18%

This community is one of New England's most threatened by development, with 112,063 acres (18%) likely to be lost over the next 30 years.

## Resilience & Securement

32% of this habitat scores high for resilience, and 20% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# North Atlantic Coastal Plain Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 634,467 | 19% |
| CT | 193,633 | 14% |
| MA | 263,497 | 26% |
| ME | 76,292 | 13% |
| NH | 35,815 | 22% |
| RI | 65,230 | 18% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 198,749 | 27% |
| CT | 62,255 | 21% |
| MA | 72,484 | 35% |
| ME | 33,566 | 21% |
| NH | 10,853 | 27% |
| RI | 19,591 | 27% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

purple milkweed (*Asclepias purpurascens*)

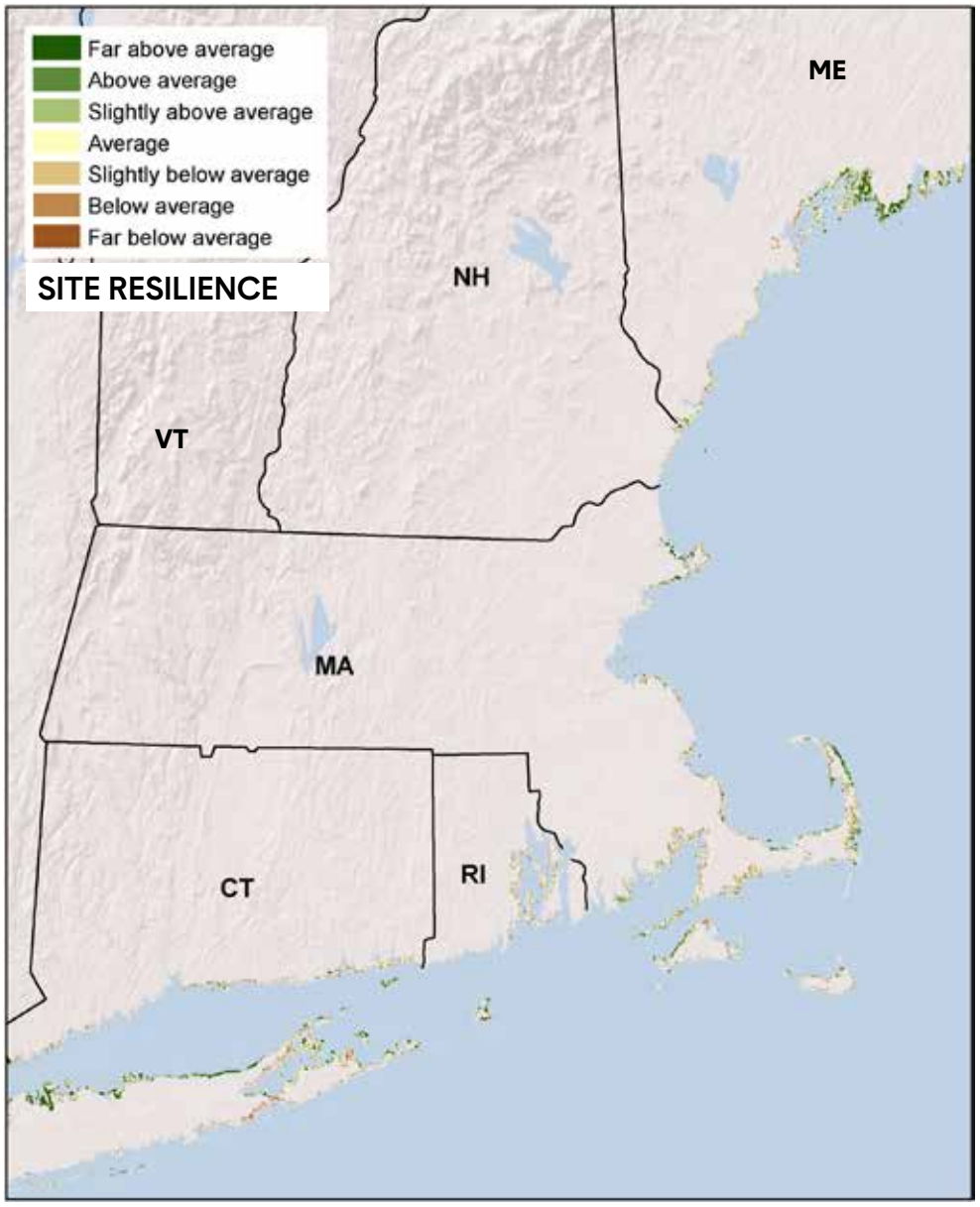
Carolina few-flowered nutsedge (*Scleria pauciflora* var. *caroliniana*)

few-flowered nutsedge (*Scleria pauciflora* var. *pauciflora*)

eastern silver American-aster (*Symphyotrichum concolor* ssp. *concolor*)

cranefly orchid (*Tipularia discolor*)

# North Atlantic Coastal Plain Maritime Forest




© Robert Coxe (Delaware Species Conservation & Research Program)

## Description

A forest-shrubland mosaic encompassing a range of woody vegetation on barrier islands, near-coastal strands, and bluffs at the outer edge of the coastal plain. Defined by its proximity to maritime environments, the stunted vegetation includes pines (pitch, white) and oaks (scarlet, black, scrub, post) as well as eastern red cedar, black cherry, American holly, and sassafras.

## Associated Herbs & Shrubs

northern blazing star (*Liatris novae-angliae*), lion's-foot rattlesnake-root (*Nabalus serpentarius*), sundial lupine (*Lupinus perennis*), butterfly milkweed (*Asclepias tuberosa*), eastern silver American-aster (*Symphyotrichum concolor* var. *concolor*), ramps (*Allium tricoccum*), coastal plain blue-eyed-grass (*Sisyrinchium fuscatum*), yellow thistle (*Cirsium horridulum* var. *horridulum*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 4% | 3,147 | 0% | 25% | 15% | 41% | 59% |
| Above average | 16% | 12,374 | 1% | 15% | 15% | 31% | 69% |
| Slightly above average | 17% | 13,530 | 1% | 13% | 12% | 25% | 75% |
| Average | 34% | 27,055 | 2% | 9% | 12% | 23% | 77% |
| Slightly below average | 8% | 6,592 | 1% | 7% | 12% | 20% | 80% |
| Below average | 4% | 3,557 | 3% | 5% | 12% | 20% | 80% |
| Far below average | 1% | 456 | 1% | 2% | 13% | 16% | 84% |
| Developed | 16% | 12,339 | 0% | 5% | 6% | 11% | 89% |
| TOTAL | 100% | 79,051 | 1% | 10% | 12% | 23% | 77% |

## Resilience & Securement

37% of this habitat scores high for resilience, and 23% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.


**Predicted Loss to Development by 2050**
High 16%

This is one of New England's most threatened communities, with 12,622 acres (16%) likely to be lost over the next 30 years.

# North Atlantic Coastal Plain Maritime Forest


| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 79,051 | 23% |
| CT | 5,489 | 26% |
| MA | 32,901 | 30% |
| ME | 31,930 | 15% |
| NH | 774 | 21% |
| RI | 7,957 | 26% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 29,051 | 29% |
| CT | 1,065 | 41% |
| MA | 11,352 | 43% |
| ME | 15,060 | 18% |
| NH | 170 | 43% |
| RI | 1,404 | 33% |
| VT | | |

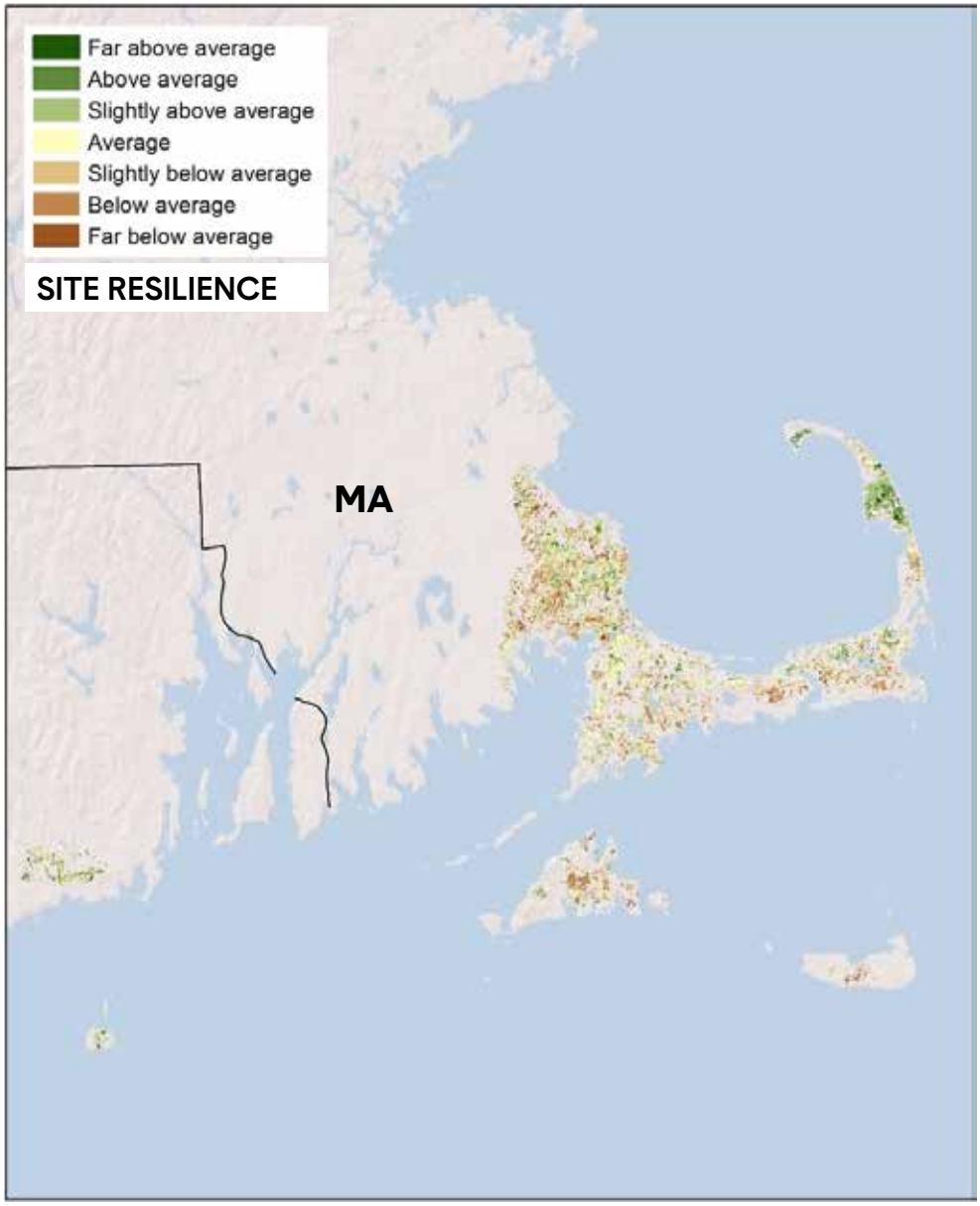
## Rare or Uncommon Plants Associated with this Habitat

southern fragile fern
(*Cystopteris protrusa*)

herbaceous seablight
(*Suaeda maritima* ssp. *richii*)

Macoun's rabbit-tobacco
(*Pseudognaphalium macounii*)

# North Atlantic Coastal Plain Pitch Pine Barrens




© Kathleen Strakosch Walz
(New Jersey Natural Heritage Program)

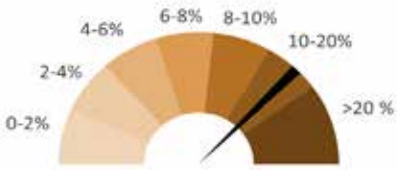
## Description

A dry, fire-adapted forest with a variable canopy of pitch pine, a tall-shrub layer dominated by scrub oak, and a low-shrub layer of blueberry and other heaths. Other oaks (scarlet, black, chestnut, white) are usually present. Composition and structure vary with fire frequency.

## Associated Herbs & Shrubs

few-flowered nutsedge (*Scleria pauciflora* var. *pauciflora*), post oak (*Quercus stellata*), little ladies'-tresses (*Spiranthes tuberosa*), northern blazing star (*Liatris novae-angliae*), butterfly milkweed (*Asclepias tuberosa*), arrow-feather threeawn (*Aristida purpurascens*), Nuttall's milkwort (*Polygala nuttallii*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 315 | 0% | 69% | 5% | 75% | 25% |
| Above average | 5% | 5,095 | 5% | 33% | 19% | 57% | 43% |
| Slightly above average | 11% | 11,395 | 7% | 19% | 26% | 52% | 48% |
| Average | 36% | 38,212 | 8% | 4% | 36% | 48% | 52% |
| Slightly below average | 16% | 16,892 | 11% | 5% | 31% | 48% | 52% |
| Below average | 15% | 15,622 | 13% | 3% | 27% | 42% | 58% |
| Far below average | 3% | 2,720 | 14% | 1% | 24% | 38% | 62% |
| Developed | 14% | 14,550 | 4% | 4% | 18% | 25% | 75% |
| TOTAL | 100% | 104,801 | 8% | 7% | 29% | 44% | 56% |




**Predicted Loss to Development by 2050**
High 15%

This rare community has a high development threat, with 15,826 acres (15%) likely to be lost over the next 30 years.

## Resilience & Securement

Only 16% of this habitat scores high for resilience, but 44% of the total acreage is secured against conversion. Long-term management is likely needed to sustain this habitat.

# North Atlantic Coastal Plain Pitch Pine Barrens


| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 104,801 | 45% |
| CT | | |
| MA | 101,027 | 46% |
| ME | | |
| NH | | |
| RI | 3,774 | 25% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 16,804 | 54% |
| CT | | |
| MA | 15,061 | 57% |
| ME | | |
| NH | | |
| RI | 1,743 | 30% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

bushy frostweed (*Crocanthemum dumosum*)

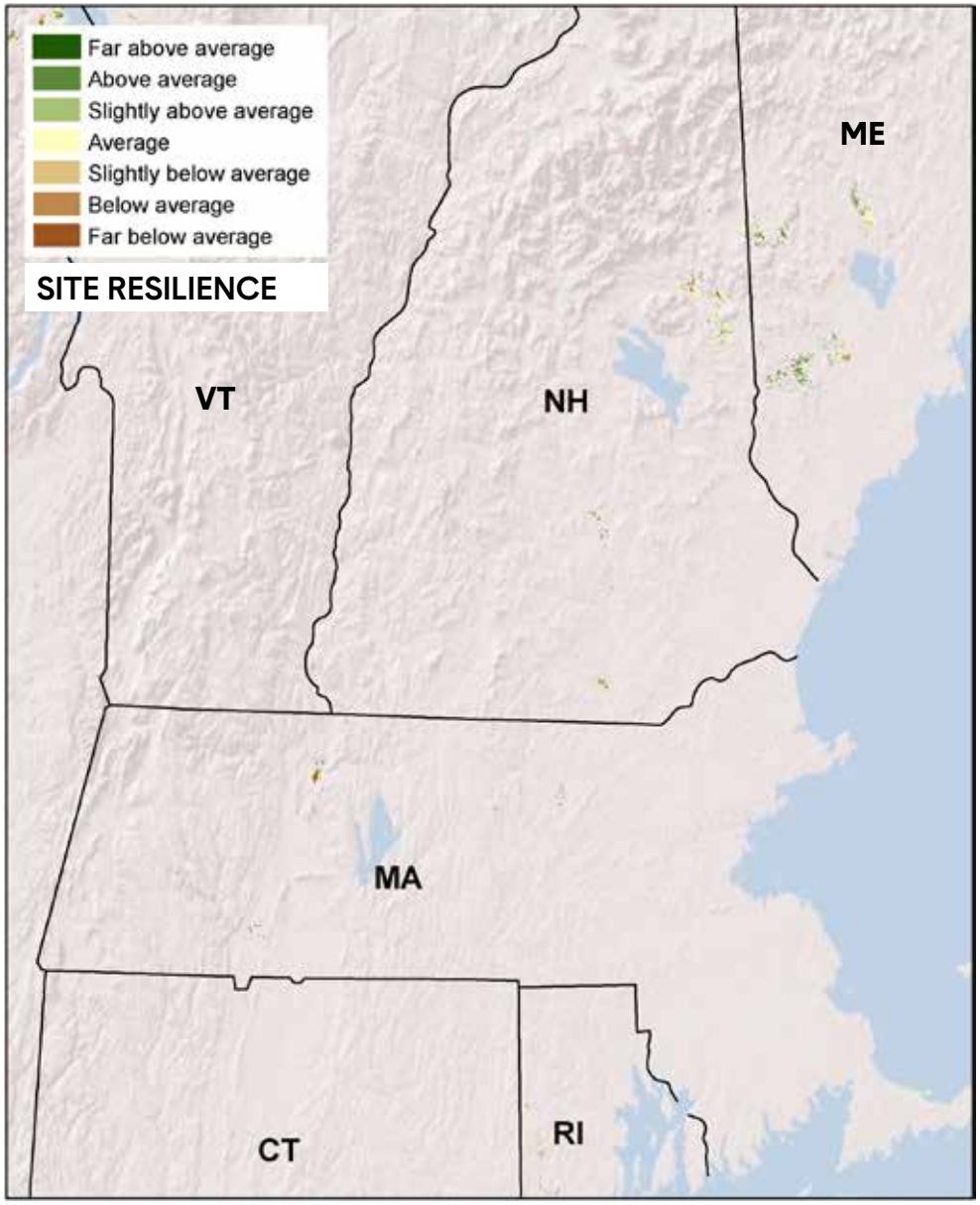
Bayard's adder's-mouth (*Malaxis bayardii*)

Bicknell's hawthorn (*Crataegus bicknellii*)

Carolina few-flowered nutsedge (*Scleria pauciflora* var. *caroliniana*)

eastern silver American-aster (*Symphyotrichum concolor* ssp. *concolor*)

# Northeastern Interior Pine Barrens




© Jennifer Case (The Nature Conservancy, Pennsylvania)

## Description

A fire-adapted system of Northeast glacial sandplains, typically an open woodland but sometimes including patches of closed-canopy forest and herbaceous openings. Pitch pine is the usual dominant; red oak, white pine, and gray birch are common associates. A tall-shrub layer of scrub oak or dwarf chinkapin oak is characteristic, as is a low-shrub layer of heath and sweetfern.

## Associated Herbs & Shrubs

Canada frostweed (*Crocanthemum canadense*), tall hairy lettuce (*Lactuca hirsuta*), large whorled pogonia (*Isotria verticillata*), hoary frostweed (*Crocanthemum bicknellii*), racemed milkwort (*Polygala polygama*), sundial lupine (*Lupinus perennis*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 53 | 13% | 0% | 17% | 30% | 70% |
| Above average | 13% | 2,642 | 18% | 4% | 21% | 44% | 56% |
| Slightly above average | 20% | 4,043 | 4% | 3% | 31% | 37% | 63% |
| Average | 40% | 7,997 | 4% | 4% | 41% | 49% | 51% |
| Slightly below average | 10% | 2,018 | 3% | 3% | 26% | 32% | 68% |
| Below average | 7% | 1,422 | 7% | 0% | 17% | 24% | 76% |
| Far below average | 2% | 493 | 0% | 0% | 58% | 58% | 42% |
| Developed | 6% | 1,162 | 1% | 3% | 22% | 26% | 74% |
| TOTAL | 100% | 19,829 | 6% | 3% | 32% | 41% | 59% |

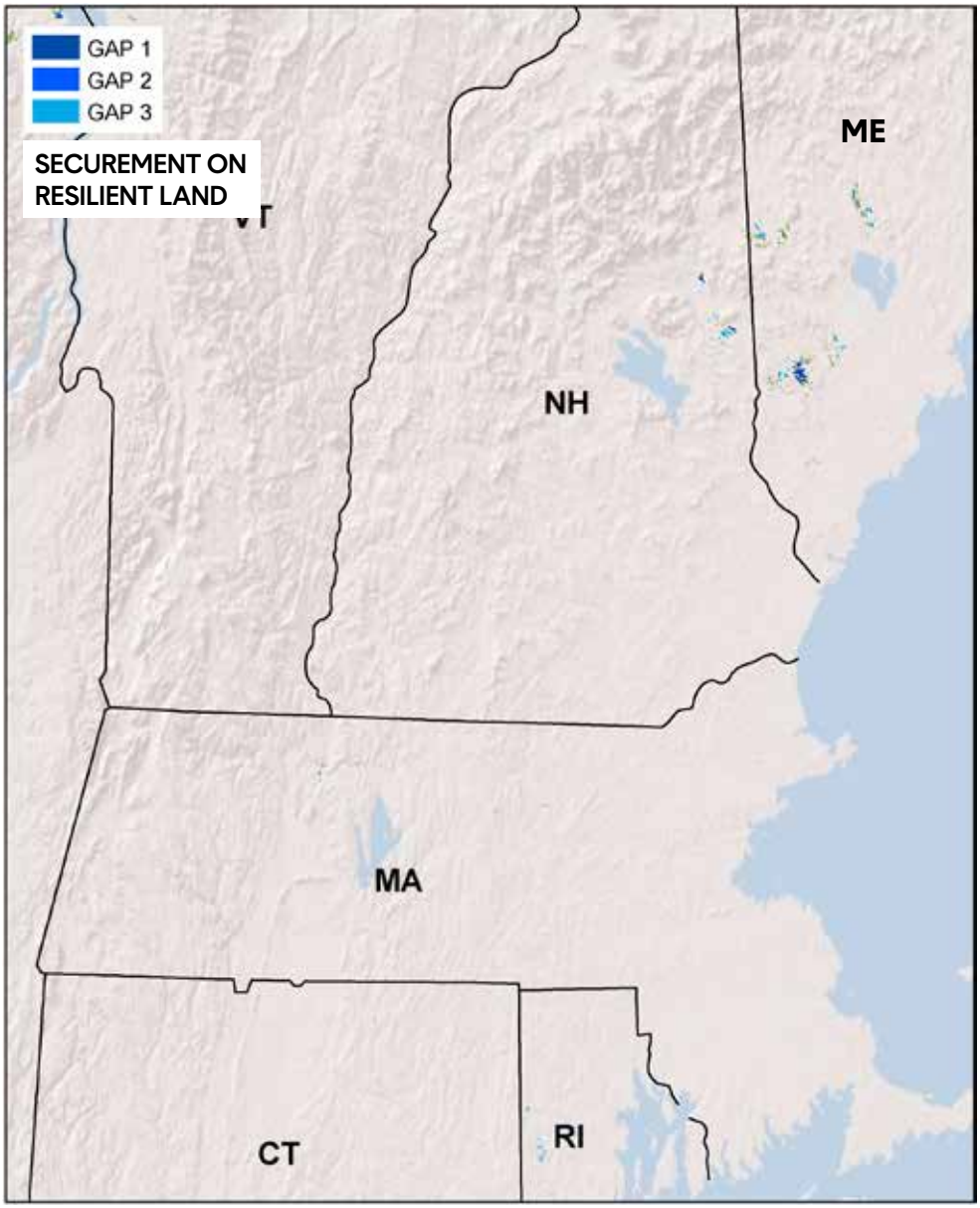

**Predicted Loss to Development by 2050**
Low 3%

This rare community has a low development threat, with 569 acres (3%) likely to be lost over the next 30 years.

## Resilience & Securement

33% of this habitat scores high for resilience, and 41% of the total acreage is secured against conversion. Long-term management is likely needed to sustain this habitat, especially on vulnerable lands.

# Northeastern Interior Pine Barrens




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 19,829 | 41% |
| CT | 147 | 55% |
| MA | 2,049 | 43% |
| ME | 9,150 | 39% |
| NH | 5,721 | 35% |
| RI | 2,228 | 69% |
| VT | 534 | 0 |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 6,738 | 40% |
| CT | 22 | 60% |
| MA | 97 | 40% |
| ME | 5,214 | 35% |
| NH | 870 | 53% |
| RI | 395 | 80% |
| VT | 140 | 24% |

## Rare or Uncommon Plants Associated with this Habitat

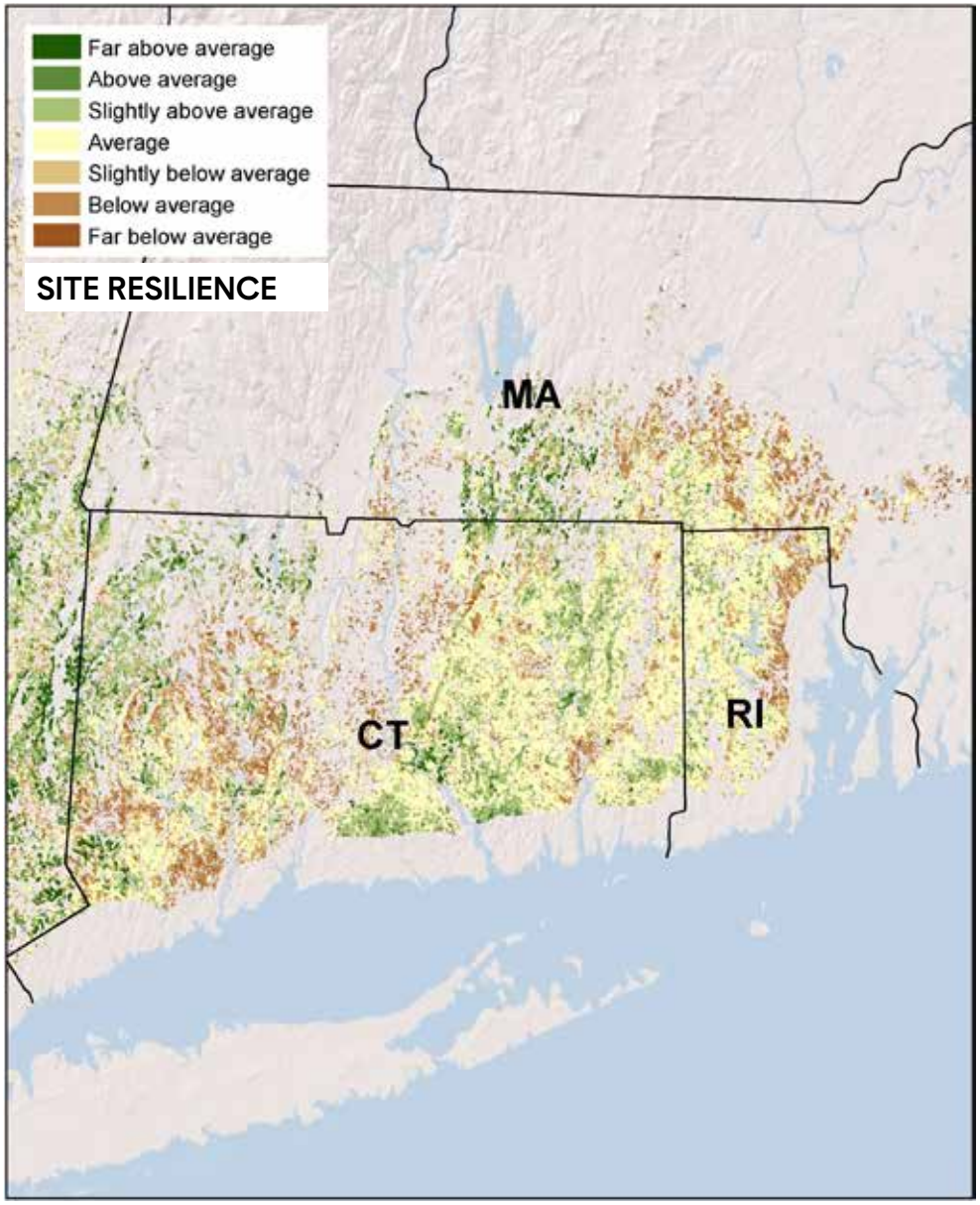
rattlesnake hawkweed (*Hieracium venosum*)

mountain and wild honeysuckle (*Lonicera villosa* and *Lonicera dioica*)

hairy rosette-panicgrass (*Dichanthelium acuminatum* ssp. *columbianum*)

ground-cedar hybrid (*Diphasiastrum xsabinifolium*)

# Northeastern Interior Dry-Mesic Oak Forest




© Gary P. Fleming (Virginia Department of Conservation & Recreation Natural Heritage Program)

## Description

An oak-dominated, mostly closed-canopy forest that occurs in southern New England. Oak species characteristic of dry to mesic conditions (e.g., red, white, black, scarlet, and occasionally chestnut oak) and hickories are typical.

## Associated Herbs & Shrubs

American wintergreen (*Pyrola americana*), blunt-lobed cliff fern (*Woodsia obtusa*), eastern bottle-brush grass (*Elymus hystrix*), common golden Alexanders (*Zizia aurea*), early buttercup (*Ranunculus fascicularis*), elliptic-leaved shinleaf (*Pyrola elliptica*), sicklepod rockcress (*Boechera canadensis*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 13,178 | 4% | 10% | 21% | 35% | 65% |
| Above average | 6% | 87,590 | 3% | 6% | 22% | 31% | 69% |
| Slightly above average | 19% | 261,867 | 3% | 4% | 20% | 28% | 72% |
| Average | 45% | 630,713 | 1% | 3% | 13% | 17% | 83% |
| Slightly below average | 12% | 172,782 | 1% | 2% | 9% | 12% | 88% |
| Below average | 8% | 108,357 | 0% | 2% | 7% | 9% | 91% |
| Far below average | 1% | 13,734 | 0% | 1% | 5% | 5% | 95% |
| Developed | 7% | 98,956 | 0% | 1% | 5% | 7% | 93% |
| TOTAL | 100% | 1,387,176 | 1% | 3% | 14% | 18% | 82% |

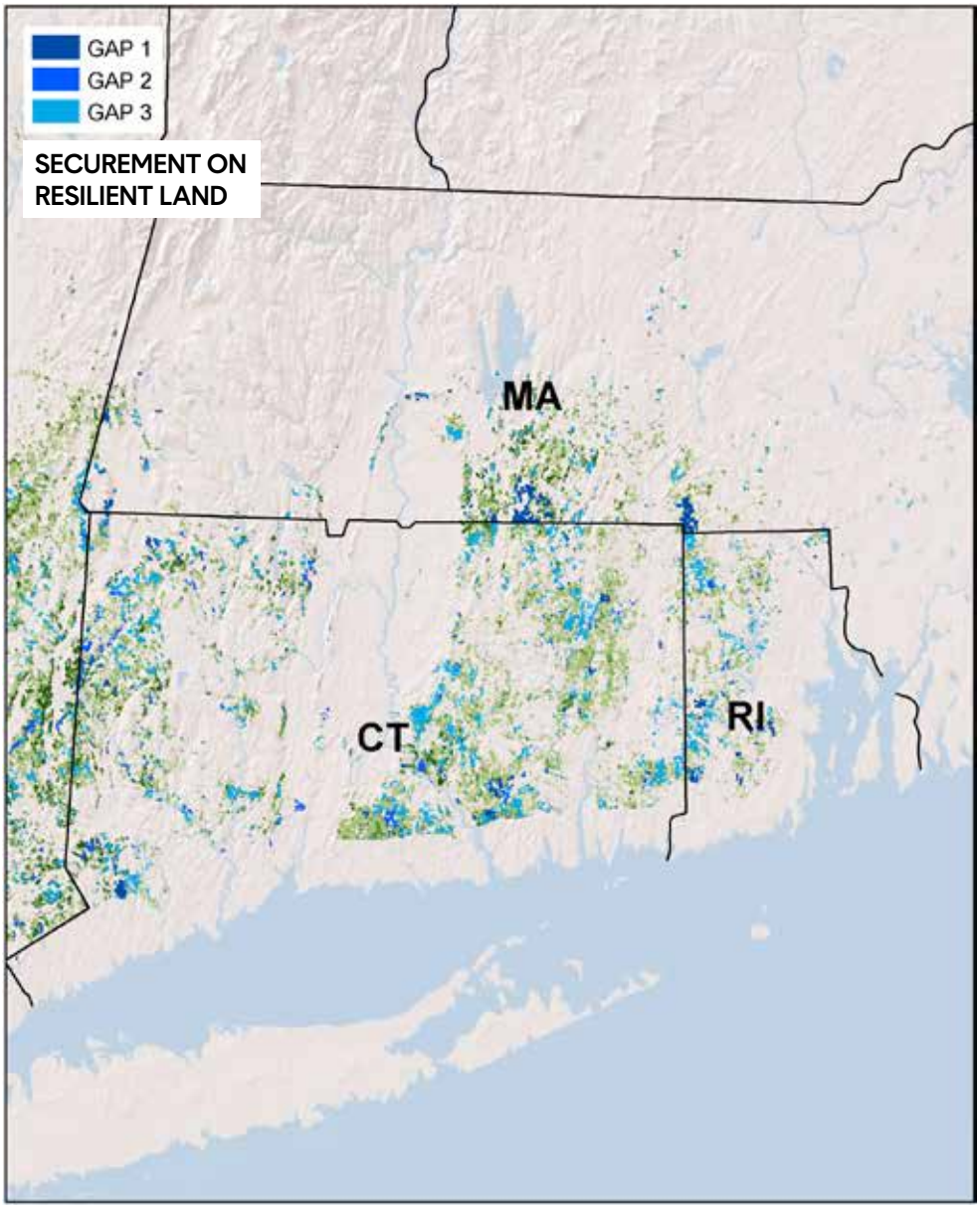

**Predicted Loss to Development by 2050**
Moderate 8%

This community is threatened by development, with 104,180 acres (8%) likely to be lost over the next 30 years.

## Resilience & Securement

26% of this habitat scores high for resilience, and 18% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Northeastern Interior Dry-Mesic Oak Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 1,387,176 | 18% |
| CT | 965,078 | 18% |
| MA | 242,723 | 17% |
| ME | | |
| NH | | |
| RI | 179,375 | 21% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 362,635 | 29% |
| CT | 272,306 | 28% |
| MA | 60,869 | 28% |
| ME | | |
| NH | | |
| RI | 29,459 | 39% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

small whorled pogonia (*Isotria medeoloides*)

devil's bit (*Chamaelirium luteum*)

goldenseal (*Hydrastis canadensis*)

two-flowered dwarf-dandelion (*Krigia biflora* var. *biflora*)

creeping bush-clover (*Lespedeza repens*)

common yellow flax (*Linum medium* ssp. *texanum*)

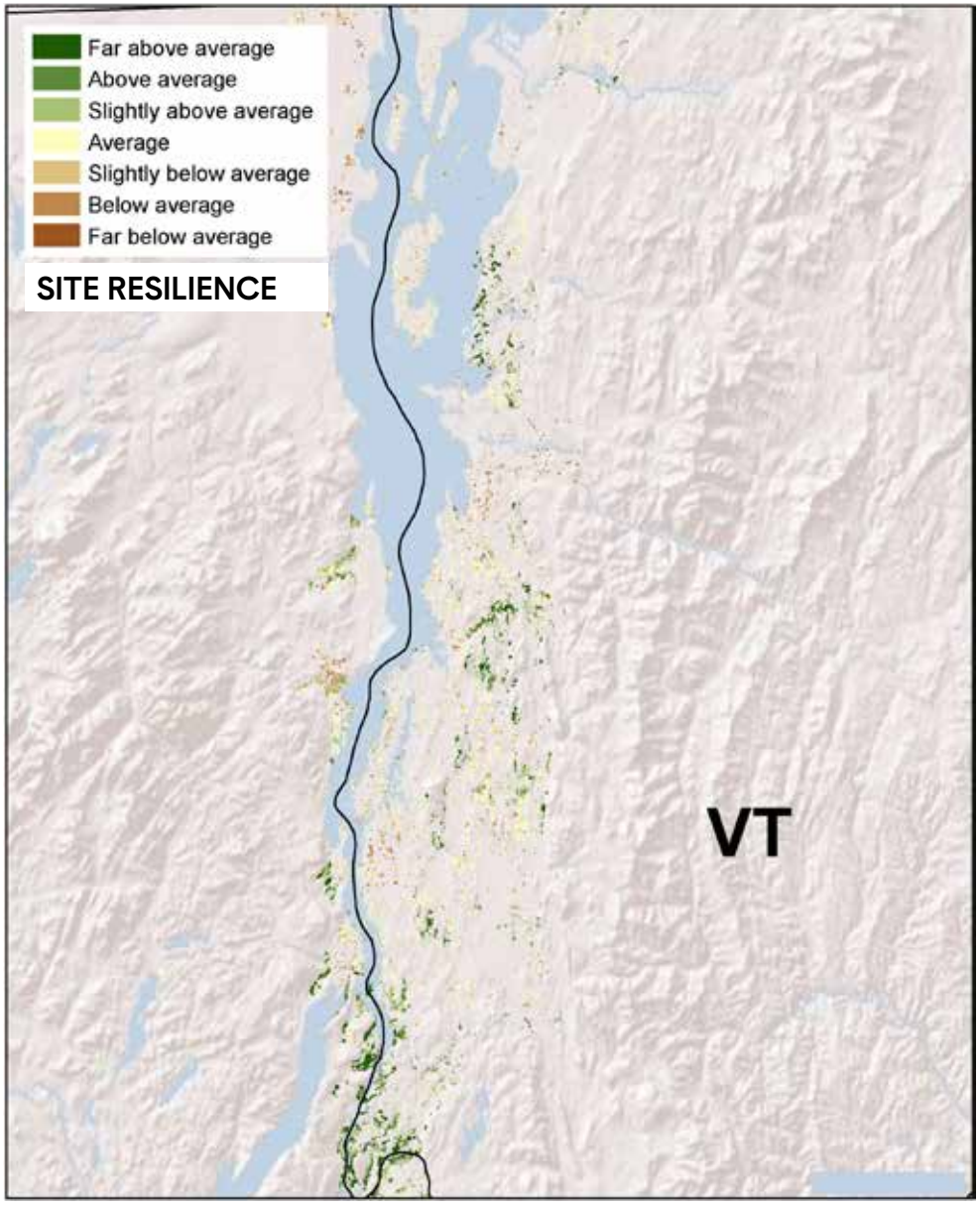
lily-leaved wide-lipped orchid (*Liparis liliifolia*)

trumpet honeysuckle (*Lonicera sempervirens* var. *sempervirens*)

whip nutsedge (*Scleria triglomerata*)

shiny wedgescale (*Sphenopholis nitida*)

# Glacial Marine & Lake Mesic Clayplain Forest




© Eric Sorenson (Vermont Fish & Wildlife)

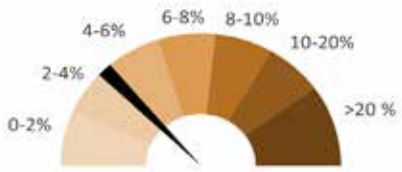
## Description

A hardwood forest of northern clayplains dominated by a shifting balance of oaks (white, red, swamp white, bur), maples (red and sugar), hemlock, white pine, ash, shagbark hickory, and other associates. The understory herb layer is distinctive and rich, and native/non-native shrubs can be dense.

## Associated Herbs & Shrubs

American hazelnut (*Corylus americana*), broad beech fern (*Phegopteris hexagonoptera*), old pasture bluegrass (*Poa saltuensis* ssp. *languida*), leafy bulrush (*Scirpus polyphyllus*), Canada sanicle (*Sanicula canadensis*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 4% | 1,385 | 13% | 1% | 3% | 17% | 83% |
| Above average | 17% | 5,472 | 6% | 0% | 4% | 11% | 89% |
| Slightly above average | 20% | 6,255 | 3% | 1% | 3% | 6% | 94% |
| Average | 42% | 13,610 | 1% | 1% | 4% | 5% | 95% |
| Slightly below average | 9% | 2,928 | 0% | 1% | 4% | 4% | 96% |
| Below average | 4% | 1,261 | 0% | 0% | 3% | 3% | 97% |
| Far below average | 0% | 74 | 0% | 0% | 0% | 0% | 100% |
| Developed | 3% | 1,082 | 0% | 0% | 6% | 6% | 94% |
| TOTAL | 100% | 32,066 | 3% | 1% | 4% | 7% | 93% |



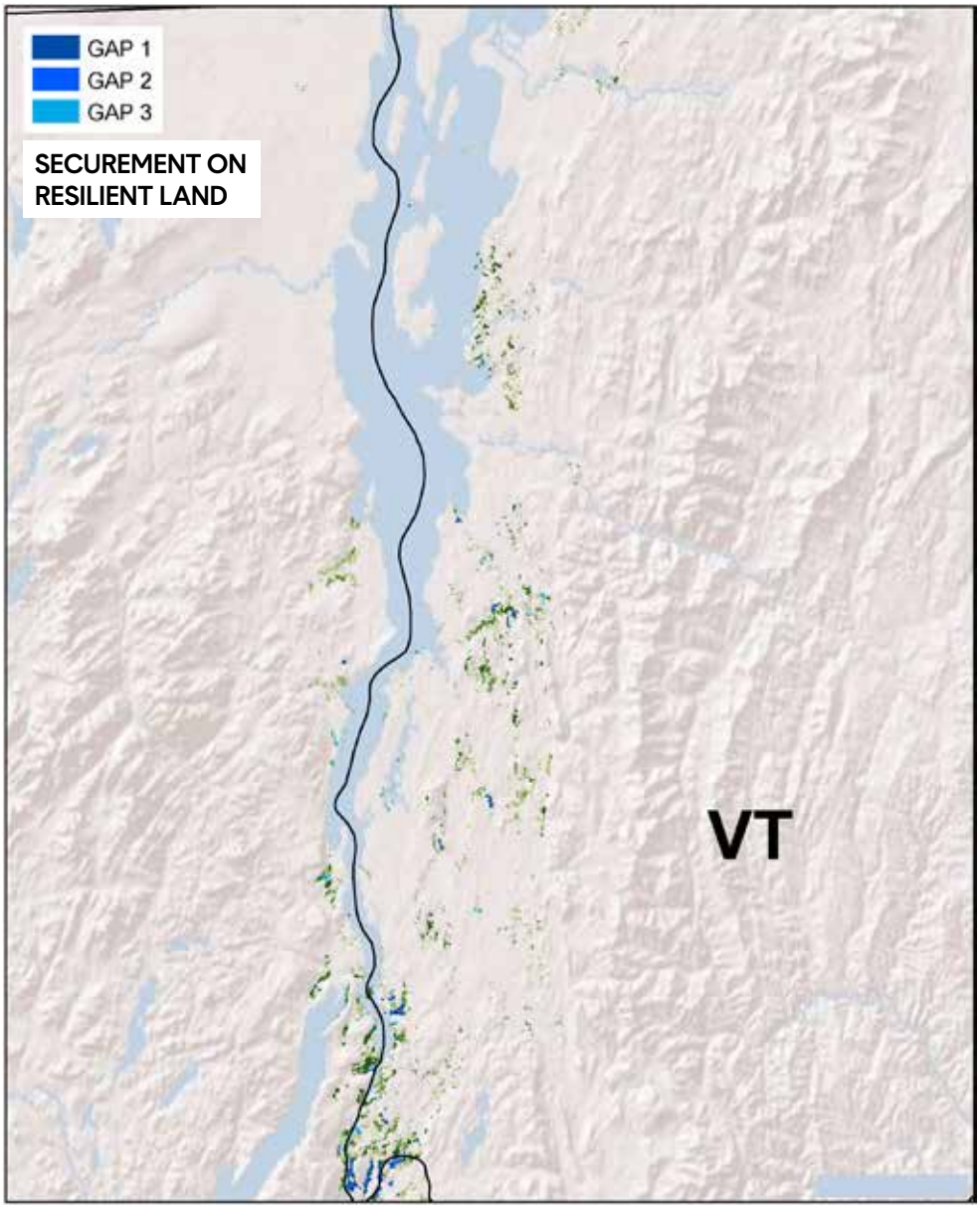

**Predicted Loss to Development by 2050**
Moderately low 4%

This community is somewhat threatened by development, with 1,237 acres (4%) likely to be lost over the next 30 years.

## Resilience & Securement

41% of this habitat scores high for resilience, but only 7% of the total acreage is secured against conversion.

# Glacial Marine & Lake Mesic Clayplain Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 32,066 | 7% |
| CT | | |
| MA | | |
| ME | | |
| NH | | |
| RI | | |
| VT | 32,066 | 7% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 13,112 | 9% |
| CT | | |
| MA | | |
| ME | | |
| NH | | |
| RI | | |
| VT | 13,112 | 9% |

## Rare or Uncommon Plants Associated with this Habitat

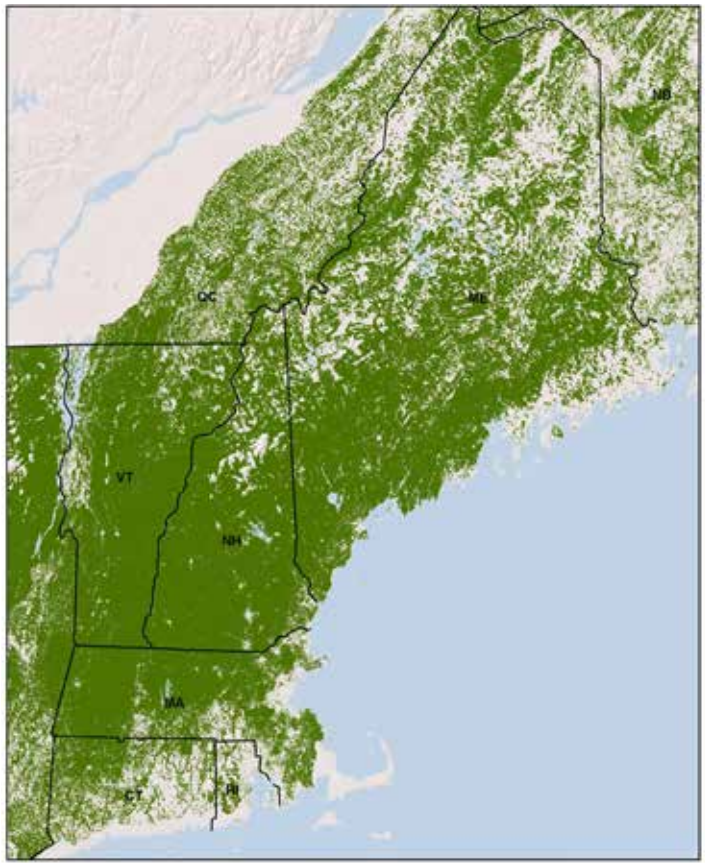
floodplain avens
(*Geum laciniatum*)

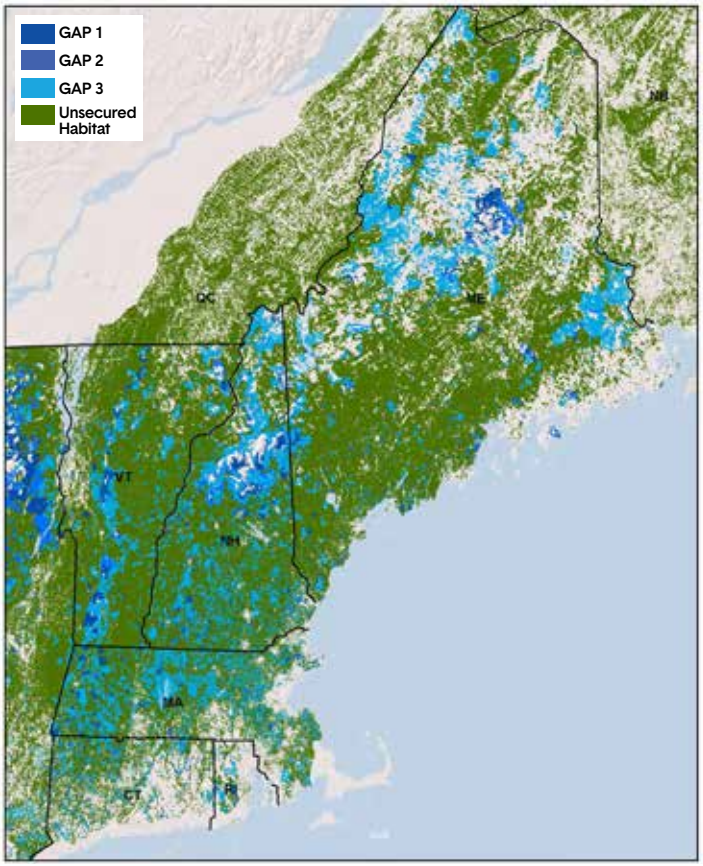
field thistle
(*Cirsium discolor*)

narrow-leaved blue-eyed-grass
(*Sisyrinchium angustifolium*)

MACROGROUP

# NORTHERN HARDWOOD & CONIFER FOREST




**Northern Hardwood & Conifer Forest**

Mixed hardwood-conifer forest of northern New England dominated by maple, beech, and birch, with Eastern hemlock and/or white pine.

**Acres in New England**

19.4 million

**Percent Secured**

GAP 1 = 2%
GAP 2 = 2%
GAP 3 = 18%

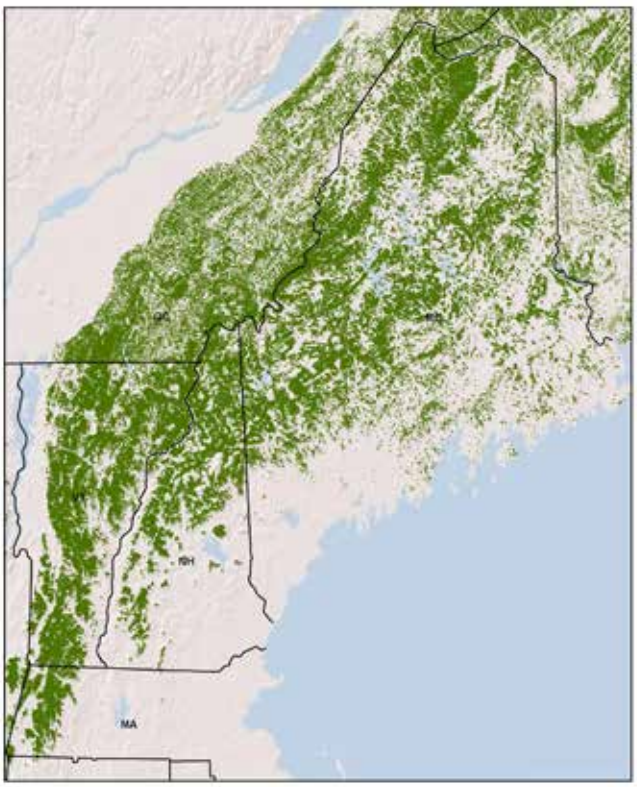

**Predicted Loss to Development by 2050**

480,309 acres (2%)

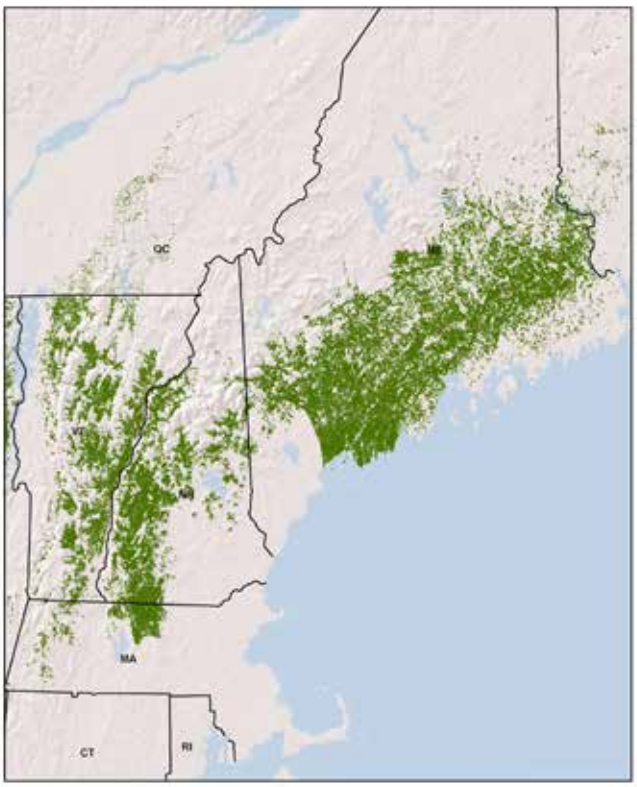
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Northern Hardwood & Conifer Forest** | **19,364,435** | **2%** | **2%** | **18%** | **78%** | **126** | **3** | **17** | **106** |
| Connecticut | 627,338 | 1% | 5% | 15% | 79% | 10 | 1 | | 9 |
| Massachusetts | 2,017,572 | 4% | 1% | 27% | 68% | 42 | | 8 | 34 |
| Maine | 8,795,168 | 2% | 2% | 15% | 82% | 28 | 1 | 3 | 24 |
| New Hampshire | 3,960,144 | 3% | 4% | 22% | 71% | 9 | | 2 | 7 |
| Rhode Island | 61,931 | 2% | 4% | 32% | 63% | | | | |
| Vermont | 3,902,283 | 3% | 1% | 15% | 81% | 37 | 1 | 4 | 32 |
| **New England** | **19,364,435** | **467,619** | **418,688** | **3,408,800** | **15,069,328** | | | | |

P = Protected S = Secured
U = Unsecured

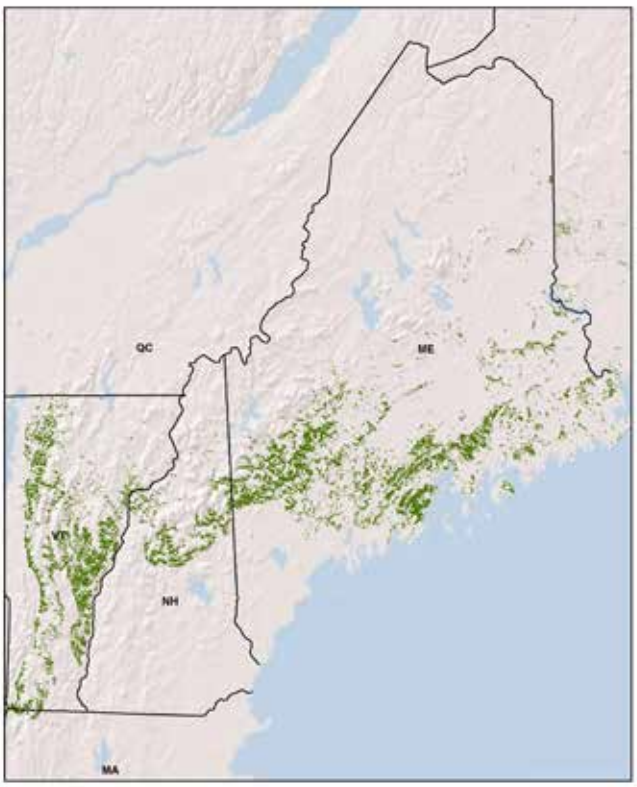
# DISTRIBUTION OF HABITATS




NORTHERN | **Laurentian-Acadian Northern Hardwood Forest**

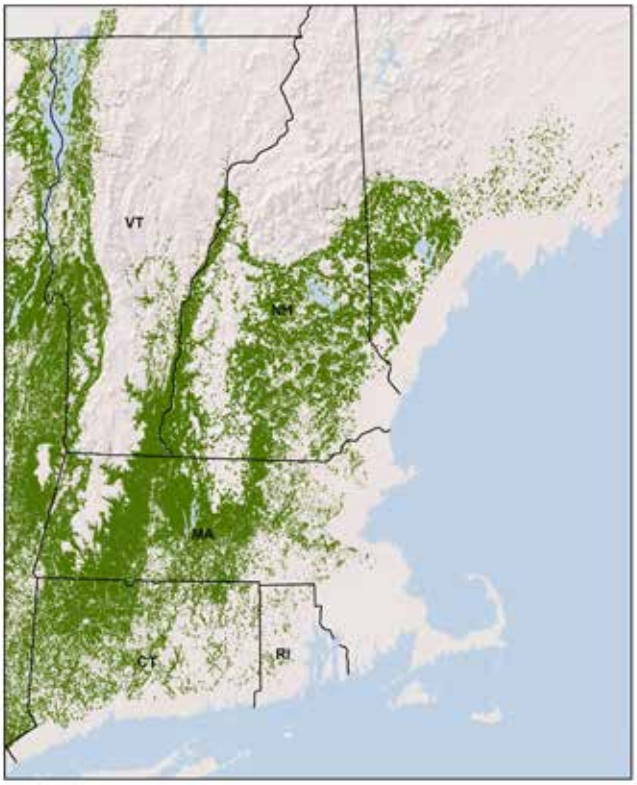



NORTHERN | **Laurentian-Acadian Pine-Hemlock-Hardwood Forest**

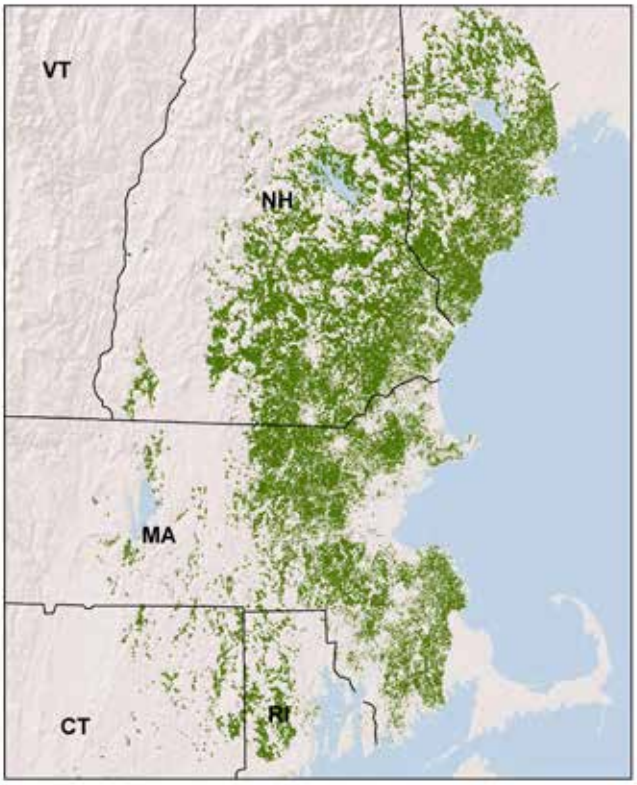



NORTHERN | **Laurentian-Acadian Red Oak-Northern Hardwood Forest**

# DISTRIBUTION OF HABITATS

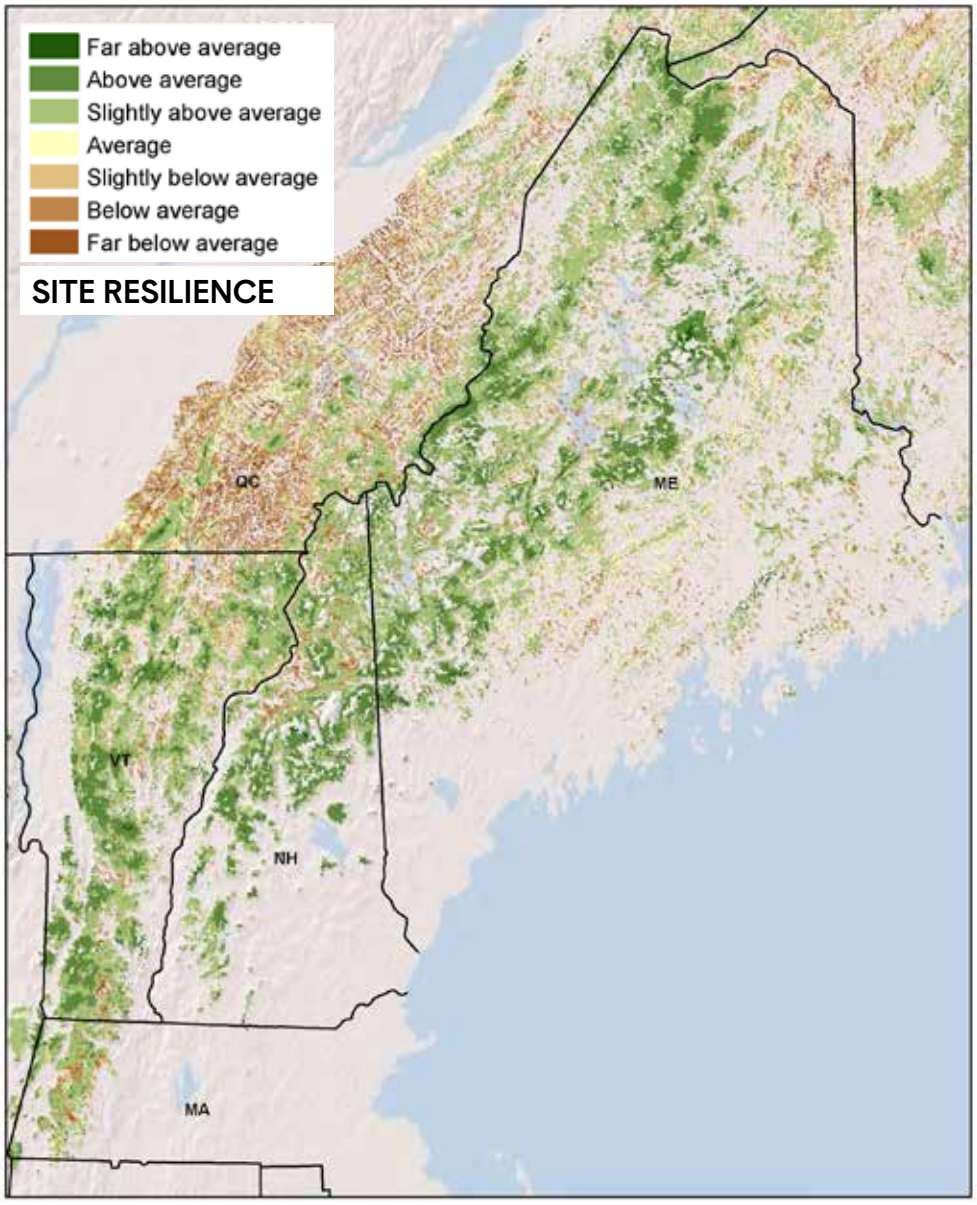



SOUTHERN | **Appalachian (Hemlock)-Northern Hardwood Forest**




SOUTHERN | **Northeastern Coastal & Interior Pine-Oak Forest**

# Laurentian-Acadian Northern Hardwood Forest




© Elizabeth Thompson (Vermont Land Trust)

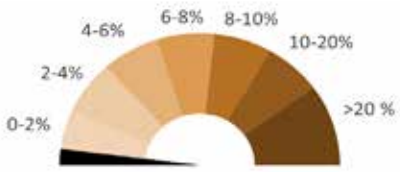
## Description

A hardwood forest dominated by sugar maple, American beech, and yellow birch. White ash, hemlock, and red spruce are frequent but minor canopy associates. Paper birch, red maple, and aspen are common.

## Associated Herbs & Shrubs

bristly swamp currant (*Ribes lacustre*), broad beech fern (*Phegopteris hexagonoptera*), mountain wood fern (*Dryopteris campyloptera*), pale jewelweed (*Impatiens pallida*), squirrel-corn (*Dicentra canadensis*), swamp red currant (*Ribes triste*), American twinflower (*Linnaea borealis* ssp. *americana*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 121,505 | 13% | 6% | 24% | 43% | 57% |
| Above average | 28% | 2,325,747 | 9% | 6% | 29% | 44% | 56% |
| Slightly above average | 50% | 4,102,761 | 2% | 2% | 24% | 28% | 72% |
| Average | 8% | 621,970 | 0% | 0% | 11% | 12% | 88% |
| Slightly below average | 6% | 509,620 | 0% | 1% | 15% | 16% | 84% |
| Below average | 5% | 388,551 | 1% | 2% | 17% | 19% | 81% |
| Far below average | 0% | 36,950 | 1% | 2% | 15% | 18% | 82% |
| Developed | 2% | 172,987 | 1% | 1% | 18% | 21% | 79% |
| TOTAL | 100% | 8,280,091 | 4% | 3% | 23% | 30% | 70% |




**Predicted Loss to Development by 2050**

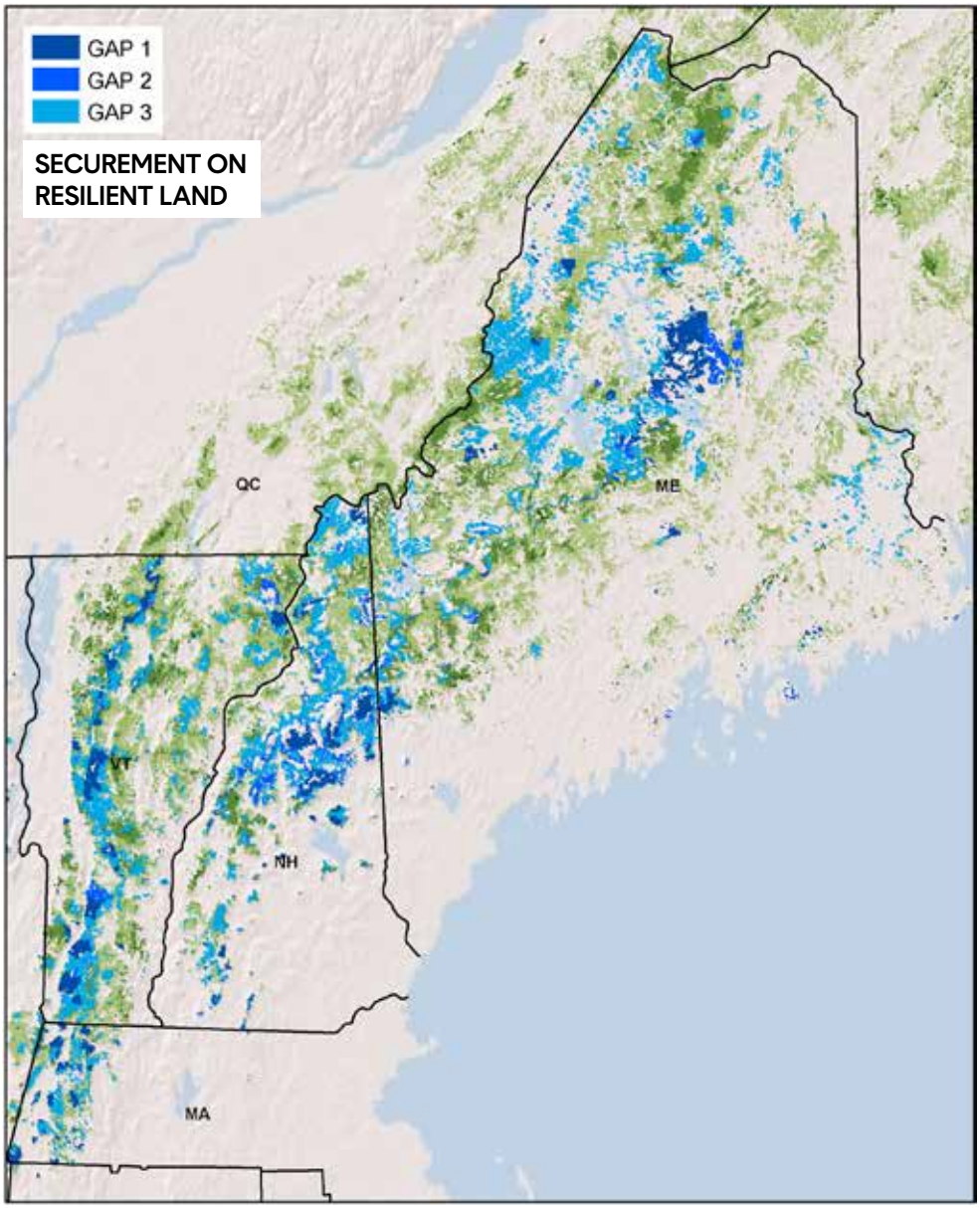
Very low 1%

This community is little threatened by development, with 42,894 acres (<1%) likely to be lost over the next 30 years.

## Resilience & Securement

79% of this habitat scores high for resilience, 30% of the total acreage is secured against conversion, and 7% is protected.

# Laurentian-Acadian Northern Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 8,280,091 | 30% |
| CT | 4,922 | 22% |
| MA | 304,911 | 46% |
| ME | 4,660,932 | 25% |
| NH | 1,148,942 | 53% |
| RI | | |
| VT | 2,160,384 | 28% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 6,550,013 | 34% |
| CT | 4,376 | 24% |
| MA | 210,563 | 53% |
| ME | 3,562,565 | 27% |
| NH | 989,577 | 58% |
| RI | | |
| VT | 1,782,933 | 32% |

## Rare or Uncommon Plants Associated with this Habitat

American ginseng (*Panax quinquefolius*)

three-birds orchid (*Triphora trianthophora* ssp. *trianthophora*)

hairy wood-mint (*Blephilia hirsuta* var. *hirsuta*)

zigzag hawthorn (*Crataegus irrasa* var. *blanchardii*)

grove hawthorn (*Crataegus lucorum*)

Oakes' hawthorn (*Crataegus oakesiana*)

poplar hawthorn (*Crataegus populnea*)

wild hound's-tongue (*Cynoglossum virginianum* ssp. *boreale*)

male wood fern (*Dryopteris filix-mas* ssp. *brittonii*)

early wild rye (*Elymus macgregorii*)

giant rattlesnake-plantain (*Goodyera oblongifolia*)

narrow-leaved hawkweed (*Hieracium umbellatum*)

green-violet (*Hybanthus concolor*)

goldenseal (*Hydrastis canadensis*)

Vasey's rush (*Juncus vaseyi*)

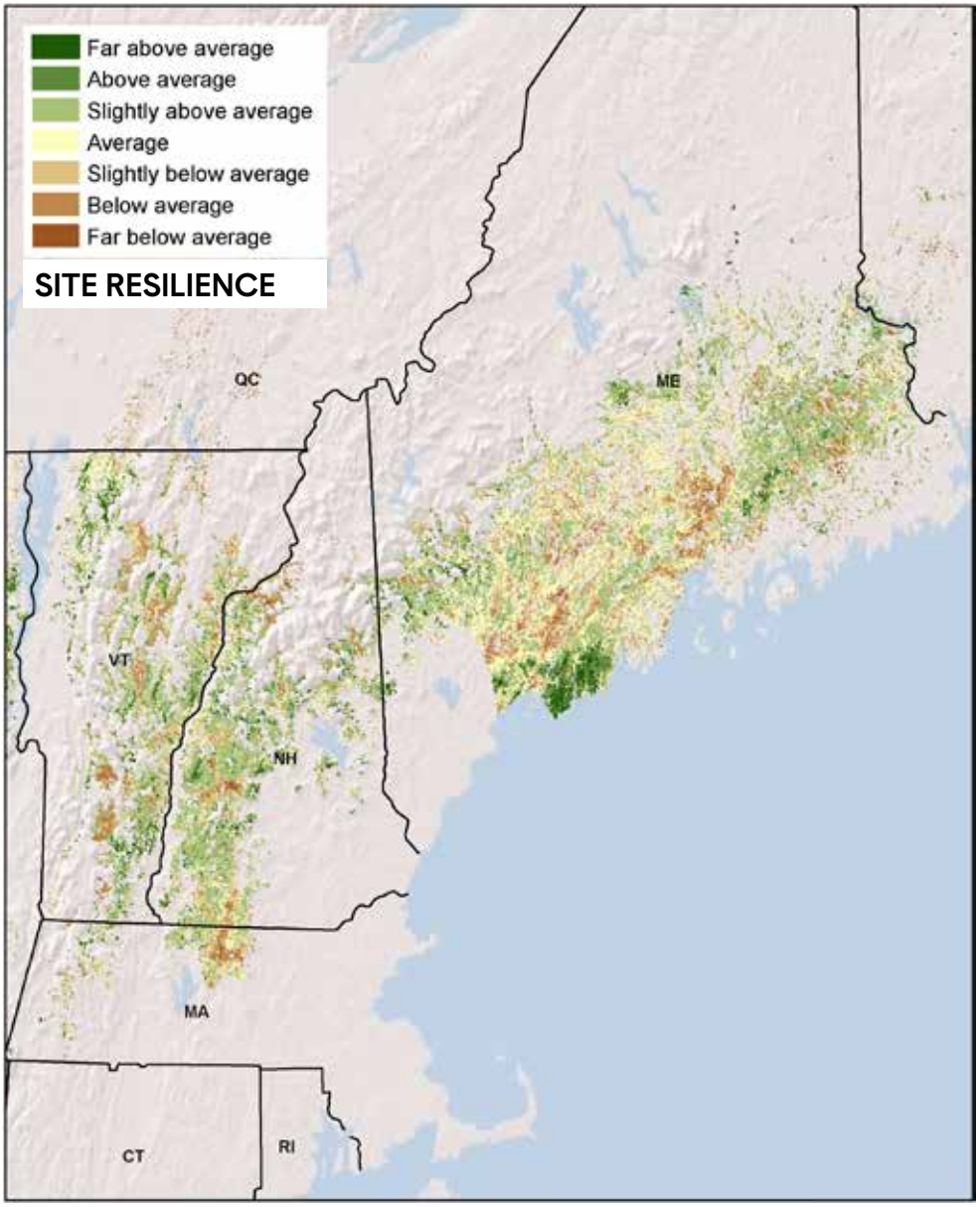
lily-leaved wide-lipped orchid (*Liparis liliifolia*)

old-pasture blue grass (*Poa saltuensis* ssp. *languida*)

white-flowered leaf-cup (*Polymnia canadensis*)

green rockcress (*Boechera missouriensis*)

# Laurentian-Acadian Pine-Hemlock-Hardwood Forest




© Josh Royte (The Nature Conservancy, Maine)

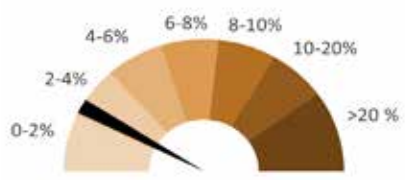
## Description

A coniferous or mixed forest of foothills and lowlands. White pine, hemlock, and red oak are typical canopy dominants. Red maple, sugar maple, beech, and birch also occur. Red spruce and balsam fir are infrequent.

## Associated Herbs & Shrubs

Appalachian barren-strawberry (*Geum fragarioides*), pine-drops (*Pterospora andromedea*), green adder's-mouth (*Malaxis unifolia*), Loesel's wide-lipped orchid (*Liparis loeselii*), hook-spurred violet (*Viola adunca*), short-awned mountain-rice grass (*Piptatherum pungens*), spotted wintergreen (*Chimaphila maculata*), Graham's rockcress (*Boechera grahamii*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 60,050 | 3% | 3% | 13% | 20% | 80% |
| Above average | 9% | 413,972 | 2% | 3% | 16% | 21% | 79% |
| Slightly above average | 39% | 1,720,390 | 1% | 1% | 15% | 18% | 82% |
| Average | 23% | 1,038,767 | 0% | 1% | 8% | 9% | 91% |
| Slightly below average | 14% | 628,410 | 0% | 1% | 8% | 9% | 91% |
| Below average | 9% | 390,676 | 0% | 1% | 6% | 7% | 93% |
| Far below average | 1% | 30,814 | 0% | 0% | 3% | 4% | 96% |
| Developed | 4% | 177,154 | 0% | 1% | 9% | 10% | 90% |
| TOTAL | 100% | 4,460,233 | 1% | 1% | 11% | 13% | 87% |



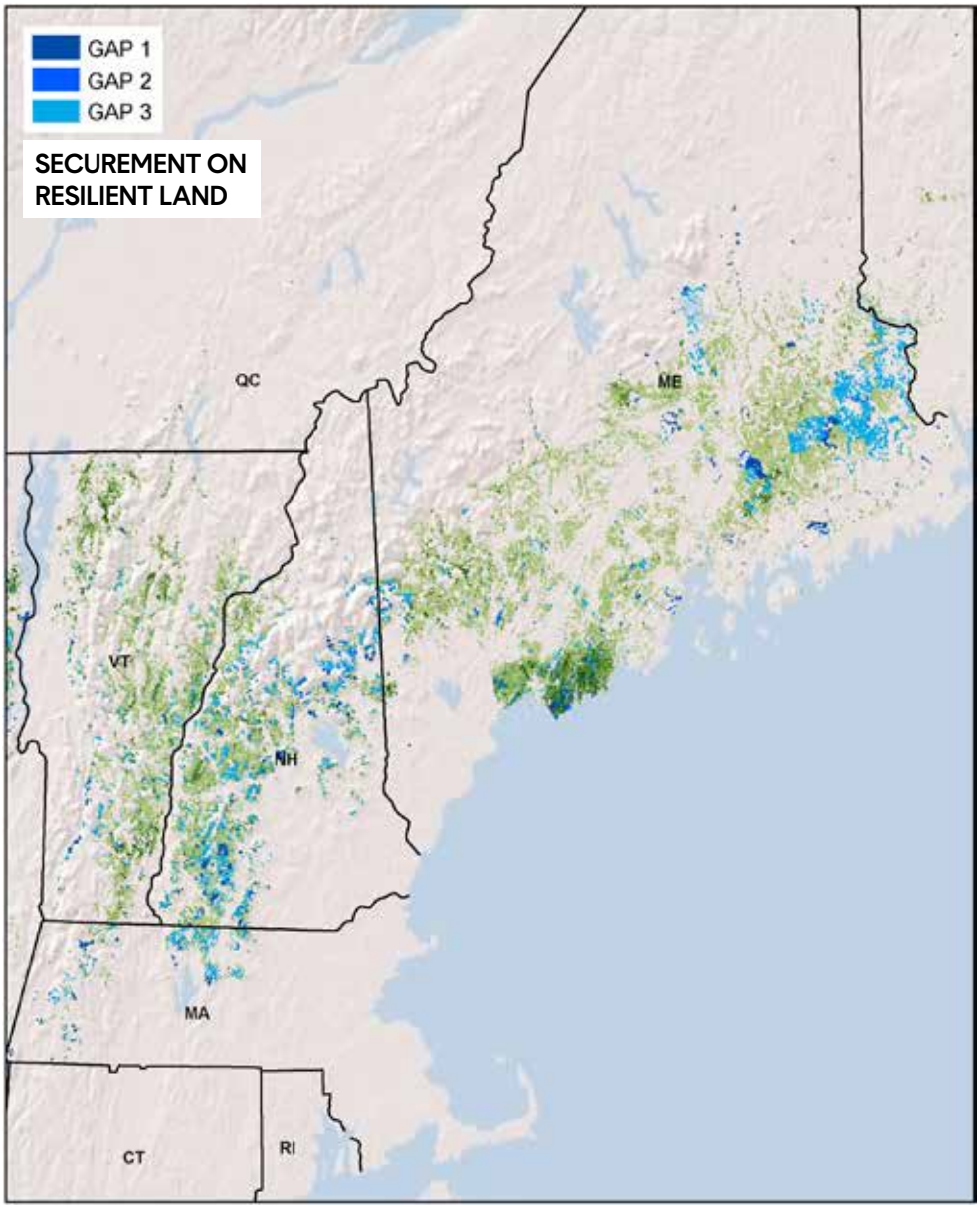

**Predicted Loss to Development by 2050**
Low 2%

This community is little threatened by development, with 94,112 acres (2%) likely to be lost over the next 30 years.

## Resilience & Securement

49% of this habitat scores high for resilience, but only 13% of the total acreage is secured against conversion, and 2% is protected.

# Laurentian-Acadian Pine-Hemlock-Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 4,460,233 | 14% |
| CT | 4 | 0% |
| MA | 158,090 | 36% |
| ME | 2,683,041 | 12% |
| NH | 845,774 | 22% |
| RI | | |
| VT | 773,325 | 6% |

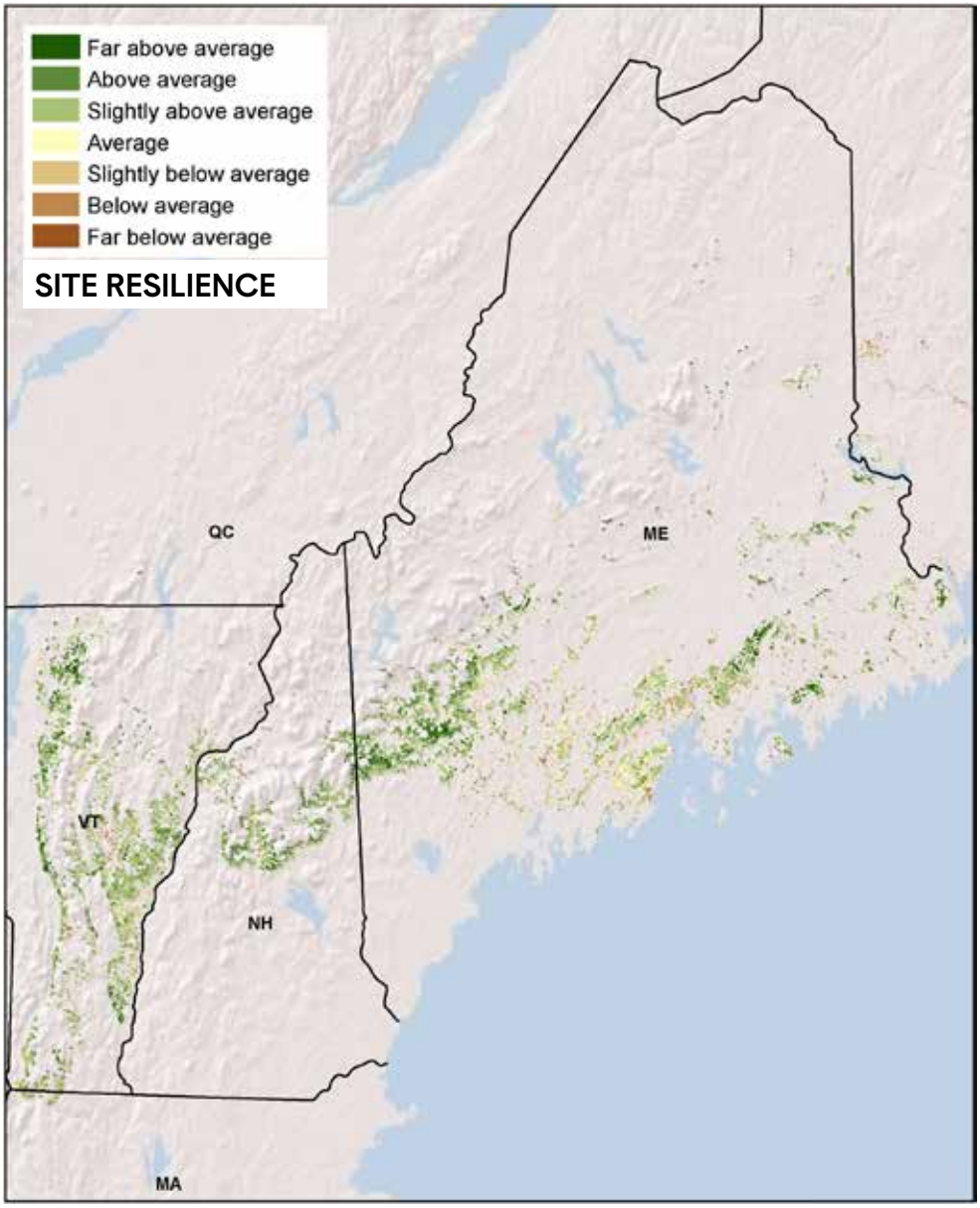
| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 2,194,412 | 18% |
| CT | 2 | 0% |
| MA | 52,481 | 47% |
| ME | 1,215,410 | 17% |
| NH | 520,186 | 27% |
| RI | | |
| VT | 406,333 | 8% |

## Rare or Uncommon Plants Associated with this Habitat

swarthy sedge
(*Carex adusta*)

pine-drops
(*Pterospora andromedea*)

# Laurentian-Acadian Red Oak-Northern Hardwood Forest




© Eric Sorenson (Vermont Fish & Wildlife)

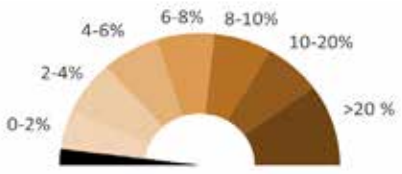
## Description

A closed canopy forest where a significant component of red oak is present along with the suite of northern hardwoods, primarily sugar maple, beech, and yellow birch. Red maple, hemlock, and white pine are common associates.

## Associated Herbs & Shrubs

American squaw-root (*Conopholis americana*), broad beech fern (*Phegopteris hexagonoptera*), flowering big-bracted dogwood (*Benthamidia florida*), perfoliate bellwort (*Uvularia perfoliata*), slender loose-flowered sedge (*Carex gracilescens*), leathery grapefern (*Botrychium multifidum*), sharp-fruited rush (*Juncus acuminatus*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 24,337 | 3% | 6% | 16% | 25% | 75% |
| Above average | 24% | 253,653 | 3% | 6% | 21% | 31% | 69% |
| Slightly above average | 50% | 531,348 | 1% | 3% | 13% | 17% | 83% |
| Average | 12% | 129,123 | 0% | 1% | 4% | 5% | 95% |
| Slightly below average | 6% | 69,476 | 1% | 1% | 3% | 5% | 95% |
| Below average | 3% | 34,030 | 1% | 1% | 5% | 7% | 93% |
| Far below average | 0% | 2,691 | 4% | 0% | 6% | 10% | 90% |
| Developed | 3% | 27,202 | 0% | 1% | 8% | 9% | 91% |
| TOTAL | 100% | 1,071,860 | 2% | 3% | 13% | 18% | 82% |




**Predicted Loss to Development by 2050**

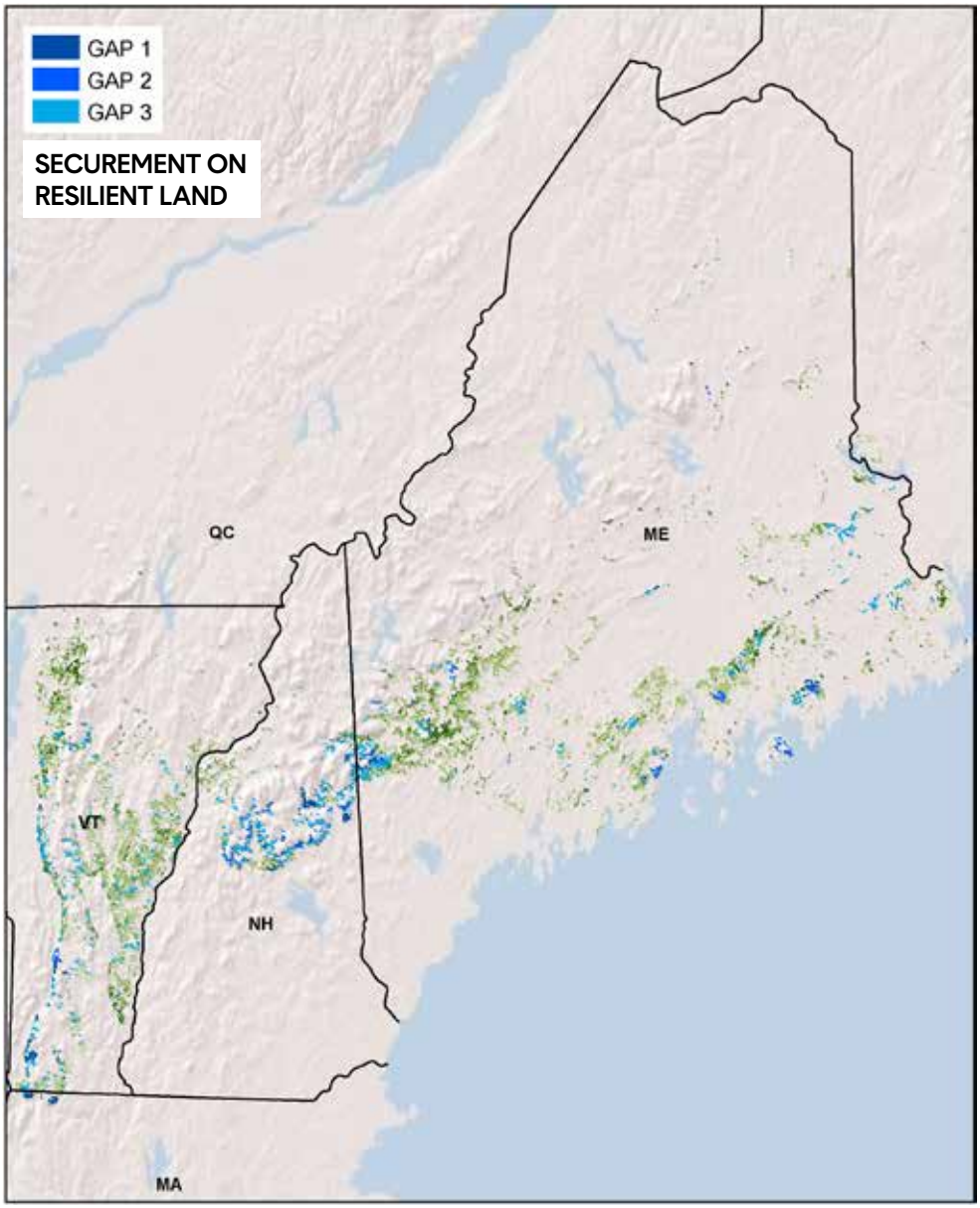
Very low 1%

This community is not threatened by development, with 13,201 acres (1%) likely to be lost over the next 30 years.

## Resilience & Securement

76% of this habitat scores high for resilience, and 18% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Laurentian-Acadian Red Oak-Northern Hardwood Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 1,071,860 | 18% |
| CT | | |
| MA | 6,566 | 46% |
| ME | 601,479 | 12% |
| NH | 114,383 | 54% |
| RI | | |
| VT | 349,432 | 15% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 809,338 | 22% |
| CT | | |
| MA | 4,911 | 48% |
| ME | 417,248 | 15% |
| NH | 102,967 | 58% |
| RI | | |
| VT | 284,213 | 17% |

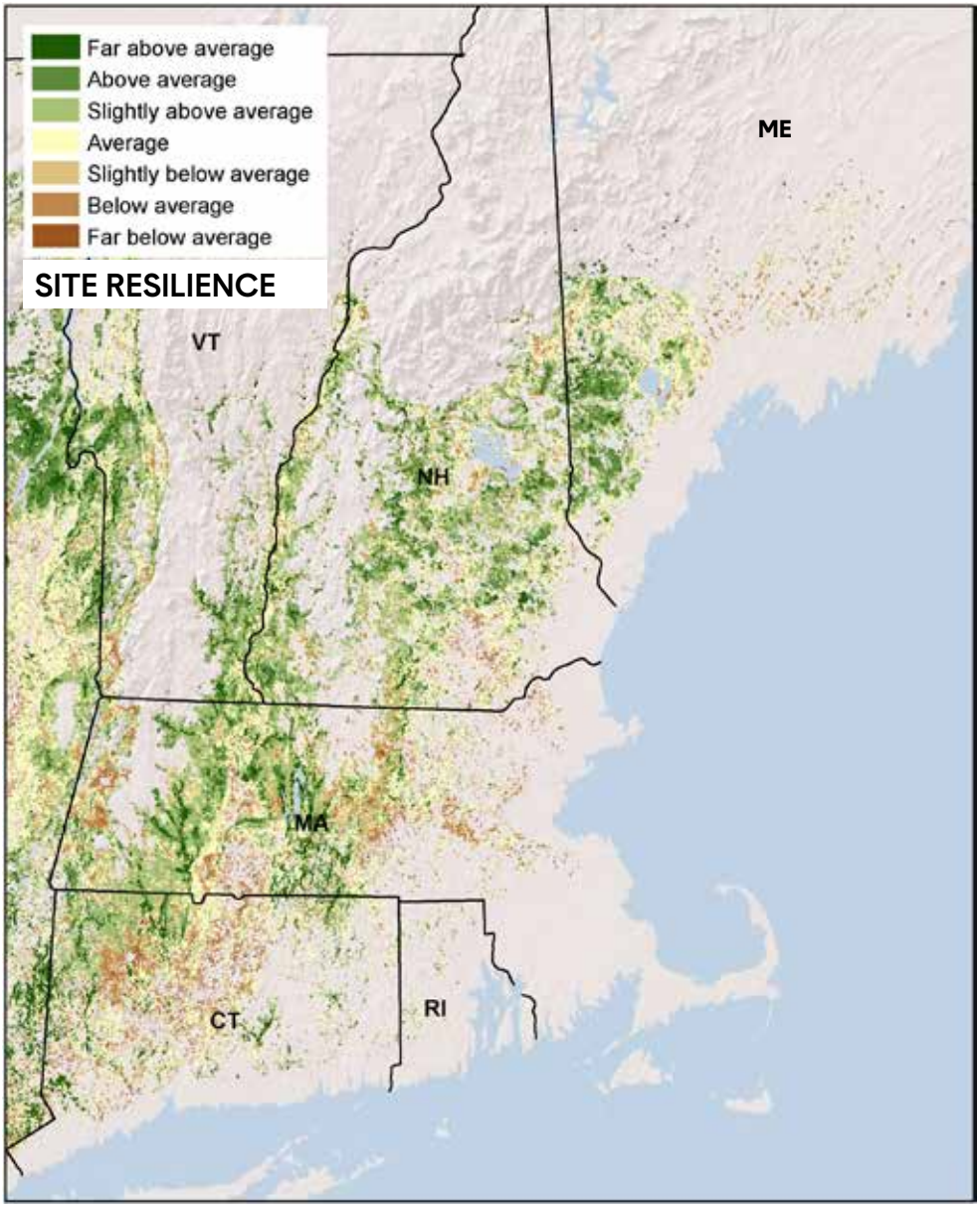
## Rare or Uncommon Plants Associated with this Habitat

American ginseng
(*Panax quinquefolius*)

large whorled pogonia
(*Isotria verticillata*)

summer sedge
(*Carex aestivalis*)

# Appalachian (Hemlock)-Northern Hardwood Forest




© Maine Natural Areas Program

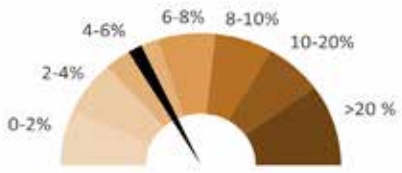
## Description

A hardwood forest of sugar maple, American beech, and yellow birch, sometimes mixed with, and sometimes dominated by, eastern hemlock. Northern red oak and white oak occur commonly, but do not dominate. Black cherry, black birch, white pine, and tuliptree are typical on nutrient rich sites.

## Associated Herbs & Shrubs

broad beech fern (*Phegopteris hexagonoptera*), four-leaved milkweed (*Asclepias quadrifolia*), perfoliate bellwort (*Uvularia perfoliata*), round-leaved trailing tick-trefoil (*Desmodium rotundifolium*), northern spicebush (*Lindera benzoin*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 4% | 154,153 | 3% | 2% | 25% | 31% | 69% |
| Above average | 18% | 736,753 | 2% | 2% | 19% | 23% | 77% |
| Slightly above average | 33% | 1,339,229 | 2% | 2% | 17% | 21% | 79% |
| Average | 25% | 1,016,503 | 1% | 1% | 12% | 15% | 85% |
| Slightly below average | 9% | 349,797 | 1% | 1% | 13% | 15% | 85% |
| Below average | 5% | 188,029 | 1% | 1% | 10% | 11% | 89% |
| Far below average | 0% | 19,345 | 0% | 0% | 6% | 7% | 93% |
| Developed | 5% | 212,785 | 1% | 1% | 8% | 10% | 90% |
| TOTAL | 100% | 4,016,594 | 1% | 2% | 15% | 18% | 82% |



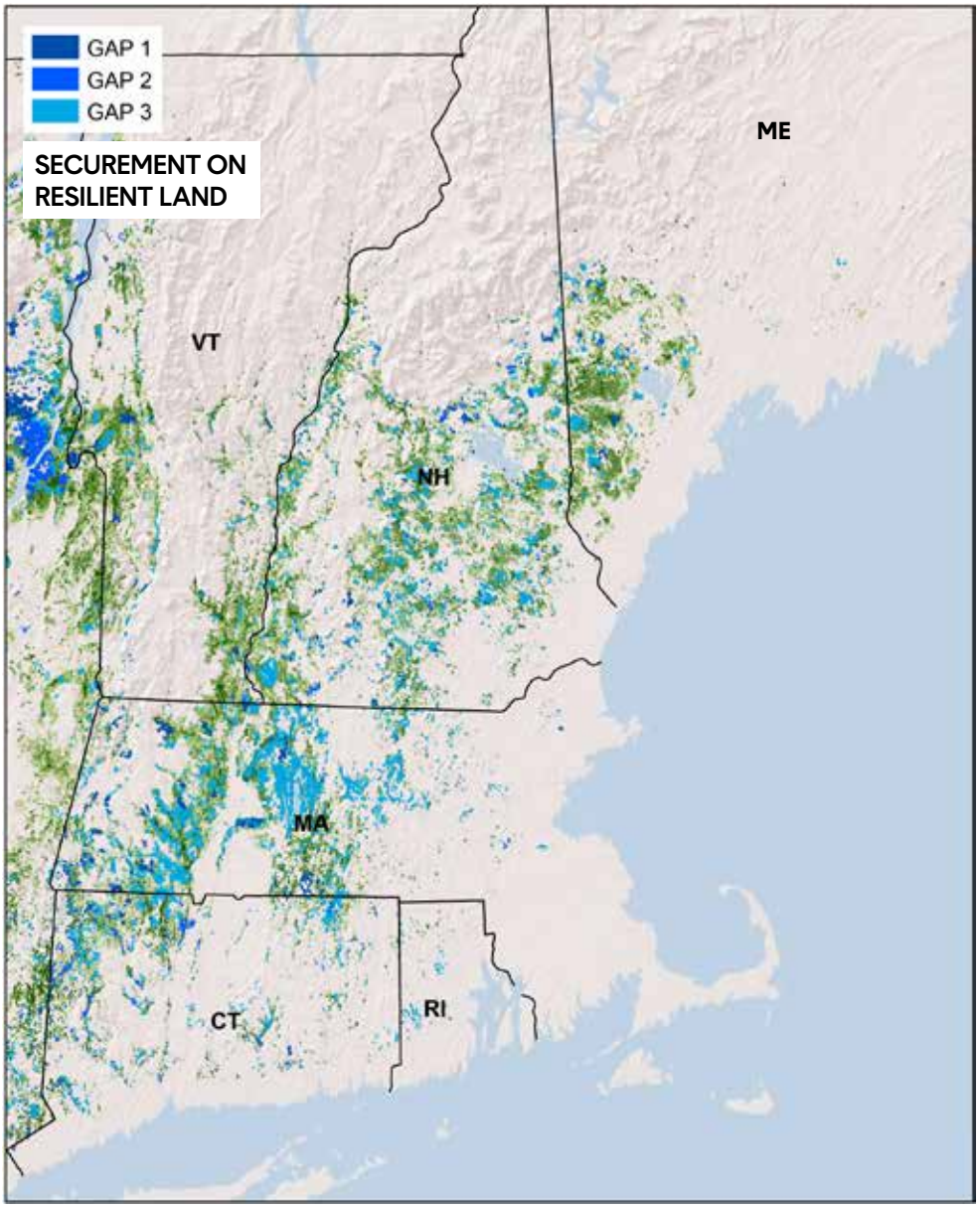

**Predicted Loss to Development by 2050**
Moderately low 5%

This community is threatened by development, with 195,274 acres (5%) likely to be lost over the next 30 years.

## Resilience & Securement

55% of this habitat scores high for resilience, and 18% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Appalachian (Hemlock)-Northern Hardwood Forest




| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 4,016,594 | 18% |
| CT | 584,064 | 20% |
| MA | 1,145,701 | 30% |
| ME | 458,126 | 8% |
| NH | 1,197,641 | 16% |
| RI | 11,920 | 42% |
| VT | 619,141 | 8% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 2,230,135 | 22% |
| CT | 224,222 | 29% |
| MA | 588,283 | 38% |
| ME | 265,563 | 10% |
| NH | 751,166 | 19% |
| RI | 4,271 | 57% |
| VT | 396,630 | 10% |

## Rare or Uncommon Plants Associated with this Habitat

ram's-head lady's-slippers (*Cypripedium arietinum*)

small whorled pogonia (*Isotria medeoloides*)

southern lady fern (*Athyrium asplenioides*)

downywood mint (*Blephilia ciliata*)

Reznicek's sedge (*Carex reznicekii*)

devil's bit (*Chamaelirium luteum*)

Appalachian white-aster (*Doellingeria infirma*)

southeastern wild-rye (*Elymus glabriflorus*)

green-violet (*Hybanthus concolor*)

big-leaved holly (*Ilex montana*)

hairy honeysuckle (*Lonicera hirsuta*)

lion's-foot rattlesnake-root (*Nabalus serpentarius*)

stiff flat-topped-goldenrod (*Oligoneuron rigidum*)

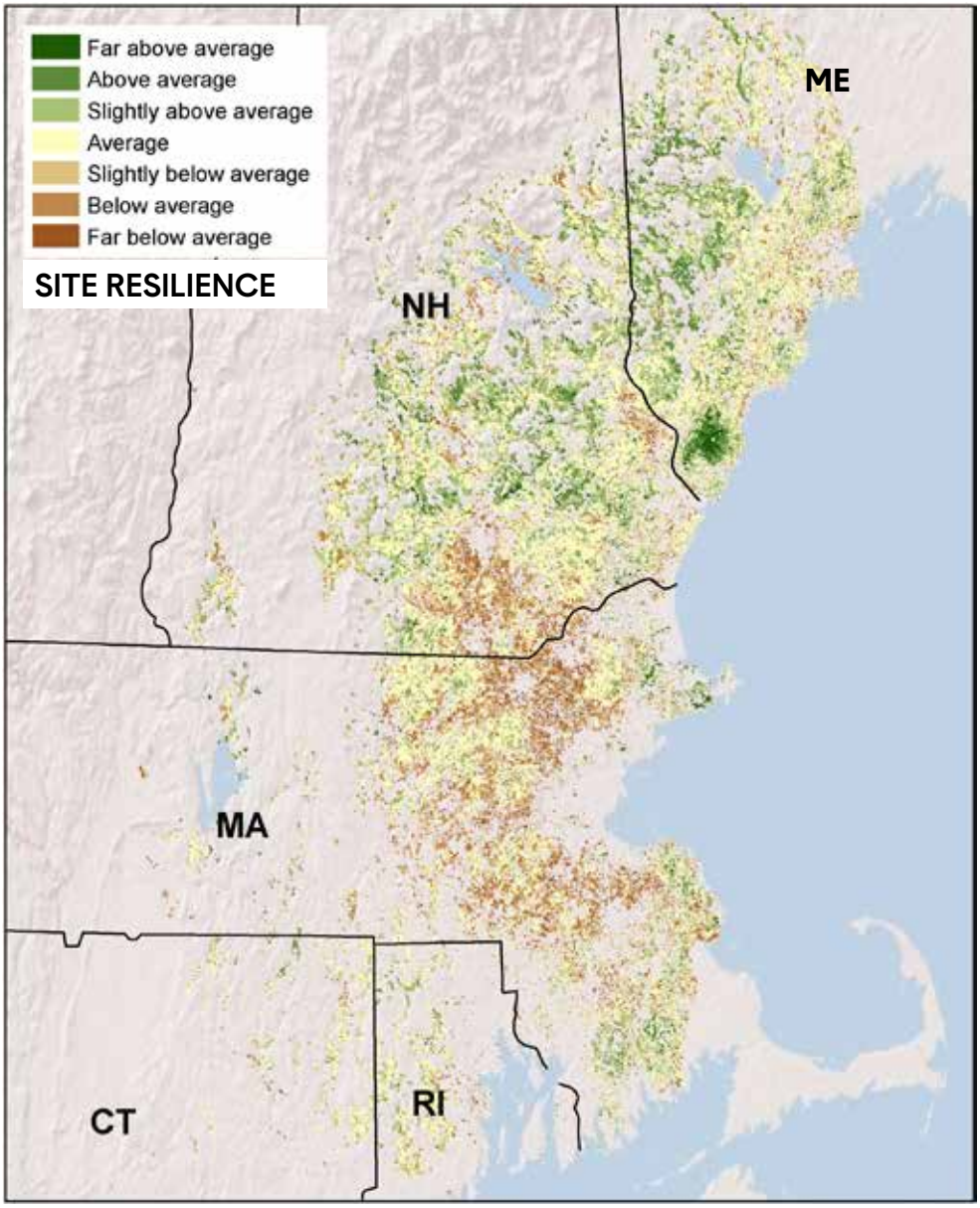
Appalachian gooseberry (*Ribes rotundifolium*)

Case's ladies'-tresses (*Spiranthes casei*)

hidden dropseed (*Sporobolus clandestinus*)

smooth blackhaw (*Viburnum prunifolium*)

# Northeastern Coastal & Interior Pine-Oak Forest




© Patricia Swain (Massachusetts Division of Fisheries & Wildlife/Natural Heritage & Endangered Species Program)

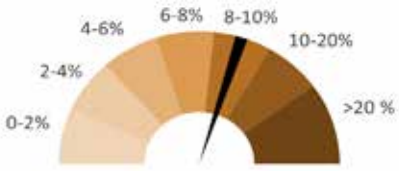
## Description

A mixed forest dominated by white pine, red oak, and hemlock in varying proportions. Red maple and white oak are common associates, as are northern hardwoods like white ash and American beech.

## Associated Herbs & Shrubs

sundial lupine (*Lupinus perennis*), large whorled pogonia (*Isotria verticillata*), northern blazing star (*Liatris novae-angliae*), Philadelphia panicgrass (*Panicum philadelphicum*), sassafras (*Sassafras albidum*), swamp small-flowered-saxifrage (*Micranthes pensylvanica*), hook-spurred violet (*Viola adunca*), northern tuberculed bog-orchid (*Platanthera flava* var. *herbiola*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 6,159 | 2% | 4% | 39% | 44% | 56% |
| Above average | 9% | 138,368 | 2% | 2% | 21% | 25% | 75% |
| Slightly above average | 21% | 320,941 | 1% | 2% | 17% | 19% | 81% |
| Average | 43% | 662,069 | 1% | 2% | 15% | 18% | 82% |
| Slightly below average | 11% | 161,484 | 1% | 1% | 13% | 15% | 85% |
| Below average | 6% | 98,241 | 1% | 1% | 12% | 13% | 87% |
| Far below average | 1% | 12,097 | 0% | 1% | 7% | 8% | 92% |
| Developed | 9% | 136,299 | 0% | 1% | 7% | 8% | 92% |
| TOTAL | 100% | 1,535,658 | 1% | 2% | 15% | 18% | 82% |



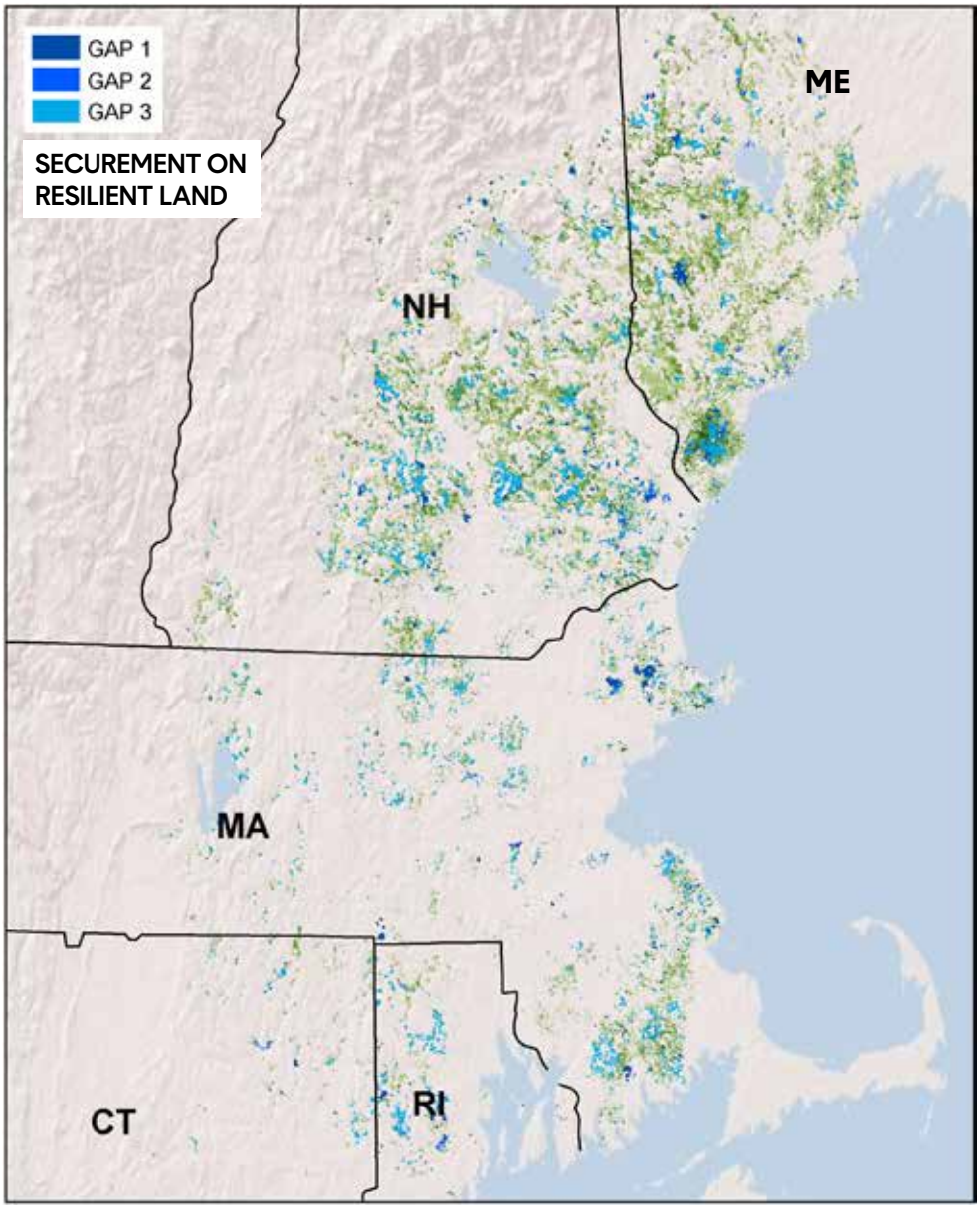

**Predicted Loss to Development by 2050**
Moderate 9%

This community is threatened by development, with 134,828 acres (9%) likely to be lost over the next 30 years.

## Resilience & Securement

30% of this habitat scores high for resilience, and 18% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Northeastern Coastal & Interior Pine-Oak Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 1,535,658 | 17% |
| CT | 38,349 | 23% |
| MA | 402,304 | 24% |
| ME | 391,590 | 9% |
| NH | 653,405 | 16% |
| RI | 50,011 | 36% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 465,468 | 21% |
| CT | 8,888 | 29% |
| MA | 54,656 | 38% |
| ME | 168,507 | 13% |
| NH | 220,752 | 22% |
| RI | 12,664 | 48% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

Torrey's mountain-mint (*Pycnanthemum torrei*)

lesser snakeroot (*Ageratina aromatica*)

Appalachian white-aster (*Doellingeria infirma*)

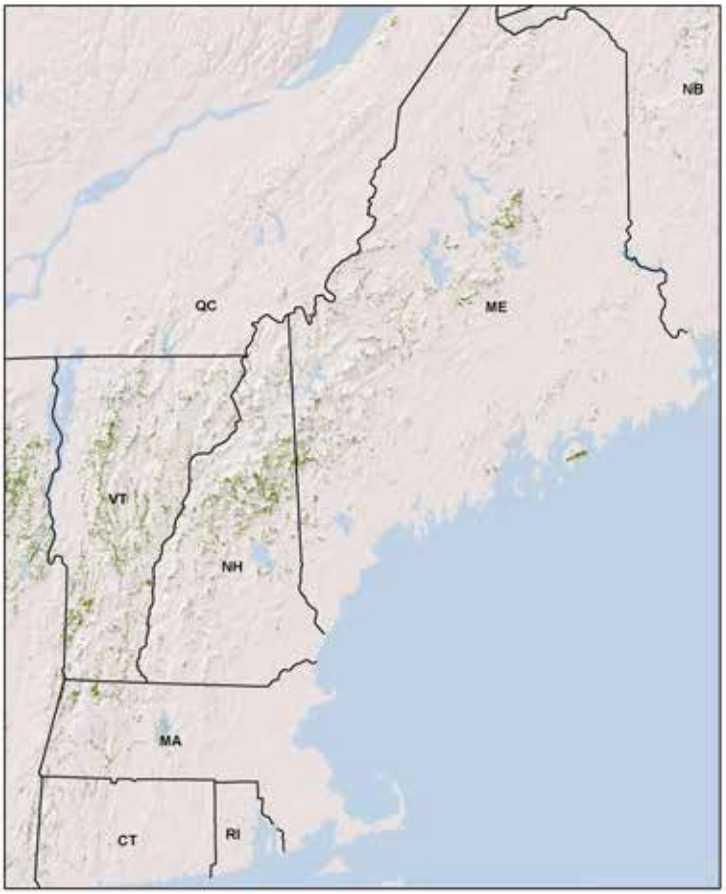
willow-leaved American-aster (*Symphyotrichum praealtum* ssp. *angustior*)

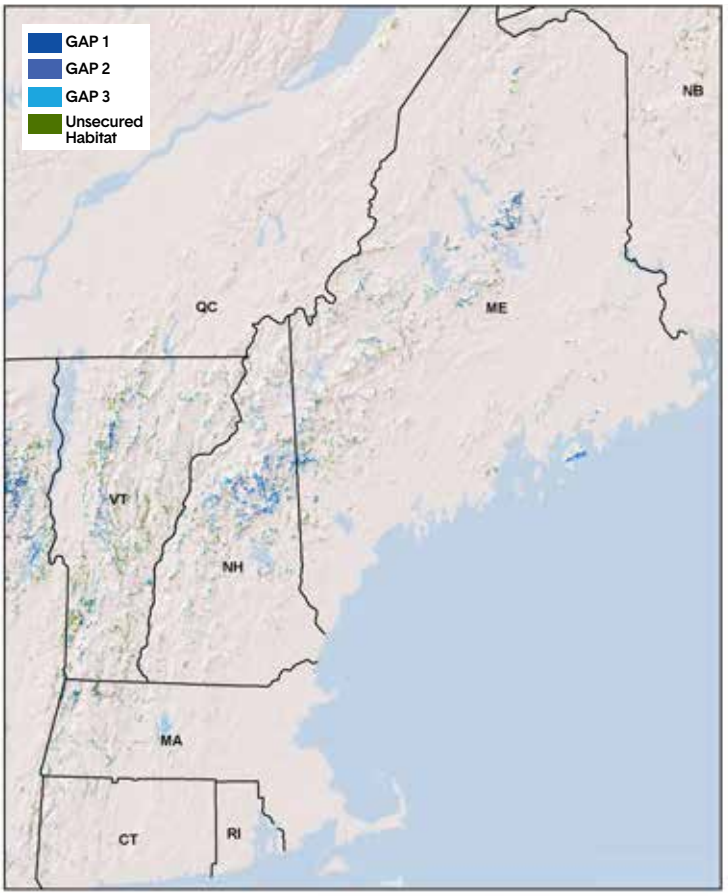
# UPLAND HABĪTATS
## PATCH-FORMĪNG HABĪTATS

©Jenny Wollensak Lussier

MACROGROUP

# CLIFF & TALUS




**Cliff & Talus**

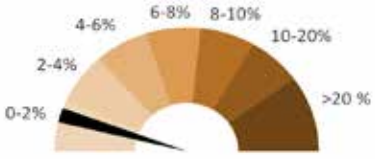
A sparsely vegetated cliff or talus slope formed on bedrock. The lack of soil limits the vegetation to mosses, lichens, and herbs growing on bare rock or in crevices.

**Acres in New England**

156,031

**Percent Secured**

GAP 1 = 16%
GAP 2 = 14%
GAP 3 = 19%




**Predicted Loss to Development by 2050**

3,433 acres (2%)

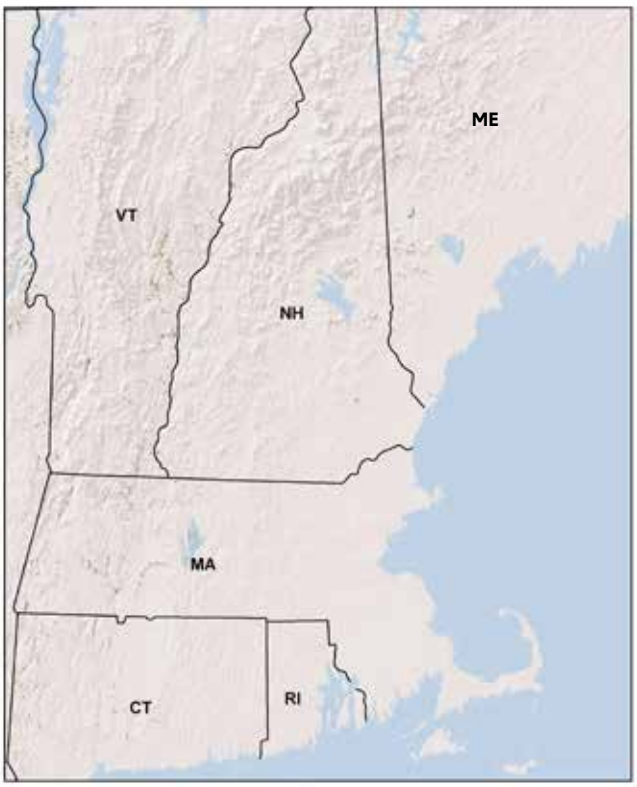
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Cliff & Talus** | **156,190** | **16%** | **14%** | **19%** | **51%** | | | | |
| Connecticut | 3,901 | 2% | 14% | 19% | 66% | | | | |
| Massachusetts | 11,700 | 22% | 1% | 28% | 49% | | | | |
| Maine | 43,935 | 19% | 19% | 15% | 48% | | | | |
| New Hampshire | 39,892 | 16% | 32% | 21% | 32% | | | | |
| Rhode Island | 3 | 0% | 0% | 0% | 100% | | | | |
| Vermont | 56,758 | 13% | 1% | 20% | 66% | | | | |
| **New England** | **156,190** | **24,283** | **22,266** | **30,254** | **79,387** | | | | |

P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS

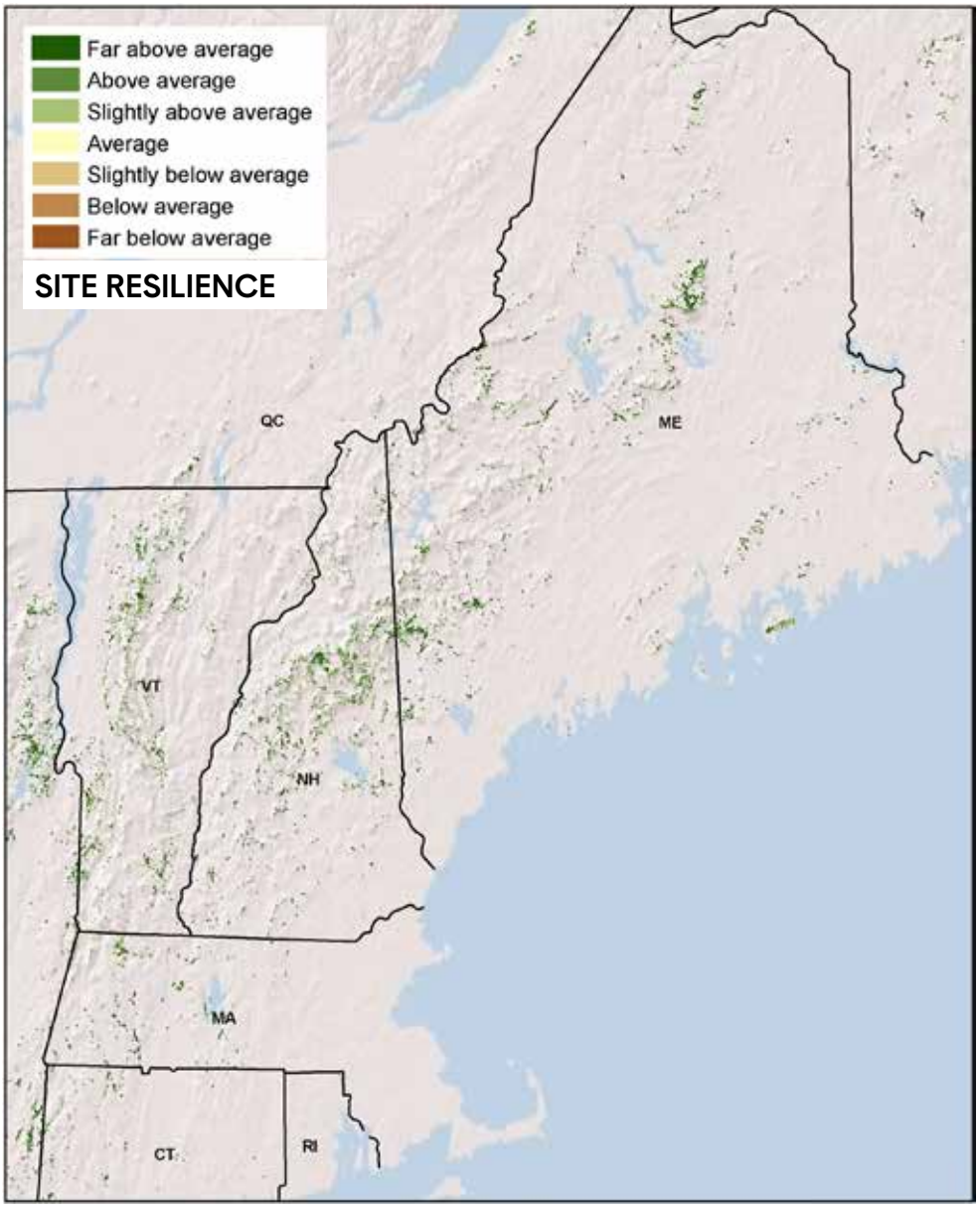

**Acidic Cliff & Talus**


**Calcareous Cliff & Talus**




**Circumneutral Cliff & Talus**

# Acidic Cliff & Talus




© Maine Natural Areas Program

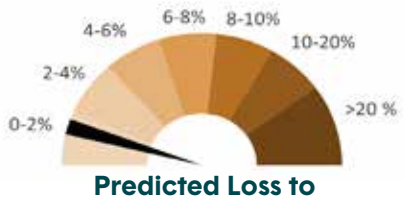
## Description

A sparsely vegetated cliff or talus slope formed on granitic, sandstone, or other acidic bedrock. The lack of soil, highly acidic bedrock, and constant erosion limit the vegetation to mosses, lichens, herbs, and stunted trees growing in rocky crevices.

## Associated Herbs & Shrubs

violet butterwort (*Pinguicula vulgaris*), fragrant wood fern (*Dryopteris fragrans*), Goldie's wood fern (*Dryopteris goldiana*) canescent whitlow-mustard (*Draba cana*), Blake's milk-vetch (*Astragalus robbinsii* var. *minor*), Michaux's sandplant (*Minuartia michauxii*), small-flower bittercress (*Cardamine parviflora*), smooth false foxglove (*Aureolaria flava*), summer grape (*Vitis gestivalis* var. *bicolor*), white mountain saxifrage (*Saxifraga paniculata*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 13% | 14,837 | 22% | 12% | 18% | 52% | 48% |
| Above average | 68% | 76,522 | 21% | 21% | 19% | 61% | 39% |
| Slightly above average | 18% | 20,365 | 7% | 10% | 19% | 37% | 63% |
| Average | 0% | 404 | 5% | 6% | 8% | 19% | 81% |
| Slightly below average | 0% | 169 | 2% | 4% | 11% | 16% | 84% |
| Below average | 0% | 143 | 1% | 9% | 32% | 42% | 58% |
| Far below average | 0% | 6 | 0% | 4% | 23% | 27% | 73% |
| Developed | 1% | 767 | 9% | 11% | 17% | 37% | 63% |
| TOTAL | 100% | 113,213 | 19% | 17% | 19% | 55% | 45% |



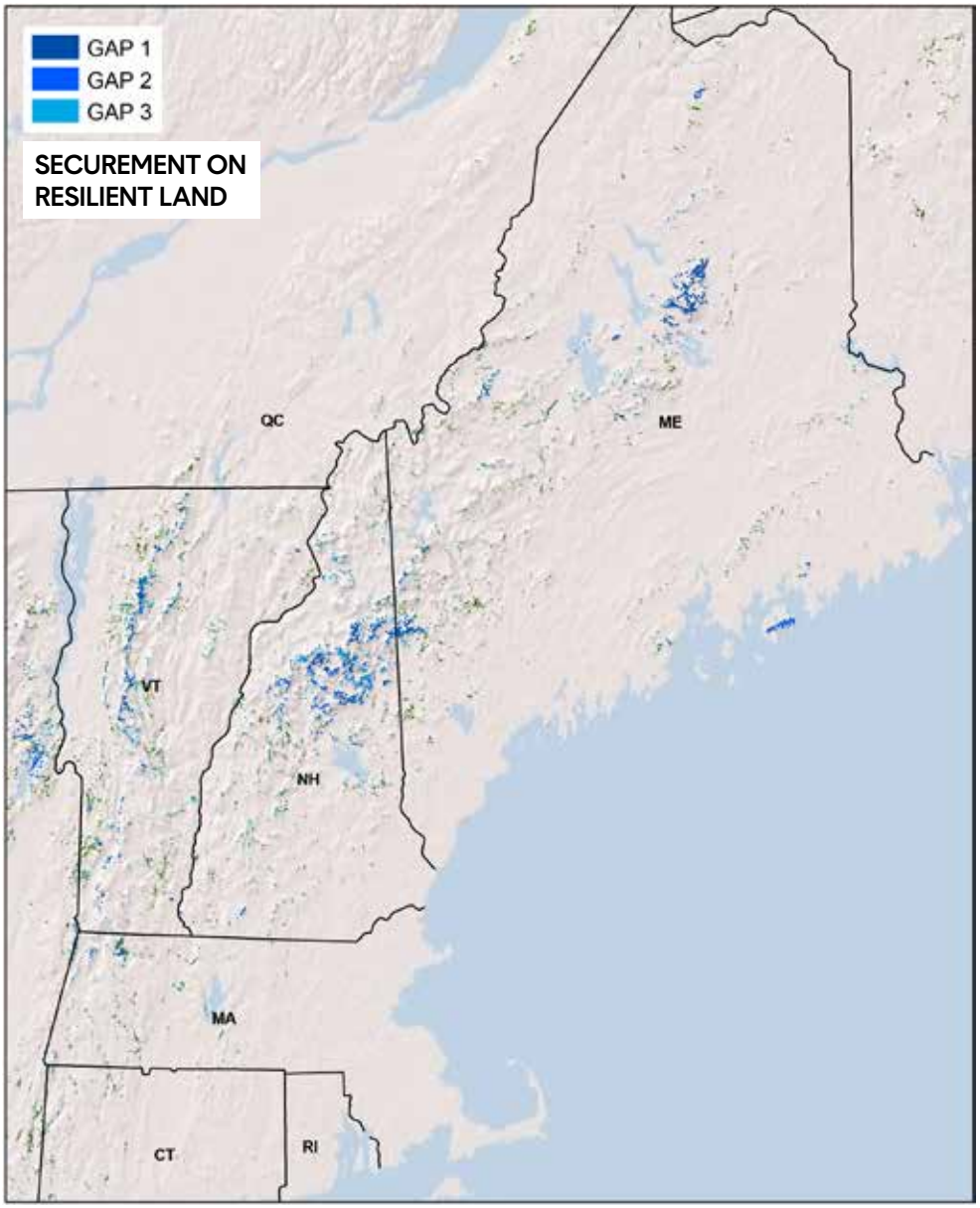

**Predicted Loss to Development by 2050**
Low 2%

This community is not threatened by development, with 2,054 acres (2%) likely to be lost over the next 30 years.

## Resilience & Securement

99% of this habitat scores high for resilience, 55% of the total acreage is secured against conversion, and 36% is protected.

# Acidic Cliff & Talus




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 113,213 | 55% |
| CT | 2,059 | 39% |
| MA | 6,149 | 49% |
| ME | 35,209 | 56% |
| NH | 35,125 | 73% |
| RI | 3 | 0% |
| VT | 34,668 | 39% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 111,724 | 56% |
| CT | 1,962 | 41% |
| MA | 6,009 | 50% |
| ME | 34,896 | 56% |
| NH | 34,833 | 73% |
| RI | 3 | 0% |
| VT | 34,021 | 39% |

## Rare or Uncommon Plants Associated with this Habitat

mountain spleenwort (*Asplenium montanum*)

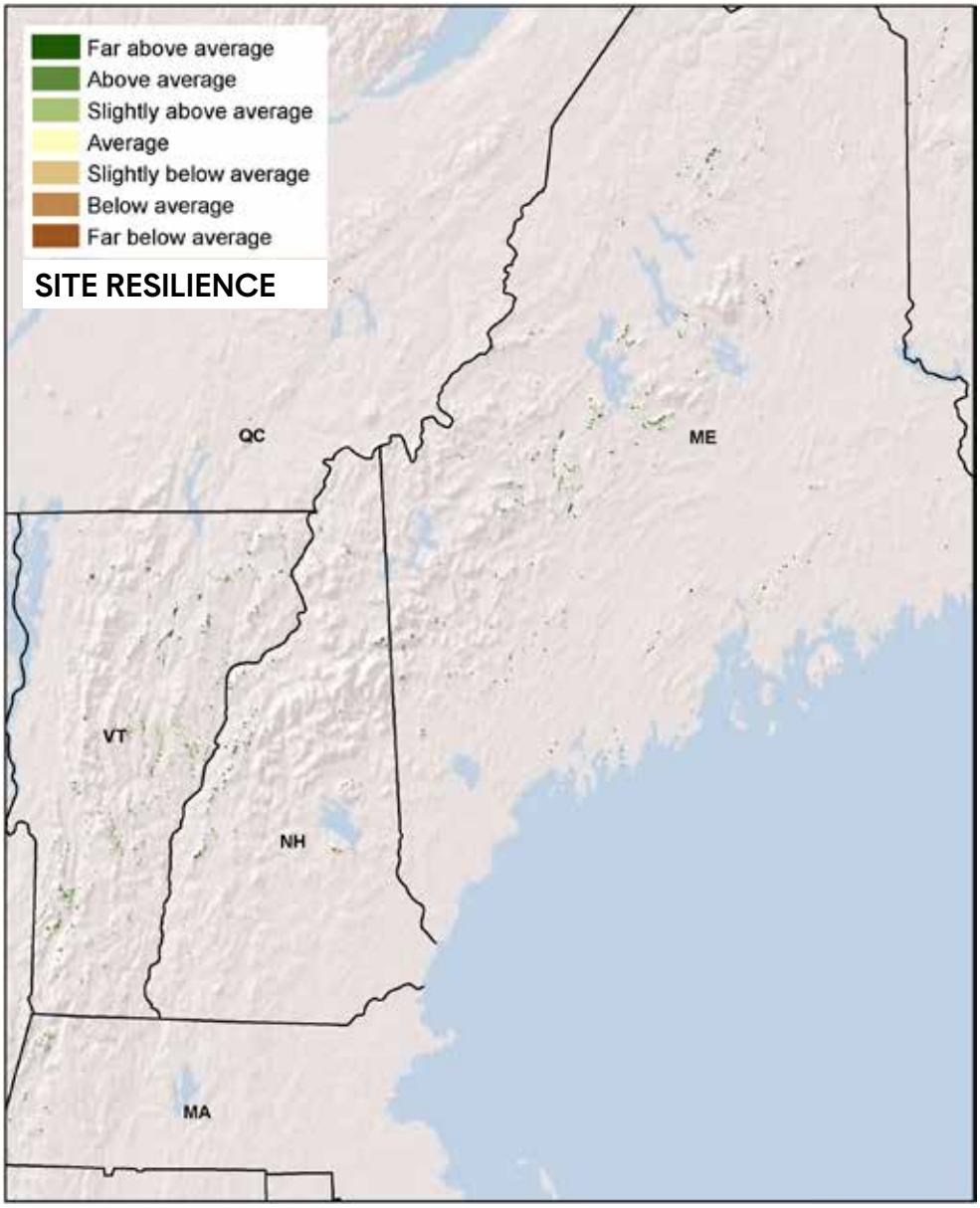
violet butterwort (*Pinguicula vulgaris*)

Canada mountain-rice grass (*Piptatherum canadense*)

neglected reed-grass (*Calamagrostis stricta* ssp. *inexpansa*)

silvery whitlow-wort (*Paronychia argyrocoma*)

# Calcareous Cliff & Talus




| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 7% | 1,975 | 2% | 10% | 19% | 31% | 69% |
| Above average | 64% | 18,810 | 9% | 9% | 22% | 40% | 60% |
| Slightly above average | 27% | 7,782 | 8% | 3% | 18% | 29% | 71% |
| Average | 1% | 182 | 0% | 0% | 3% | 3% | 97% |
| Slightly below average | 0% | 89 | 0% | 1% | 6% | 7% | 93% |
| Below average | 0% | 102 | 5% | 0% | 3% | 7% | 93% |
| Far below average | 0% | 6 | 7% | 0% | 19% | 26% | 74% |
| Developed | 1% | 279 | 5% | 1% | 19% | 25% | 75% |
| TOTAL | 100% | 29,225 | 8% | 7% | 21% | 36% | 64% |

## Resilience & Securement

98% of this habitat scores high for resilience, 36% of the total acreage is secured against conversion, and 15% is protected.

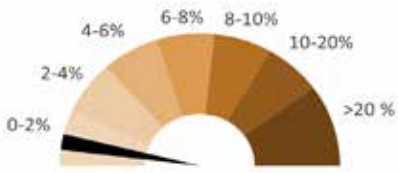
© Elizabeth Thompson (Vermont Land Trust)

## Description

A sparsely vegetated talus slope formed on limestone, dolomite, dolostone, or other calcareous bedrock. Edaphic conditions limit vegetation to herbs, ferns, and sparse trees growing in rock crevices. Northern white cedar is characteristic. Ash, basswood, and bladdernut are other indicators.

## Associated Herbs & Shrubs

Lake Mistassini primrose (*Primula mistassinica*), Blake's milk-vetch (*Astragalus robbinsii* var. *minor*), alpine northern-rockcress (*Braya humilis* ssp. *humilis*), Canadian single-spike sedge (*Carex scirpoidea*), few-flowered spikesedge (*Eleocharis quinqueflora* ssp. *fernaldii*), slender rock-brake (*Cryptogramma stelleri*), fragrant wood fern (*Dryopteris fragrans*), hyssop-leaved fleabane (*Erigeron hyssopifolius*), thale-cress (*Arabidopsis lyrata*), roseroot (*Rhodiola rosea*), slender cliff-brake (*Pellaea glabella*), smooth rockcress (*Boechera laevigata*), smooth cliff fern (*Woodsia glabella*), boreal sandplant (*Minuartia rubella*)

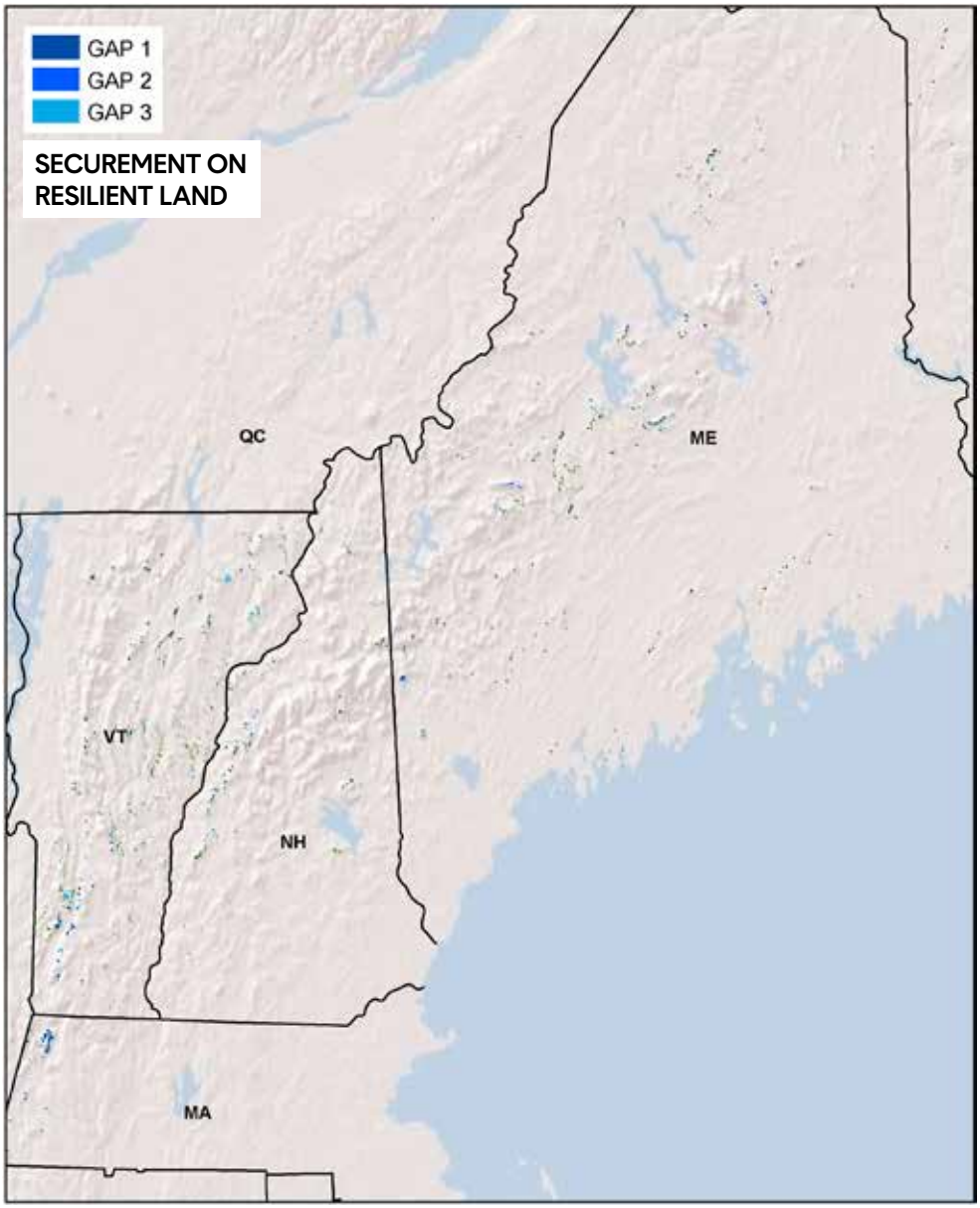



**Predicted Loss to Development by 2050**

Very low 1%

This community is not threatened by development, with only 428 acres (<1%) likely to be lost over the next 30 years.

# Calcareous Cliff & Talus




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 29,225 | 36% |
| CT | | |
| MA | 1,868 | 63% |
| ME | 7,868 | 38% |
| NH | 3,757 | 35% |
| RI | | |
| VT | 15,732 | 31% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 28,567 | 36% |
| CT | | |
| MA | 1,834 | 63% |
| ME | 7,804 | 38% |
| NH | 3,732 | 36% |
| RI | | |
| VT | 15,198 | 32% |

© Eric Sorenson (Vermont Fish & Wildlife)

## Rare or Uncommon Plants Associated with this Habitat

mountain death camas (*Anticlea elegans* ssp. *glauca*)

green spleenwort (*Asplenium viride*)

Crave's sedge (*Carex crawei*)

slender rock-brake (*Cryptogramma stelleri*)

wiry panicgrass (*Panicum flexile*)

northern cliff fern (*Woodsia alpina*)

violet butterwort (*Pinguicula vulgaris*)

glaucous blue grass (*Poa glauca* ssp. *glauca*)

yellow mountain saxifrage (*Saxifraga aizoides*)

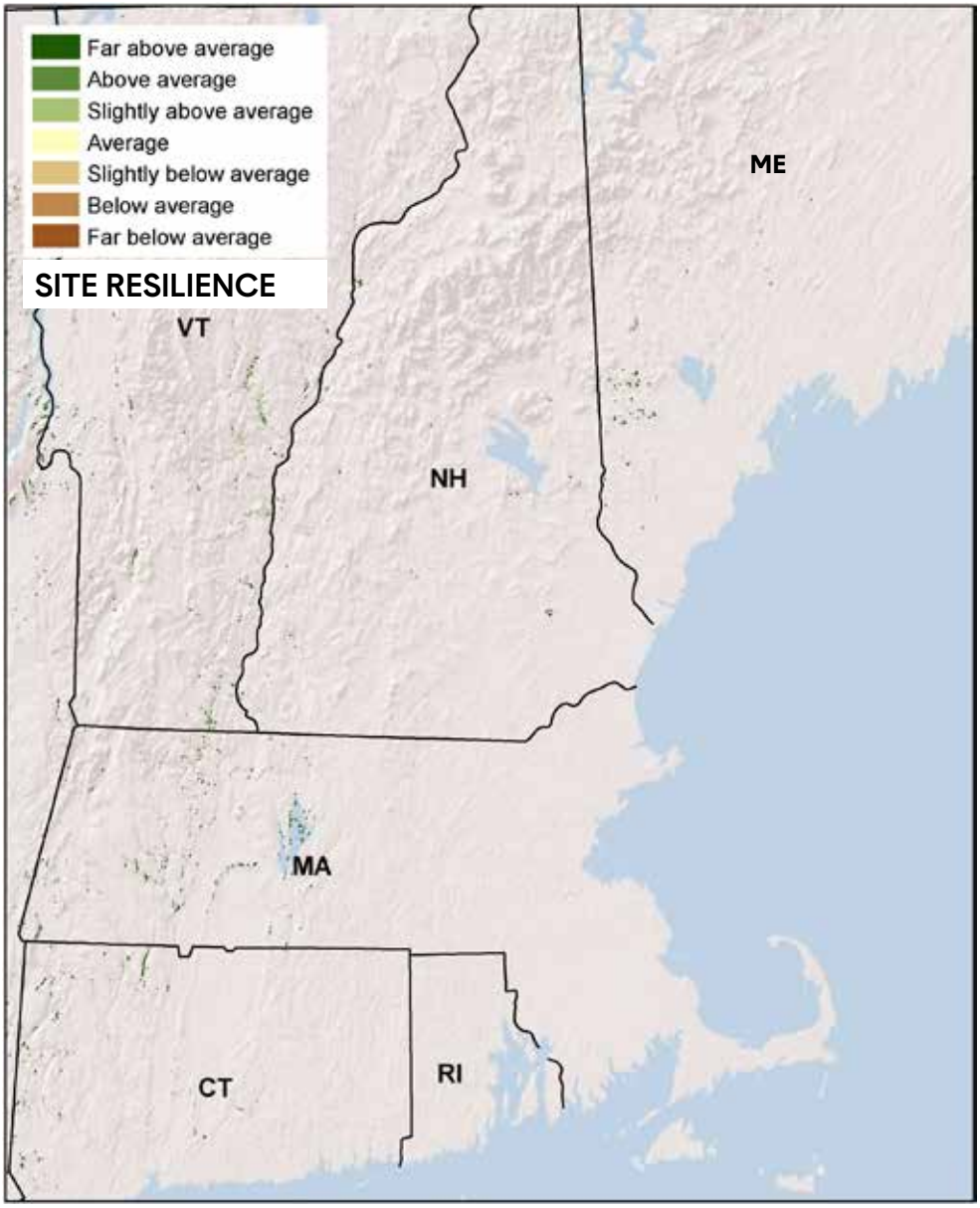
purple mountain saxifrage (*Saxifraga oppositifolia*)

little skullcap (*Scutellaria parvula* var. *parvula*)

small dropseed (*Sporobolus neglectus*)

pennyroyal bluecurls (*Trichostema brachiatum*)

# Circumneutral Cliff & Talus




© West Virginia Division of Natural Resources

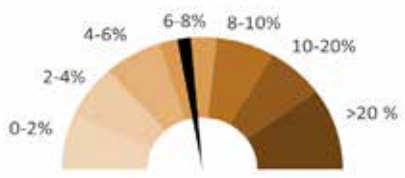
## Description

A sparsely vegetated cliff or talus slope formed on moderately calcareous substrates such as calcareous shales or sandstones mixed with limestone. Edaphic conditions limit vegetation to herbs, ferns, and sparse trees growing in rock crevices.

## Associated Herbs & Shrubs

rock muhly (*Muhlenbergia sobolifera*), Allegheny-vine (*Adlumia fungosa*), downy arrowwood (*Viburnum rafinesquianum*), narrow-leaved glade fern (*Diplazium pycnocarpon*), ledge spikemoss (*Selaginella rupestris*), whorled milkweed (*Asclepias verticillata*), Michaux's stitchwort (*Minuartia michauxii*), narrow-leaved vervain (*Verbena simplex*), nodding stickseed (*Hackelia deflexa* ssp. *americana*), purple virgin's-bower (*Clematis occidentalis*), small-flowered crowfoot (*Ranunculus micranthus*), upland boneset (*Eupatorium sessilifolium*), wall-rue spleenwort (*Asplenium ruta-muraria*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 19% | 2,632 | 11% | 3% | 21% | 35% | 65% |
| Above average | 45% | 6,204 | 6% | 5% | 19% | 29% | 71% |
| Slightly above average | 30% | 4,083 | 1% | 5% | 17% | 23% | 77% |
| Average | 3% | 367 | 3% | 6% | 17% | 25% | 75% |
| Slightly below average | 1% | 118 | 2% | 0% | 29% | 31% | 69% |
| Below average | 0% | 50 | 0% | 0% | 42% | 42% | 58% |
| Far below average | 0% | 1 | 0% | 0% | 0% | 0% | 100% |
| Developed | 2% | 298 | 2% | 1% | 12% | 15% | 85% |
| TOTAL | 100% | 13,752 | 5% | 4% | 19% | 28% | 72% |



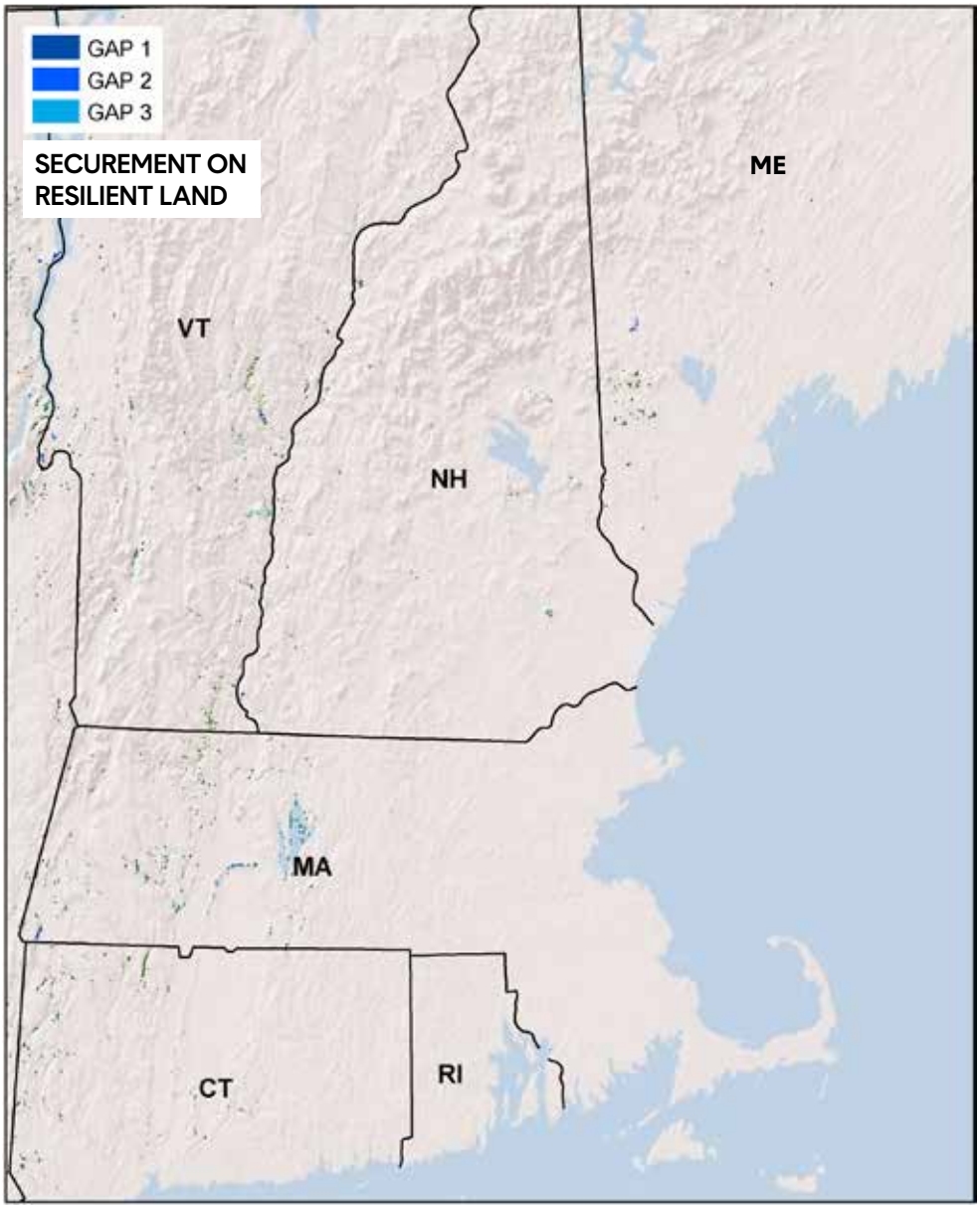

**Predicted Loss to Development by 2050**
Moderate 7%

This community is somewhat threatened by development, with 951 acres (7%) likely to be lost over the next 30 years.

## Resilience & Securement

94% of this habitat scores high for resilience, 28% of the total acreage is secured against conversion, and 9% is protected.

# Circumneutral Cliff & Talus




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 13,752 | 28% |
| CT | 1,842 | 29% |
| MA | 3,683 | 48% |
| ME | 858 | 36% |
| NH | 1,010 | 32% |
| RI | | |
| VT | 6,358 | 15% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 12,919 | 29% |
| CT | 1,658 | 29% |
| MA | 3,488 | 48% |
| ME | 839 | 36% |
| NH | 955 | 33% |
| RI | | |
| VT | 5,980 | 15% |



## Rare or Uncommon Plants Associated with this Habitat

wavy blue grass (*Poa laxa* ssp. *fernaldiana*)

field wormwood (*Artemisia campestris* ssp. *canadensis*)

neglected reed grass (*Calamagrostis stricta* ssp. *stricta*)

scabrous black sedge (*Carex atratiformis*)

hair-like sedge (*Carex capillaris* ssp. *capillaris*)

Appalachian bristle fern (*Crepidomanes* (*Trichomanes*) *intricatum*)

western tansy-mustard (*Descurainia pinnata* ssp. *brachycarpa*)

canescent whitlow-mustard (*Draba cana*)

smooth whitlow-mustard (*Draba glabella*)

northern firmoss (*Huperzia selago*)

glaucous blue grass (*Poa glauca* ssp. *glauca*)

interior blue grass (*Poa interior*)

bird's-eye primrose (*Primula laurentiana*)

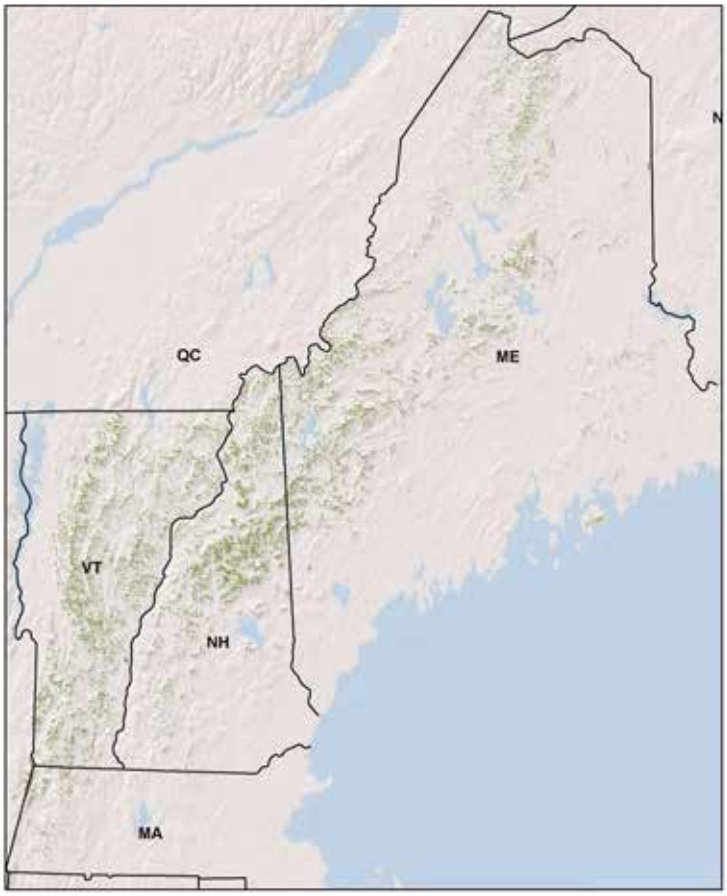
needle beaksedge (*Rhynchospora capillacea*)

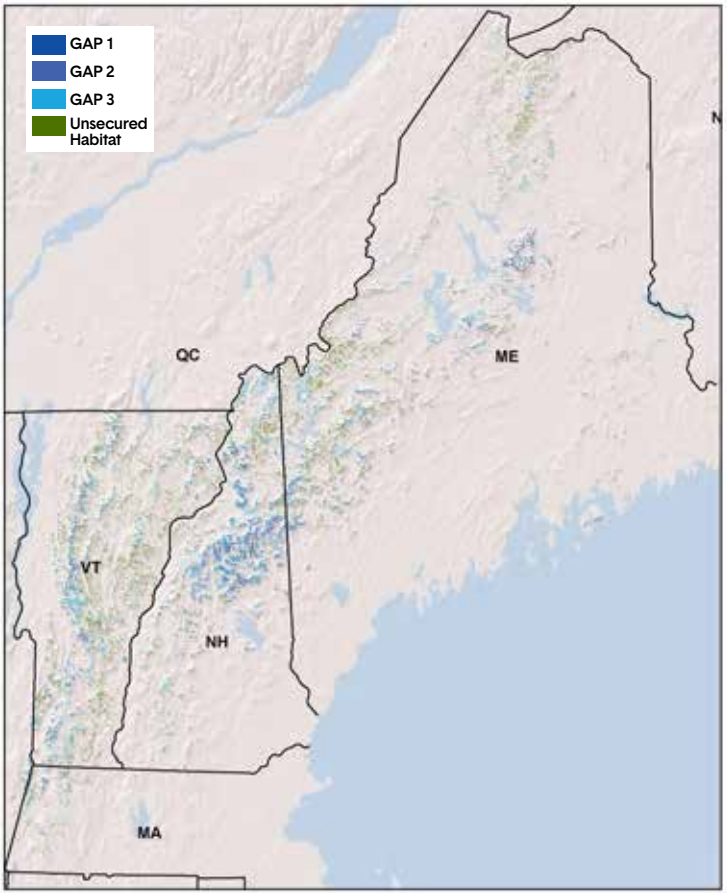
Appalachian gooseberry (*Ribes rotundifolium*)

rough dropseed (*Sporobolus compositus* var. *drummondii*)

MACROGROUP

# OUTCROP, SUMMIT & ALPINE

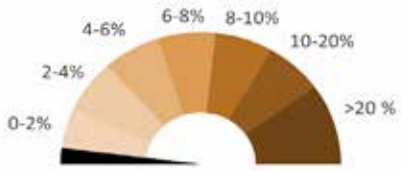



**Outcrop, Summit & Alpine**
An herbaceous or sparsely vegetated mountain summit with thin soils and bedrock outcrops.

**Acres in New England**
191,682

**Percent Secured**
GAP 1 = 16%
GAP 2 = 13%
GAP 3 = 20%

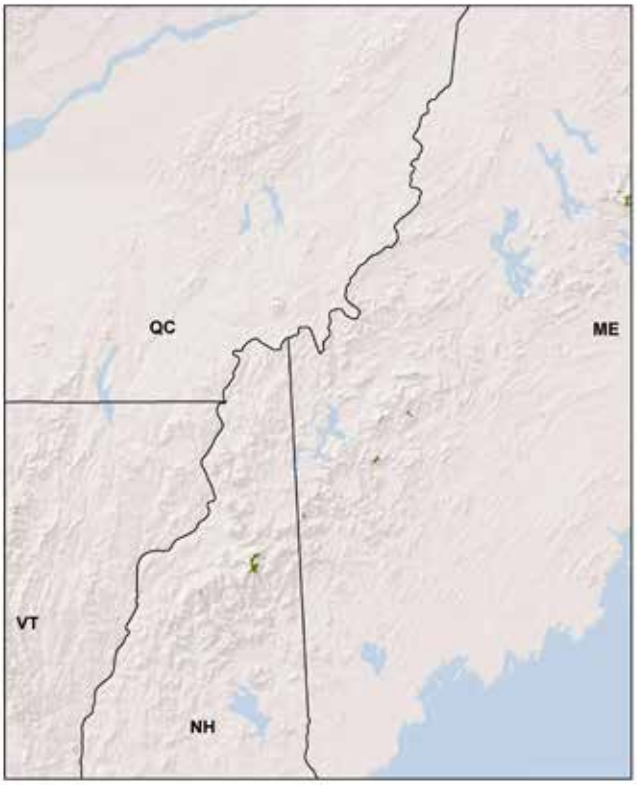



**Predicted Loss to Development by 2050**
658 acres (0%)

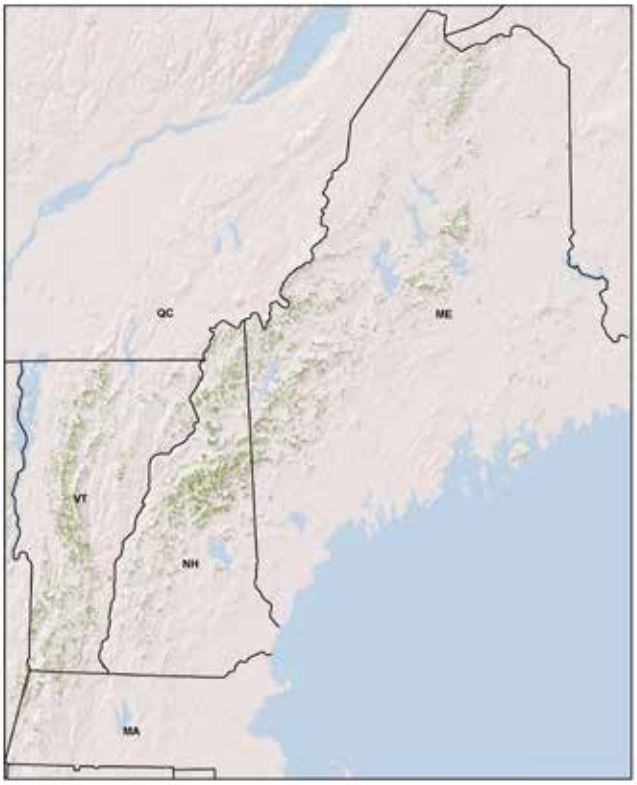
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Outcrop, Summit & Alpine** | **191,618** | **16%** | **13%** | **20%** | **51%** | | | | |
| Connecticut | 91 | 0% | 0% | 7% | 93% | | | | |
| Massachusetts | 5,005 | 21% | 2% | 29% | 48% | | | | |
| Maine | 67,998 | 11% | 9% | 19% | 61% | | | | |
| New Hampshire | 57,488 | 26% | 32% | 18% | 25% | | | | |
| Vermont | 61,036 | 12% | 3% | 22% | 63% | | | | |
| **New England** | **191,618** | **30,610** | **25,831** | **38,339** | **96,837** | | | | |

P = Protected S = Secured
U = Unsecured

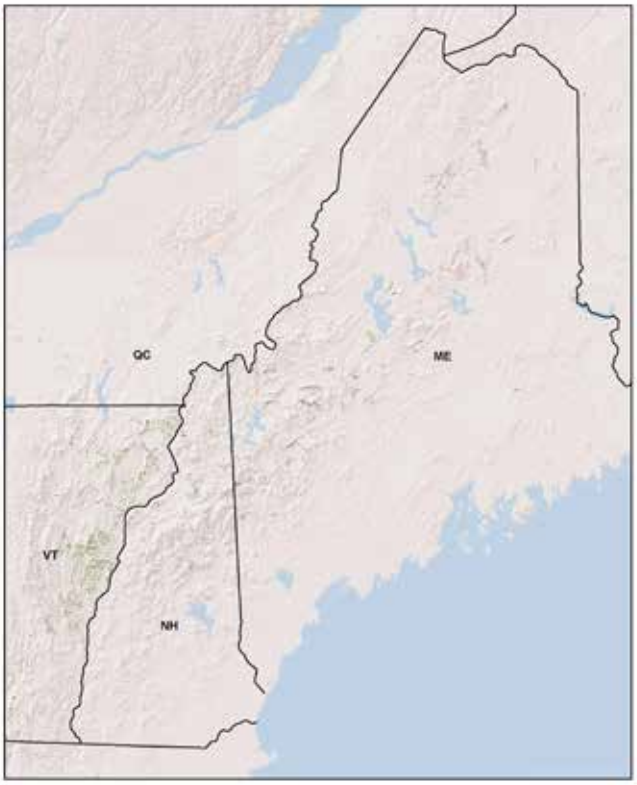
# DISTRIBUTION OF HABITATS




**Acadian-Appalachian Alpine Tundra**

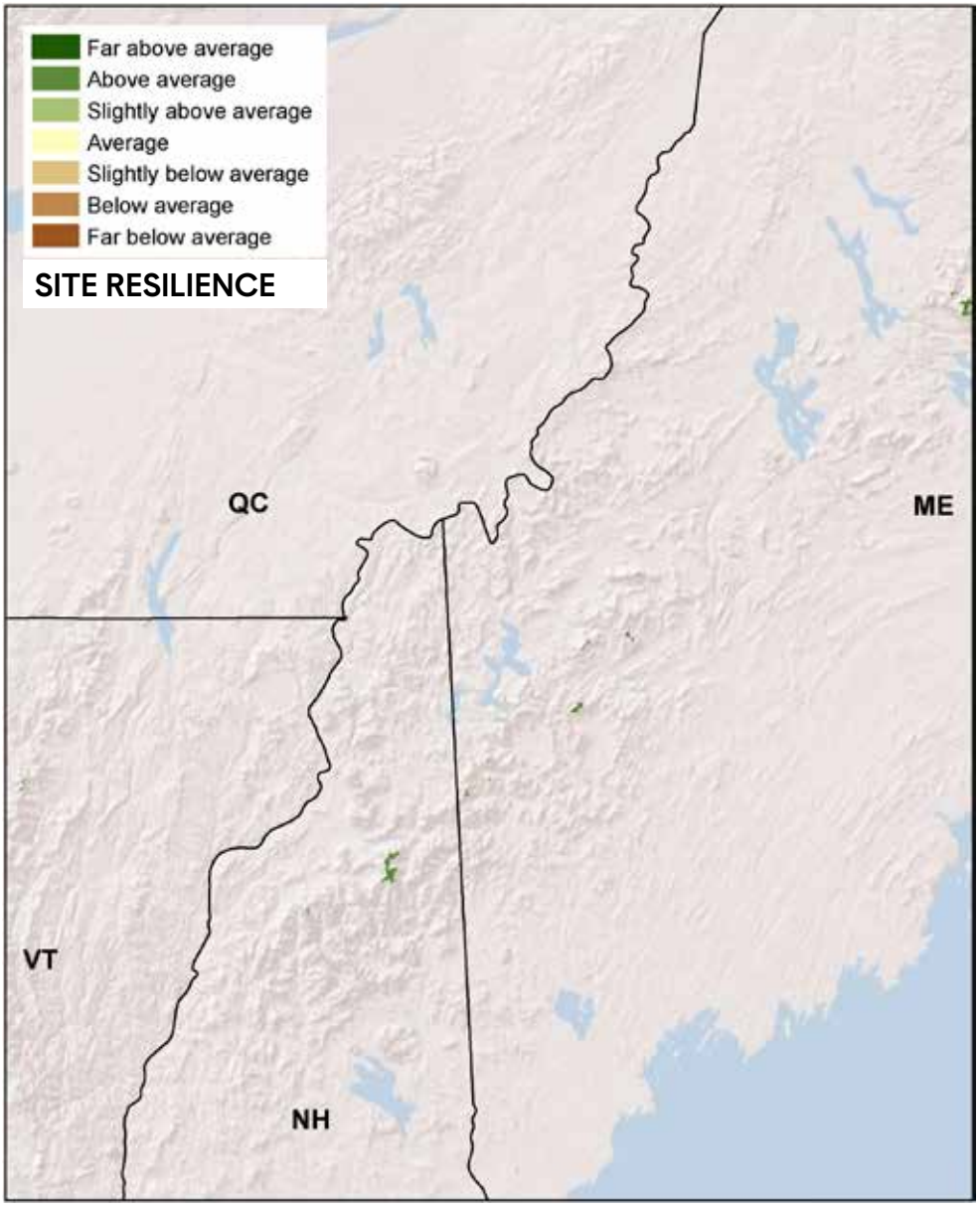



**Acidic Rocky Outcrop**




**Calcareous Rocky Outcrop**

# Acadian-Appalachian Alpine Tundra




© Josh Royte (The Nature Conservancy, Maine)

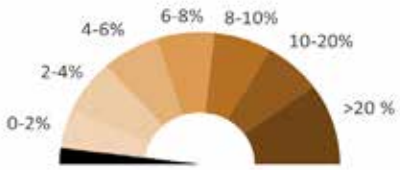
## Description

A sparsely vegetated system near or above treeline in the Northern Appalachian mountains, dominated by lichens, dwarf-shrubland, and sedges. At the highest elevations, the dominant plants are dwarf heaths such as alpine bilberry and cushion-plants.

## Associated Herbs & Shrubs

alpine-azalea (*Loiseleuria procumbens*), alpine blueberry (*Vaccinium uliginosum*), alpine bitter-cress (*Cardamine bellidifolia*), alpine sweet grass (*Anthoxanthum monticola*), bearberry willow (*Salix uva-ursi*), Bigelow's sedge (*Carex bigelowii*), black crowberry (*Empetrum nigrum*), highland rush (*Juncus trifidus*), cushion-plant (*Diapensia lapponica*), Lapland rosebay (*Rhododendron lapponicum*), mountain cranberry (*Vaccinium vitis-idaea*), mountain sandplant (*Minuartia groenlandica*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 127 | 76% | 5% | 19% | 100% | 0% |
| Above average | 97% | 7,647 | 76% | 9% | 14% | 99% | 1% |
| Slightly above average | 1% | 101 | 93% | 5% | 2% | 100% | 0% |
| Average | 0% | | | | | | |
| Slightly below average | 0% | | | | | | |
| Below average | 0% | | | | | | |
| Far below average | 0% | | | | | | |
| Developed | 0% | 25 | 68% | 14% | 11% | 93% | 7% |
| TOTAL | 100% | 7,900 | 76% | 9% | 14% | 99% | 1% |



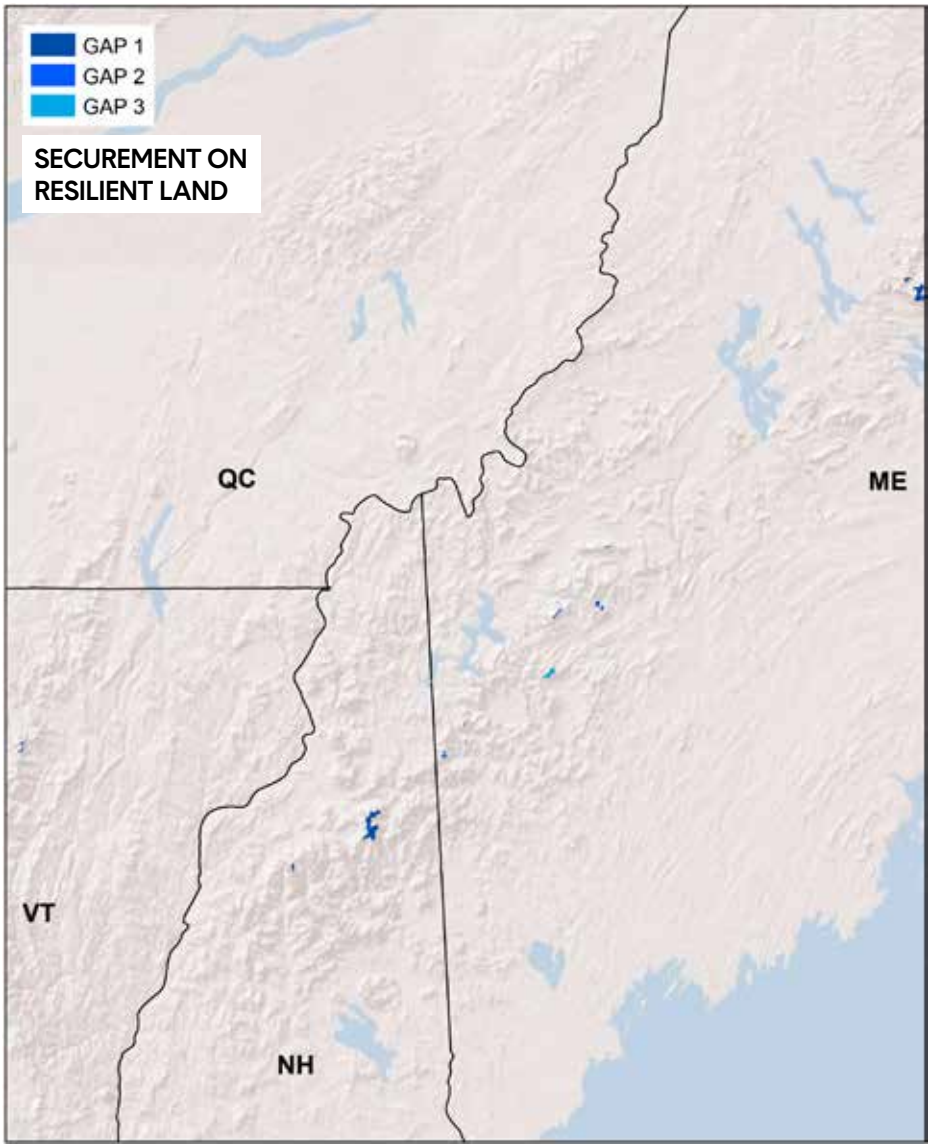

**Predicted Loss to Development by 2050**
Very low 0%

This community is not threatened by development.

## Resilience & Securement

100% of this habitat scores high for resilience, 99% of the total acreage is secured against conversion, and 85% is protected.

# Acadian-Appalachian Alpine Tundra




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 7,900 | 99% |
| CT | | |
| MA | | |
| ME | 3,624 | 99% |
| NH | 4,160 | 99% |
| RI | | |
| VT | 115 | 100% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 7,875 | 99% |
| CT | | |
| MA | | |
| ME | 3,622 | 99% |
| NH | 4,138 | 99% |
| RI | | |
| VT | 115 | 100% |

## Rare or Uncommon Plants Associated with this Habitat

lance-leaved arnica (*Arnica lanceolata* ssp. *lanceolata*)

White Mountain avens (*Geum peckii*)

Robbins' cinquefoil (*Potentilla robbinsiana*)

alpine bearberry (*Arctous alpina*)

glandular birch (*Betula glandulosa*)

alpine bistort (*Bistorta vivipara*)

capitate sedge (*Carex arctogena*)

scabrous black sedge (*Carex atratiformis*)

Sitka ground-cedar (*Diphasiastrum sitchense*)

Hornemann's willow-herb (*Epilobium hornemannii* ssp. *hornemannii*)

Oakes" eyebright (*Euphrasia oakesii*)

alpine fescue (*Festuca brachyphylla* ssp. *brachyphylla*)

moss-plant (*Harrimanella hypnoides*)

alpine azalea (*Kalmia procumbens*)

spiked wood rush (*Luzula spicata*)

leafy stemmed saxifrage (*Micranthes foliolosa*)

alpine arctic-cudweed (*Omalotheca supina*)

mountain-sorrel (*Oxyria digyna*)

mountain Timothy (*Phleum alpinum*)

purple mountain-heath (*Phyllodoce caerulea*)

little yellow-rattle (*Rhinanthus minor* ssp. *groenlandicus*)

northern willow (*Salix arctophila*)

Labrador willow (*Salix argyrocarpa*)

nodding saxifrage (*Saxifraga cernua*)

alpine-brook saxifrage (*Saxifraga rivularis* ssp. *rivularis*)

sibbaldia (*Sibbaldia procumbens*)

moss campion (*Silene acaulis*)

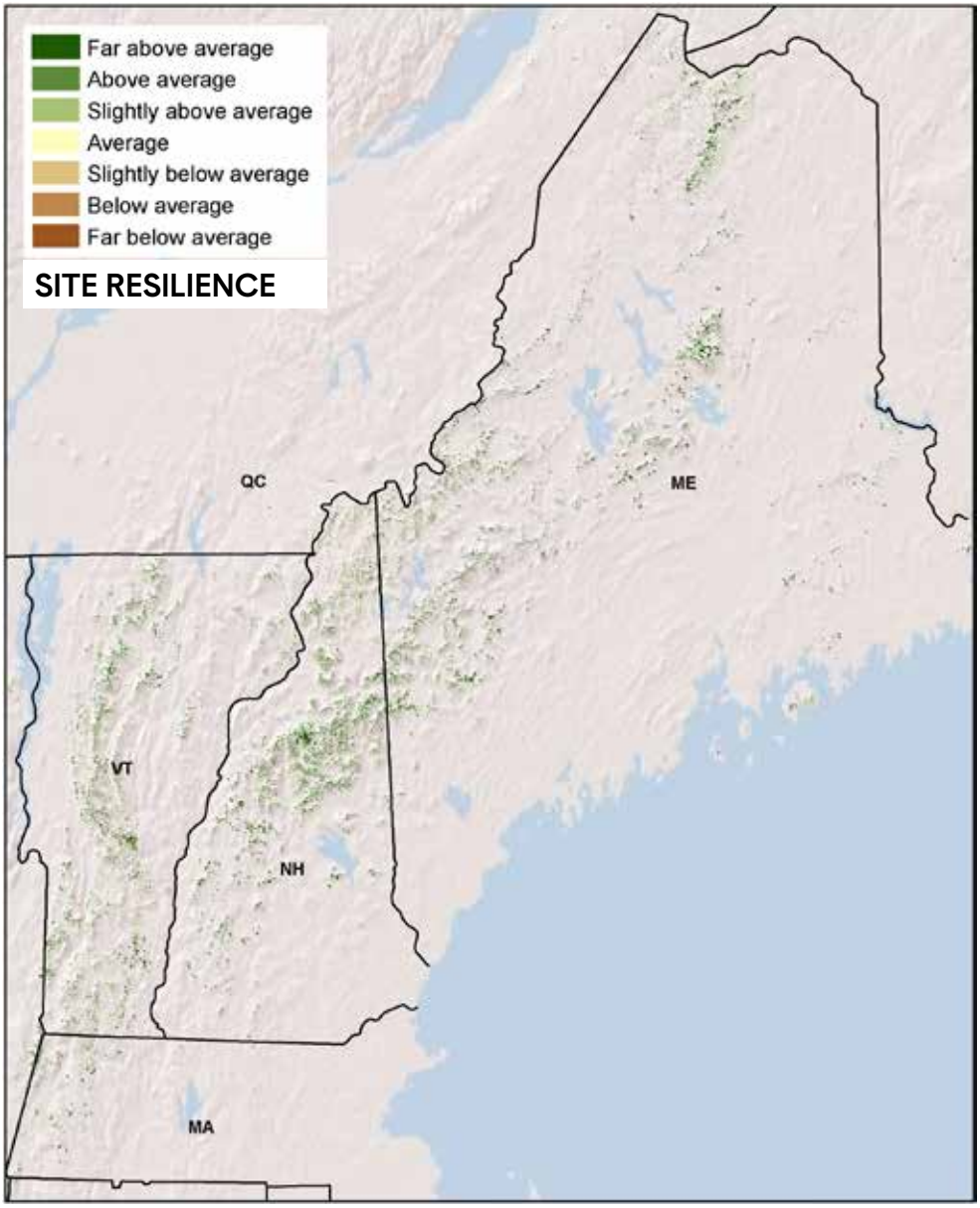
arctic hair grass (*Vahlodea atropurpurea*)

American alpine-speedwell (*Veronica wormskjoldii* var. *wormskjoldii*)

northern marsh violet (*Viola palustris* var. *palustris*)

northern painted-cup (*Castilleja septentrionalis*)

# Acidic Rocky Outcrop




© Josh Royte (The Nature Conservancy, Maine)

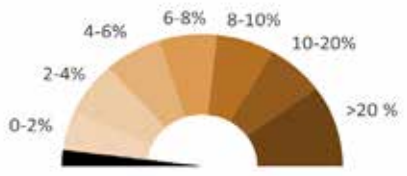
## Description

A sparsely vegetated system on resistant acidic bedrock such as sandstone, quartzite, or granite. The vegetation is a mosaic of woodlands and open glades, reflecting the proportion of rock surface to thin soil. Stunted trees over low heath shrubs are characteristic. Lichens and mosses dominate the ground cover.

## Associated Herbs & Shrubs

variable depending upon elevation; includes alpine blueberry (*Vaccinium uliginosum*), alpine sweet-grass (*Anthoxanthum monticola*), Canada mountain-rice grass (*Piptatherum canadense*), Douglas's knotweed (*Polygonum douglasii*), mountain sandplant (*Minuartia groenlandica*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 3% | 4,362 | 25% | 14% | 18% | 56% | 44% |
| Above average | 63% | 96,467 | 20% | 21% | 20% | 61% | 39% |
| Slightly above average | 32% | 48,957 | 5% | 5% | 23% | 33% | 67% |
| Average | 1% | 781 | 0% | 1% | 10% | 11% | 89% |
| Slightly below average | 0% | 513 | 2% | 1% | 12% | 15% | 85% |
| Below average | 1% | 1,156 | 2% | 1% | 17% | 21% | 79% |
| Far below average | 0% | 164 | 3% | 0% | 10% | 13% | 87% |
| Developed | 0% | 571 | 1% | 4% | 12% | 17% | 83% |
| TOTAL | 100% | 152,972 | 15% | 15% | 21% | 51% | 49% |




**Predicted Loss to Development by 2050**

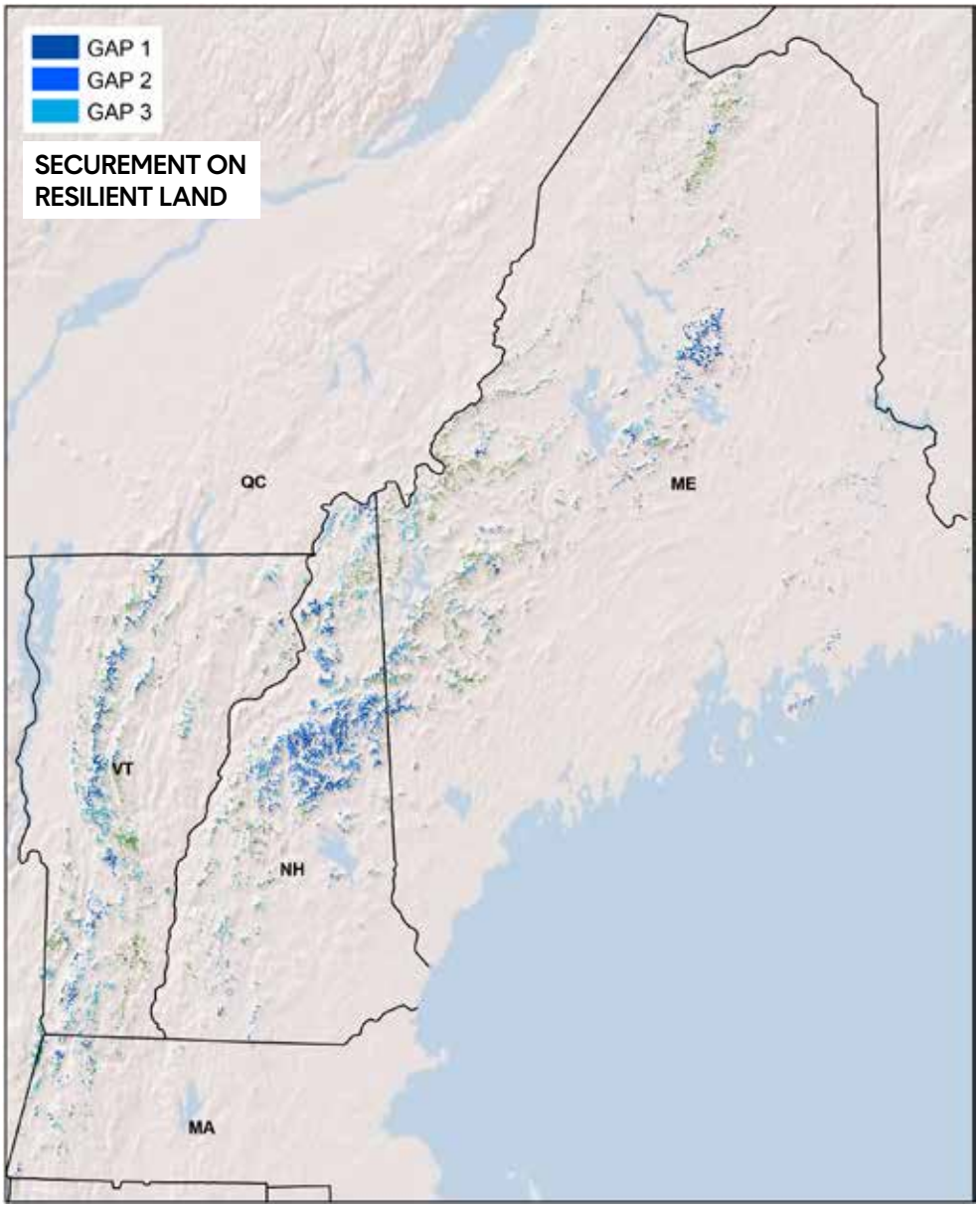
Very low 0%

This community is not threatened by development, with only 560 acres (0%) likely to be lost over the next 30 years.

## Resilience & Securement

98% of this habitat scores high for resilience, 51% of the total acreage is secured against conversion, and 30% is protected.

# Acidic Rocky Outcrop




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 152,972 | 51% |
| CT | 91 | 7% |
| MA | 5,005 | 52% |
| ME | 53,631 | 36% |
| NH | 50,309 | 74% |
| RI | | |
| VT | 43,936 | 42% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 149,786 | 52% |
| CT | 87 | 8% |
| MA | 4,753 | 53% |
| ME | 52,604 | 36% |
| NH | 49,446 | 75% |
| RI | | |
| VT | 42,896 | 43% |

## Rare or Uncommon Plants Associated with this Habitat

Nantucket shadbush (*Amelanchier nantucketensis*)

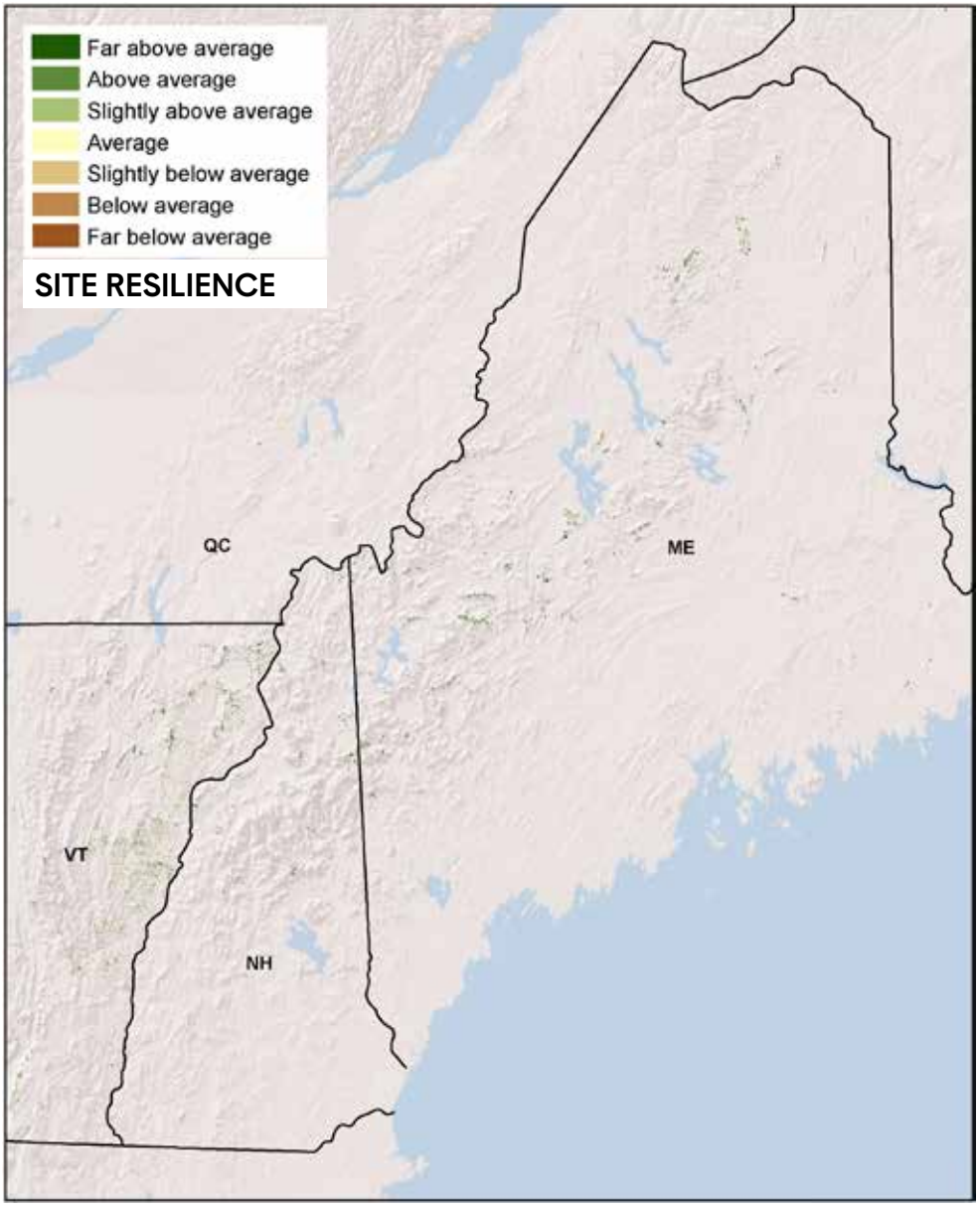
pale-seeded plantain (*Plantago virginica*)

Agassiz's Kentucky blue grass (*Poa pratensis* ssp. *agassizensis*)

silvery whitlow-wort (*Paronychia argyrocoma*)

© George Gress (The Nature Conservancy, Pennsylvania)

# Calcareous Rocky Outcrop




© Maine Natural Areas Program

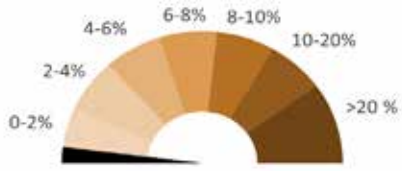
## Description

A sparsely vegetated ridge, summit, dome, or flat plain, composed of circumneutral or calcareous bedrock such as limestone or dolomite. The vegetation is a mosaic of woodlands and open glades. Northern white cedar is characteristic.

## Associated Herbs & Shrubs

straw sedge (*Carex foenea*), creeping juniper (*Juniperus horizontalis*), downy arrowwood (*Viburnum rafinesquianum*), bristle-leaved sedge (*Carex eburnea*), four-leaved milkweed (*Asclepias quadrifolia*), fragrant sumac (*Rhus aromatica*), northeastern beardtongue (*Penstemon hirsutus*), hairy honeysuckle (*Lonicera hirsuta*), pale-leaved sunflower (*Helianthus strumosus*), lyre-leaved thale-cress (*Arabis lyrata*), purple virgin's-bower (*Clematis occidentalis*), Richardson's sedge (*Carex richardsonii*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 391 | 6% | 5% | 25% | 36% | 64% |
| Above average | 50% | 15,327 | 7% | 10% | 23% | 40% | 60% |
| Slightly above average | 42% | 12,955 | 3% | 2% | 16% | 21% | 79% |
| Average | 2% | 579 | 0% | 0% | 2% | 2% | 98% |
| Slightly below average | 2% | 594 | 0% | 0% | 5% | 5% | 95% |
| Below average | 2% | 719 | 1% | 0% | 3% | 4% | 96% |
| Far below average | 0% | 96 | 0% | 0% | 5% | 6% | 94% |
| Developed | 0% | 86 | 4% | 0% | 7% | 11% | 89% |
| TOTAL | 100% | 30,746 | 5% | 6% | 19% | 30% | 70% |




**Predicted Loss to Development by 2050**

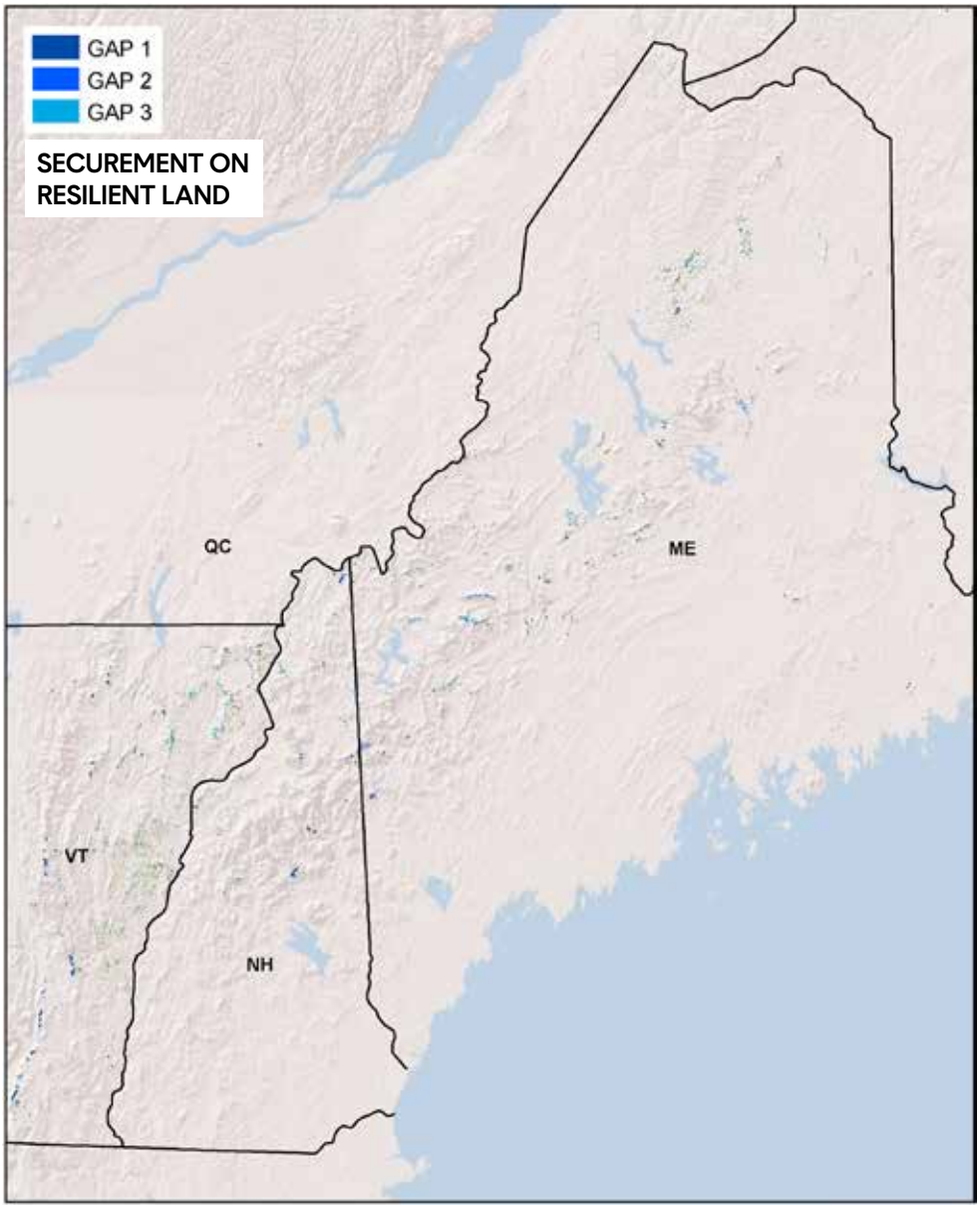
Very low 0%

This community is not threatened by development, with only 98 acres (0%) likely to be lost over the next 30 years.

## Resilience & Securement

93% of this habitat scores high for resilience, 30% of the total acreage is secured against conversion, and 11% is protected.

# Calcareous Rocky Outcrop




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 30,746 | 30% |
| CT | | |
| MA | | |
| ME | 10,743 | 35% |
| NH | 3,018 | 46% |
| RI | | |
| VT | 16,985 | 23% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 28,673 | 31% |
| CT | | |
| MA | | |
| ME | 10,556 | 35% |
| NH | 2,856 | 48% |
| RI | | |
| VT | 15,260 | 26% |

## Rare or Uncommon Plants Associated with this Habitat

upswept moonwort
(*Botrychium ascendens*)

prairie moonwort
(*Botrychium campestre*)

Fogg's goosefoot
(*Chenopodium foggii*)

northern blazing star
(*Liatris novae-angliae* var. *novae-angliae*)

sideoats grama
(*Bouteloua curtipendula* var. *curtipendula*)

Carolina whitlow-mustard
(*Draba reptans*)

white flat-topped goldenrod
(*Oligoneuron album*)

stiff flat-topped goldenrod
(*Oligoneuron rigidum* var. *rigidum*)

old-pasture blue grass
(*Poa saltuensis* ssp. *languida*)

small-flowered crowfoot
(*Ranunculus micranthus*)

bristly rose
(*Rosa acicularis* ssp. *sayi*)

little skullcap
(*Scutellaria parvula* var. *parvula*)

pennyroyal bluecurls
(*Trichostema brachiatum*)

rock elm
(*Ulmus thomasii*)

green rockcress
(*Boechera missouriensis*)

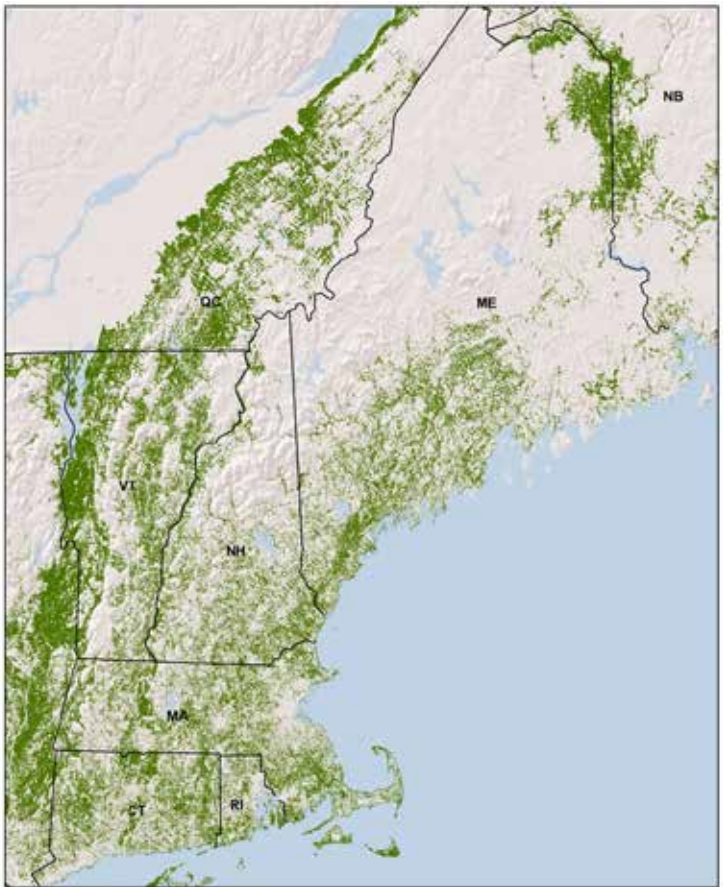
neglected reedgrass
(*Calamagrostis stricta* ssp. *inexpansa*)

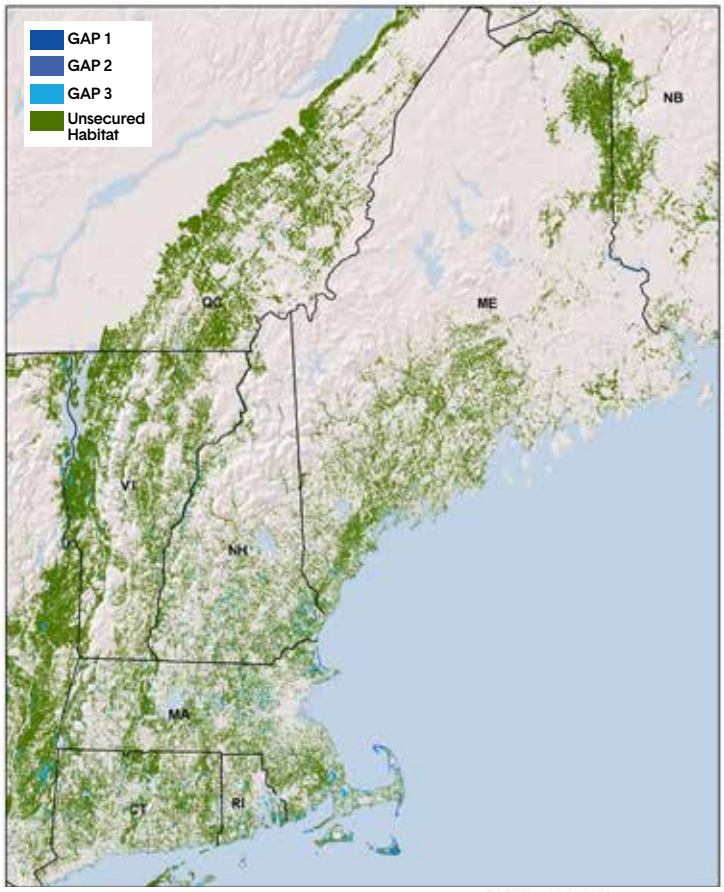
Canadian single-spike sedge
(*Carex scirpoidea* ssp. *scirpoidea*)

rock whitlow-mustard
(*Draba arabisans*)

MACROGROUP

# GRASSLAND & SHRUBLAND



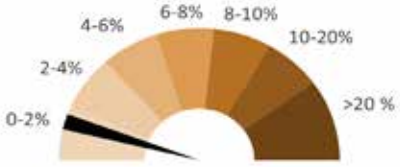




**Grassland & Shrubland**

Herbaceous communities dominated by grasses and sedges and sparse to dense shrubs. Naturally occurring grasslands are rare and restricted to conditions where soil, fire, or disturbance limits tree growth. This type includes farmland, old fields and agricultural edges, and coastal heathlands.

**Acres in New England**
2,691,236

**Percent Secured**
GAP 1 = 0%
GAP 2 = 0%
GAP 3 = 4%




**Predicted Loss to Development by 2050**
193,318 acres (7%)

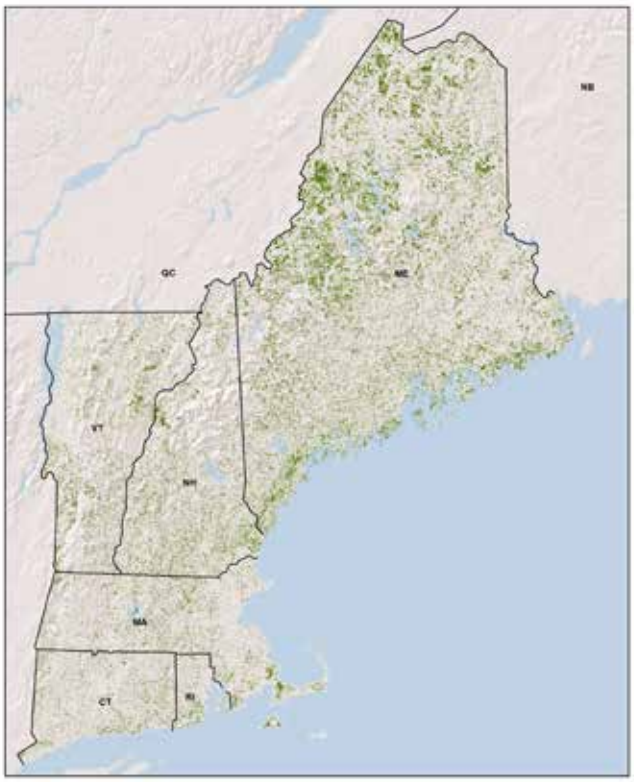
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Grassland & Shrubland** | **2,691,236** | **0%** | **1%** | **4%** | **95%** | **13** | **1** | **1** | **11** |
| Connecticut | 282,051 | 0% | 2% | 4% | 95% | | | | |
| Massachusetts | 415,501 | 1% | 3% | 9% | 87% | 9 | 1 | 1 | 7 |
| Maine | 832,972 | 0% | 0% | 1% | 99% | 2 | | | 2 |
| New Hampshire | 261,934 | 0% | 1% | 9% | 90% | | | | |
| Rhode Island | 51,672 | 1% | 3% | 12% | 85% | | | | |
| Vermont | 847,105 | 0% | 0% | 2% | 98% | 2 | | | 2 |
| **New England** | **2,691,236** | **6,094** | **26,964** | **103,037** | **2,555,140** | | | | |

P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS


**Atlantic Coastal Plain Beach & Dune**

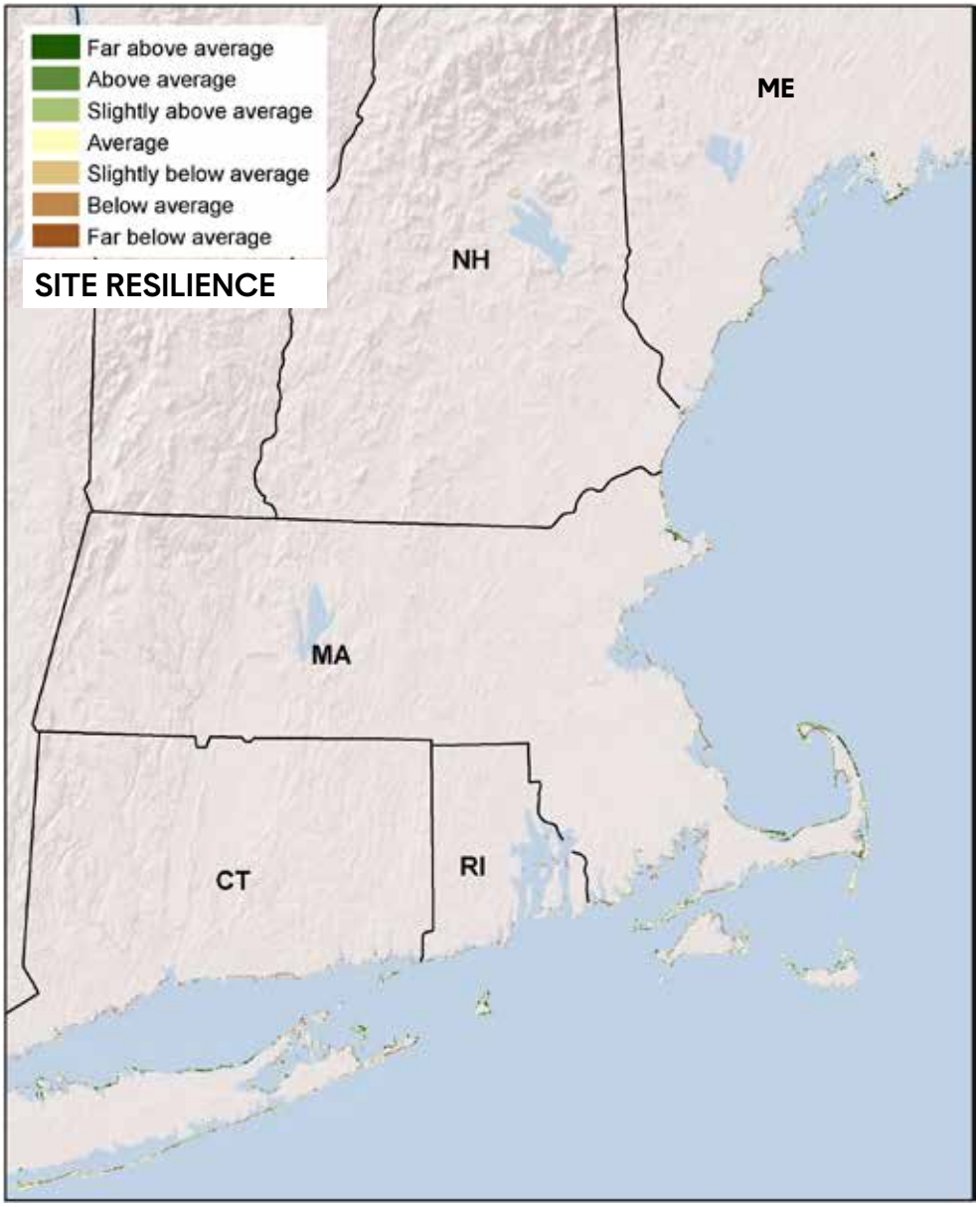

**North Atlantic Coastal Plain Heathland & Grassland**



**Ruderal Grassland & Shrubland**

**Agricultural Grassland**

# Atlantic Coastal Plain Beach & Dune




© Kathleen Strakosch Walz
(New Jersey Natural Heritage Program)

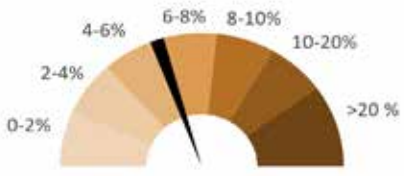
## Description

A sparsely vegetated beach, dune, or barrier island on unconsolidated sand and shell sediments on the Atlantic coast. Shifting winds and floods largely limit vegetation to pioneering, salt-tolerant grasses and succulents.

## Associated Herbs & Shrubs

American beach grass (*Ammophila breviligulata*), American lyme grass (*Leymus mollis* var. *mollis*), saltmarsh rush (*Juncus gerardii*), maritime marsh-elder (*Iva frutescens*), saltgrass (*Distichlis spicata*), smooth cordgrass (*Spartina alterniflora*), saltmarsh hay (*Spartina patens*), Carolina sea-lavender (*Limonium carolinianum*), American sea-rocket (*Cakile edentula*), seaside-sandwort (*Honckenya peploides*), seaside goldenrod (*Solidago sempervirens*), oysterleaf (*Mertensia maritima*), northern bayberry (*Myrica pensylvanica*), poison-ivy (*Toxicodenron radicans*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 3% | 953 | 0% | 48% | 20% | 68% | 32% |
| Above average | 16% | 5,822 | 1% | 46% | 19% | 65% | 35% |
| Slightly above average | 17% | 6,159 | 1% | 35% | 14% | 49% | 51% |
| Average | 27% | 9,898 | 2% | 28% | 14% | 44% | 56% |
| Slightly below average | 6% | 2,144 | 3% | 23% | 13% | 38% | 62% |
| Below average | 3% | 1,118 | 1% | 20% | 14% | 36% | 64% |
| Far below average | 0% | 115 | 0% | 16% | 24% | 40% | 60% |
| Developed | 28% | 10,276 | 0% | 8% | 10% | 18% | 82% |
| TOTAL | 100% | 36,484 | 1% | 26% | 14% | 41% | 59% |




**Predicted Loss to Development by 2050**

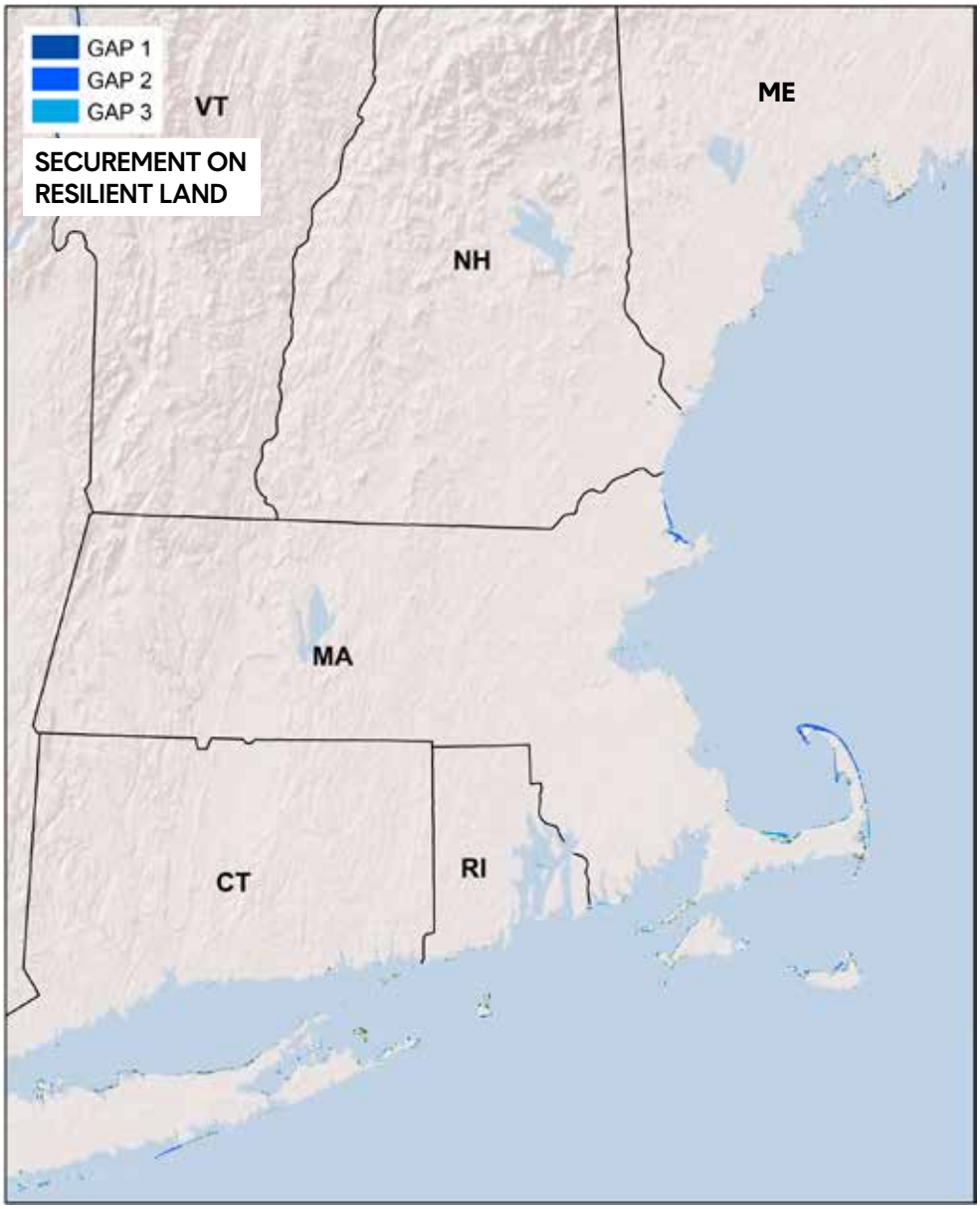
Moderate 6%

This community is moderately threatened by development, with 2,646 acres (6%) likely to be lost over the next 30 years.

## Resilience & Securement

36% of this habitat scores high for resilience, 41% of the total acreage is secured against conversion, and 27% is protected.

# Atlantic Coastal Plain Beach & Dune




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 36,484 | 41% |
| CT | 2,378 | 27% |
| MA | 27,104 | 49% |
| ME | 3,371 | 14% |
| NH | 743 | 31% |
| RI | 2,888 | 17% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 12,934 | 58% |
| CT | 93 | 52% |
| MA | 11,250 | 63% |
| ME | 1,021 | 24% |
| NH | 73 | 62% |
| RI | 497 | 24% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

coastal plain blue-eyed-grass (*Sisyrinchium fuscatum*)

yellow thistle (*Cirsium horridulum*)

eastern prickly-pear (*Opuntia humifusa*)

field wormwood (*Artemisia campestris* ssp. *caudata*)

velvety rosette-panicgrass (*Dichanthelium scoparium*)

foxtail bog-clubmoss (*Lycopodiella alopecuroides*)

ambiguous spikesedge (*Eleocharis ambigens*)

quill-leaved arrowhead (*Sagittaria teres*)

bristly smartweed (*Persicaria setacea*)

Plymouth rose-gentian (*Sabatia kennedyana*)

Torrey's beaksedge (*Rhynchospora torreyana*)

narrow-fruited beaksedge (*Rhynchospora inundata*)

netted nutsedge (*Scleria reticularis*)

Pursh's blue maidencane (*Amphicarpum amphicarpon*)

Wright's rosette-panicgrass (*Dichanthelium wrightianum*)

New England thoroughwort (*Eupatorium novae-angliae*)

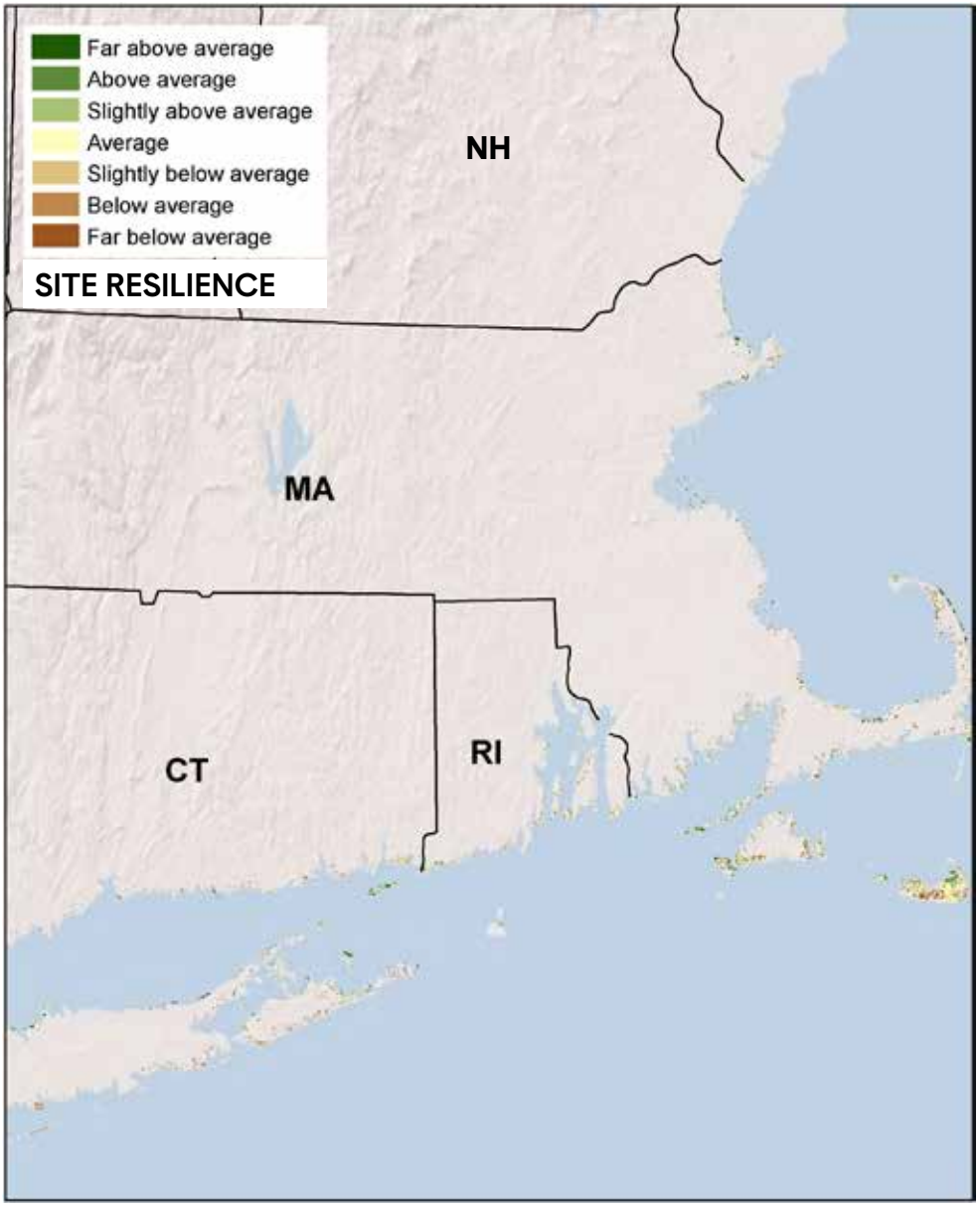
whorled marsh-pennywort (*Hydrocotyle verticillata*)

thyme-leaved pinweed (*Lechea minor*)

seaside knotweed (*Polgyonum glaucum*)

seabeach amaranth (*Amaranthus pumilus*)

# North Atlantic Coastal Plain Heathland & Grassland




© Ben Kimball (New Hampshire Natural Heritage Bureau)

## Description

A heathland/grassland complex of acidic, nutrient-poor, and very well drained soils in coastal areas. The vegetation is maintained by extreme soil conditions and periodic fire or other disturbance. Characteristic species include huckleberry, bearberry, broom crowberry, Nantucket shadbush, golden heather, blueberry, little bluestem, and Pennsylvania sedge.

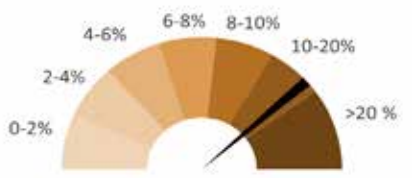
## Associated Herbs & Shrubs

Abroom crowberry (*Corema conradii*), bushy rockrose (*Helianthemum dumosum*), hyssopleaf hedge-nettle (*Stachys hyssopifolia*), sandplain flax (*Linum intercursum*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 156 | 0% | 42% | 16% | 59% | 41% |
| Above average | 8% | 2,014 | 1% | 17% | 19% | 37% | 63% |
| Slightly above average | 14% | 3,491 | 3% | 19% | 15% | 37% | 63% |
| Average | 38% | 9,613 | 3% | 25% | 14% | 42% | 58% |
| Slightly below average | 11% | 2,729 | 3% | 23% | 11% | 36% | 64% |
| Below average | 7% | 1,721 | 2% | 12% | 12% | 25% | 75% |
| Far below average | 2% | 411 | 0% | 2% | 19% | 21% | 79% |
| Developed | 20% | 5,083 | 1% | 8% | 8% | 17% | 83% |
| TOTAL | 100% | 25,219 | 2% | 18% | 13% | 33% | 67% |

## Resilience & Securement

23% of this habitat scores high for resilience, 33% of the total acreage is secured against conversion, and 20% is protected.




**Predicted Loss to Development by 2050**

High 18%

This community is highly threatened by development, with more than 4,664 acres (18%) likely to be lost over the next 30 years.

# North Atlantic Coastal Plain Heathland & Grassland


| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 25,219 | 34% |
| CT | 1,364 | 28% |
| MA | 20,654 | 36% |
| ME | | |
| NH | 38 | 45% |
| RI | 3,163 | 24% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 5,661 | 38% |
| CT | 182 | 13% |
| MA | 5,182 | 39% |
| ME | | |
| NH | 1 | 0% |
| RI | 296 | 33% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

sandplain agalinis (*Agalinis acuta*)

Nantucket shadbush (*Amelanchier nantucketensis*)

arrow-feather threeawn (*Aristida purpurascens*)

butterfly milkweed (*Asclepias tuberosa*)

eastern silver American-aster (*Symphyotrichum concolor*)

yellow thistle (*Cirsium horridulum*)

bushy frowstweed (*Crocanthemum dumosum*)

tall hairy lettuce (*Lactuca hirsuta*)

sundial lupine (*Lupinus perennis*)

Nuttall's milkwort (*Polygala nuttallii*)

northern blazing star (*Liatris novae-angliae*)

coastal plain blue-eyed-grass (*Sisyrinchium fuscatum*)

spring ladies-tresses (*Spiranthes vernalis*)

thyme-leaved pinweed (*Lechea minor*)

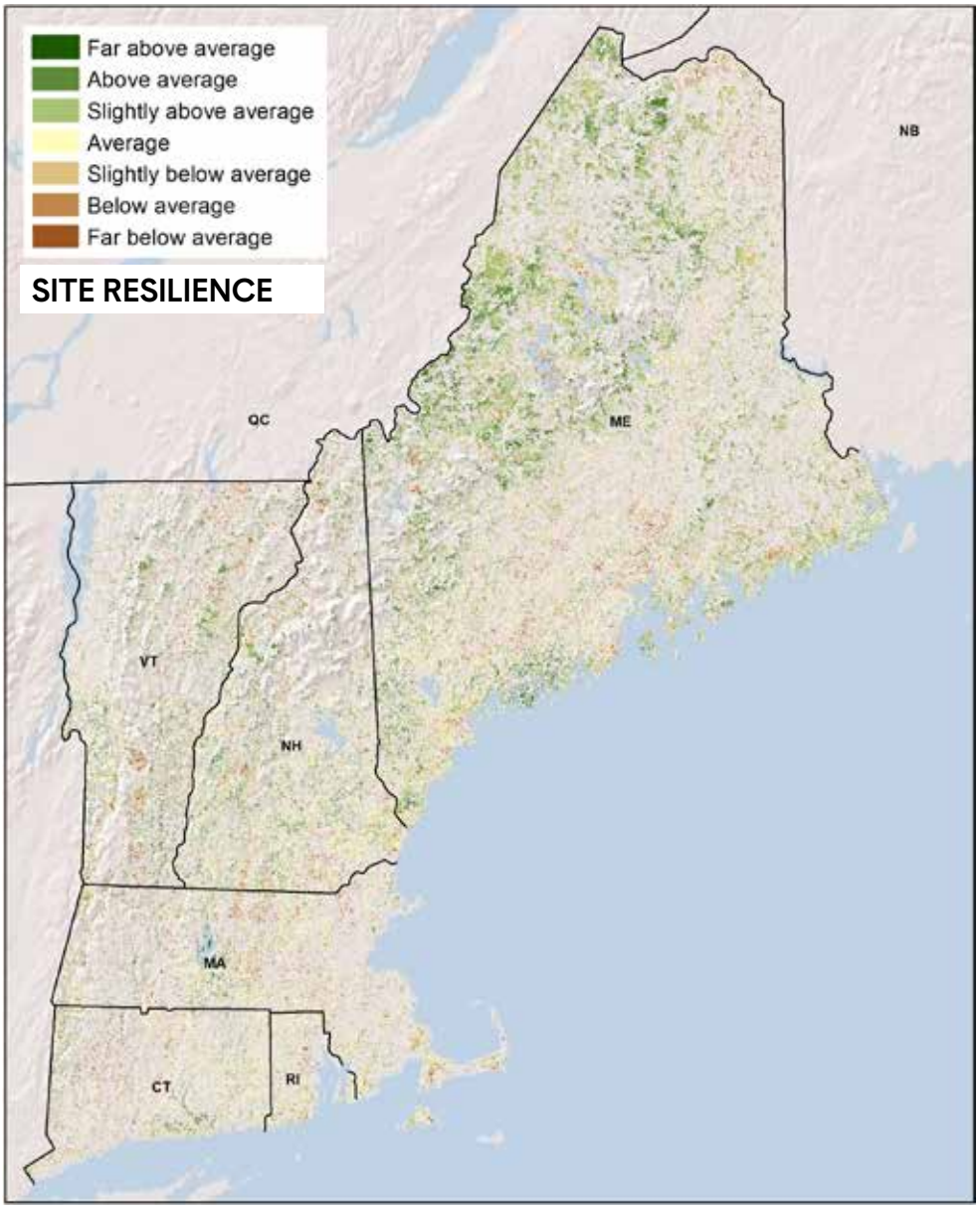
post oak (*Quercus stellata*)

broom-crowberry (*Corema conradii*)

multi-stemmed St. John's-wort (*Hypericum stragulum*)

lion's-foot rattlesnake-root (*Nabalus serpentarius*)

# Ruderal Grassland & Shrubland




© Ken Lund (Flickr Creative Commons)

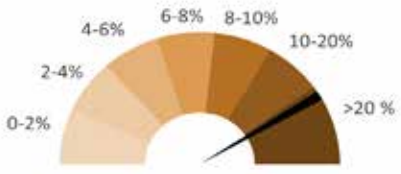
## Description

Abandoned, marginal, or recovering agricultural land and/or pastures. Ruderal communities may be found interspersed with working farmlands. The vegetation is dominated by a mix of native and non-native grasses and herbs, with shrub cover becoming more extensive the longer the time since abandonment.

## Associated Herbs & Shrubs

common milkweed (*Asclepias syriaca*), common strawberry (*Fragaria virginiana*), common grass-leaved-goldenrod (*Euthamia graminifolia*), common evening-primrose (*Oenethera biennis*), Canada goldenrod (*Solidago canadensis*), common wrinkle-leaved goldenrod (*Solidago rugosa*), New England American-aster (*Symphyotrichum novae-angliae*), staghorn sumac (*Rhus hirta*), smooth sumac (*Rhus glabra*), silky dogwood (*Swida amomum*), eastern red cedar (*Juniperus virginiana*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 941 | 4% | 4% | 10% | 17% | 83% |
| Above average | 10% | 5,148 | 2% | 2% | 11% | 15% | 85% |
| Slightly above average | 14% | 7,570 | 2% | 2% | 9% | 13% | 87% |
| Average | 34% | 18,242 | 2% | 2% | 15% | 18% | 82% |
| Slightly below average | 10% | 5,455 | 2% | 1% | 20% | 23% | 77% |
| Below average | 7% | 3,694 | 2% | 1% | 22% | 25% | 75% |
| Far below average | 1% | 718 | 1% | 0% | 18% | 19% | 81% |
| Developed | 21% | 11,174 | 0% | 1% | 5% | 6% | 94% |
| TOTAL | 100% | 52,942 | 2% | 1% | 13% | 16% | 84% |




**Predicted Loss to Development by 2050**

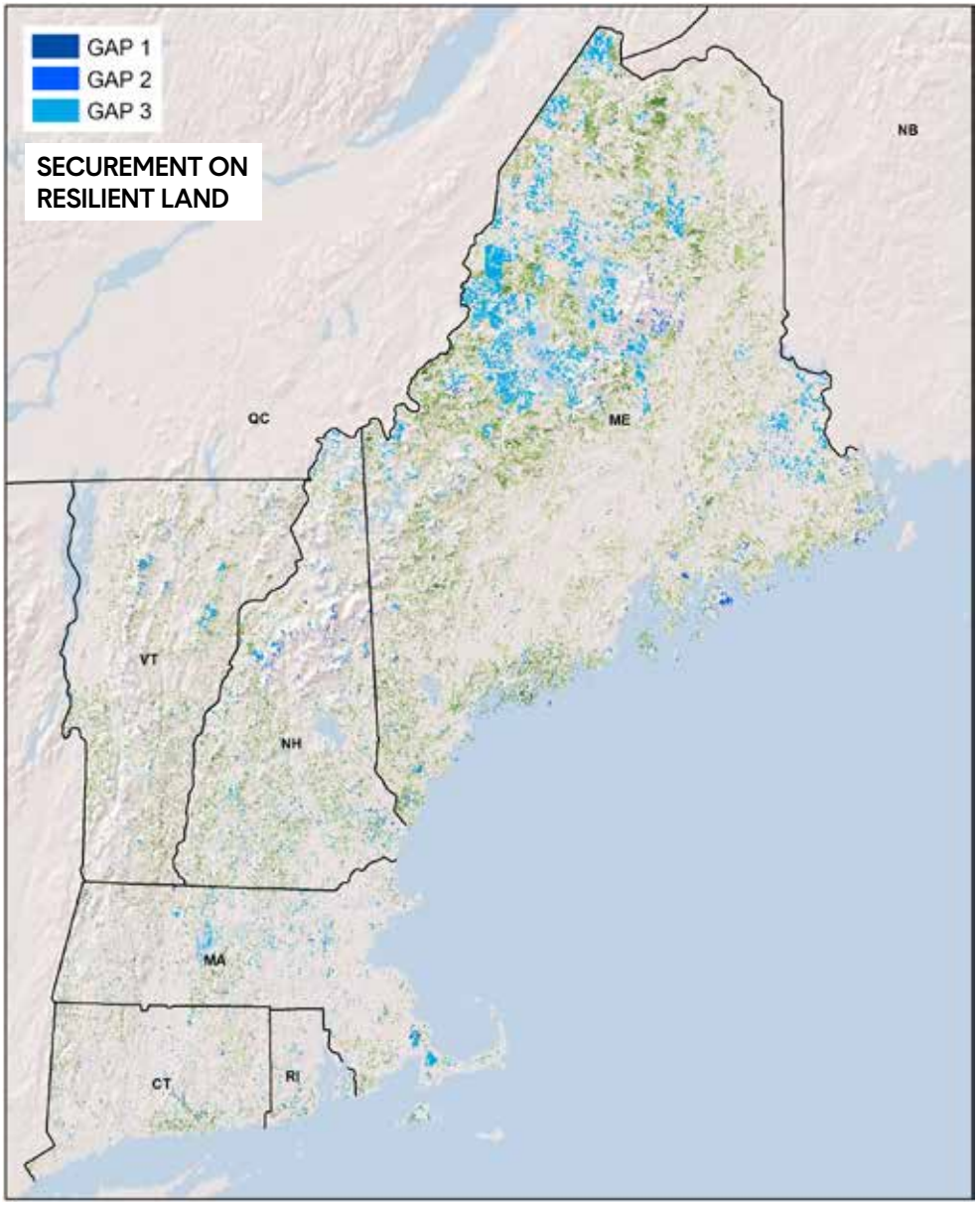
Very high 23%

This community is highly threatened by development, with more than 11,960 acres (23%) likely to be lost over the next 30 years.

## Resilience & Securement

26% of this habitat scores high for resilience, 16% of the total acreage is secured against conversion, and 3% is protected.

# Ruderal Grassland & Shrubland




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 52,942 | 16% |
| CT | 5,089 | 5% |
| MA | 17,992 | 29% |
| ME | 22,569 | 8% |
| NH | 4,106 | 12% |
| RI | 3,185 | 17% |
| VT | | |

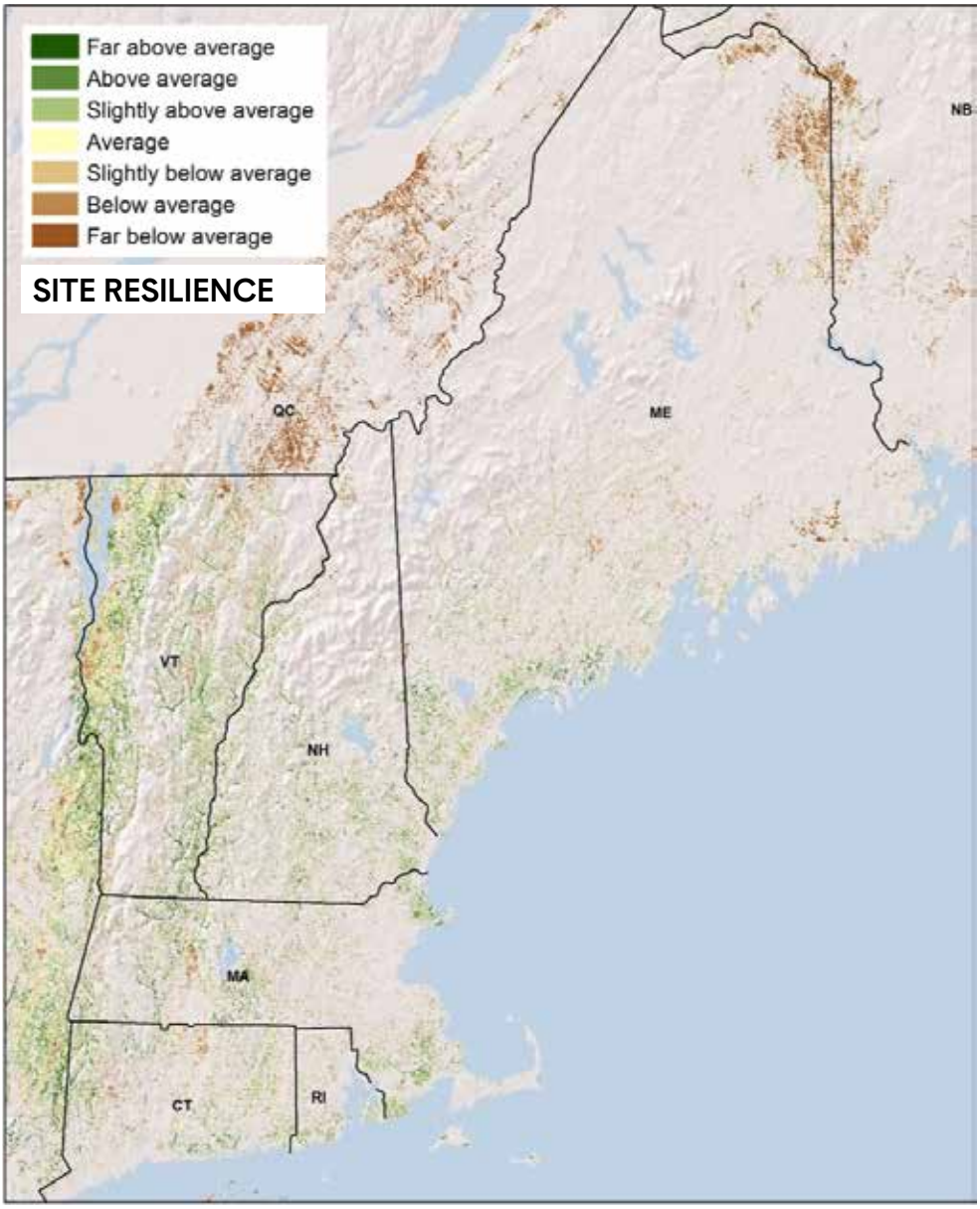
| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 13,659 | 14% |
| CT | 1,246 | 9% |
| MA | 3,019 | 25% |
| ME | 8,282 | 10% |
| NH | 594 | 25% |
| RI | 518 | 13% |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

upswept moonwort (*Botrychium ascendens*)

common moonwort (*Botrychium lunaria*)

# Agricultural Grassland




© Barbara Slavin (Flickr Creative Commons)

## Description

An agricultural field planted in row crops (corn, potatoes, and soybean), field crops (alfalfa, wheat, timothy, and oat), or hay. This also includes land permanently maintained (or recently abandoned) as a pasture area.

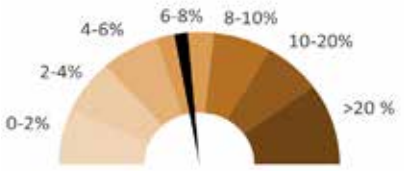
## Associated Herbs & Shrubs

common Timothy (*Phleum pratense*), slender meadow-foxtail (*Alopecurus pratensis*), poverty grass (*Danthonia spicata*), little bluestem (*Schizachyrium scoparium*), common wrinkle-leaved goldenrod (*Solidago rugosa*), Canada goldenrod (*Solidago canadensis*), common milkweed (*Asclepias syriaca*), Pennsylvania sedge (*Carex pensylvanica*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 12,809 | 2% | 1% | 6% | 9% | 91% |
| Above average | 4% | 104,324 | 1% | 1% | 6% | 8% | 92% |
| Slightly above average | 12% | 318,172 | 0% | 1% | 5% | 6% | 94% |
| Average | 30% | 766,321 | 0% | 1% | 4% | 5% | 95% |
| Slightly below average | 17% | 445,204 | 0% | 0% | 3% | 3% | 97% |
| Below average | 19% | 479,378 | 0% | 0% | 2% | 3% | 97% |
| Far below average | 5% | 128,286 | 0% | 0% | 2% | 2% | 98% |
| Developed | 13% | 322,096 | 0% | 0% | 2% | 3% | 97% |
| TOTAL | 100% | 2,576,591 | 0% | 0% | 3% | 4% | 96% |

## Resilience & Securement

16% of this habitat scores high for resilience, but only 4% of the total acreage is secured against conversion. The data do not include farmland under conservation easement.




**Predicted Loss to Development by 2050**

Moderate 7%

About 174,048 acres (7%) are likely to be lost over the next 30 years. Many farms have conservation easements that prevent their conversion; these are not included in the secured lands dataset.

# Agricultural Grassland


| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 2,576,591 | 4% |
| CT | 273,220 | 5% |
| MA | 349,751 | 8% |
| ME | 807,032 | 1% |
| NH | 257,047 | 10% |
| RI | 42,435 | 15% |
| VT | 847,105 | 2% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 435,305 | 6% |
| CT | 35,386 | 8% |
| MA | 60,482 | 12% |
| ME | 78,902 | 4% |
| NH | 62,522 | 13% |
| RI | 5,340 | 16% |
| VT | 192,673 | 3% |

## Rare or Uncommon Plants Associated with this Habitat

straw sedge
(*Carex foenea*)

creeping juniper
(*Juniperus horizontalis*)

downy arrowwood
(*Viburnum rafinesquianum*)

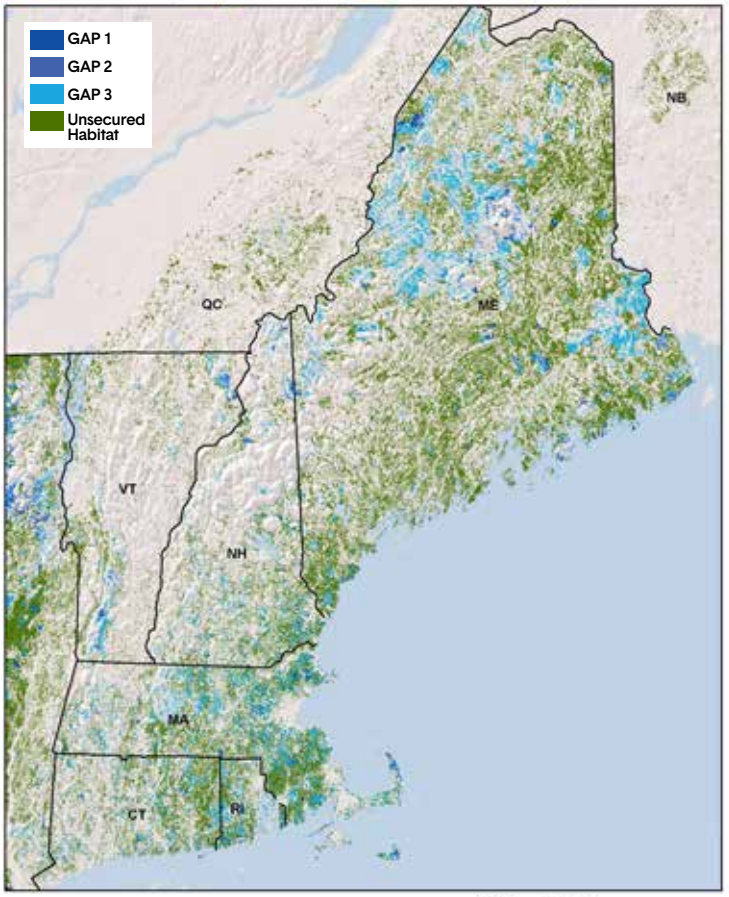
bristle-leaved sedge
(*Carex eburnea*)

butterfly milkweed
(*Asclepias tuberosa*)

sundial lupine
(*Lupinus perennis*)

# WETLAND HABĪTATS

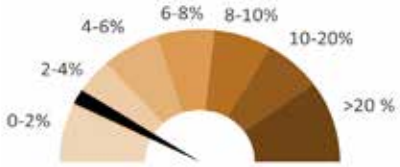
# MACROGROUP
# NORTHERN SWAMP


**Northern Swamp**
Conifer or mixed forested swamps of permanently saturated basins with seasonal standing water.

**Acres in New England**
2.2 million

**Percent Secured**
GAP 1 = 2%
GAP 2 = 3%
GAP 3 = 17%

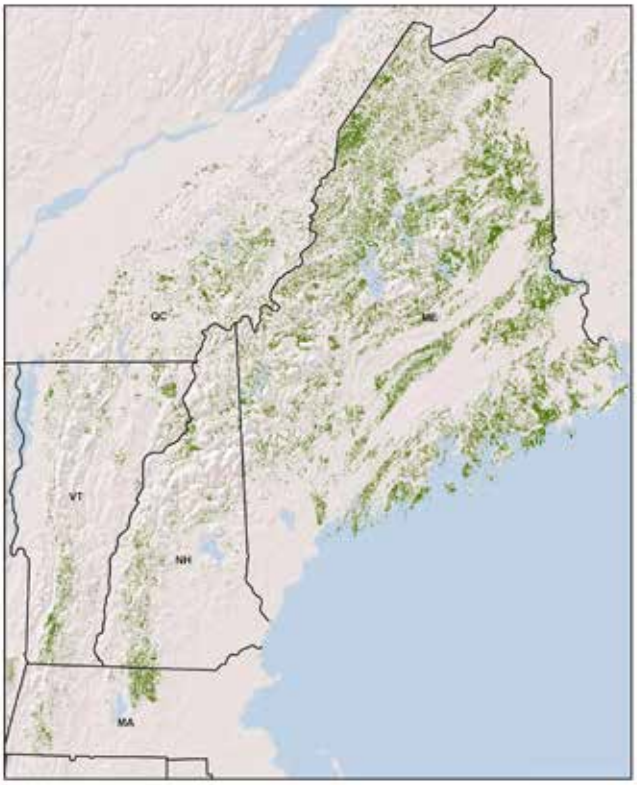



**Predicted Loss to Development by 2050**
66,414 acres (3%)

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Northern Swamp** | **2,195,240** | **2%** | **3%** | **17%** | **77%** | **11** | | **2** | **9** |
| Connecticut | 173,279 | 1% | 5% | 15% | 79% | 1 | | | 1 |
| Massachusetts | 399,178 | 2% | 3% | 25% | 70% | 6 | | 2 | 4 |
| Maine | 1,270,481 | 2% | 2% | 15% | 81% | 1 | | | 1 |
| New Hampshire | 167,020 | 3% | 4% | 19% | 74% | | | | |
| Rhode Island | 72,999 | 3% | 7% | 20% | 71% | 3 | | | 3 |
| Vermont | 112,283 | 5% | 4% | 18% | 74% | | | | |
| **New England** | **2,195,240** | **47,668** | **64,577** | **381,708** | **1,701,287** | | | | |

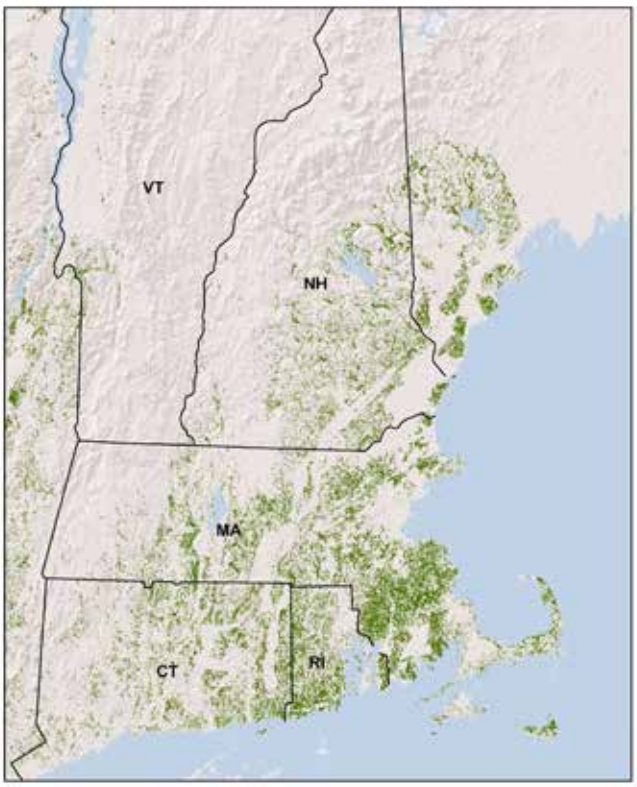
P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS

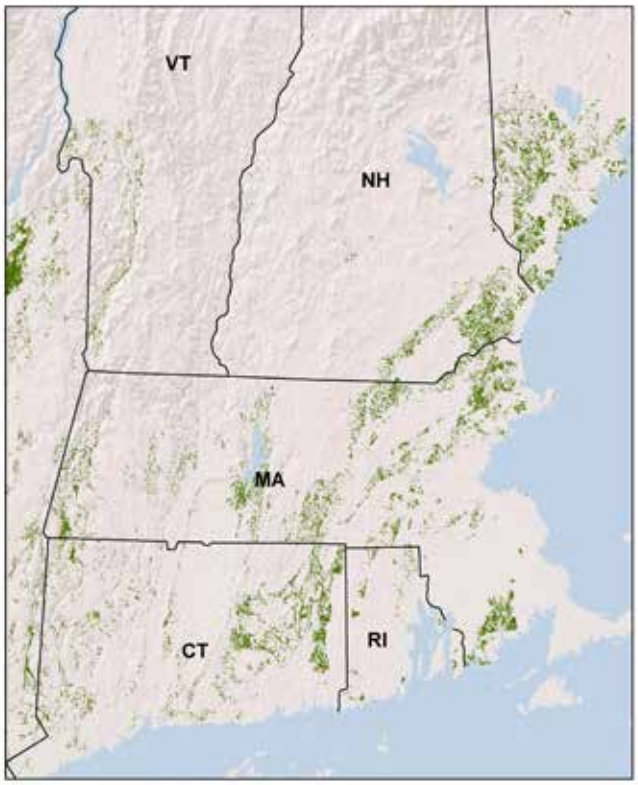



NORTHERN | **Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp**


NORTHERN | **Laurentian-Acadian Alkaline Conifer-Hardwood Swamp**

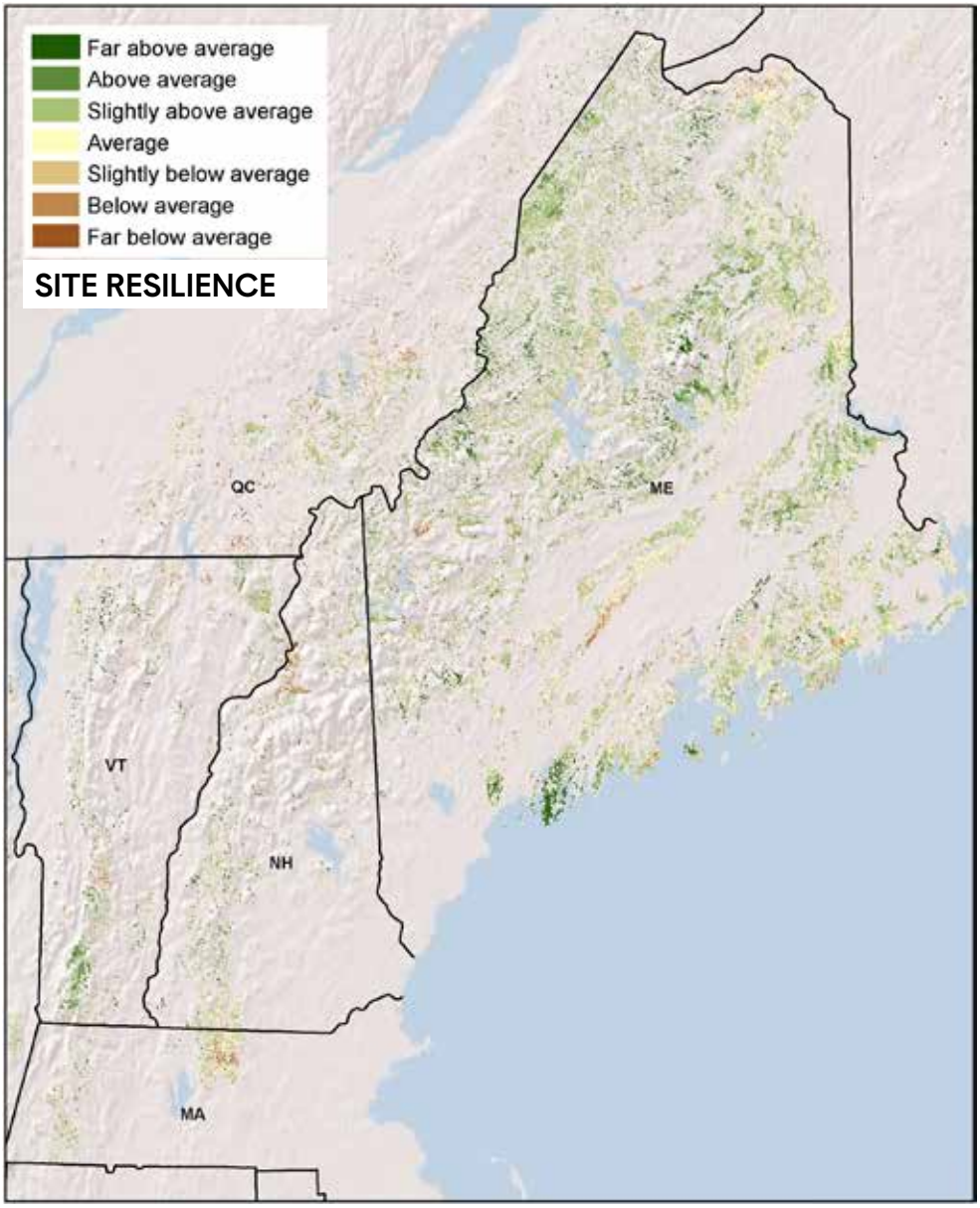



SOUTHERN | **North-Central Appalachian Acidic Swamp**




SOUTHERN | **North-Central Interior & Appalachian Rich Swamp**

# Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp




© Maine Natural Areas Program

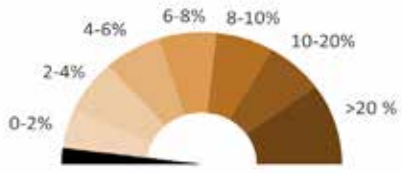
## Description

A conifer or mixed forested swamp of permanently saturated basins with seasonal standing water. Peat soils tend to support black spruce and larch, while mineral soils often include red maple, red spruce and balsam fir.

## Associated Herbs & Shrubs

greater water-starwort (*Callitriche heterophylla*), large-leaved avens (*Geum macrophyllum*), northern spicebush (*Lindera benzoin*), swamp lousewort (*Pedicularis lanceolata*), small-flowered-saxifrage (*Saxifraga pensylvanica*), mosses (*Calliergon obtusifolium, Calliergon richardsonii*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 5,291 | 13% | 5% | 16% | 33% | 67% |
| Above average | 14% | 106,926 | 9% | 4% | 23% | 35% | 65% |
| Slightly above average | 54% | 409,013 | 3% | 2% | 23% | 29% | 71% |
| Average | 17% | 132,211 | 1% | 1% | 11% | 14% | 86% |
| Slightly below average | 7% | 55,575 | 1% | 3% | 17% | 21% | 79% |
| Below average | 4% | 31,630 | 1% | 4% | 13% | 18% | 82% |
| Far below average | 0% | 3,386 | 1% | 1% | 8% | 11% | 89% |
| Developed | 2% | 17,480 | 1% | 2% | 13% | 16% | 84% |
| TOTAL | 100% | 761,511 | 4% | 3% | 20% | 26% | 74% |




**Predicted Loss to Development by 2050**

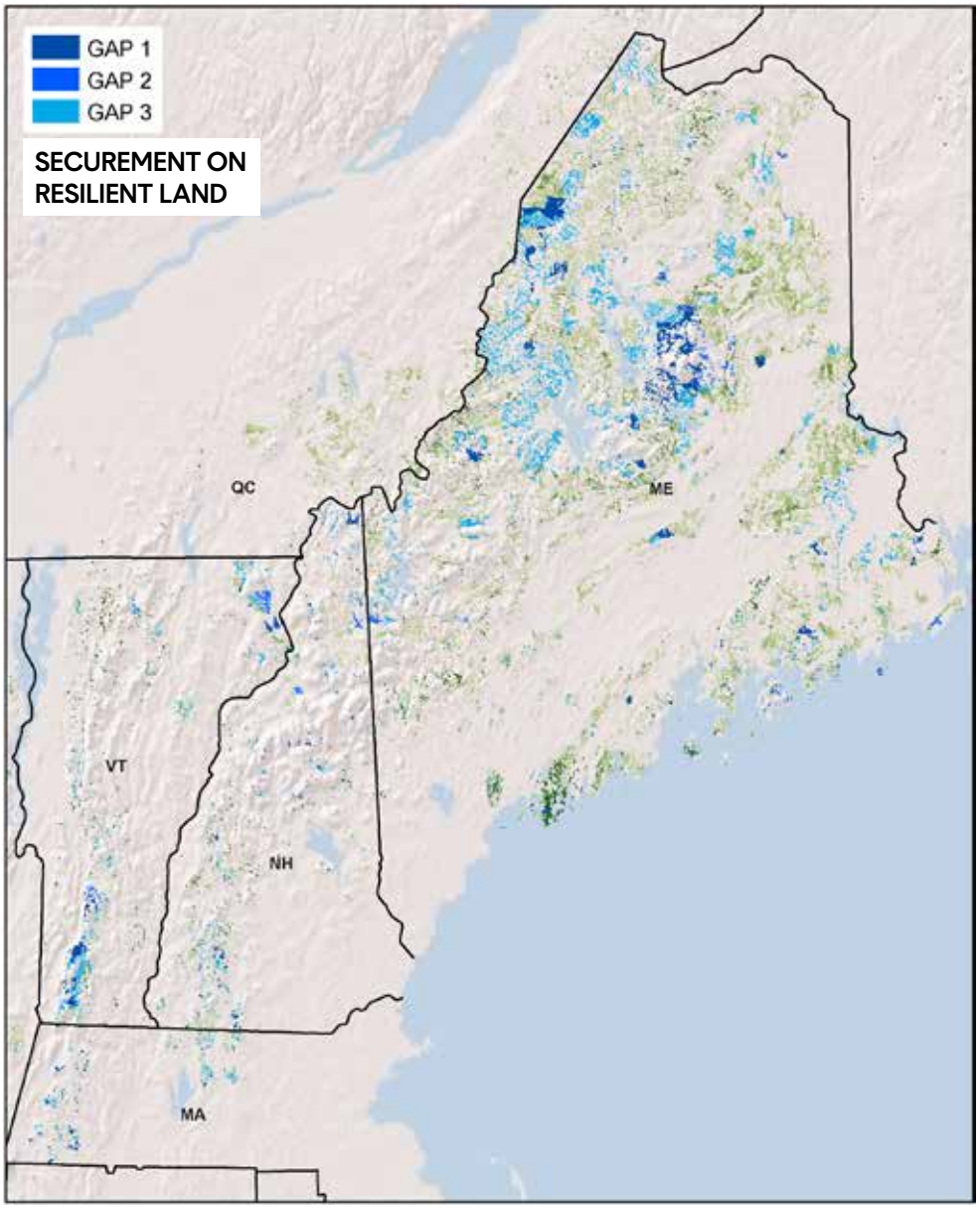
Very low 0%

This community is not threatened by development, with 3,680 acres (0%) likely to be lost over the next 30 years.

## Resilience & Securement

69% of this habitat scores high for resilience, 26% of the total acreage is secured against conversion, and 7% is protected.

# Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 761,511 | 26% |
| CT | 218 | 7% |
| MA | 26,596 | 44% |
| ME | 639,804 | 23% |
| NH | 45,741 | 33% |
| RI | | |
| VT | 49,153 | 44% |

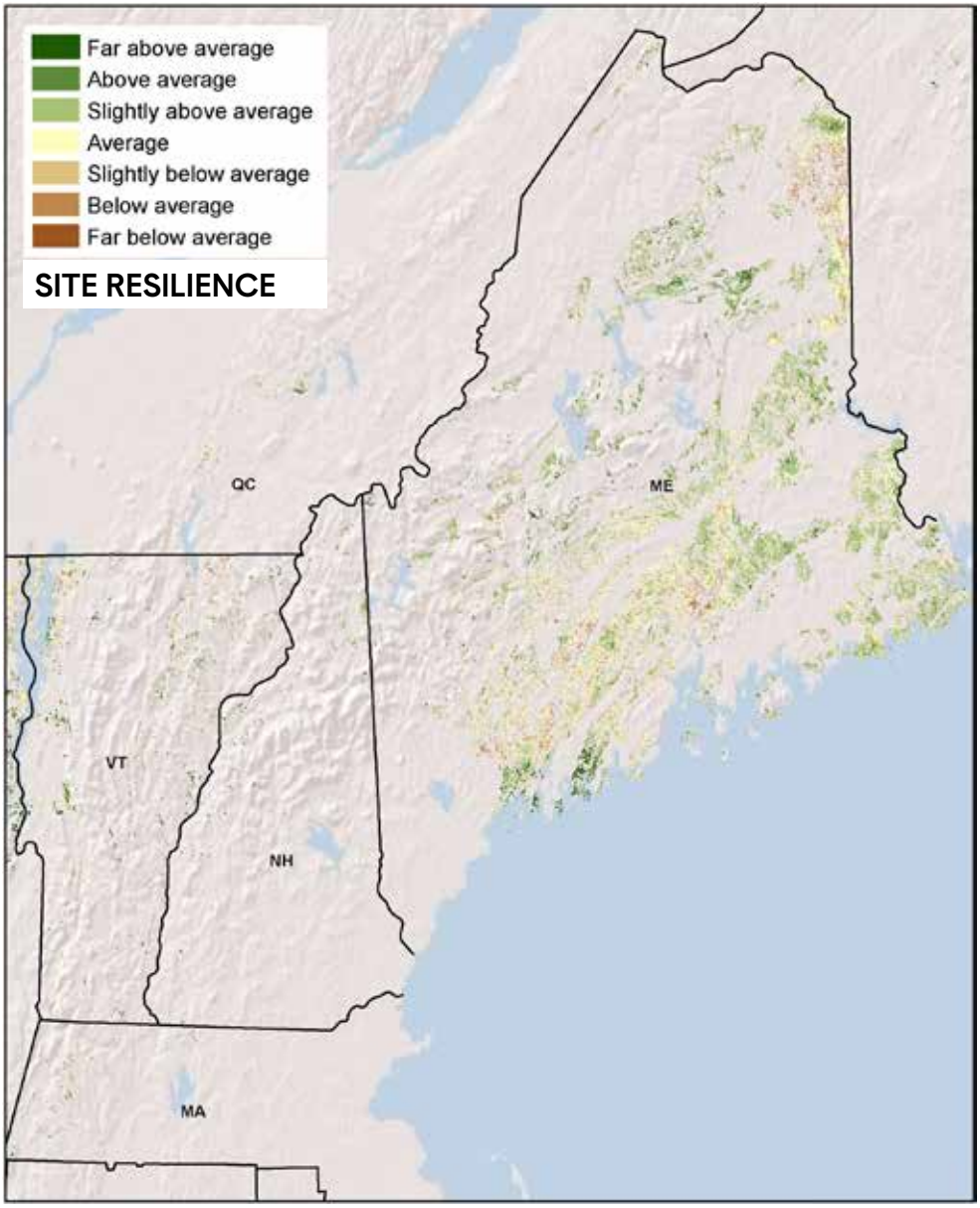
| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 521,230 | 30% |
| CT | 211 | 7% |
| MA | 9,834 | 57% |
| ME | 449,498 | 27% |
| NH | 26,546 | 40% |
| RI | | |
| VT | 35,141 | 55% |

## Rare or Uncommon Plants Associated with this Habitat

slender beadgrass
(*Paspalum setaceum* var. *psammophilum*)

© Elizabeth Thompson (Vermont Land Trust)

# Laurentian-Acadian Alkaline Conifer-Hardwood Swamp




© Elizabeth Thompson (Vermont Land Trust)

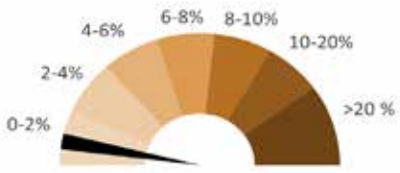
## Description

A forested swamp of alkaline wetlands associated with limestone or other calcareous substrate. Northern white cedar may dominate the canopy or be mixed with other conifers and hardwoods like red maple or black ash. Red-osier dogwood is a common shrub.

## Associated Herbs & Shrubs

bog aster (*Oclemena nemoralis*), fairy-slipper (*Calypso bulbosa*), green adder's-mouth (*Malaxis unifolia*), sage-willow (*Salix candida*), Lapland-crowfoot (*Coptidium lapponicum*), Loesel's wide-lipped orchid (*Liparis loeselii*), pink shinleaf (*Pyrola asarifolia*), swamp thistle (*Cirsium muticum*), Virginia screwstem (*Bartonia virginica*), greater yellow water-crowfoot (*Ranunculus flabellaris*), fen mosses (*Calliergon* spp., *Meesia triquetra*, etc.)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 2,359 | 2% | 5% | 11% | 18% | 82% |
| Above average | 9% | 52,923 | 2% | 4% | 16% | 21% | 79% |
| Slightly above average | 46% | 264,129 | 2% | 3% | 18% | 22% | 78% |
| Average | 26% | 150,800 | 1% | 2% | 7% | 10% | 90% |
| Slightly below average | 11% | 61,218 | 0% | 2% | 5% | 7% | 93% |
| Below average | 5% | 27,019 | 1% | 3% | 6% | 9% | 91% |
| Far below average | 0% | 1,693 | 1% | 0% | 6% | 7% | 93% |
| Developed | 2% | 13,826 | 0% | 2% | 7% | 9% | 91% |
| TOTAL | 100% | 573,968 | 1% | 3% | 13% | 17% | 83% |




**Predicted Loss to Development by 2050**

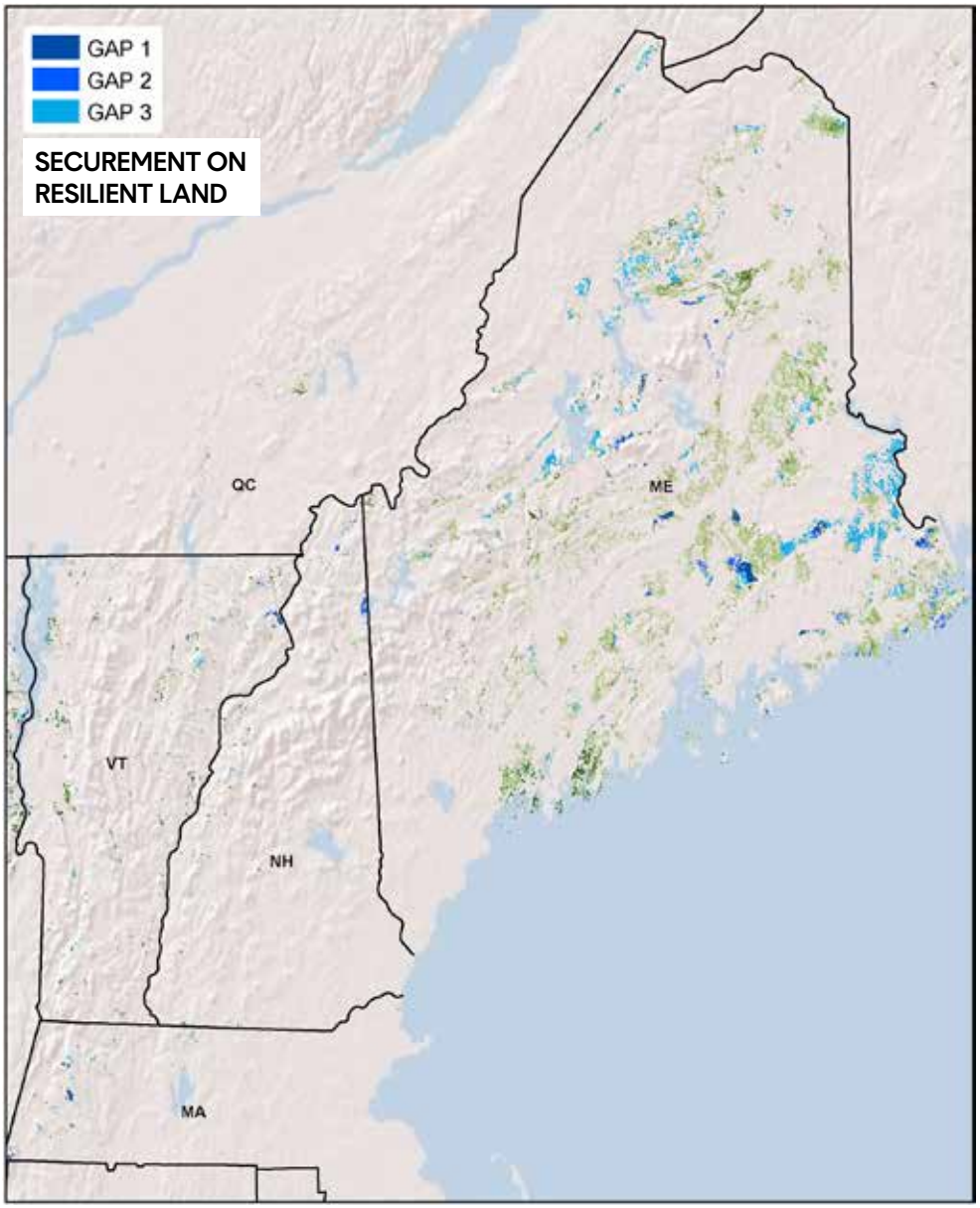
Very low 1%

This community is little threatened by development, with 5,531 acres (1%) likely to be lost over the next 30 years.

## Resilience & Securement

45% of this habitat scores high for resilience, 17% of the total acreage is secured against conversion, and 4% is protected.

# Laurentian-Acadian Alkaline Conifer-Hardwood Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 573,968 | 16% |
| CT | 86 | 0% |
| MA | 4,253 | 46% |
| ME | 518,316 | 16% |
| NH | 7,330 | 42% |
| RI | | |
| VT | 43,985 | 14% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 319,412 | 22% |
| CT | 36 | 0% |
| MA | 2,556 | 52% |
| ME | 295,248 | 21% |
| NH | 4,781 | 45% |
| RI | | |
| VT | 16,791 | 21% |

© Charles Ferree (The Nature Conservancy)

## Rare or Uncommon Plants Associated with this Habitat

ram's-head lady's-slipper (*Cypripedium arietinum*)

auricled twayblade (*Neottia auriculata*)

bog Jacob's-ladder (*Polemonium vanbruntiae*)

round-leaved orchid (*Amerorchis rotundifolia*)

northern bog sedge (*Carex gynocrates*)

sparse-flowered sedge (*Carex tenuiflora*)

yellow lady's-slipper (*Cypripedium parviflorum* var. *makasin*)

lesser yellow water crowfoot (*Ranunculus gmelinii*)

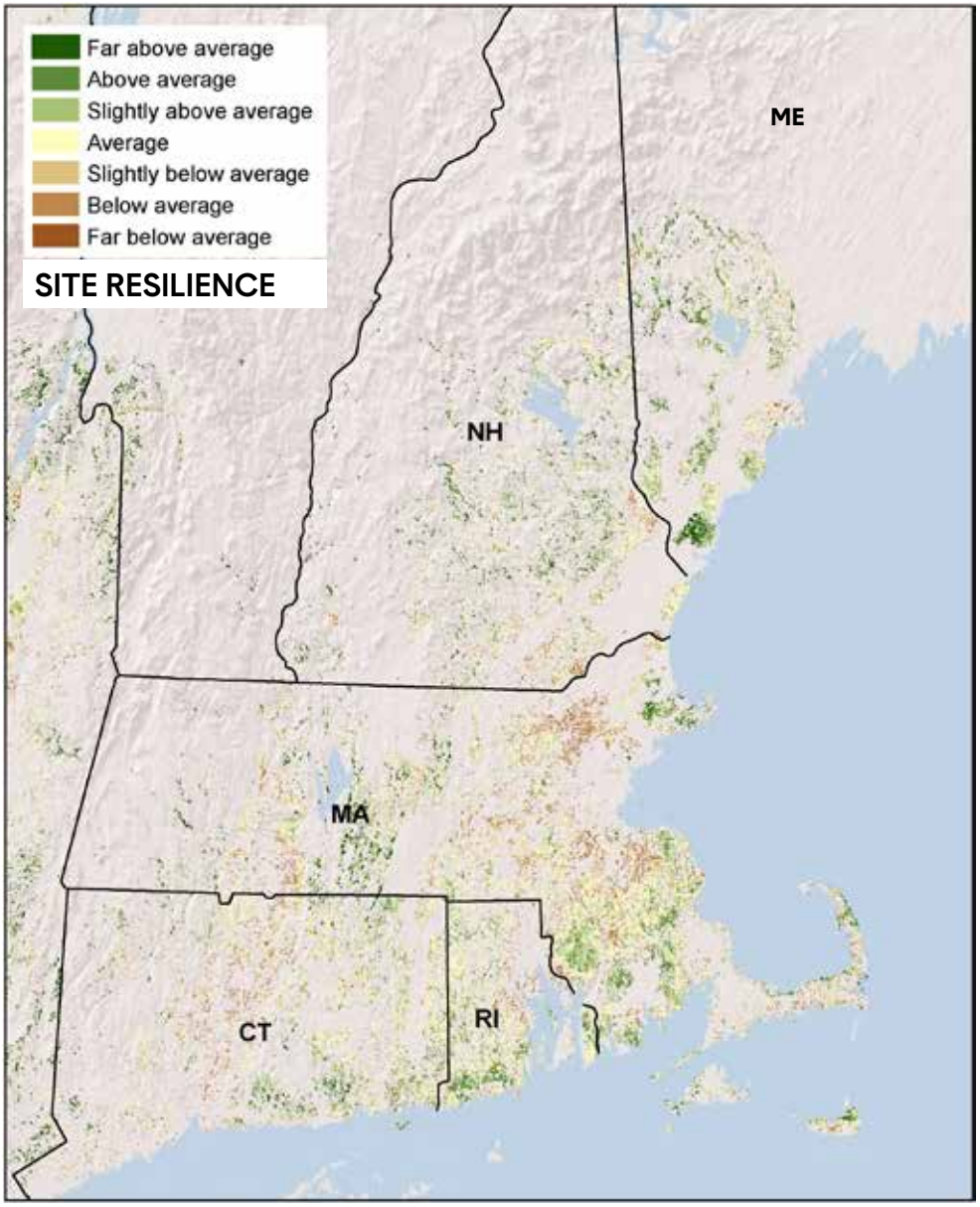
needle beak-sedge (*Rhynchospora capillacea*)

northern spikemoss (*Selaginella selaginoides*)

marsh valerian (*Valeriana uliginosa*)

white adder's-mouth (*Malaxis monophyllos* ssp. *brachypoda*)

# North-Central Appalachian Acidic Swamp




© Shane Gebauer (New York Natural Heritage Program)

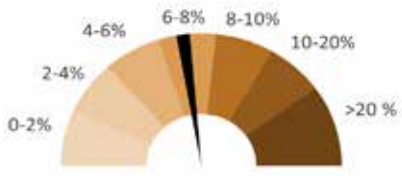
## Description

A conifer or mixed conifer-hardwood swamp of poorly drained acidic substrates, encompassing a broad range of basin, seepage, and stream-associated wetland communities. Hemlock may be dominant, along with red maple or black gum.

## Associated Herbs & Shrubs

bog-rosemary (*Andromeda polifolia* var. *glaucophylla*), boreal bog sedge (*Carex magellanica*), Canada lily (*Lilium canadense*), Labrador-tea (*Ledum groenlandicum*), creeping snowberry (*Gaultheria hispidula*), hairy hedge-nettle (*Stachys pilosa*), hairy-stemmed gooseberry (*Ribes hirtellum*), swamp dock (*Rumex verticillatus*), sweetgale (*Myrica gale*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 6,842 | 2% | 5% | 32% | 39% | 61% |
| Above average | 5% | 85,295 | 2% | 5% | 23% | 31% | 69% |
| Slightly above average | 11% | 148,072 | 2% | 4% | 21% | 27% | 73% |
| Average | 36% | 242,192 | 1% | 4% | 19% | 24% | 76% |
| Slightly below average | 16% | 48,501 | 1% | 3% | 19% | 23% | 77% |
| Below average | 15% | 29,550 | 1% | 1% | 19% | 21% | 79% |
| Far below average | 3% | 3,665 | 0% | 1% | 14% | 15% | 85% |
| Developed | 14% | 44,112 | 1% | 2% | 11% | 13% | 87% |
| TOTAL | 100% | 608,230 | 2% | 4% | 20% | 26% | 74% |




**Predicted Loss to Development by 2050**

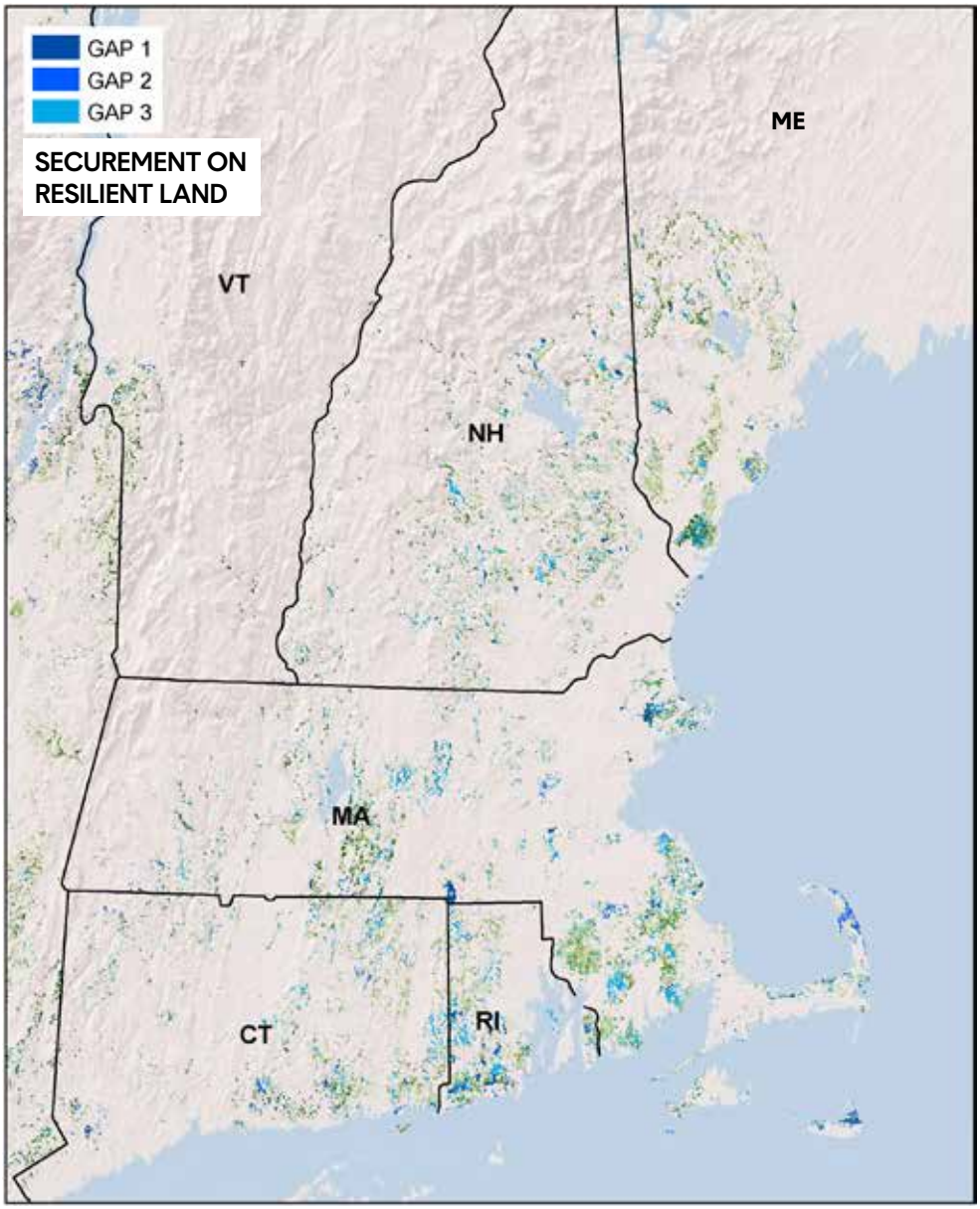
Moderate 7%

This community is somewhat threatened by development, with 43,405 acres (7%) likely to be lost over the next 30 years.

## Resilience & Securement

16% of this habitat scores high for resilience, 26% of the total acreage is secured against conversion, and 6% is protected.

# North-Central Appalachian Acidic Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 608,230 | 25% |
| CT | 111,732 | 22% |
| MA | 271,609 | 29% |
| ME | 61,573 | 13% |
| NH | 85,738 | 23% |
| RI | 67,364 | 30% |
| VT | 10,214 | 7% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 608,230 | 25% |
| CT | 111,732 | 22% |
| MA | 271,609 | 29% |
| ME | 61,573 | 13% |
| NH | 85,738 | 23% |
| RI | 67,364 | 30% |
| VT | 10,214 | 7% |

## Rare or Uncommon Plants Associated with this Habitat

southern lady fern (*Athyrium asplenioides*)

blunt-lobed grapefern (*Botrychium oneidense*)

Collins' sedge (*Carex collinsii*)

Mitchell's sedge (*Carex mitchelliana*)

forked rosette-panicgrass (*Dichanthelium dichotomum* ssp. *mattamuskeetense*)

sweet-gum (*Liquidambar styraciflua*)

many-fruited water-primrose (*Ludwigia polycarpa*)

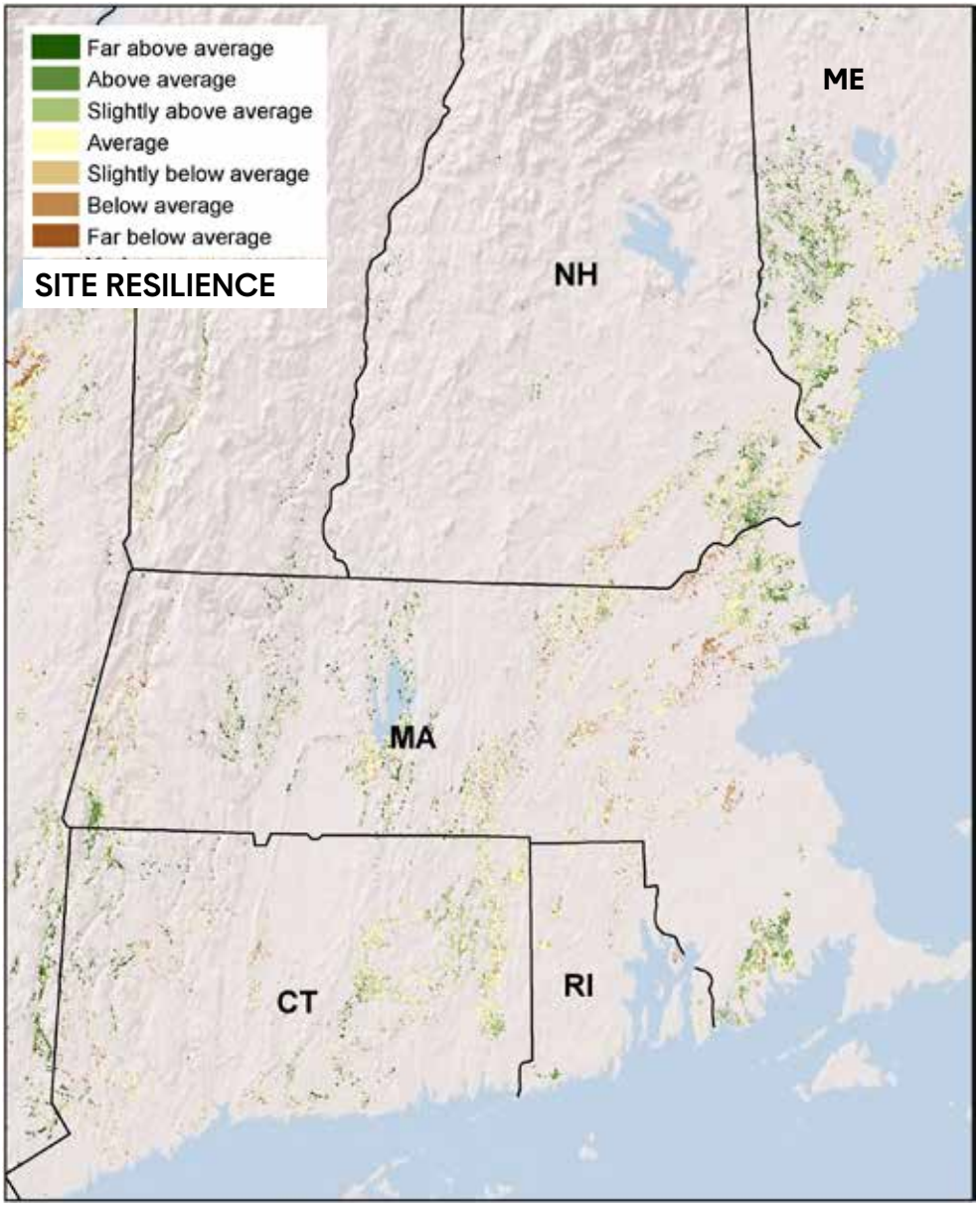
stalked water-horehound (*Lycopus rubellus*)

sweet-bay (*Magnolia virginiana* ssp. *virginiana*)

orange fringed bod-orchid (*Platanthera ciliaris*)

water-plantain crowfoot (*Ranunculus ambigens*)

# North-Central Interior & Appalachian Rich Swamp




© Elizabeth Thompson (Vermont Land Trust)

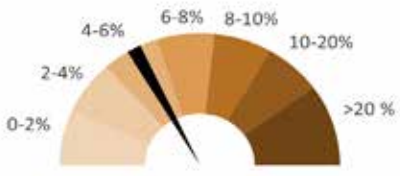
## Description

A hardwood or mixed swamp of alkaline wetlands associated with limestone or other calcareous substrate. Red maple and black ash are generally dominant, and conifers may include larch. A diverse ground cover is made up of herbs indicative of nutrient-rich conditions, ferns, and bryophytes characteristic of fens.

## Associated Herbs & Shrubs

bunchberry (*Chamaepericlymenum canadense*), four-flowered yellow-loosestrife (*Lysimachia quadriflora*), naked bishop's-cap (*Mitella nuda*), water avens (*Geum rivale*), rough-leaved goldenrod (*Solidago patula*), showy lady's-slipper (*Cypripedium reginae*), yellow-green sedge (*Carex flava*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 3,705 | 5% | 4% | 23% | 32% | 68% |
| Above average | 17% | 42,458 | 4% | 3% | 17% | 24% | 76% |
| Slightly above average | 25% | 64,044 | 2% | 3% | 17% | 23% | 77% |
| Average | 39% | 98,535 | 1% | 3% | 15% | 19% | 81% |
| Slightly below average | 6% | 16,054 | 1% | 4% | 16% | 20% | 80% |
| Below average | 4% | 9,153 | 1% | 3% | 15% | 18% | 82% |
| Far below average | 0% | 1,231 | 0% | 1% | 9% | 10% | 90% |
| Developed | 7% | 16,351 | 1% | 2% | 8% | 10% | 90% |
| TOTAL | 100% | 251,531 | 2% | 3% | 16% | 21% | 79% |




**Predicted Loss to Development by 2050**

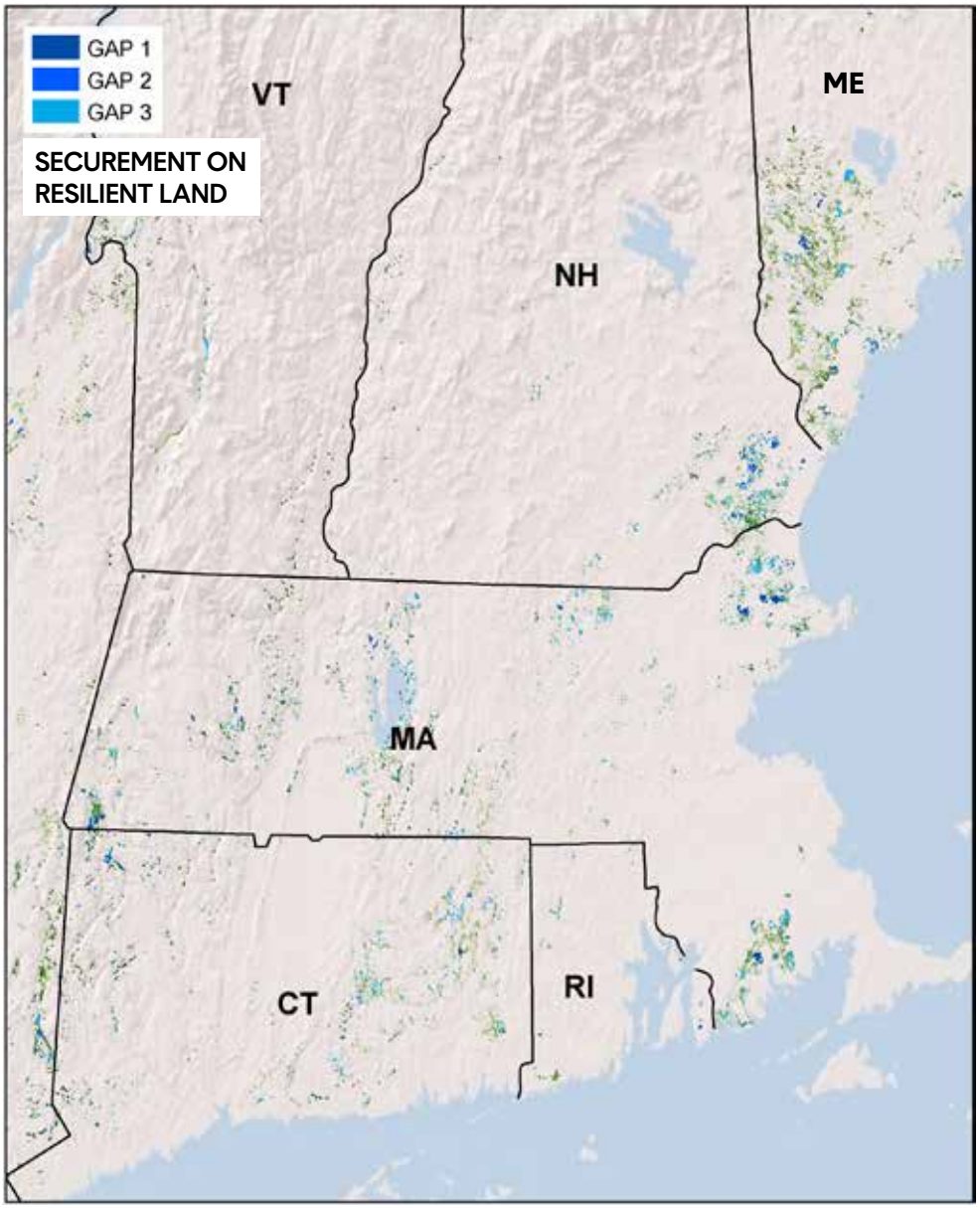
Moderately low 5%

This community is somewhat threatened by development, with 13,798 acres (5%) likely to be lost over the next 30 years.

## Resilience & Securement

43% of this habitat scores high for resilience, 21% of the total acreage is secured against conversion, and 5% is protected.

# North-Central Interior & Appalachian Rich Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 251,531 | 20% |
| CT | 61,244 | 19% |
| MA | 96,720 | 27% |
| ME | 50,788 | 11% |
| NH | 28,212 | 24% |
| RI | 5,635 | 18% |
| VT | 8,932 | 9% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 110,206 | 23% |
| CT | 23,010 | 23% |
| MA | 37,937 | 33% |
| ME | 30,976 | 12% |
| NH | 12,219 | 29% |
| RI | 1,665 | 16% |
| VT | 4,400 | 14% |

## Rare or Uncommon Plants Associated with this Habitat

white cuckoo bitter-cress (*Cardamine dentata*)

pink bitter-cress (*Cardamine douglassii*)

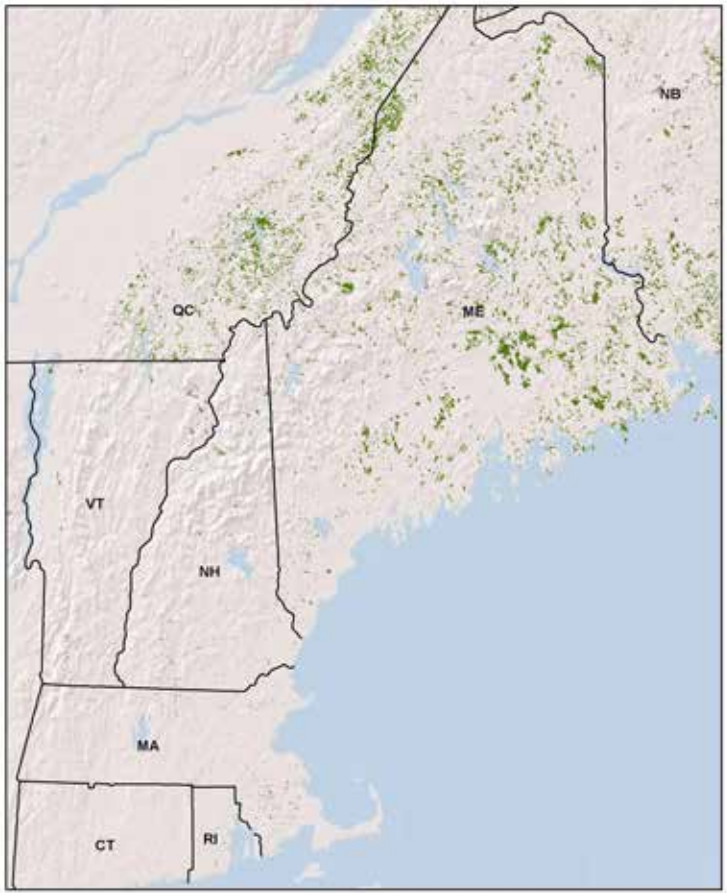
Crawe's sedge (*Carex crawei*)

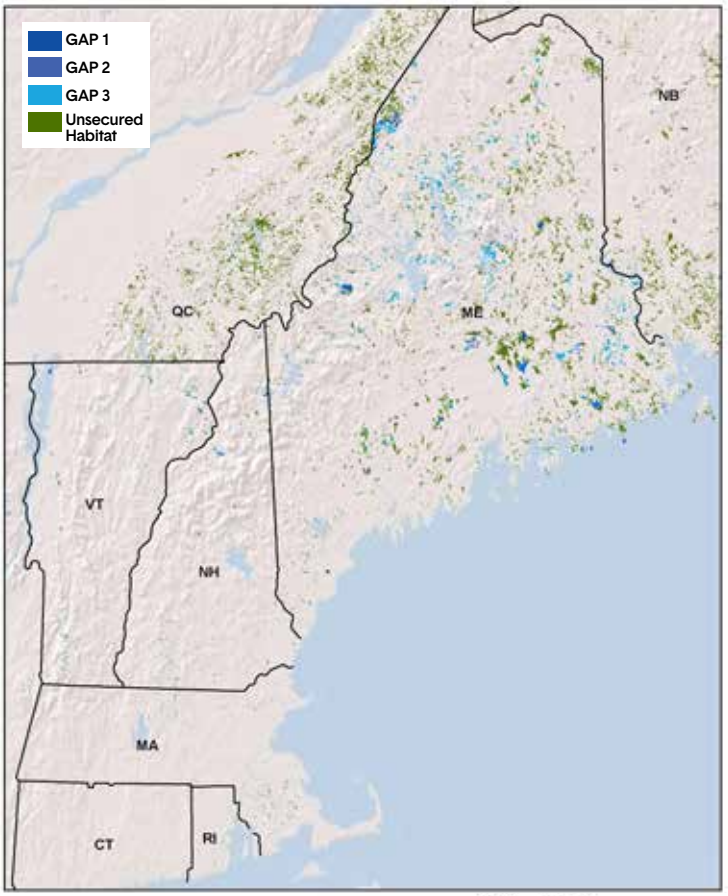
needle beak-sedge (*Rhynchospora capillacea*)

water speedwell (*Veronica catenata*)

MACROGROUP

# NORTHERN PEATLAND

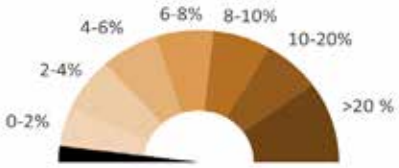



**Northern Peatland**
Sedge, grass, dwarf-shrub, or tree-dominated peatlands, mostly in northern New England.

**Acres in New England**
386,247

**Percent Secured**
GAP 1 = 5%
GAP 2 = 6%
GAP 3 = 19%

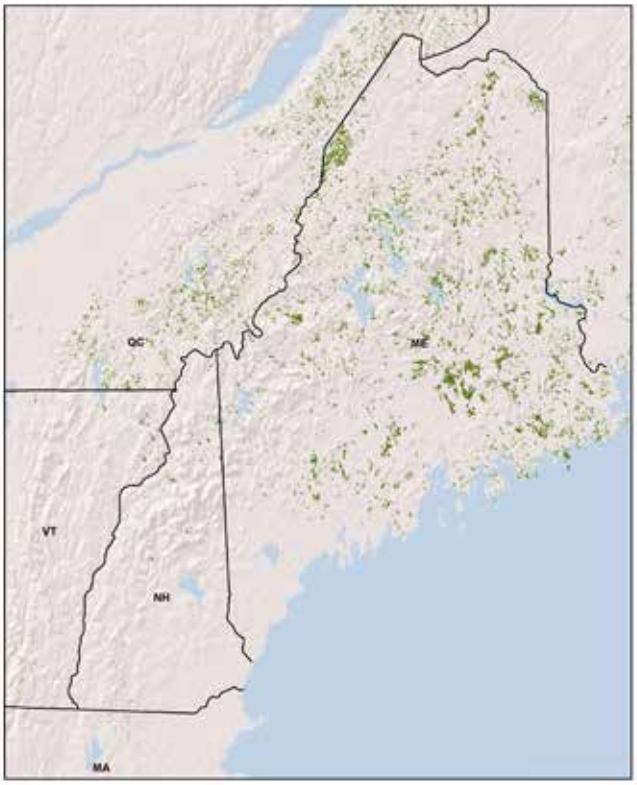



**Predicted Loss to Development by 2050**
1,965 acres (<1%)

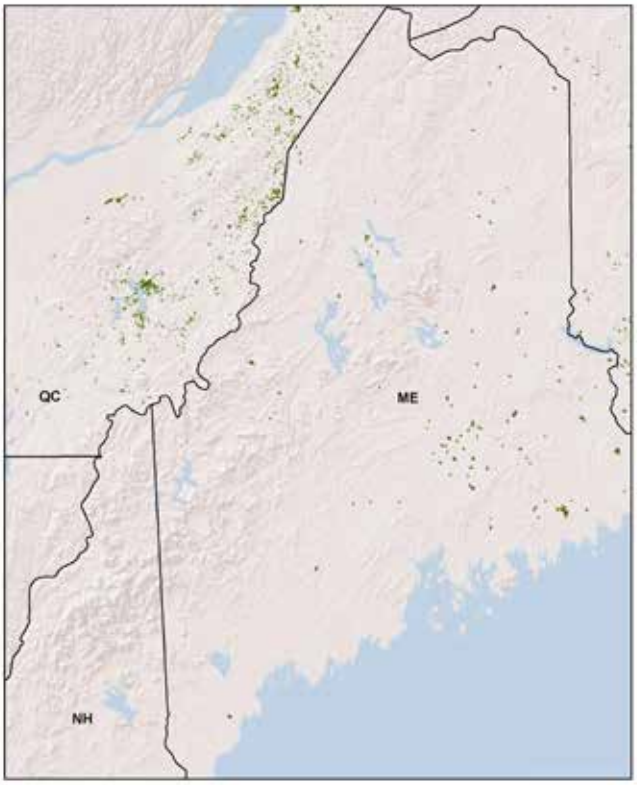
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Northern Peatland** | **381,257** | **5%** | **6%** | **19%** | **69%** | **1** | | | **1** |
| Connecticut | 558 | 8% | 7% | 18% | 67% | | | | |
| Massachusetts | 4,539 | 3% | 4% | 33% | 61% | | | | |
| Maine | 357,092 | 5% | 6% | 18% | 71% | 1 | | | 1 |
| New Hampshire | 9,657 | 15% | 9% | 22% | 53% | | | | |
| Rhode Island | 333 | 0% | 11% | 62% | 27% | | | | |
| Vermont | 9,078 | 13% | 27% | 24% | 35% | | | | |
| **New England** | **381,257** | **20,627** | **24,162** | **71,515** | **264,952** | | | | |

P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS

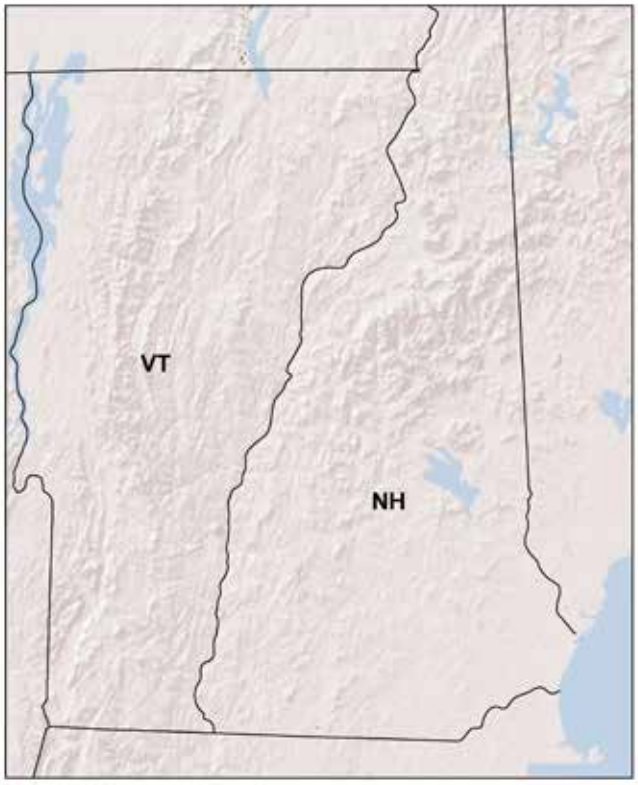



**Boreal-Laurentian-Acadian Acidic Basin Fen**




**Boreal-Laurentian Bog**


**Acadian Maritime Bog**

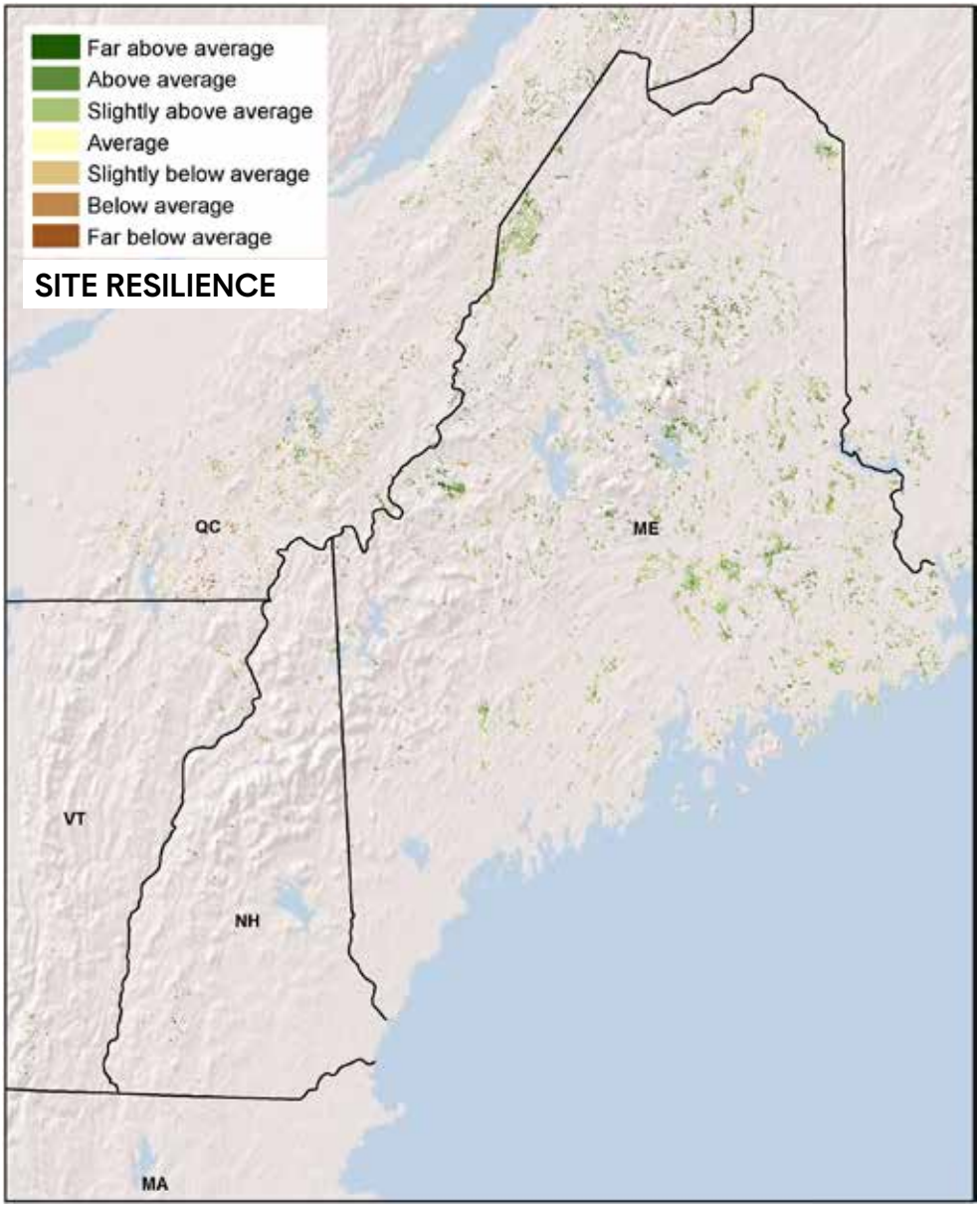



**Laurentian-Acadian Alkaline Fen**

# DISTRIBUTION OF HABITATS


**North-Central Interior & Appalachian Acidic Peatland**

# Boreal-Laurentian-Acadian Acidic Basin Fen




© Eric Sorenson (Vermont Fish & Wildlife)

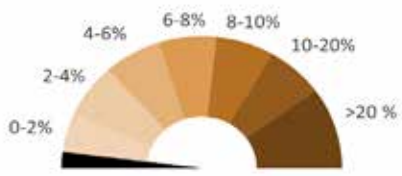
## Description

A sedge, grass, and dwarf-shrub dominated peatland of the north. Intermediate between a marsh and a bog, these fens develop in relatively shallow basins with nutrient-poor and acidic conditions and may form a floating peat-based mat over water. Sparse trees.

## Associated Herbs & Shrubs

aster (*Oclemena nemoralis*), northern bog bedstraw (*Galium labradoricum*), boreal bog sedge (*Carex magellanica*), bog willow (*Salix pedicellaris*), dwarf water-lily (*Nymphaea leibergii*), mud sedge (*Carex limosa*), prickly bog sedge (*Carex atlantica*), swamp birch (*Betula pumila*), inkberry (*Ilex glabra*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 1,435 | 17% | 3% | 33% | 53% | 47% |
| Above average | 20% | 63,531 | 8% | 4% | 22% | 34% | 66% |
| Slightly above average | 59% | 190,194 | 5% | 5% | 21% | 31% | 69% |
| Average | 14% | 46,890 | 2% | 6% | 9% | 17% | 83% |
| Slightly below average | 4% | 13,987 | 3% | 8% | 19% | 30% | 70% |
| Below average | 1% | 4,108 | 12% | 10% | 21% | 43% | 57% |
| Far below average | 0% | 159 | 16% | 5% | 11% | 32% | 68% |
| Developed | 1% | 3,570 | 3% | 3% | 12% | 18% | 82% |
| TOTAL | 100% | 323,874 | 5% | 5% | 19% | 29% | 71% |




**Predicted Loss to Development by 2050**

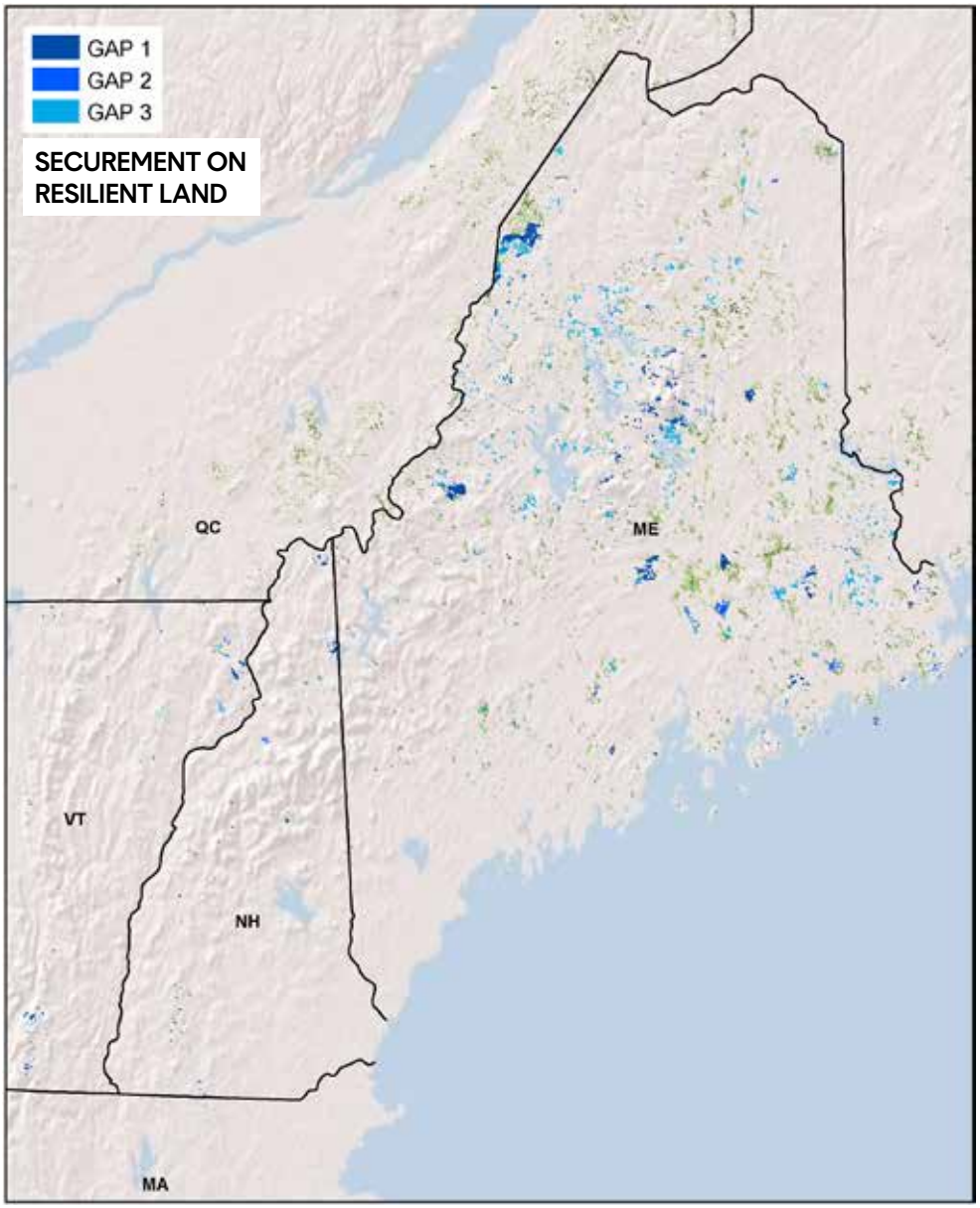
Very low 0%

This community is not threatened by development.

## Resilience & Securement

79% of this habitat scores high for resilience, 29% of the total acreage is secured against conversion, and 10% is protected.

# Boreal-Laurentian-Acadian Acidic Basin Fen




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 323,874 | 29% |
| CT | | |
| MA | 684 | 38% |
| ME | 309,849 | 28% |
| NH | 6,950 | 50% |
| RI | | |
| VT | 6,391 | 65% |

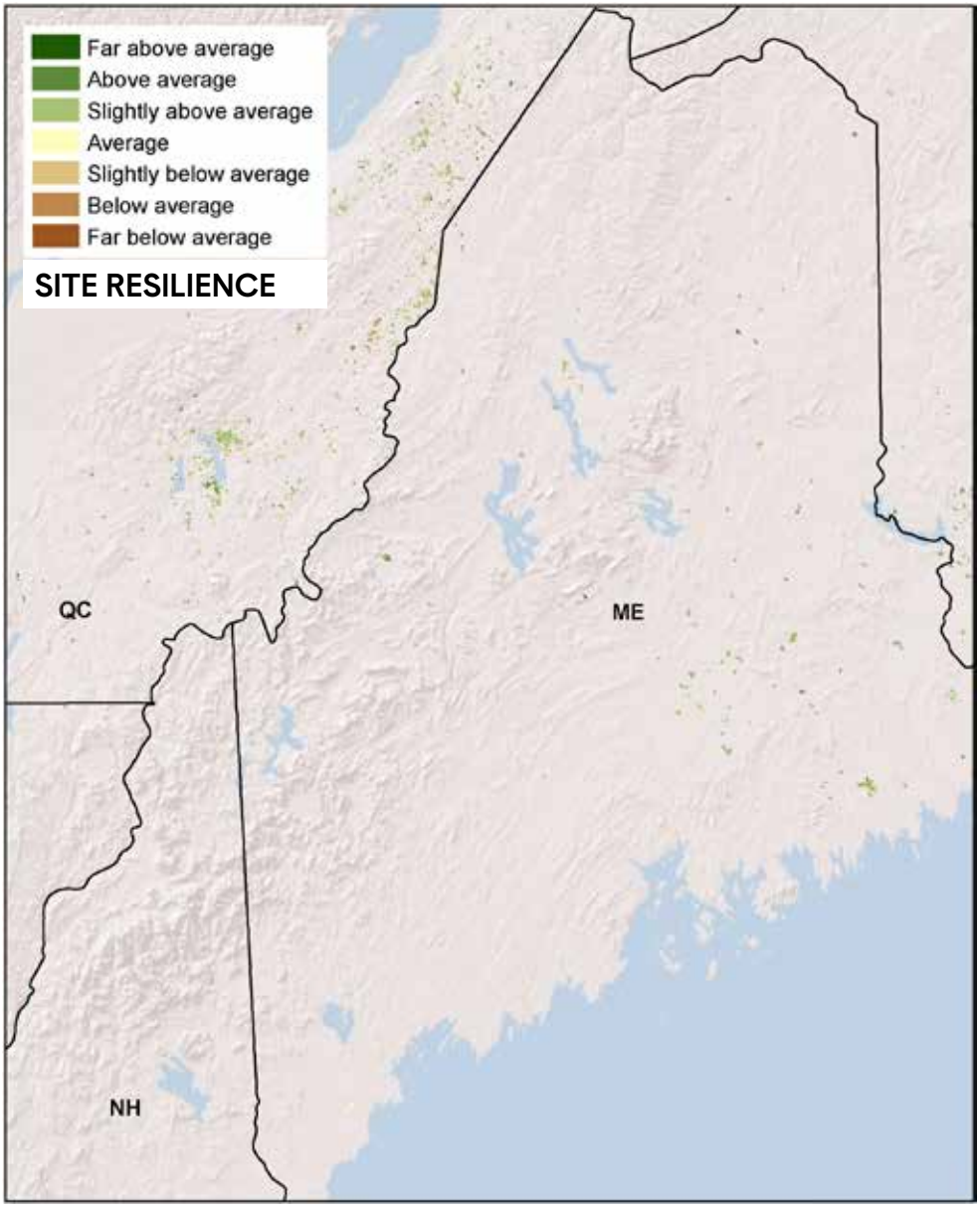
| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 255,161 | 32% |
| CT | | |
| MA | 309 | 53% |
| ME | 245,653 | 31% |
| NH | 4,792 | 50% |
| RI | | |
| VT | 4,407 | 69% |

## Rare or Uncommon Plants Associated with this Habitat

Long's woolsedge
(*Scirpus longii*)

© Elizabeth Thompson (Vermont Land Trust)

# Boreal-Laurentian Bog




© Maine Natural Areas Program

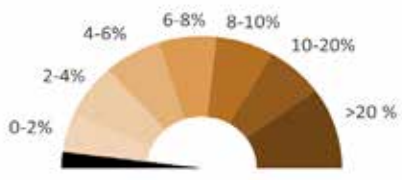
## Description

A raised peatland of near-boreal latitudes dominated by low heath shrubs (sheep laurel, bog laurel, Labrador tea, leatherleaf) and patches of sedge and bryophyte lawns. Sparse black spruce and larch are characteristic. Typical forbs include sundews, pitcher plants, and several orchids.

## Associated Herbs & Shrubs

bog aster (*Oclemena nemoralis*), boreal bog sedge (*Carex magellanica*), inkberry (*Ilex glabra*), green alder (*Alnus viridis* ssp. *crispa*), mountain cranberry (*Vaccinium vitis-idaea*), twining bartonia (*Bartonia paniculata*), swamp birch (*Betula pumila*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 73 | 15% | 13% | 28% | 56% | 44% |
| Above average | 15% | 5,553 | 6% | 20% | 13% | 39% | 61% |
| Slightly above average | 57% | 21,393 | 7% | 14% | 16% | 37% | 63% |
| Average | 21% | 7,930 | 17% | 12% | 7% | 36% | 64% |
| Slightly below average | 6% | 2,266 | 0% | 7% | 26% | 32% | 68% |
| Below average | 1% | 257 | 0% | 0% | 10% | 10% | 90% |
| Far below average | 0% | | | | | | |
| Developed | 0% | 65 | 0% | 2% | 4% | 6% | 94% |
| **TOTAL** | **100%** | **37,537** | **9%** | **14%** | **14%** | **37%** | **63%** |




**Predicted Loss to Development by 2050**

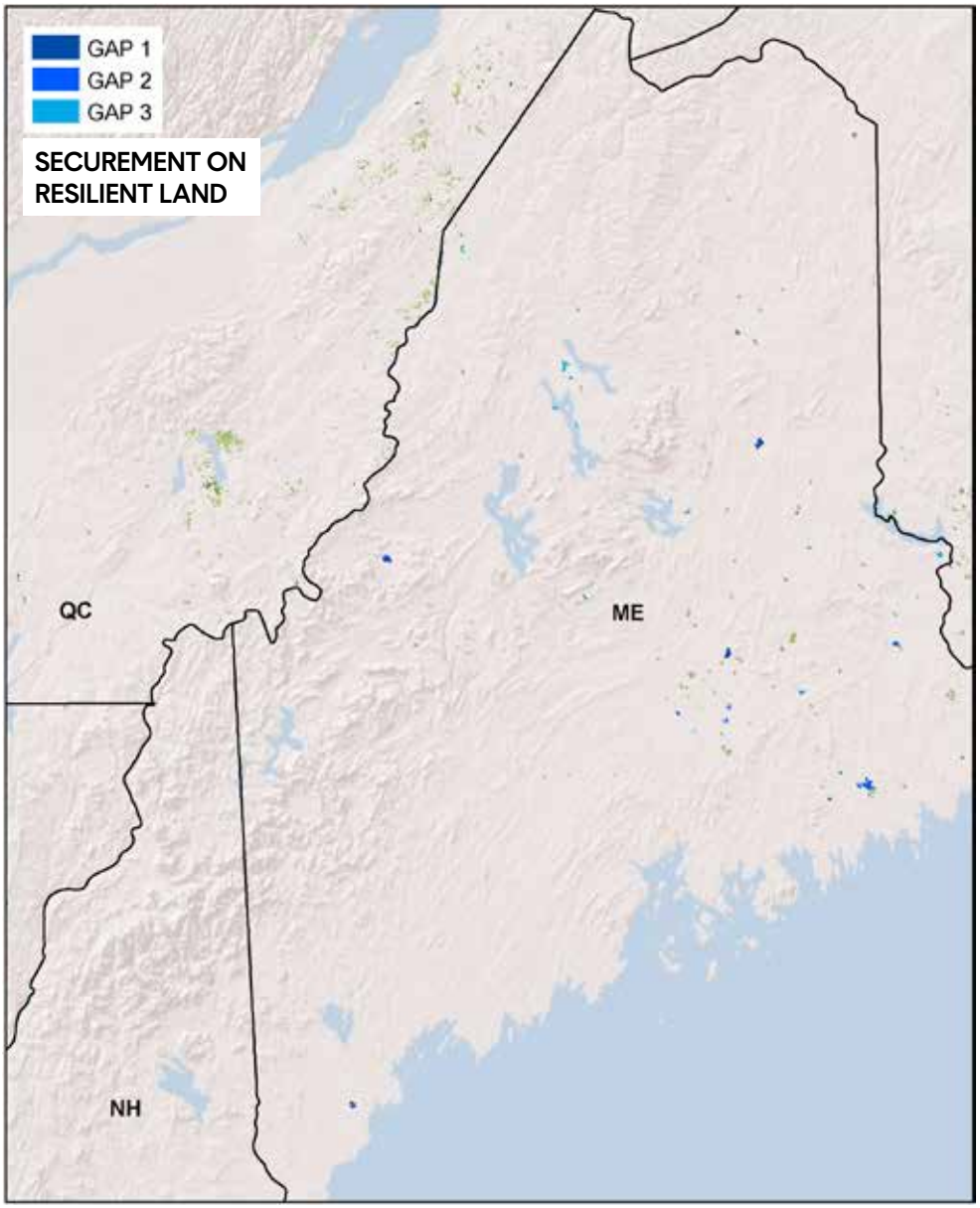
Very low 0%

This community is not threatened by development.

## Resilience & Securement

72% of this habitat scores high for resilience, 37% of the total acreage is secured against conversion, and 23% is protected.

# Boreal-Laurentian Bog




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 37,537 | 37% |
| CT | | |
| MA | | |
| ME | 37,381 | 36% |
| NH | 2 | 57% |
| RI | | |
| VT | 154 | 100% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 27,019 | 38% |
| CT | | |
| MA | | |
| ME | 26,865 | 37% |
| NH | 0 | |
| RI | | |
| VT | 154 | 100% |

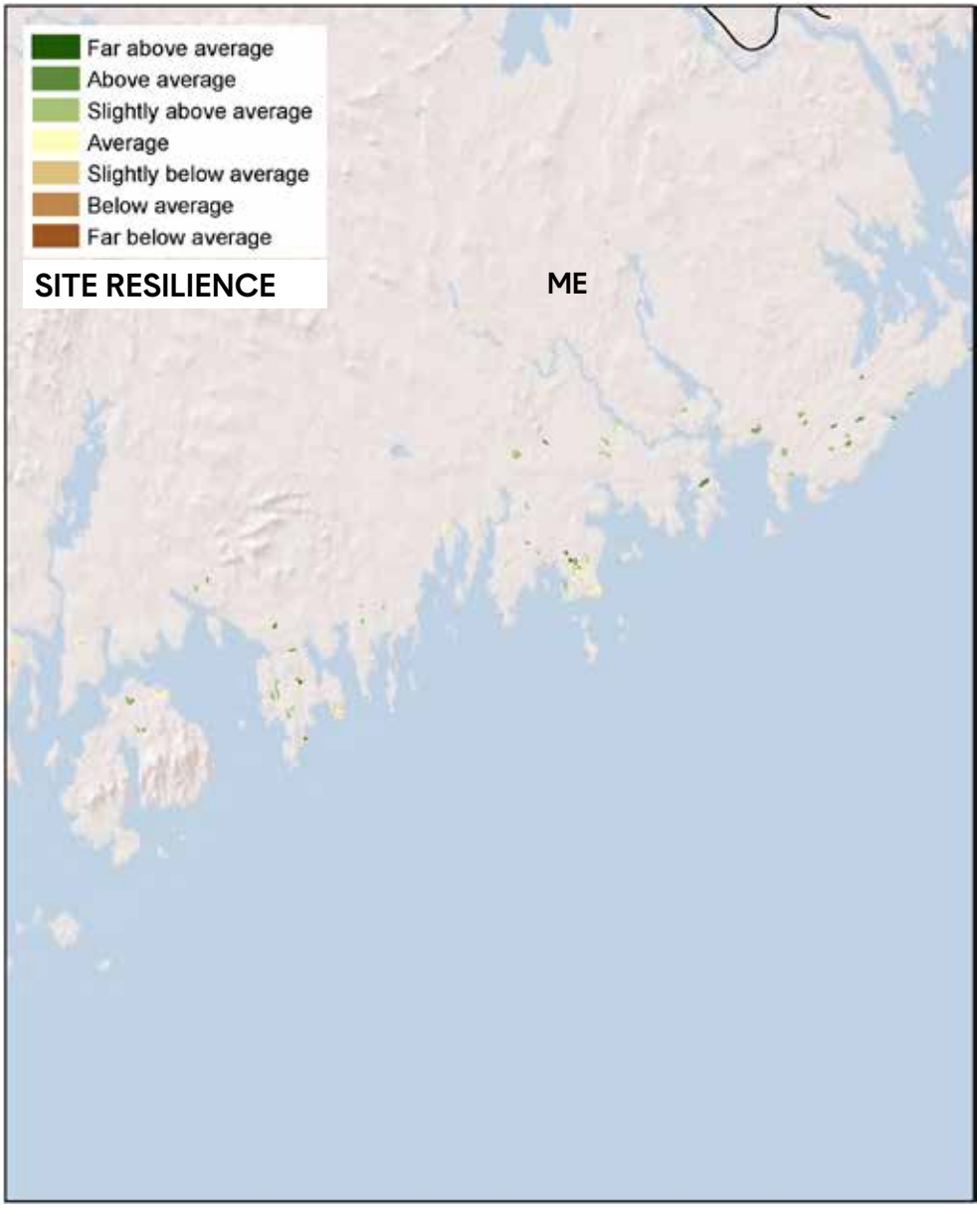
## Rare or Uncommon Plants Associated with this Habitat

livid sedge
(*Carex livida*)

southern twayblade
(*Neottia bifolia*)

© Andy Cutco (Maine Natural Areas Program)

# Acadian Maritime Bog




© Maine Natural Areas Program

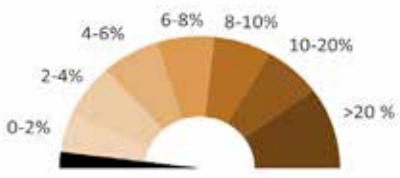
## Description

An acidic peatland dominated by dwarf shrubs, sedges, and peat-mosses and occurring along the northern Atlantic Coast. When these form in basins, they develop raised plateaus with undulating sedge and dwarf-shrub vegetation. They also occur as "blanket bogs" over a sloping rocky substrate in extreme maritime settings.

## Associated Herbs & Shrubs

swamp birch (*Betula pumila*), sheep-laurel (*Kalmia angustifolia*), bog laurel (*Kalmia polifolia*), black huckleberry (*Gaylussacia baccata*), Labrador-tea (*Rhododendron groenlandicum*), black crowberry (*Empetrum nigrum*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 38 | 18% | 22% | 0% | 40% | 60% |
| Above average | 15% | 773 | 12% | 29% | 4% | 45% | 55% |
| Slightly above average | 43% | 2,252 | 2% | 18% | 4% | 24% | 76% |
| Average | 34% | 1,757 | 3% | 19% | 1% | 22% | 78% |
| Slightly below average | 6% | 310 | 3% | 30% | 0% | 32% | 68% |
| Below average | 1% | 54 | 0% | 21% | 0% | 22% | 78% |
| Far below average | 0% | 1 | 0% | 100% | 0% | 100% | 0% |
| Developed | 1% | 38 | 0% | 53% | 6% | 59% | 41% |
| TOTAL | 100% | 5,223 | 4% | 21% | 3% | 27% | 73% |




**Predicted Loss to Development by 2050**

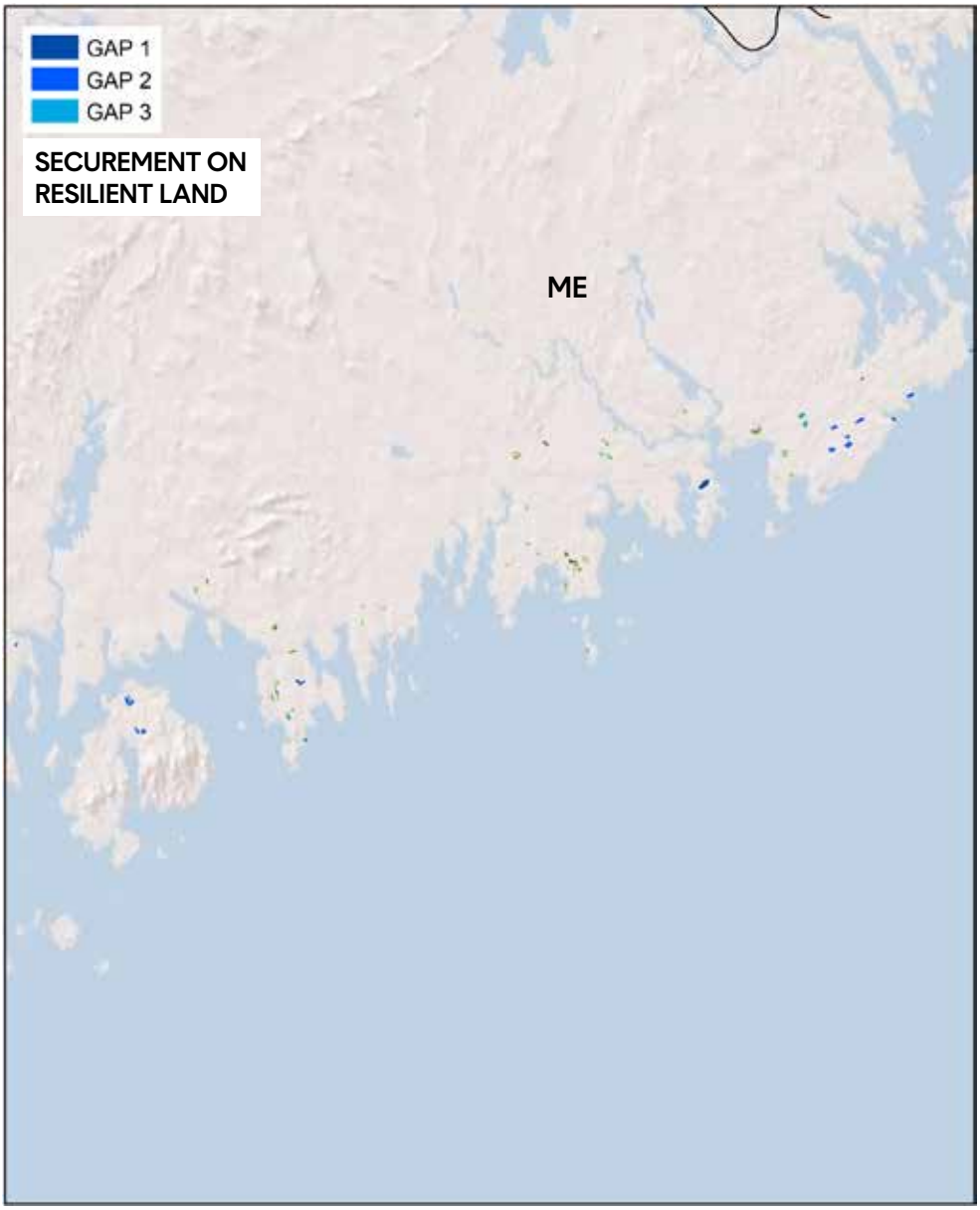
Very low 0%

This community is not threatened by development.

## Resilience & Securement

59% of this habitat scores high for resilience, 28% of the total acreage is secured against conversion, and 25% is protected.

# Acadian Maritime Bog




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 5,223 | 27% |
| CT | | |
| MA | | |
| ME | 5,223 | 27% |
| NH | | |
| RI | | |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 3,063 | 29% |
| CT | | |
| MA | | |
| ME | 3,063 | 29% |
| NH | | |
| RI | | |
| VT | | |

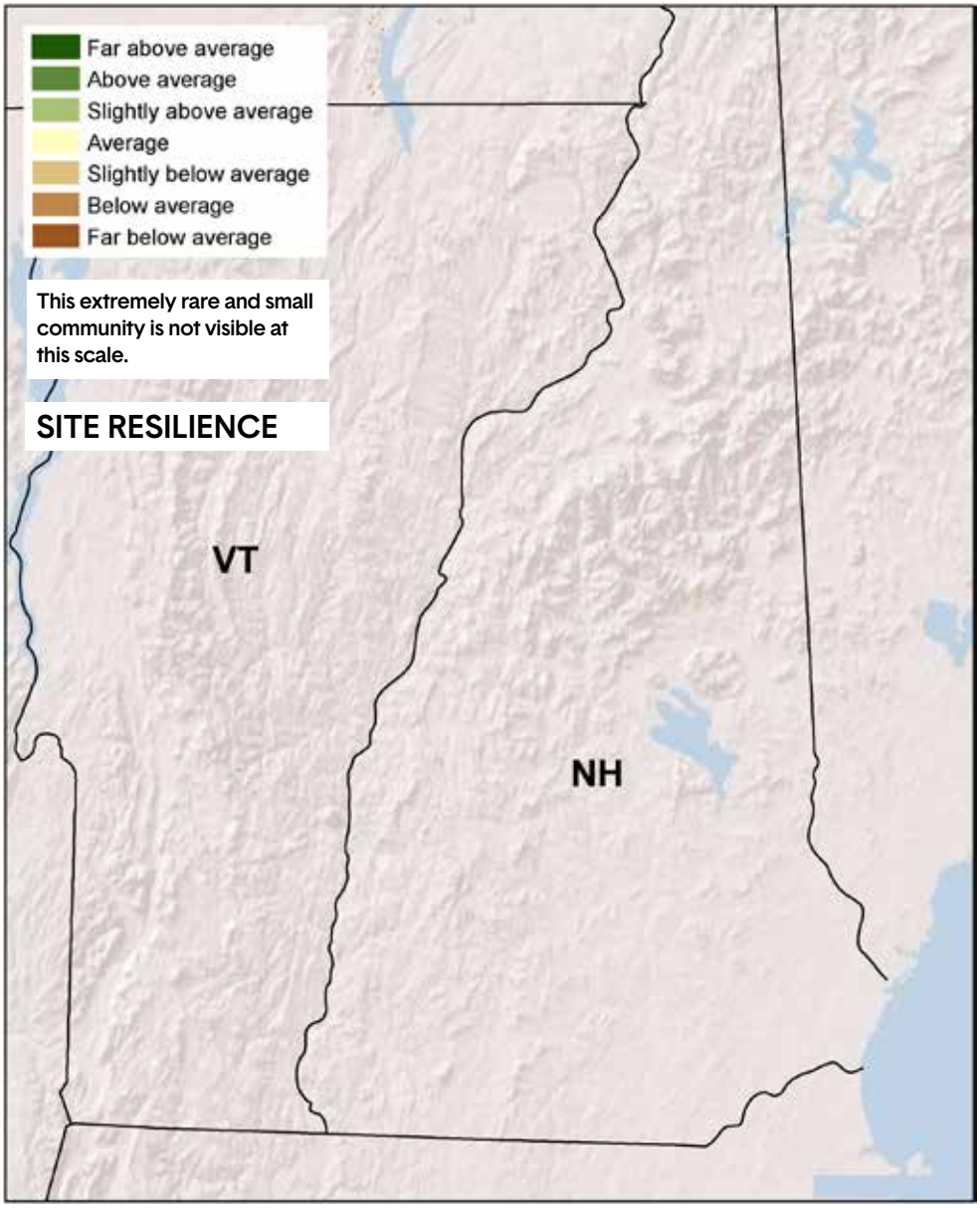
## Rare or Uncommon Plants Associated with this Habitat

baked-apple-berry
(*Rubus chamaemorus*)

northern comandra
(*Geocaulon lividum*)

© Josh Royte (The Nature Conservancy, Maine)

# Laurentian-Acadian Alkaline Fen




© Maine Natural Areas Program

## Description

A sedge-shrub wetland associated with calcareous groundwater or seepage. Dominated by sedges such as yellow-green sedge, wooly-fruited sedge, and herbs such as fen grass-of-Parnassus, buck-bean, and shrubby-cinquefoil.

## Associated Herbs & Shrubs

boreal bedstraw (*Galium kamtchaticum*), bog willow (*Salix pedicellaris*), seaside arrow-grass (*Triglochin maritima*), rope-root sedge (*Carex chordohrizza*), dragon's-mouth (*Arethusa bulbosa*), rigid sedge (*Carex tetanica*), few-flowered spikesedge (*Eleocharis quinqueflora*), flat-leaved bladderwort (*Utricularia intermedia*), hard-stemmed club-bulrush (*Schoenoplectus acutus*), many-headed sedge (*Carex synchocephala*), prairie sedge (*Carex prairea*), slender cottongrass (*Eriophorum gracile*), bog birch (*Betula pumila*), swamp thistle (*Cirsium muticum*), northern sweet-coltsfoot (*Petasites frigidus* var. *palmatus*), water sedge (*Carex aquatilis*)

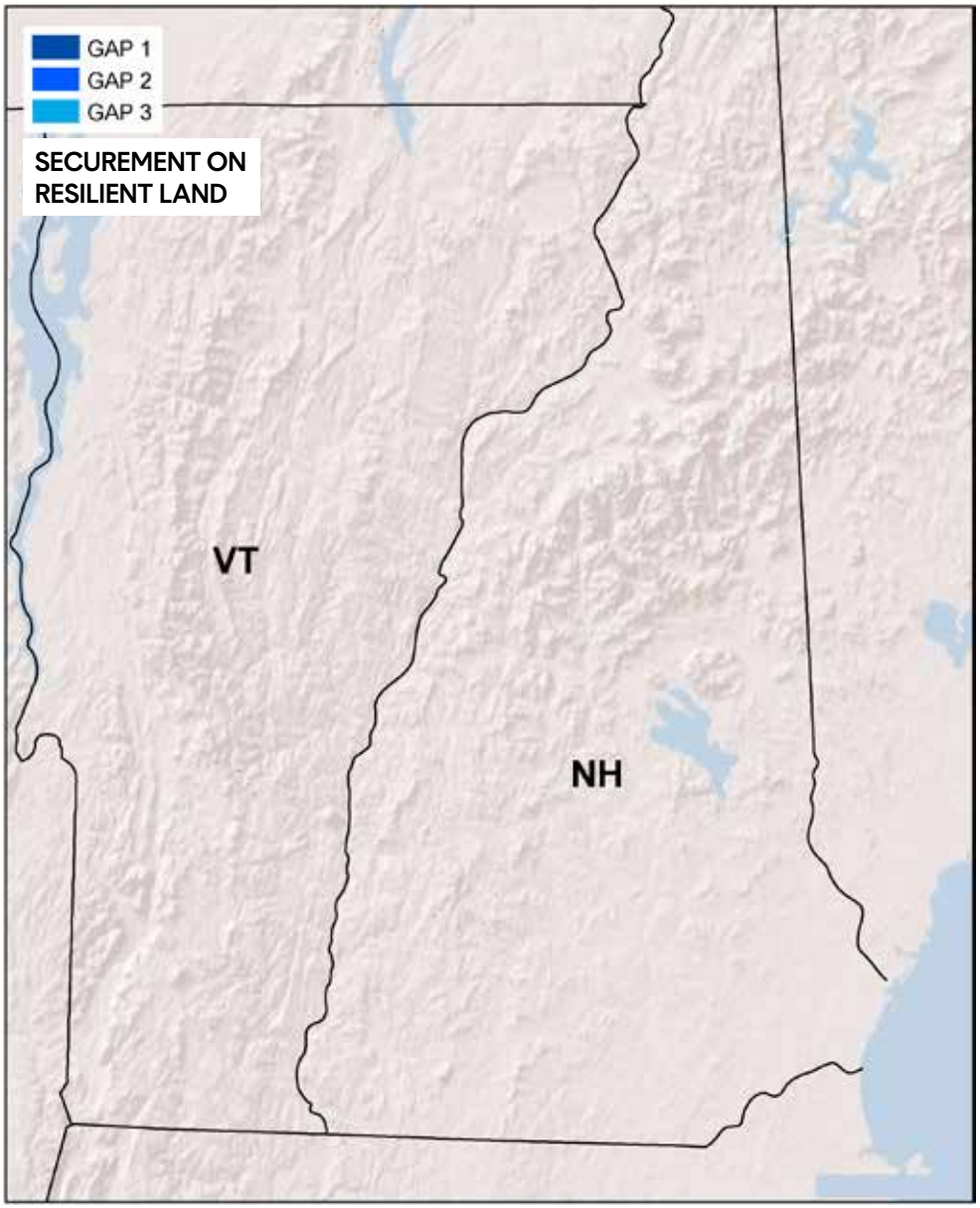
| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 4 | 0% | 0% | 22% | 22% | 78% |
| Above average | 14% | 29 | 8% | 0% | 23% | 31% | 69% |
| Slightly above average | 30% | 65 | 2% | 0% | 60% | 62% | 38% |
| Average | 21% | 46 | 0% | 0% | 29% | 29% | 71% |
| Slightly below average | 27% | 58 | 0% | 0% | 3% | 3% | 97% |
| Below average | 6% | 14 | 6% | 0% | 6% | 13% | 87% |
| Far below average | 0% | | | | | | |
| Developed | 1% | 1 | 0% | 0% | 40% | 40% | 60% |
| TOTAL | 100% | 217 | 2% | | 29% | 31% | 69% |

**This rare habitat is not well mapped, and the numbers on these pages should be considered very approximate.**

## Resilience & Securement

46% of this rare habitat scores high for resilience, 31% of the total acreage is secured against conversion, and 2% is protected.

# Laurentian-Acadian Alkaline Fen




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 217 | 31% |
| CT | | |
| MA | 23 | 38% |
| ME | 20 | 76% |
| NH | 80 | 53% |
| RI | | |
| VT | 95 | 1% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 98 | 51% |
| CT | | |
| MA | 17 | 43% |
| ME | 20 | 76% |
| NH | 35 | 75% |
| RI | | |
| VT | 26 | 5% |

## Rare or Uncommon Plants Associated with this Habitat

livid sedge
(*Carex livida*)

English sundew
(*Drosera anglica*)

slender-leaved sundew
(*Drosera linearis*)

moor rush
(*Juncus stygius* ssp. *americanus*)

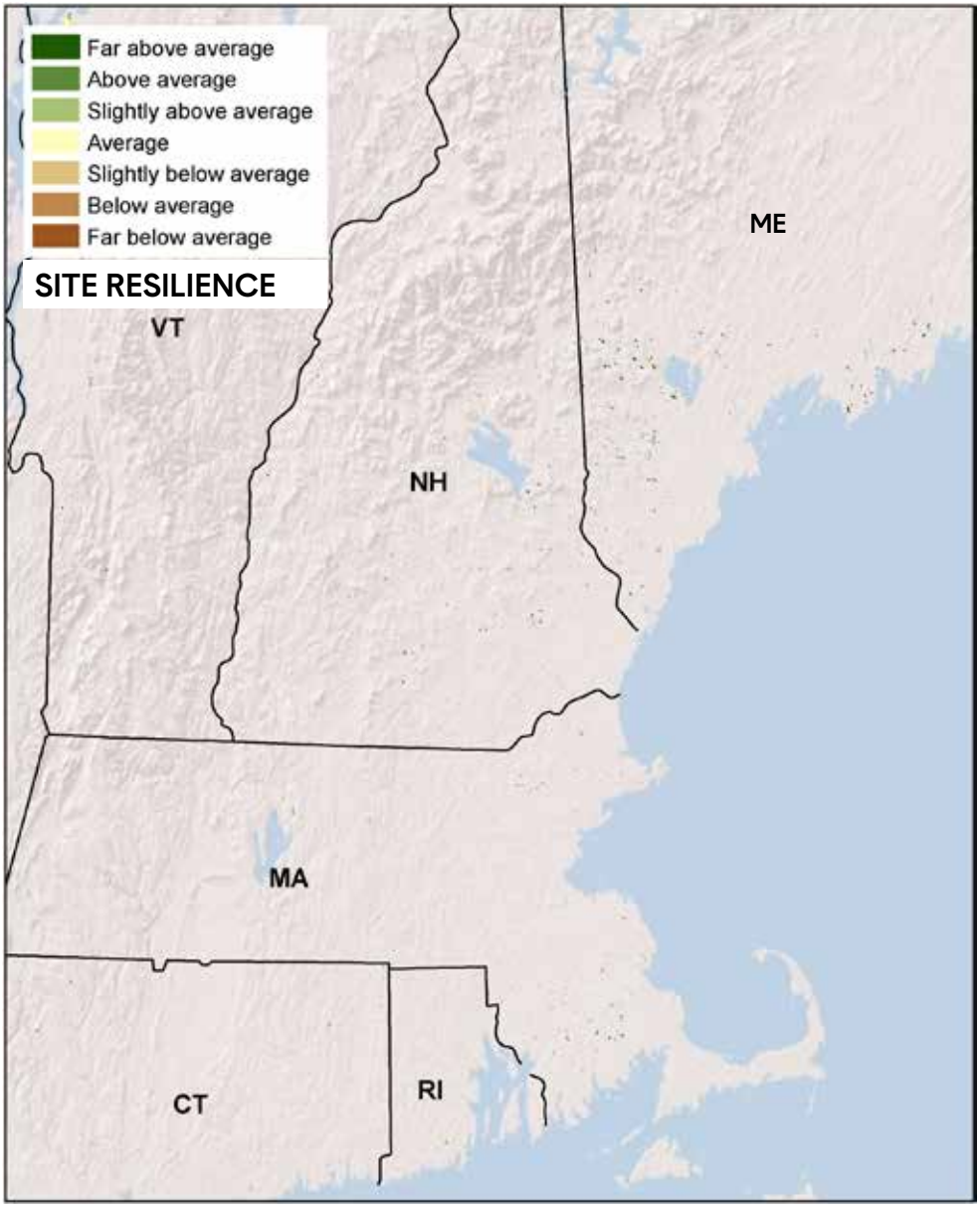
northern spikemoss
(*Selaginella selaginoides*)

hair-like sedge
(*Carex capillaris* ssp. *capillaris*)

needle beaksedge
(*Rhynchospora capillacea*)

sparse-flowered sedge
(*Carex tenuiflora*)

# North-Central Interior & Appalachian Acidic Peatland




© Maine Natural Areas Program

## Description

A dwarf-shrub peatland of small basins near the glacial boundary, where stagnated ice left coarse deposits and glacial depressions. Dominated by heath shrubs and dwarf-shrubs (e.g., leatherleaf), with patches of sedges and forbs, and sparse trees (black spruce, larch, pitch pine).

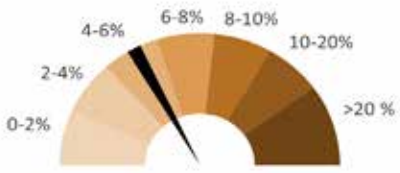
## Associated Herbs & Shrubs

bog goldenrod (*Solidago uliginosa*), bog-rosemary (*Andromeda polifolia*), boreal bog sedge (*Carex magellanica*), northern comandra (*Geocaulon lividum*), north wind bog-orchid (*Platanthera aquilonis*), sword-like bog-mat (*Wolffiella gladiata*), smooth saw-edge (*Cladium mariscoides*) pod-grass (*Scheuchzeria palustris*), flat-leaved bladderwort (*Utricularia intermedia*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 3% | 362 | 5% | 3% | 28% | 37% | 63% |
| Above average | 31% | 4,437 | 3% | 4% | 25% | 32% | 68% |
| Slightly above average | 25% | 3,624 | 2% | 8% | 28% | 38% | 62% |
| Average | 32% | 4,663 | 2% | 25% | 21% | 48% | 52% |
| Slightly below average | 4% | 595 | 0% | 33% | 23% | 55% | 45% |
| Below average | 2% | 234 | 0% | 0% | 33% | 34% | 66% |
| Far below average | 0% | 10 | 0% | 0% | 0% | 0% | 100% |
| Developed | 3% | 481 | 2% | 5% | 13% | 20% | 80% |
| TOTAL | 100% | 14,406 | 2% | 13% | 24% | 39% | 61% |

## Resilience & Securement

59% of this rare habitat scores high for resilience, 39% of the total acreage is secured against conversion, and 15% is protected, mostly in areas with average resilience.

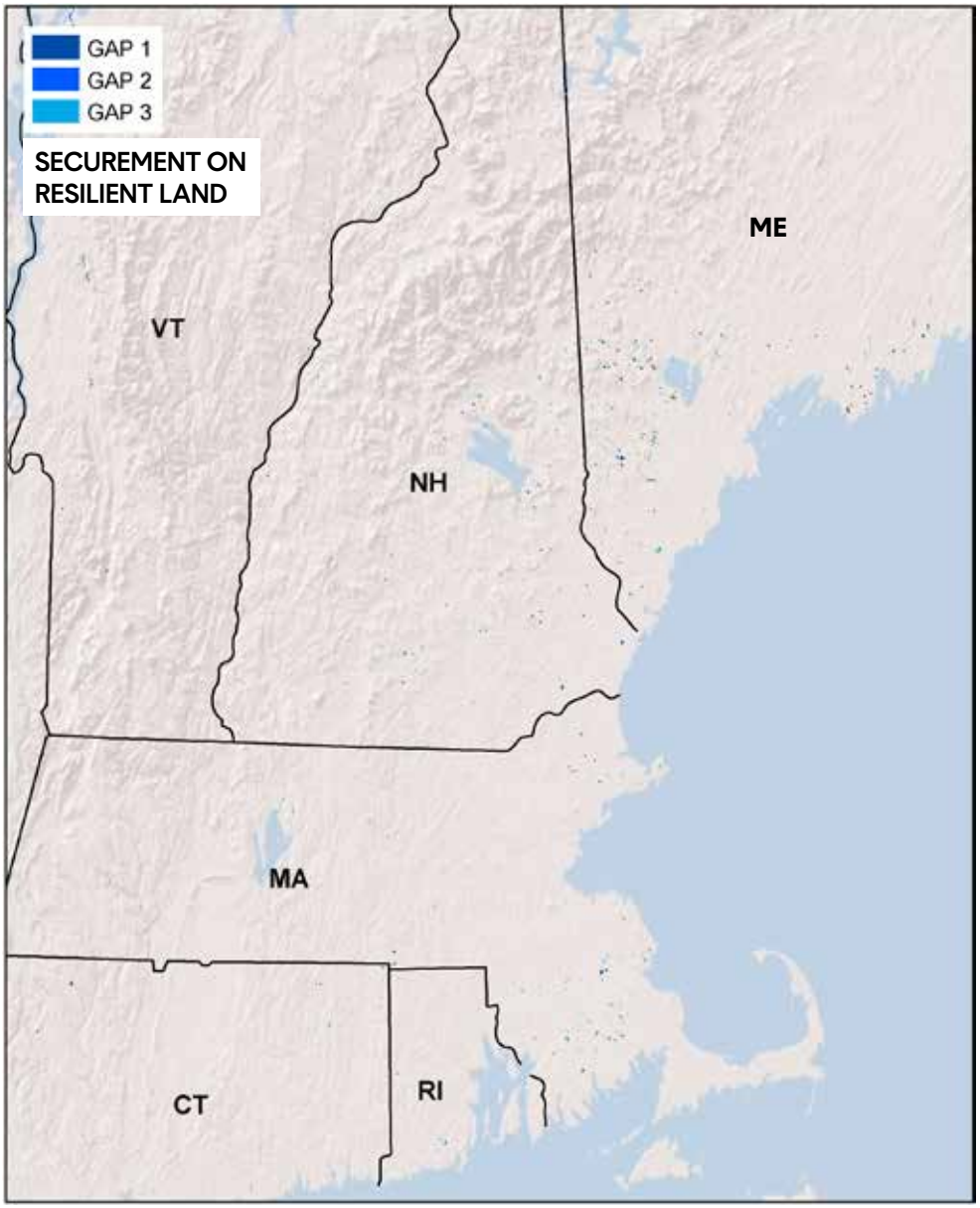



**Predicted Loss to Development by 2050**

Moderately low 5%

This community is mildly threatened by development, with 738 acres (5%) likely to be lost over the next 30 years.

# North-Central Interior & Appalachian Acidic Peatland




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 14,406 | 40% |
| CT | 558 | 33% |
| MA | 3,833 | 39% |
| ME | 4,619 | 25% |
| NH | 2,626 | 39% |
| RI | 333 | 73% |
| VT | 2,437 | 65% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 8,423 | 35% |
| CT | 293 | 52% |
| MA | 1,694 | 42% |
| ME | 3,720 | 27% |
| NH | 1,728 | 39% |
| RI | 103 | 83% |
| VT | 885 | 37% |

## Rare or Uncommon Plants Associated with this Habitat

dragon's mouth (*Arethusa bulbosa*)

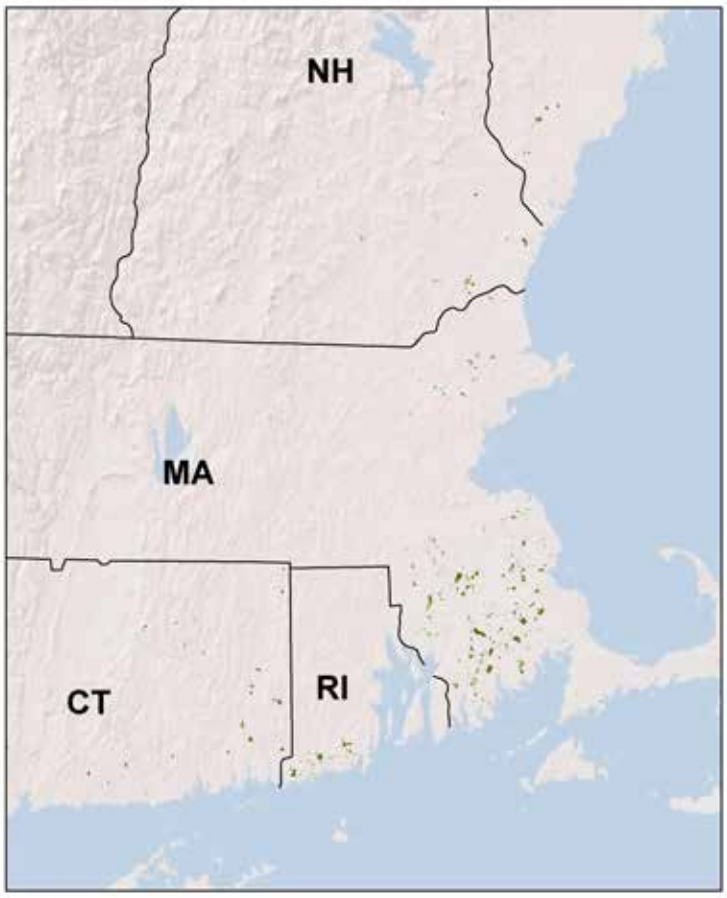
Long's woolsedge (*Scirpus longii*)

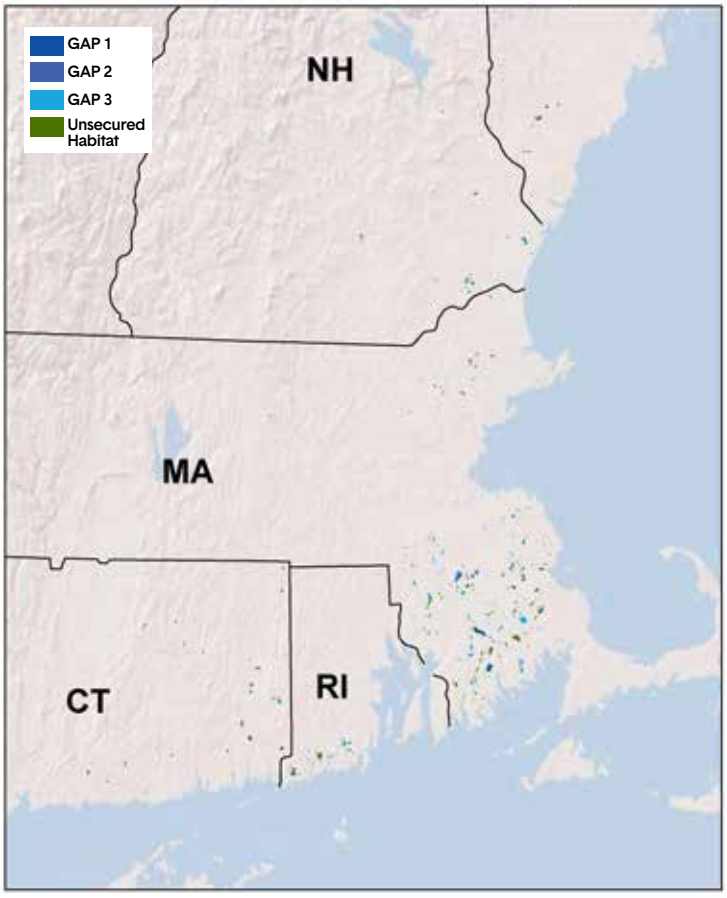
mud sedge (*Carex limosa*)

bog birch (*Betula pumila*)

MACROGROUP

# COASTAL PLAIN SWAMP & PEATLAND




**Coastal Plain Swamp & Peatland**

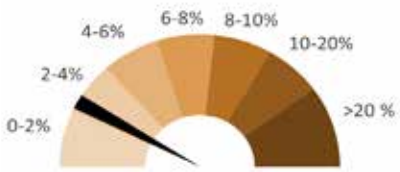
Sedge, grass, dwarf-shrub, or tree-dominated peatlands in southern New England.

**Acres in New England**

18,628

**Percent Secured**

GAP 1 = 10%
GAP 2 = 7%
GAP 3 = 26%




**Predicted Loss to Development by 2050**

571 acres (3%)

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Coastal Plain Swamp & Peatland** | **18,628** | **10%** | **7%** | **26%** | **56%** | | | | |
| Connecticut | 2,474 | 1% | 8% | 24% | 67% | | | | |
| Massachusetts | 12,619 | 12% | 8% | 27% | 53% | | | | |
| Maine | 637 | 0% | 4% | 17% | 79% | | | | |
| New Hampshire | 1,154 | 18% | 4% | 38% | 40% | | | | |
| Rhode Island | 1,744 | 6% | 3% | 25% | 66% | | | | |
| **New England** | **18,628** | **1,911** | **1,313** | **4,924** | **10,480** | | | | |

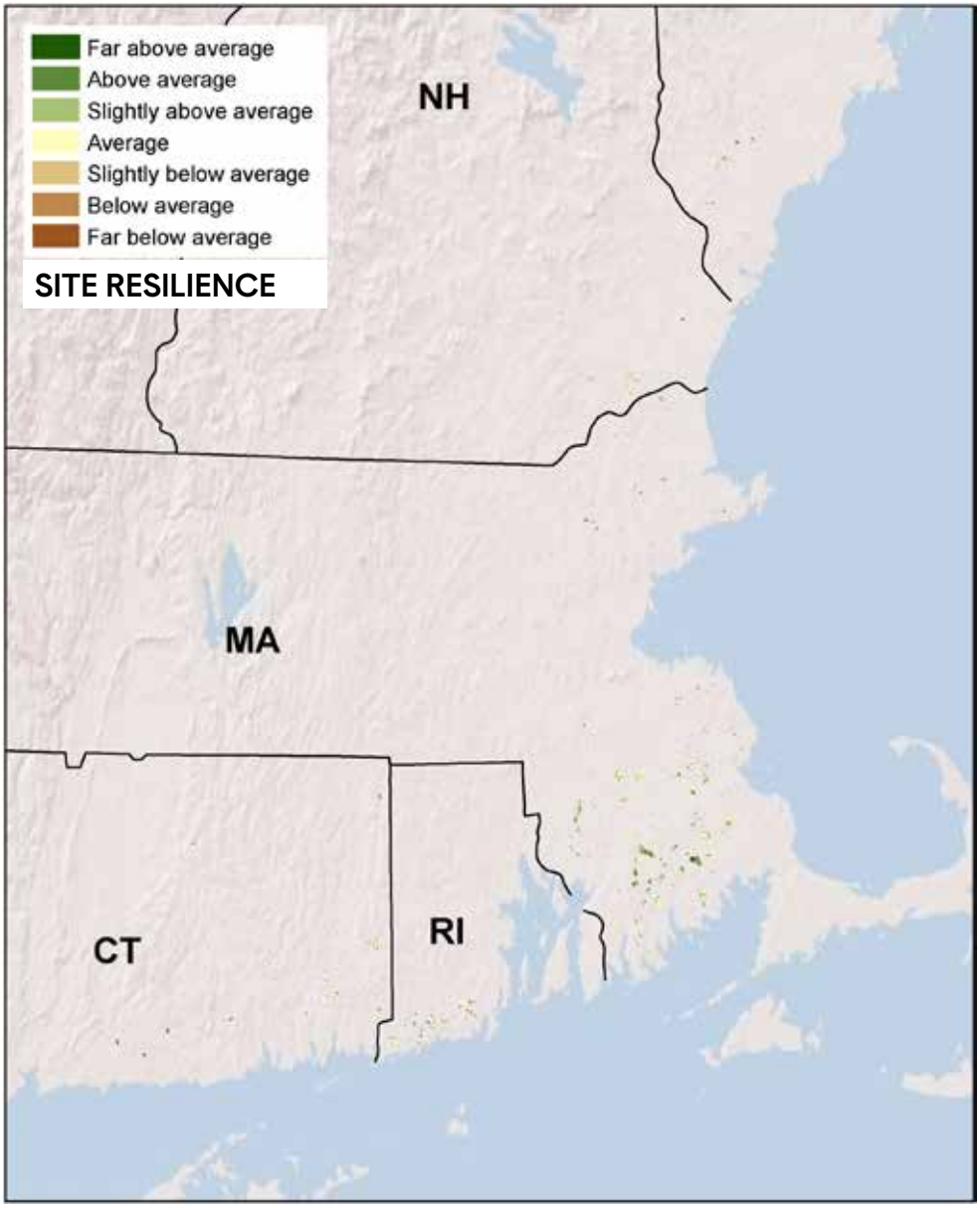
P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS


**North Atlantic Coastal Plain Basin Peat Swamp**


**Atlantic Coastal Plain Northern Bog**

# North Atlantic Coastal Plain Basin Peat Swamp




© Robert Coxe (Delaware Species Conservation & Research Program)

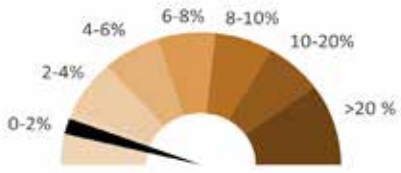
## Description

A forested swamp of peat-accumulating basins in the coastal plain. Atlantic white cedar is characteristic; red maple and/or black spruce may be present. Understory plants include alder, great laurel, high-bush blueberry, winterberry, swamp azalea, and sphagnum moss.

## Associated Herbs & Shrubs

bayonet rush (*Juncus militaris*), bushy bluestem (*Andropogon glomeratus*), coastal sedge (*Carex exilis*), woolly-fruited sedge (*Carex lasiocarpa*), tussock sedge (*Carex stricta*), Billings' sedge (*Carex billingsii*), tawny cottonsedge (*Eriophorum virginicum*), leatherleaf (*Chamaedaphne calyculata*), bayonet rush (*Juncus militaris*), bushy bluestem (*Andropogon glomeratus*), coastal sedge (*Carex exilis*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 137 | 0% | 5% | 9% | 15% | 85% |
| Above average | 21% | 3,743 | 15% | 5% | 24% | 44% | 56% |
| Slightly above average | 28% | 4,945 | 11% | 4% | 28% | 43% | 57% |
| Average | 42% | 7,522 | 10% | 10% | 27% | 47% | 53% |
| Slightly below average | 4% | 757 | 2% | 4% | 35% | 41% | 59% |
| Below average | 2% | 359 | 0% | 0% | 22% | 22% | 78% |
| Far below average | 0% | 10 | 0% | 0% | 11% | 11% | 89% |
| Developed | 2% | 310 | 7% | 3% | 18% | 28% | 72% |
| TOTAL | 100% | 17,783 | 11% | 7% | 27% | 45% | 55% |




**Predicted Loss to Development by 2050**

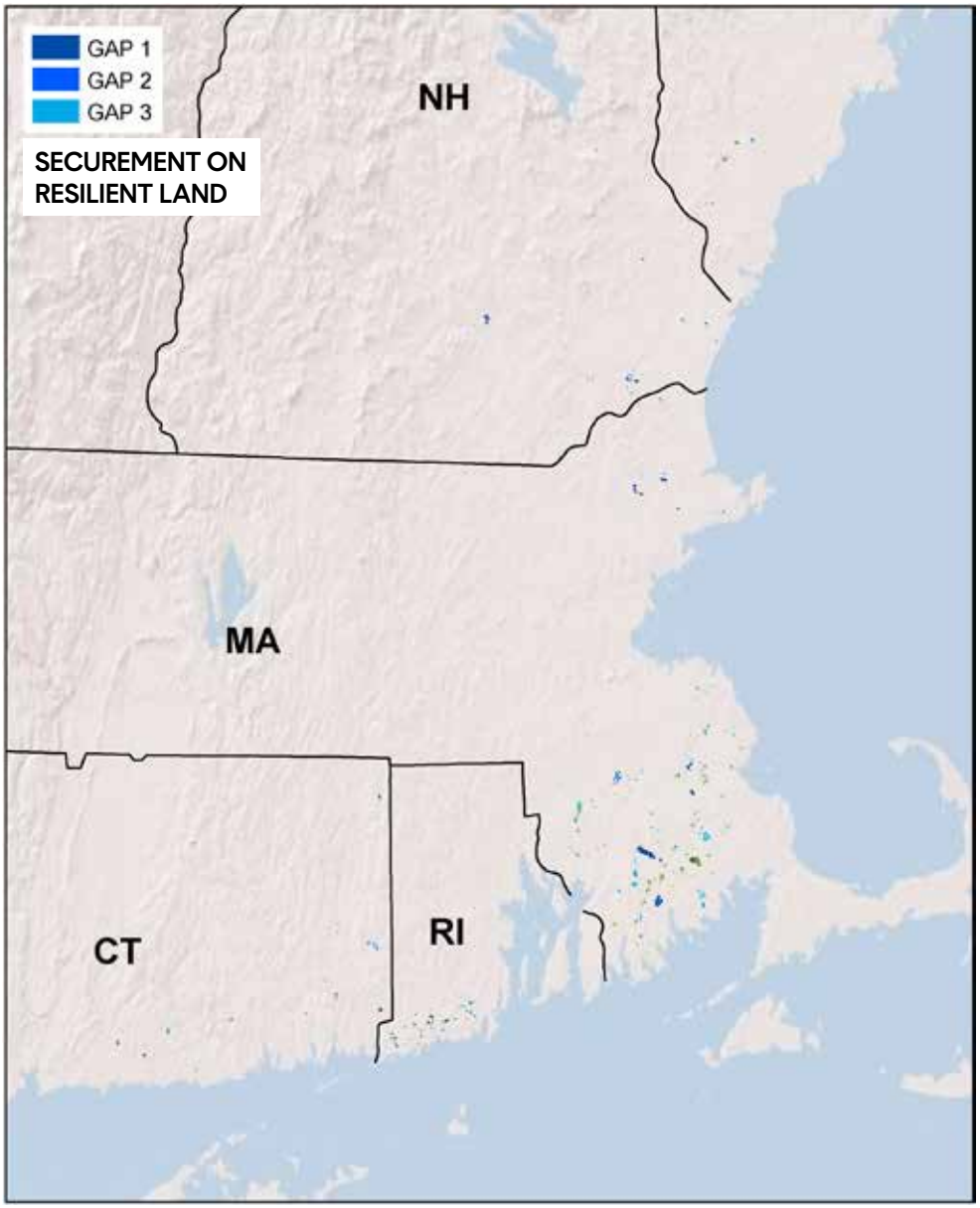
Low 2%

This community has a low development threat, with 444 acres (2%) likely to be lost over the next 30 years.

## Resilience & Securement

50% of this rare habitat scores high for resilience, 45% of the total acreage is secured against conversion, and 18% is protected.

# North Atlantic Coastal Plain Basin Peat Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 17,783 | 44% |
| CT | 2,475 | 33% |
| MA | 11,774 | 47% |
| ME | 637 | 21% |
| NH | 1,154 | 60% |
| RI | 1,744 | 34% |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 8,826 | 43% |
| CT | 1,234 | 36% |
| MA | 5,950 | 45% |
| ME | 443 | 25% |
| NH | 389 | 54% |
| RI | 810 | 43% |
| VT | | |

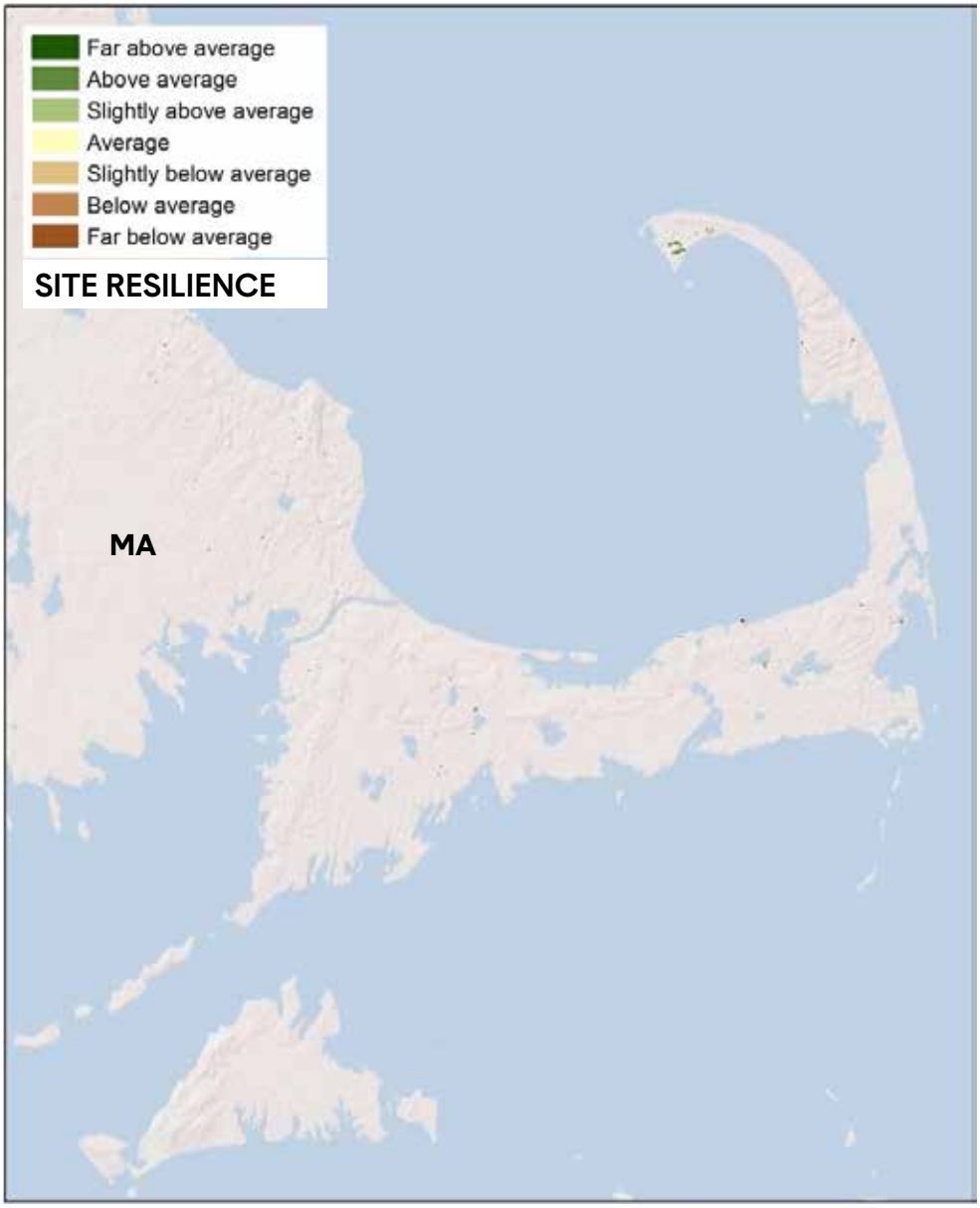
## Rare or Uncommon Plants Associated with this Habitat

Collins' sedge
(*Carex collinsii*)

swamp wedgescale
(*Sphenopholis pensylvanica*)

© Keith Love

# Atlantic Coastal Plain Northern Bog




© Kathleen Strakosch Walz
(New Jersey Natural Heritage Program)

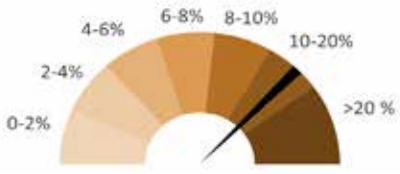
## Description

Dwarf-shrub and sphagnum bogs occurring in isolated glacial kettleholes. The system is characterized by acidic, tannic water supporting a floating or grounded sphagnum mat over which leatherleaf and dwarf huckleberry are rooted.

## Associated Herbs & Shrubs

highbush blueberry (*Vaccinium corymbosum*) swamp-loosestrife (*Decodon verticillatus*), pitch pine (*Pinus rigida*), Atlantic white cedar (*Chamaecyparis thyoides*), black spruce (*Picea mariana*), white water-lily (*Nymphaea odorata*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 7 | 0% | 0% | 0% | 0% | 100% |
| Above average | 21% | 181 | 0% | 49% | 21% | 70% | 30% |
| Slightly above average | 16% | 135 | 1% | 7% | 38% | 46% | 54% |
| Average | 38% | 322 | 4% | 0% | 24% | 28% | 72% |
| Slightly below average | 7% | 60 | 15% | 0% | 21% | 35% | 65% |
| Below average | 2% | 20 | 0% | 0% | 13% | 13% | 88% |
| Far below average | 0% | 0 | | | | | |
| Developed | 14% | 121 | 0% | 8% | 20% | 29% | 71% |
| **TOTAL** | **100%** | **845** | **3%** | **13%** | **24%** | **40%** | **60%** |



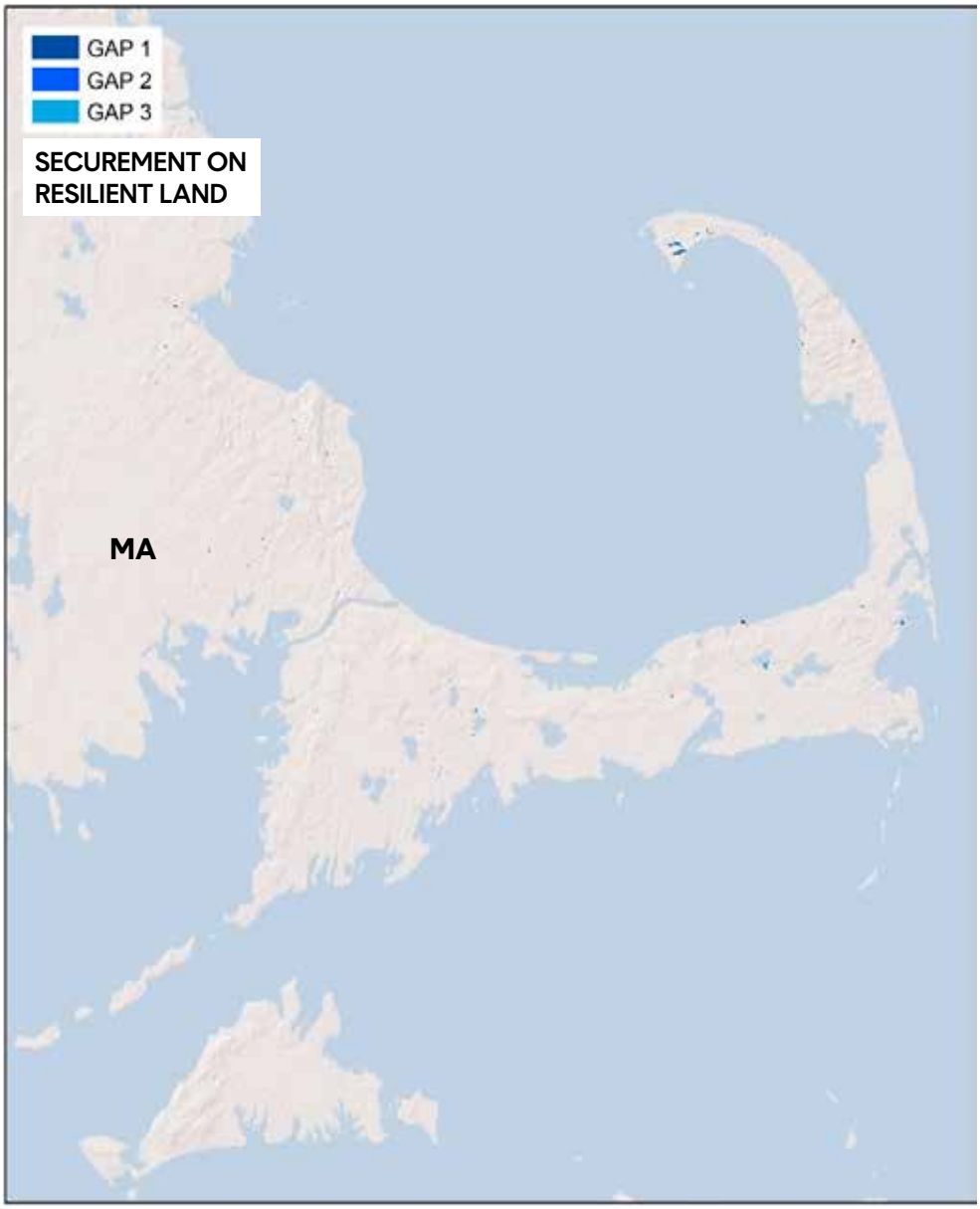

**Predicted Loss to Development by 2050**
High 15%

This community is threatened by development, with127 acres (15%) likely to be lost over the next 30 years.

## Resilience & Securement

38% of this rare habitat scores high for resilience, 40% of the total acreage is secured against conversion, and 16% is protected.

# Atlantic Coastal Plain Northern Bog




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 845 | 40% |
| CT | | |
| MA | 845 | 40% |
| ME | | |
| NH | | |
| RI | | |
| VT | | |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 323 | 58% |
| CT | | |
| MA | 323 | 58% |
| ME | | |
| NH | | |
| RI | | |
| VT | | |

## Rare or Uncommon Plants Associated with this Habitat

dwarf mistletoe
(*Arceuthobium pusillum*)

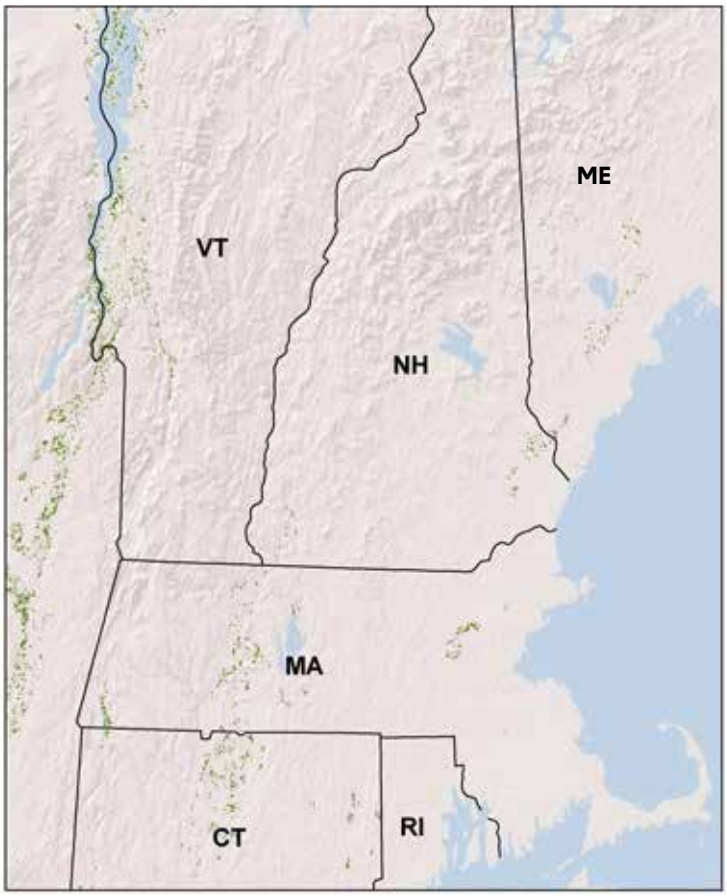
mud sedge
(*Carex limosa*)

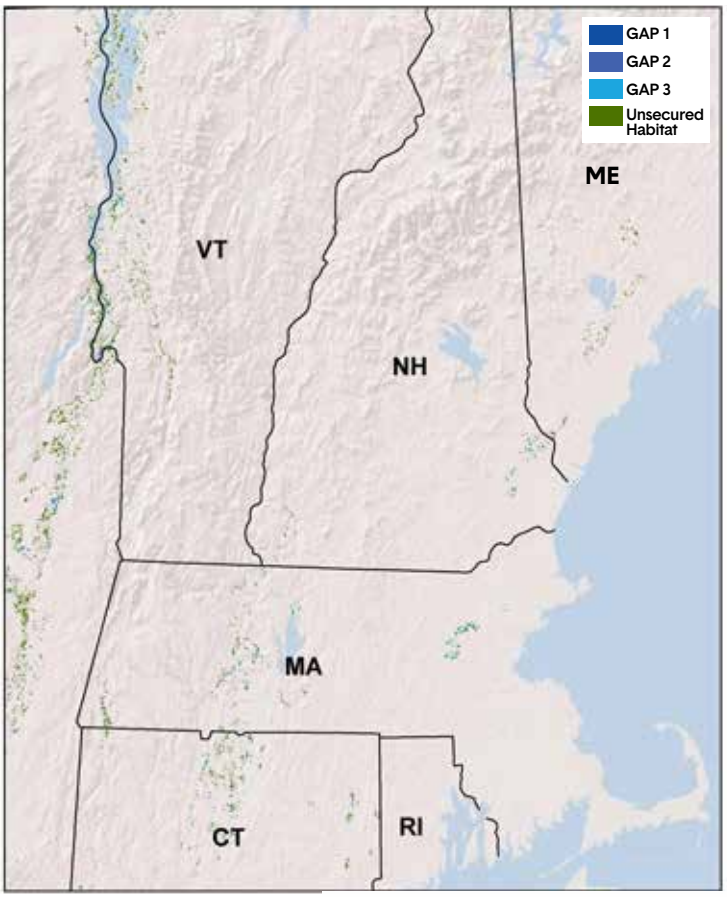
pod-grass
(*Scheuchzeria palustris*)

Long's woolsedge
*(Scirpus longii)*

MACROGROUP

# CENTRAL HARDWOOD SWAMP




**Central Hardwood Swamp**

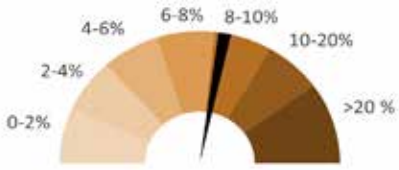
Broadleaved or mixed forested swamps in central New England.

**Acres in New England**

39,338

**Percent Secured**

GAP 1 = 1%
GAP 2 = 2%
GAP 3 = 11%




**Predicted Loss to Development by 2050**

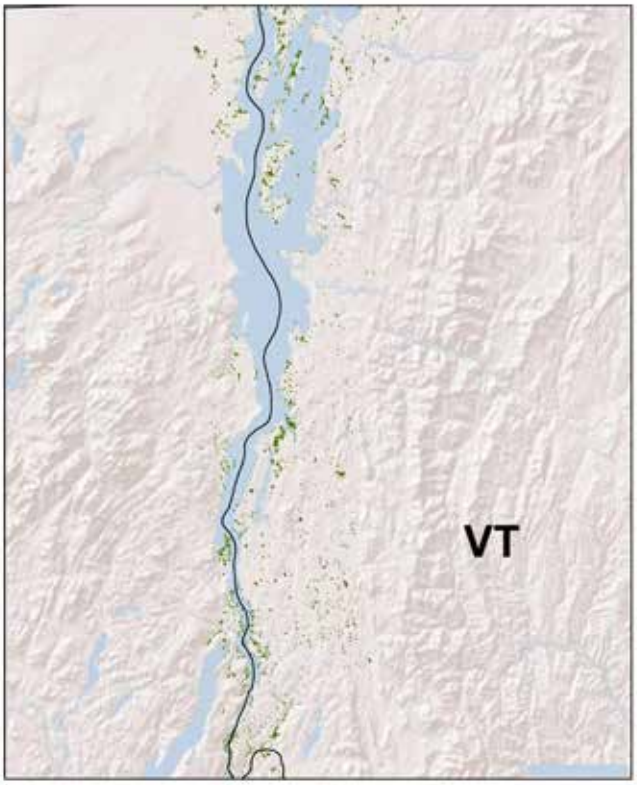
3,120 acres (8%)

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Central Hardwood Swamp** | **39,338** | **1%** | **2%** | **11%** | **85%** | **1** | | | **1** |
| Connecticut | 9,249 | 0% | 3% | 13% | 84% | | | | |
| Massachusetts | 9,553 | 0% | 3% | 17% | 80% | 1 | | | 1 |
| Maine | 2,783 | 0% | 2% | 1% | 97% | | | | |
| New Hampshire | 1,955 | 1% | 3% | 20% | 76% | | | | |
| Rhode Island | 0 | 0% | 0% | 0% | 100% | | | | |
| Vermont | 15,798 | 3% | 0% | 8% | 88% | | | | |
| **New England** | **39,338** | **499** | **787** | **4,501** | **33,550** | | | | |

P = Protected S = Secured
U = Unsecured

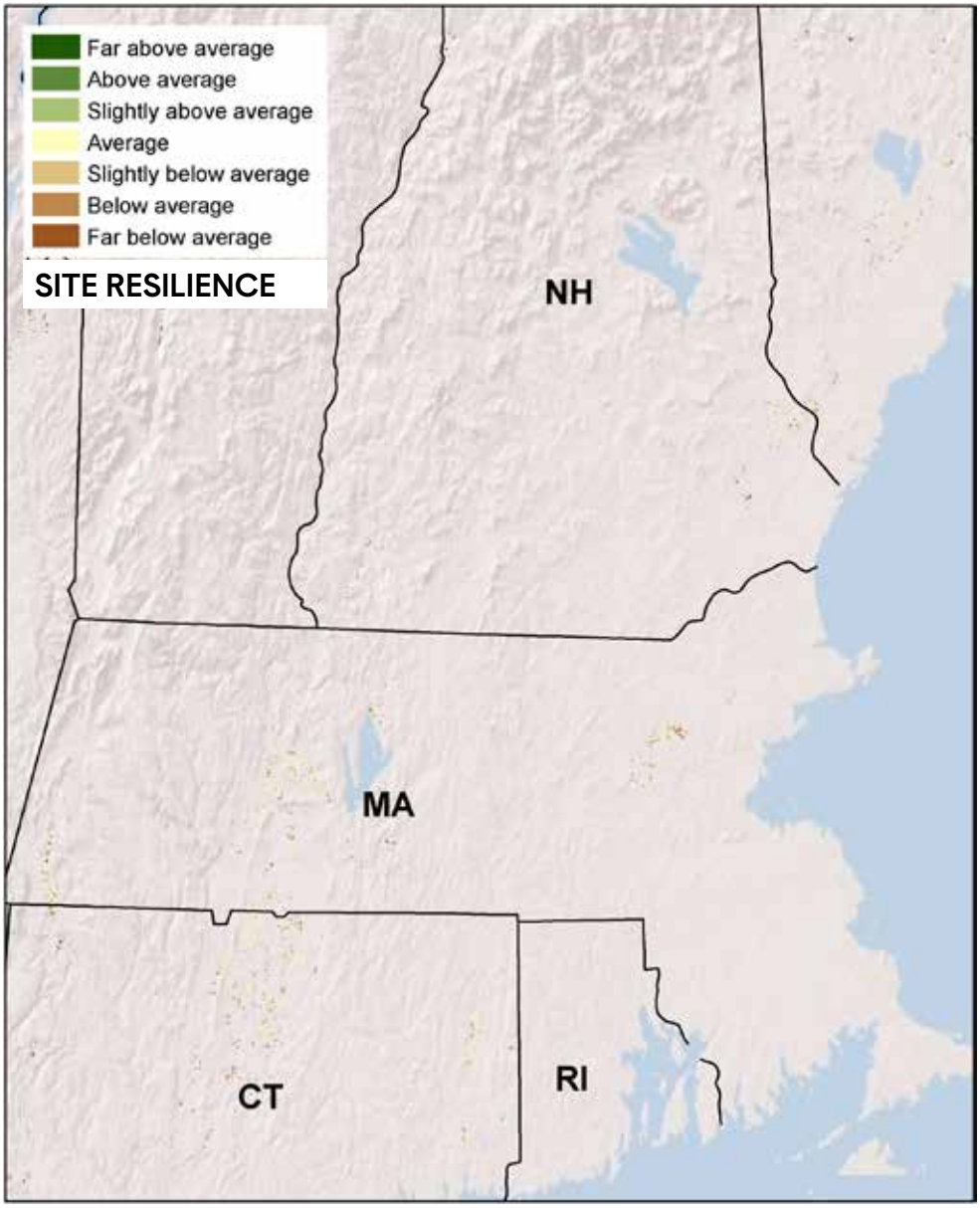
# DISTRIBUTION OF HABITATS


North-Central Interior Wet Flatwoods




Glacial Marine & Lake Wet Clayplain Forest

# North Central Interior Wet Flatwoods





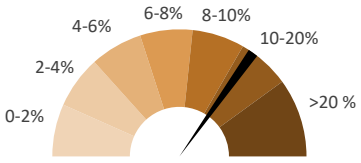

## Description

A hardwood forest of upland and wetland species occurring in depressions or poorly drained lowlands. Pin oak dominates in many areas; other common trees include swamp white oak, bur oak, black gum, sweet gum, and red maple. Buttonbush, winterberry, alder, various sedges, and cinnamon fern are typical.

## Associated Herbs & Shrubs

Canada moonseed (*Menispermum canadense*), American climbing fern (*Lygodium palmatum*), common hackberry (*Celtis occidentalis*), fall sneezeweed (*Helenium autumnale*), fox-tail sedge (*Carex alopecoidea*), Virginia spring-beauty (*Claytonia virginica*), pink bitter-cress (*Cardamine douglassii*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 0% | 88 | 6% | 1% | 6% | 12% | 88% |
| Above average | 8% | 1,901 | 2% | 2% | 14% | 17% | 83% |
| Slightly above average | 17% | 4,308 | 0% | 5% | 12% | 17% | 83% |
| Average | 44% | 11,016 | 0% | 3% | 13% | 16% | 84% |
| Slightly below average | 13% | 3,405 | 0% | 1% | 13% | 15% | 85% |
| Below average | 11% | 2,725 | 0% | 2% | 17% | 19% | 81% |
| Far below average | 1% | 296 | 1% | 4% | 11% | 16% | 84% |
| Developed | 6% | 1,565 | 0% | 2% | 10% | 12% | 88% |
| TOTAL | 100% | 25,306 | 0% | 3% | 13% | 16% | 84% |



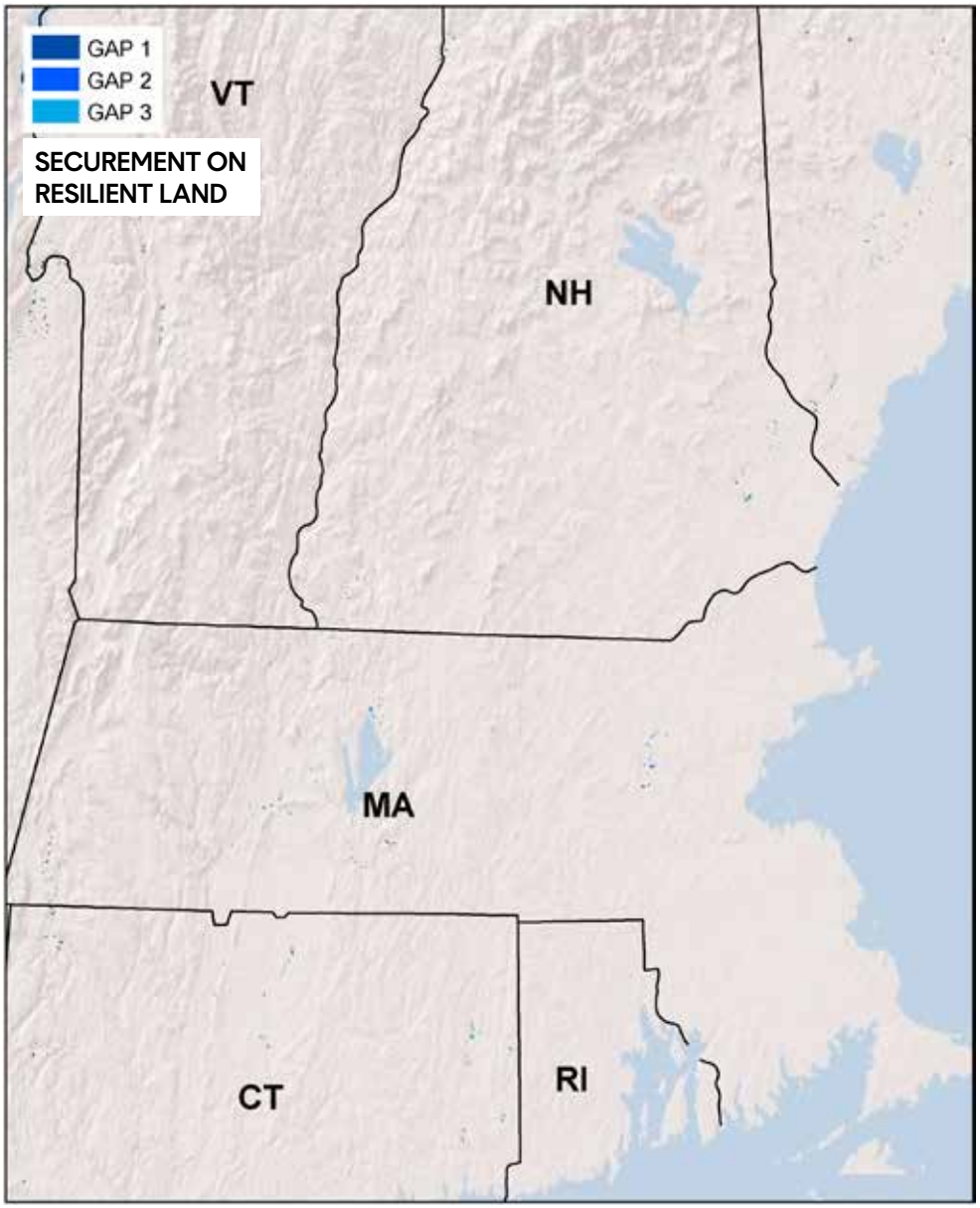

**Predicted Loss to Development by 2050**
High 11%

This community is threatened by development, with 2,743 acres (11%) likely to be lost over the next 30 years.

## Resilience & Securement

25% of this rare habitat scores high for resilience, 16% of the total acreage is secured against conversion, and 3% is protected.

# North Central Interior Wet Flatwoods




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 25,306 | 16% |
| CT | 9,249 | 16% |
| MA | 9,553 | 20% |
| ME | 2,783 | 3% |
| NH | 1,955 | 24% |
| RI | | |
| VT | 1,765 | 6% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 6,297 | 17% |
| CT | 1,551 | 21% |
| MA | 1,829 | 26% |
| ME | 1,548 | 3% |
| NH | 613 | 23% |
| RI | | |
| VT | 757 | 9% |

## Rare or Uncommon Plants Associated with this Habitat

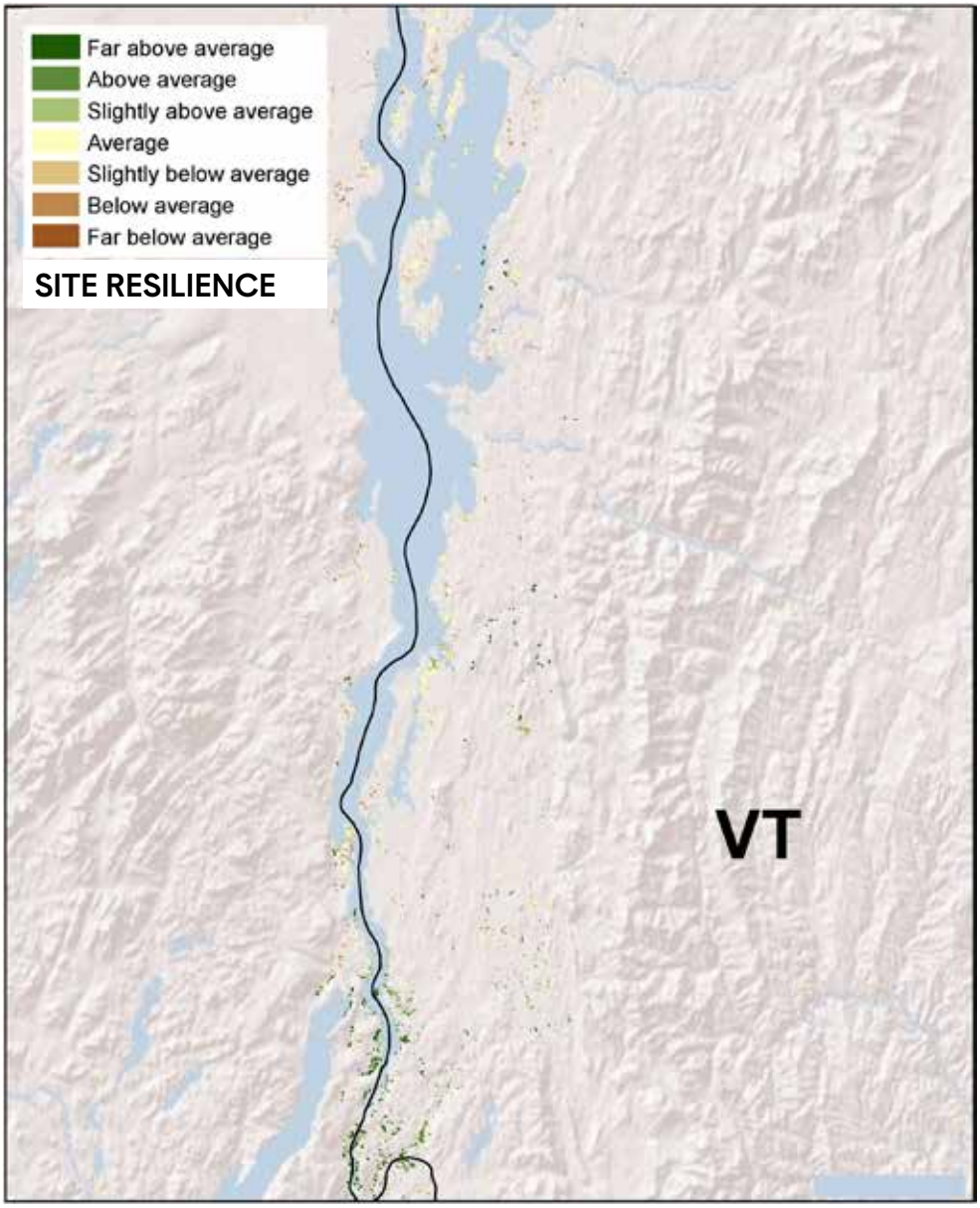
southern agrimony (*Agrimonia parviflora*)

fox-tail sedge (*Carex alopecoidea*)

Virginia spring-beauty (*Claytonia virginica*)

sweet-gum (*Liquidambar styraciflua*)

# Glacial Marine & Lake Wet Clayplain Forest




© Eric Sorenson (Vermont Fish & Wildlife)

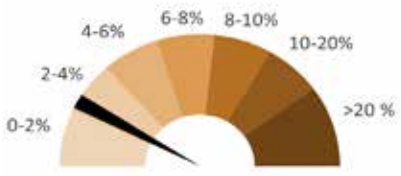
## Description

A wetland variant of the mesic clayplain forest. The two types occur in a tight mosaic on the landscape. Swamp white oak, green ash, red maple, black ash, and musclewood are common along with moisture-loving sedges and herbs such as sensitive fern and water hemlock.

## Associated Herbs & Shrubs

American hazelnut (*Corylus americana*) broad beech fern (*Phegopteris hexagonoptera*), buxbaum's sedge (*Carex buxbaumii*), folliculate sedge (*Carex folliculate*), fragrant sumac (*Rhus aromatic*), rough avens (*Geum laciniatum*), spicebush (*Lindera benzoin*), leafy bulrush (*Scirpus polyphyllus*), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvanica*), black ash (*Fraxinus nigra*), eastern hemlock (*Tsuga canadensis*), northern red oak (*Quercus rubra*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 301 | 13% | 0% | 6% | 19% | 81% |
| Above average | 10% | 1,396 | 8% | 1% | 5% | 14% | 86% |
| Slightly above average | 19% | 2,642 | 6% | 1% | 7% | 14% | 86% |
| Average | 52% | 7,332 | 2% | 0% | 10% | 12% | 88% |
| Slightly below average | 11% | 1,513 | 0% | 0% | 9% | 9% | 91% |
| Below average | 3% | 449 | 0% | 0% | 3% | 3% | 97% |
| Far below average | 0% | 18 | 0% | 0% | 0% | 0% | 100% |
| Developed | 3% | 381 | 1% | 1% | 15% | 17% | 83% |
| TOTAL | 100% | 14,032 | 3% | 0% | 9% | 12% | 88% |




**Predicted Loss to Development by 2050**

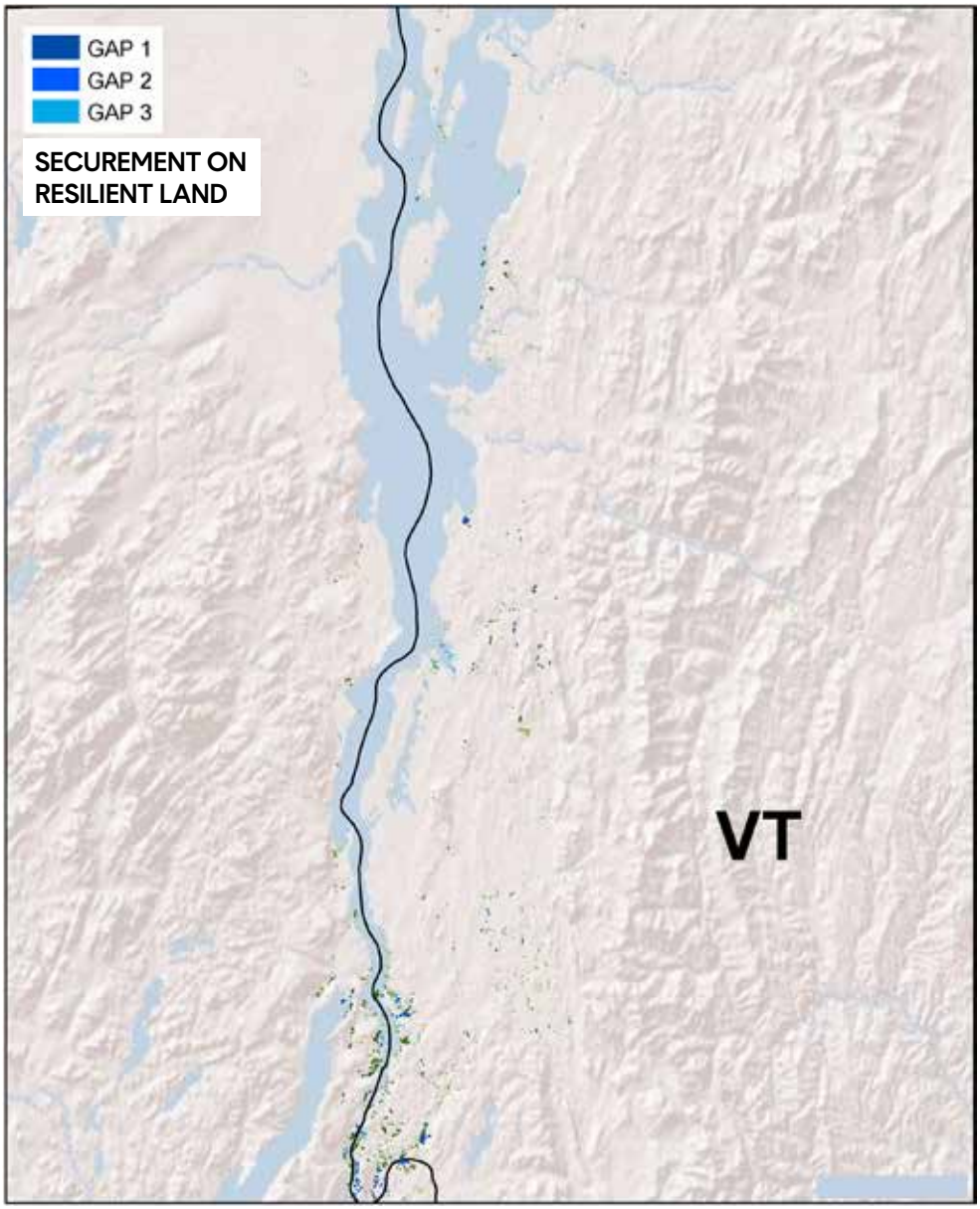
Low 3%

This community is not threatened by development, with 377 acres (3%) likely to be lost over the next 30 years.

## Resilience & Securement

31% of this rare habitat scores high for resilience, 12% of the total acreage is secured against conversion, and 3% is protected.

# Glacial Marine & Lake Wet Clayplain Forest




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 14,032 | 12% |
| CT | | |
| MA | | |
| ME | | |
| NH | | |
| RI | | |
| VT | 14,032 | 12% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 4,340 | 14% |
| CT | | |
| MA | | |
| ME | | |
| NH | | |
| RI | | |
| VT | 4,340 | 14% |

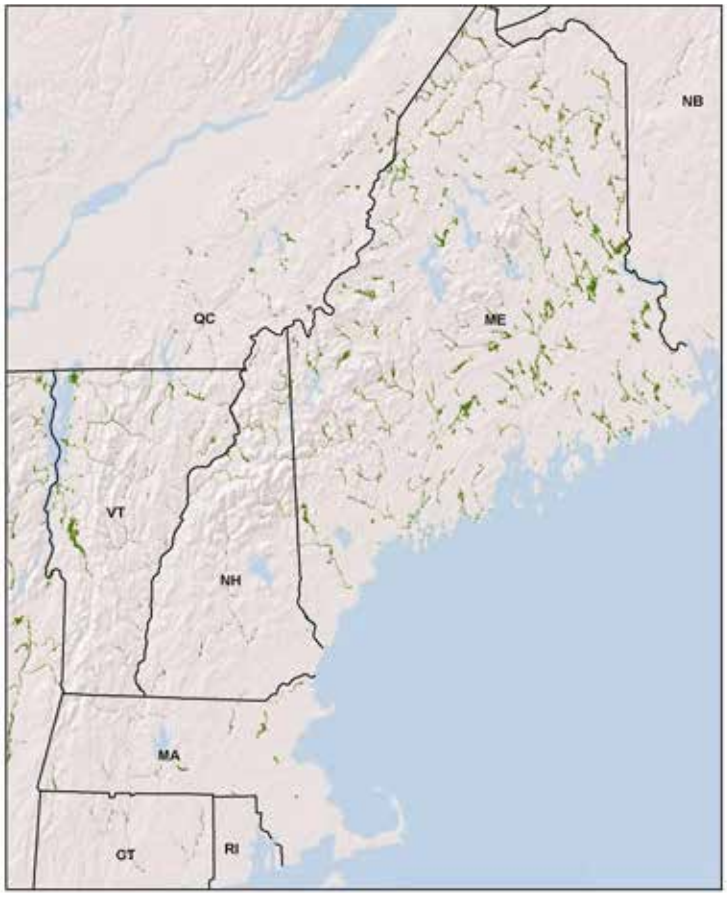
## Rare or Uncommon Plants Associated with this Habitat

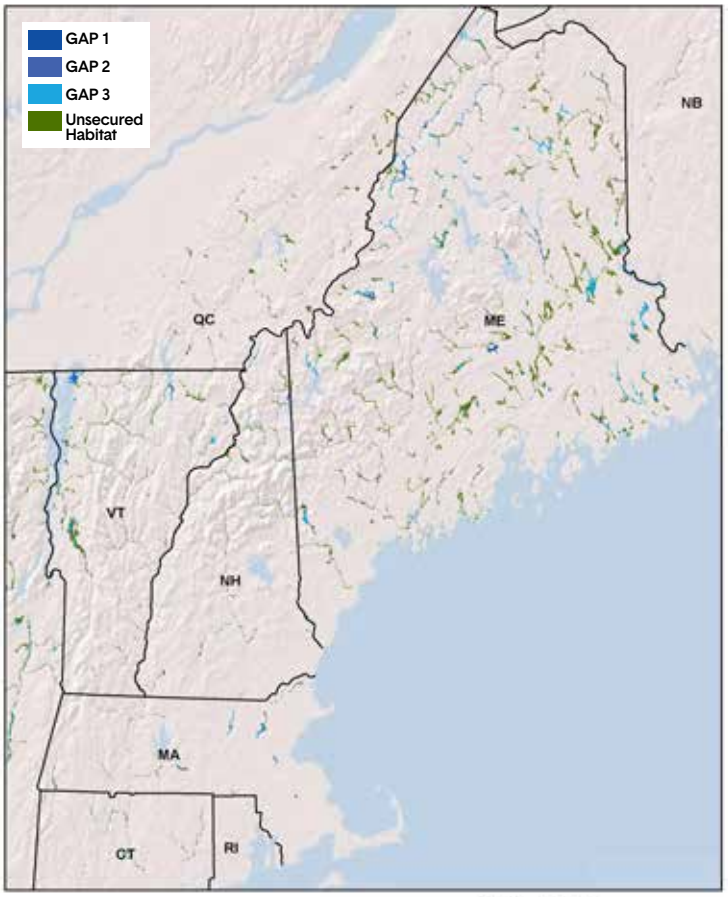
handsome sedge
(*Carex formosa*)

American ginseng
(*Panax quinquefolius*)

pine-drops
(*Pterospora andromedea*)

# MACROGROUP
# LARGE RIVER FLOODPLAIN

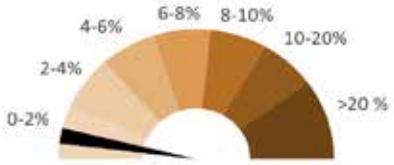



**Large River Floodplain**
A complex of wetland and upland vegetation on floodplains of medium to large rivers in New England.

**Acres in New England**
340,644

**Percent Secured**
GAP 1 = 3%
GAP 2 = 5%
GAP 3 = 17%

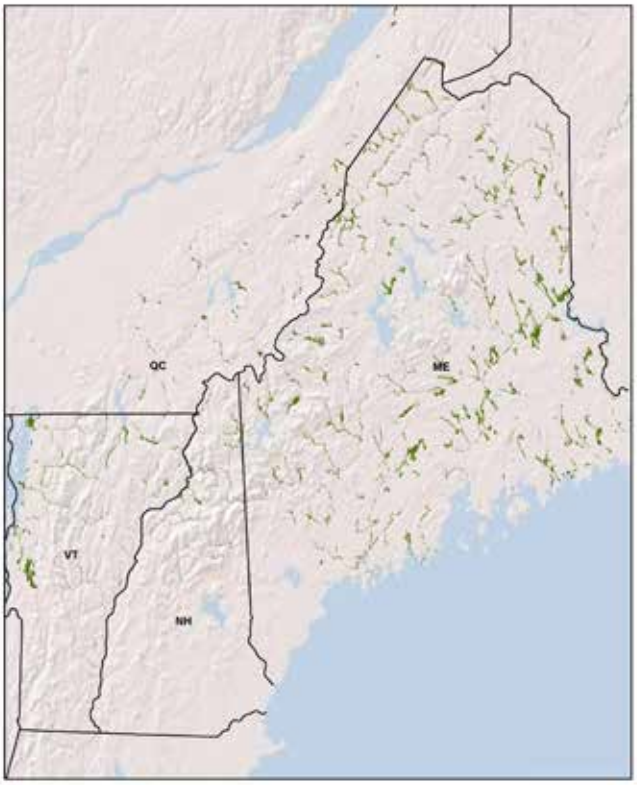



**Predicted Loss to Development by 2050**
3,846 acres (1%)

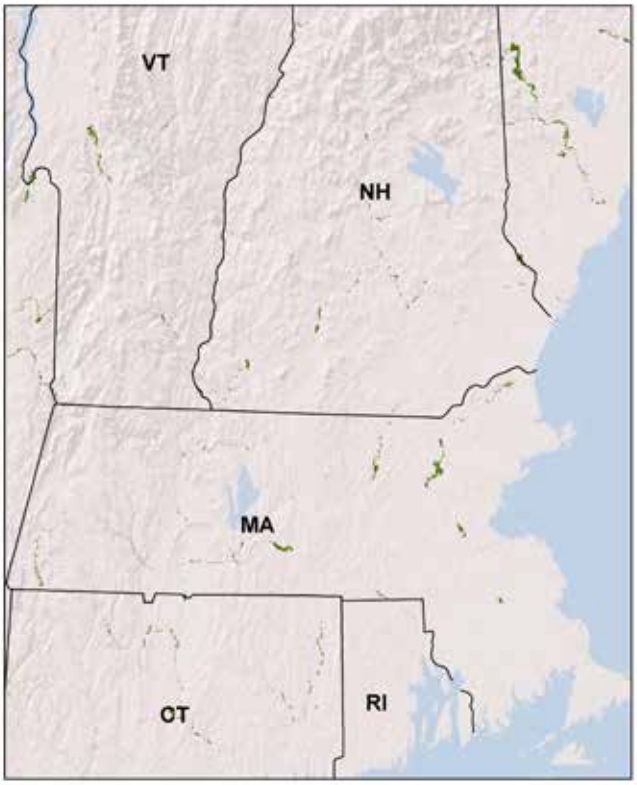
| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Large River Floodplain** | **340,644** | **3%** | **5%** | **17%** | **75%** | **3** | | | **3** |
| Connecticut | 3,814 | 0% | 6% | 25% | 68% | | | | |
| Massachusetts | 9,684 | 0% | 17% | 24% | 59% | 3 | | 1 | 2 |
| Maine | 259,721 | 3% | 3% | 18% | 76% | | | | |
| New Hampshire | 16,413 | 3% | 5% | 12% | 80% | | | | |
| Rhode Island | 19 | 0% | 0% | 12% | 88% | | | | |
| Vermont | 50,993 | 2% | 9% | 14% | 74% | | | | |
| **New England** | **340,644** | **9,409** | **16,055** | **59,440** | **255,741** | | | | |

P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS

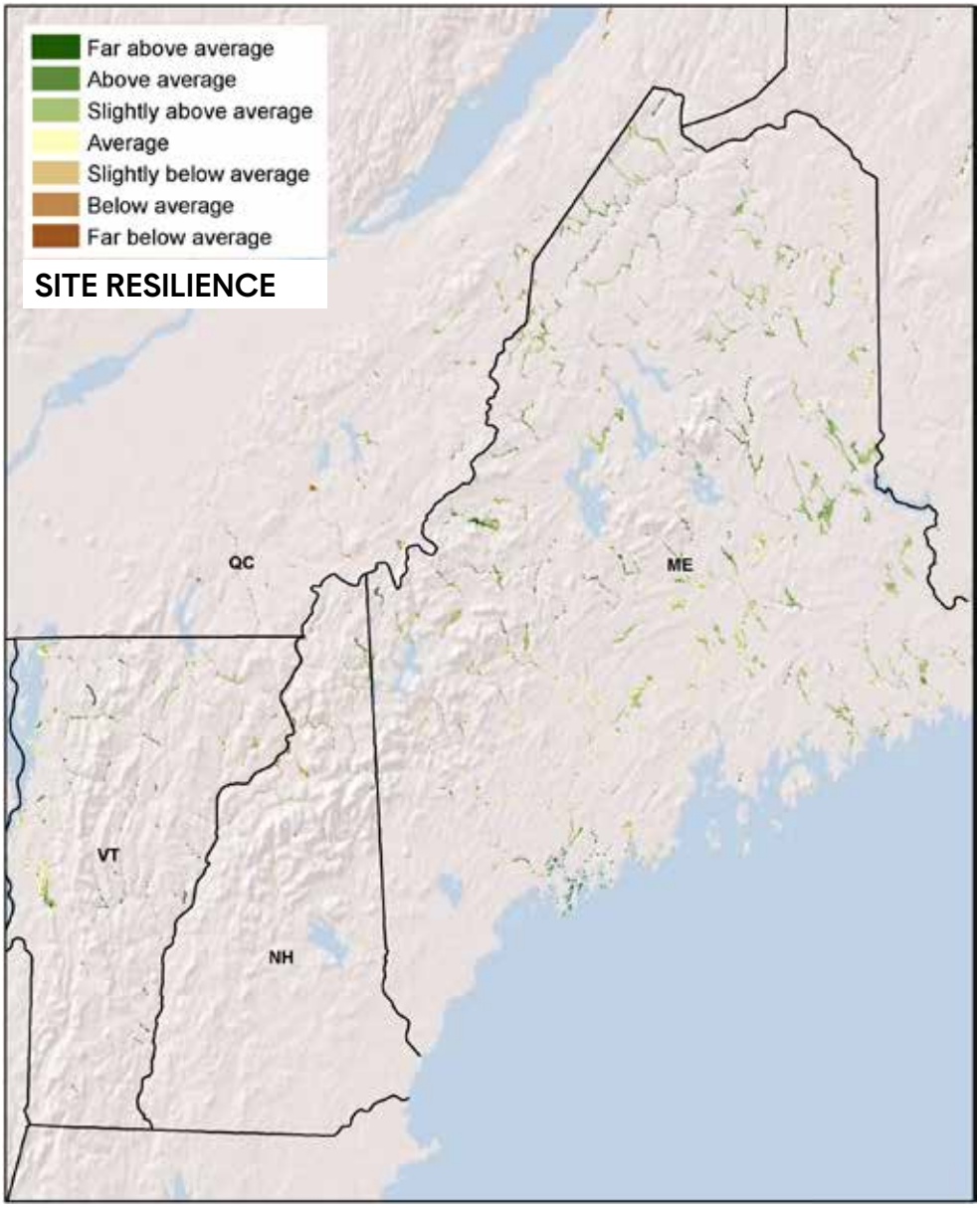



**Laurentian-Acadian Large River Floodplain**




**North-Central Appalachian Large River Floodplain**

# Laurentian-Acadian Large River Floodplain




© Elizabeth Thompson (Vermont Land Trust)

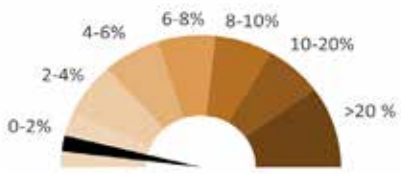
## Description

A complex of wetland and upland vegetation on floodplains of medium to large northern rivers. Vegetation includes silver maple forests as well as shrub wetlands. Green ash, American elm, red maple, and musclewood are typical. Spring ephemeral herbs are abundant.

## Associated Herbs & Shrubs

eastern bottle-brush grass (*Elymus hystrix*), green-dragon (*Arisaema dracontium*), lance-leaved figwort (*Scrophularia lanceolata*), cut-leaved windflower (*Anemone multifida*), winged loosestrife (*Lythrum alatum*), false water-pepper smartweed (*Polygonum hydropiperoides*), purple virgin's-bower (*Clematis occidentalis*), Virginia water-horehound (*Lycopus virginicus*), greater yellow water crowfoot (*Ranunculus flabellaris*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 2,828 | 4% | 5% | 20% | 29% | 71% |
| Above average | 18% | 56,876 | 5% | 6% | 21% | 32% | 68% |
| Slightly above average | 49% | 152,433 | 3% | 4% | 21% | 27% | 73% |
| Average | 20% | 62,774 | 2% | 6% | 9% | 16% | 84% |
| Slightly below average | 5% | 16,559 | 2% | 2% | 6% | 10% | 90% |
| Below average | 3% | 8,681 | 0% | 4% | 6% | 11% | 89% |
| Far below average | 0% | 913 | 0% | 0% | 6% | 6% | 94% |
| Developed | 3% | 7,992 | 1% | 3% | 11% | 15% | 85% |
| TOTAL | 100% | 309,055 | 3% | 5% | 17% | 25% | 75% |




**Predicted Loss to Development by 2050**

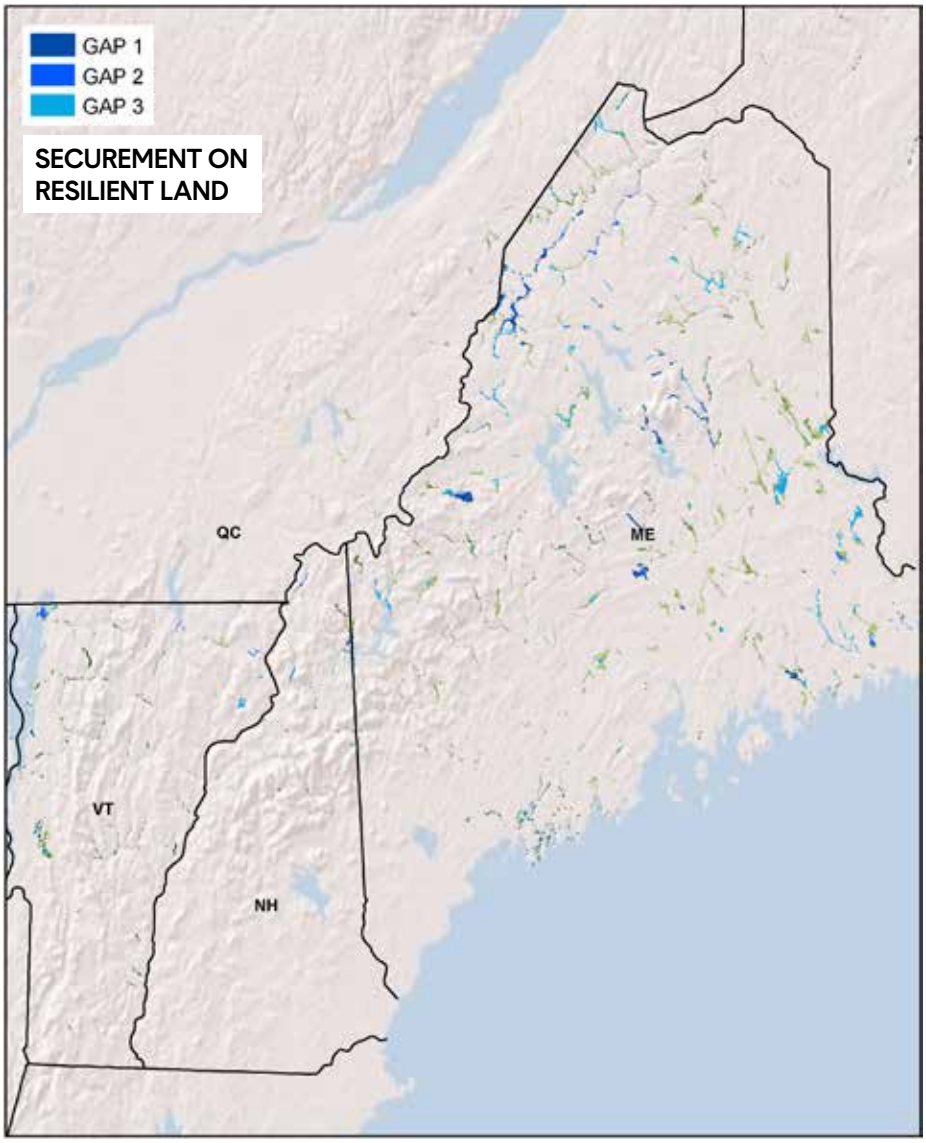
Very low <1%

This community is not threatened by development, with 2,405 acres (<1%) likely to be lost over the next 30 years.

## Resilience & Securement

68% of this habitat scores high for resilience, and 25% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Laurentian-Acadian Large River Floodplain




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 309,055 | 24% |
| CT | | |
| MA | | |
| ME | 249,426 | 24% |
| NH | 12,010 | 20% |
| RI | | |
| VT | 47,620 | 26% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 212,136 | 29% |
| CT | | |
| MA | | |
| ME | 186,857 | 29% |
| NH | 5,373 | 27% |
| RI | | |
| VT | 19,906 | 27% |

## Rare or Uncommon Plants Associated with this Habitat

Eaton's beggar-ticks (*Bidens eatonii*)

Long's bitter-cress (*Cardamine longii*)

tidal spikesedge (*Eleocharis aestuum*)

Provancher's Philadelphia fleabane (*Erigeron philadelphicus* var. *provancheri*)

parker's pipewort (*Eriocaulon parkeri*)

Robinson's hawkweed (*Hieracium robinsonii*)

auricled twayblade (*Neottia auriculata*)

Furbish's lousewort (*Pedicularis furbishiae*)

Anticosti American-aster (*Symphyotrichum anticostense*)

Gaspe serviceberry (*Amelanchier gaspensis*)

scabrous black sedge (*Carex atratiformis*)

Crawe's sedge (*Carex crawei*)

beaked sedge (*Carex rostrata*)

early wild-rye (*Elymus macgregorii*)

hyssop-leaved fleabane (*Erigeron hyssopifolius*)

musky monkey-flower (*Erythranthe [Mimulus] moschata*)

northern dwarf-gentian (*Gentianella amarella* ssp. *acuta*)

greater creeping rush (*Juncus subtilis*)

Vasey's rush (*Juncus vaseyi*)

field oxytrope (*Oxytropis campestris* var. *johannensis*)

bayberry willow (*Salix myricoides*)

northern wild senna (*Senna hebecarpa*)

rough dropseed (*Sporobolus compositus* var. *drummondii*)

eastern tansy (*Tanacetum bipinnatum* ssp. *huronense*)

veiny-leaved meadow-rue (*Thalictrum venulosum* var. *confine*)

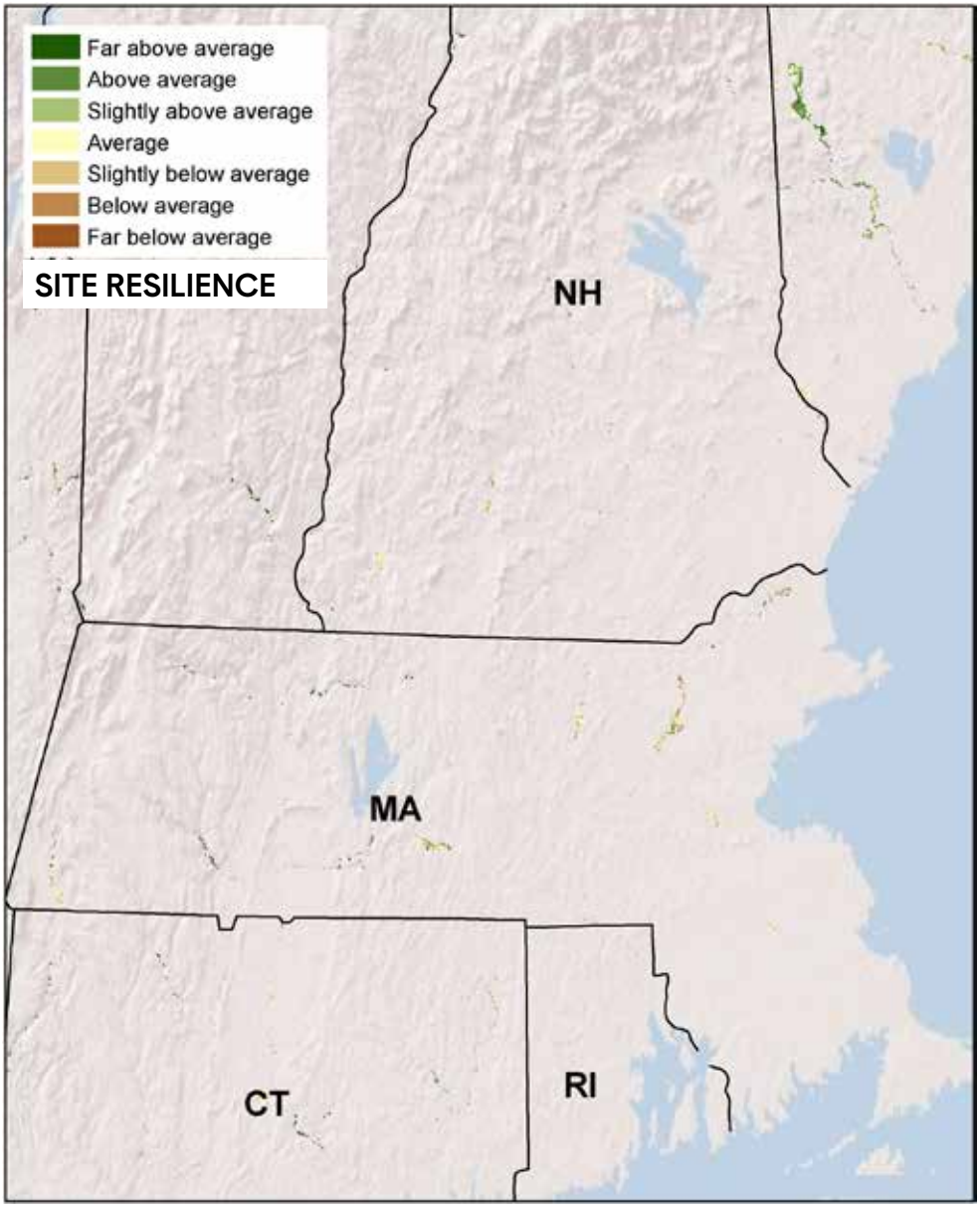
water speedwell (*Veronica catenata*)

Clinton's bulrush (*Trichophorum clintonii*)

New England violet (*Viola novae-angliae*)

elk sedge (*Carex garberi*)

# North-Central Appalachian Large River Floodplain




© Bruce A. Sorrie (Massachusetts Division of Fisheries & Wildlife/ Natural Heritage & Endangered Species Program)

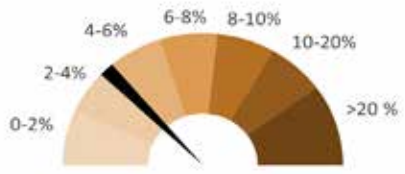
## Description

A complex of wetland and upland vegetation on floodplains of medium to large rivers. The vegetation includes floodplain forests of silver maple, sycamore, box elder, and cottonwood, as well as herbaceous sloughs, shrub wetlands, ice scours, and riverside prairies.

## Associated Herbs & Shrubs

green-dragon (*Arisaema dracontium*), Canada moonseed (*Menispermum canadense*), smooth beggar-ticks (*Bidens laevis*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 4% | 1,183 | 9% | 5% | 21% | 36% | 64% |
| Above average | 24% | 7,575 | 5% | 3% | 28% | 37% | 63% |
| Slightly above average | 22% | 7,081 | 1% | 4% | 26% | 31% | 69% |
| Average | 34% | 10,655 | 0% | 9% | 18% | 28% | 72% |
| Slightly below average | 7% | 2,064 | 1% | 14% | 18% | 33% | 67% |
| Below average | 3% | 993 | 2% | 10% | 14% | 25% | 75% |
| Far below average | 0% | 60 | 0% | 0% | 6% | 6% | 94% |
| Developed | 6% | 1,979 | 1% | 5% | 12% | 18% | 82% |
| TOTAL | 100% | 31,590 | 2% | 6% | 22% | 30% | 70% |




**Predicted Loss to Development by 2050**

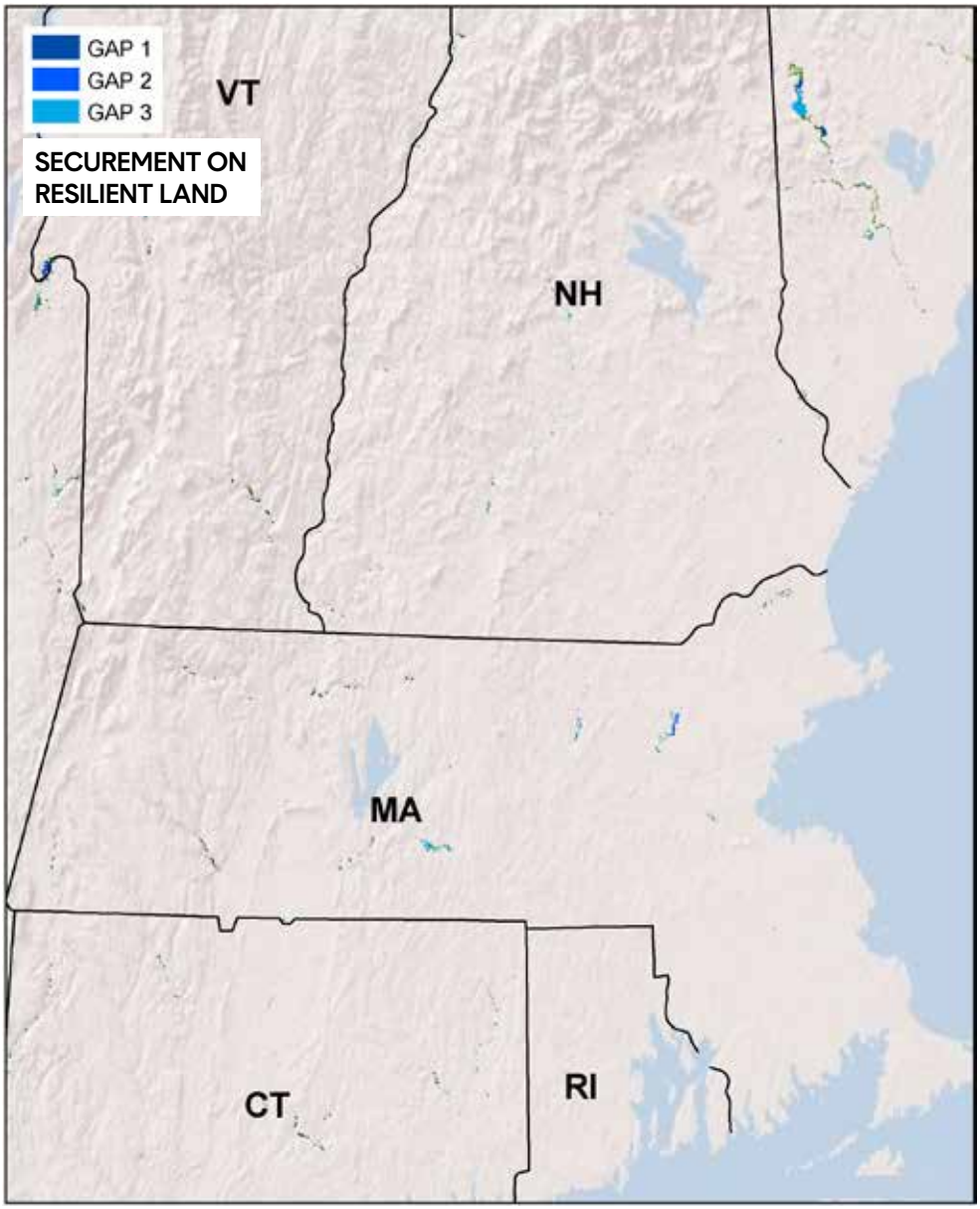
Moderately low 4%

This community is moderately threatened by development, with 1,441 acres (4%) likely to be lost over the next 30 years.

## Resilience & Securement

50% of this habitat scores high for resilience, 30% of the total acreage is secured against conversion, and 8% is protected.

# North-Central Appalachian Large River Floodplain




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 31,590 | 30% |
| CT | 3,814 | 32% |
| MA | 9,684 | 41% |
| ME | 10,296 | 30% |
| NH | 4,403 | 20% |
| RI | 19 | 12% |
| VT | 3,374 | 15% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 15,839 | 34% |
| CT | 1,277 | 32% |
| MA | 3,173 | 40% |
| ME | 7,770 | 37% |
| NH | 1,345 | 29% |
| RI | 1 | 0% |
| VT | 2,274 | 18% |

## Rare or Uncommon Plants Associated with this Habitat

Provancher's Philadelphia fleabane (*Erigeron philadelphicus* var. *provancheri*)

Robinson's hawkweed (*Hieracium robinsonii*)

early wild-rye (*Elymus macgregorii*)

musky monkey-flower (*Erythranthe [Mimulus] moschata*)

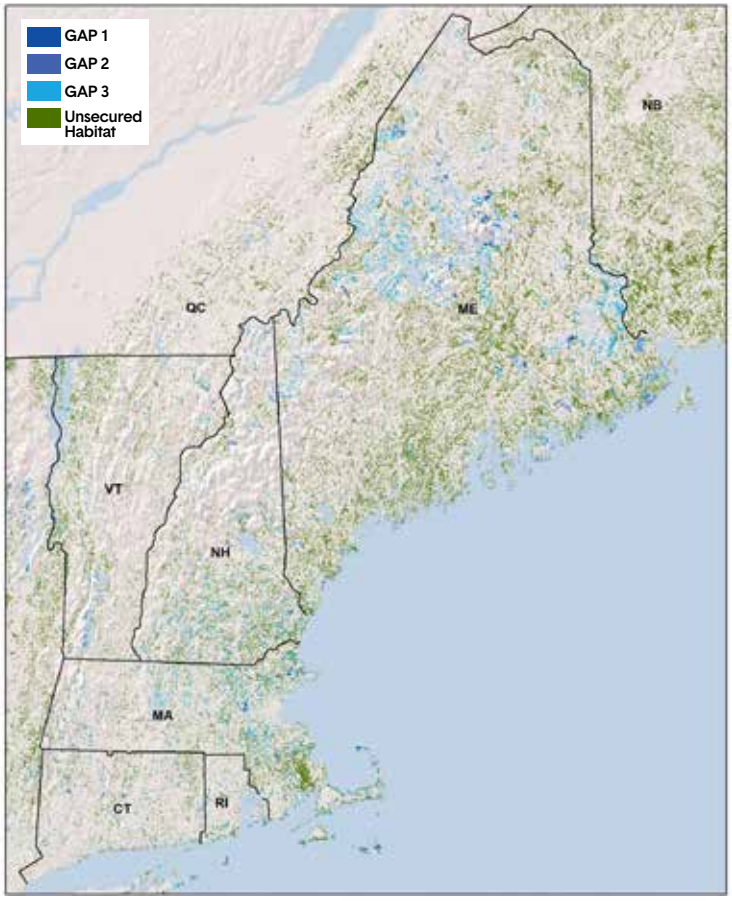
northern wild senna (*Senna hebecarpa*)

hairy hedge-nettle (*Stachys pilosa* var. *arenicola*)

crooked-stemmed American-aster (*Symphyotrichum prenanthoides*)

MACROGROUP

# FRESHWATER MARSH & SHRUB SWAMP


**Freshwater Marsh & Shrub Swamp**

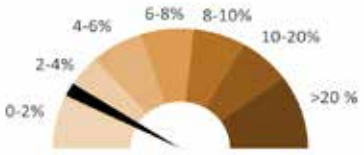
Freshwater marshes, meadows, and shrub swamps dominated by herbaceous or shrubby vegetation without trees.

**Acres in New England**

860,248

**Percent Secured**

GAP 1 = 2%
GAP 2 = 4%
GAP 3 = 16%




**Predicted Loss to Development by 2050**

26,984 acres (3%)

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Freshwater Marsh & Shrub Swamp** | **860,248** | **2%** | **4%** | **16%** | **77%** | **8** | | **1** | **7** |
| Connecticut | 37,445 | 1% | 7% | 16% | 76% | 2 | | | 2 |
| Massachusetts | 125,850 | 2% | 5% | 25% | 69% | 5 | | 1 | 4 |
| Maine | 503,015 | 2% | 4% | 14% | 80% | 1 | | | 1 |
| New Hampshire | 104,684 | 2% | 4% | 22% | 72% | | | | |
| Rhode Island | 9,349 | 2% | 7% | 24% | 66% | | | | |
| Vermont | 79,905 | 0 | 0 | 0 | 1% | | | | |
| **New England** | **860,248** | **19,621** | **33,048** | **141,563** | **666,016** | | | | |

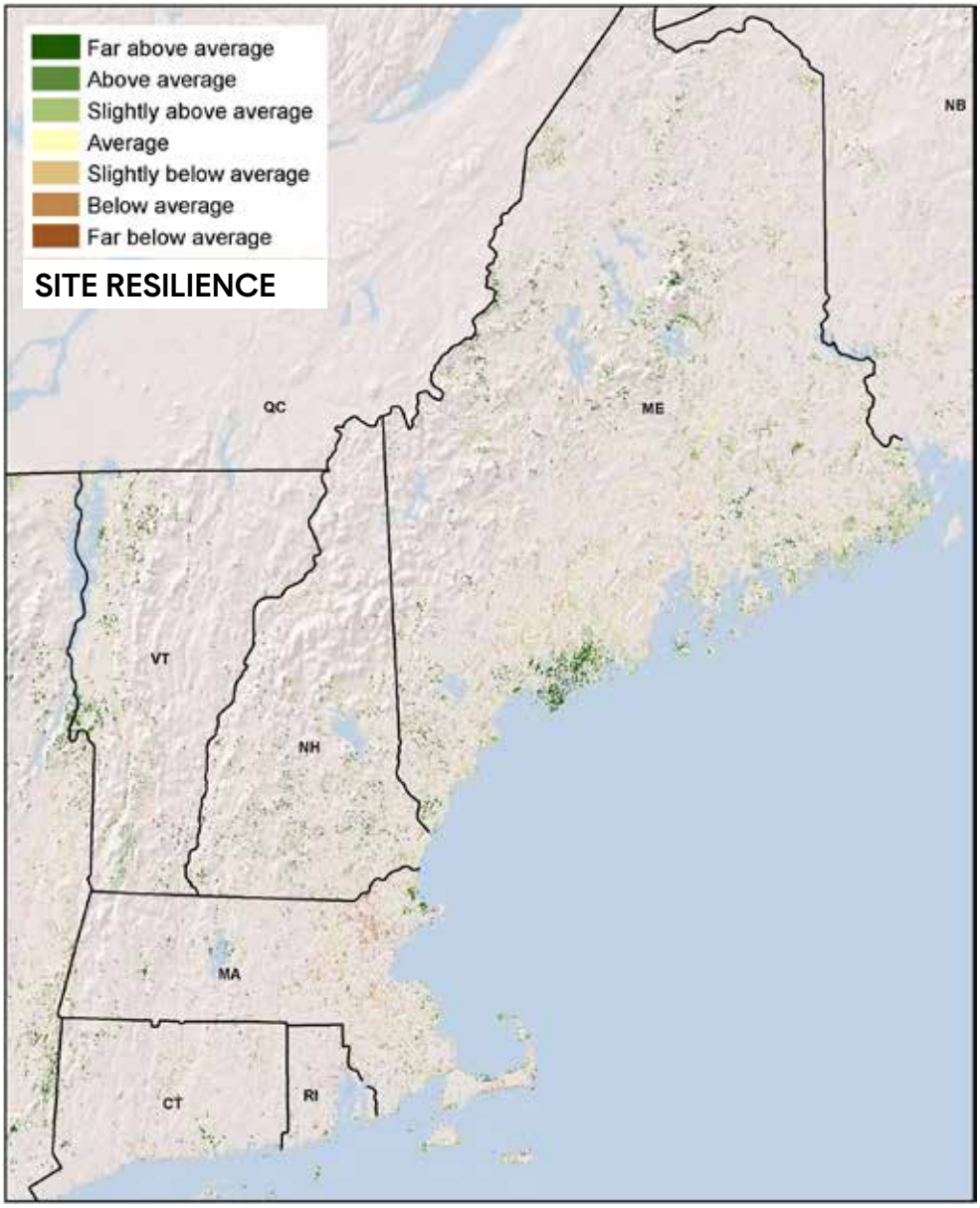
P = Protected S = Secured
U = Unsecured

# DISTRIBUTION OF HABITATS


**Laurentian-Acadian Freshwater Marsh**


**Laurentian-Acadian Wet Meadow-Shrub Swamp**

# Laurentian-Acadian Freshwater Marsh




© Maine Natural Areas Program

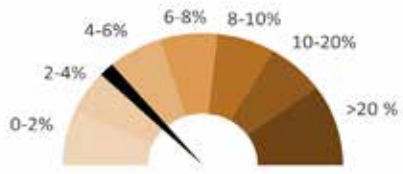
## Description

An emergent or submergent freshwater marsh dominated by herbaceous vegetation and associated with basins, streamways, and seepage slopes. Typical plants include cattails, marsh fern, touch-me-not, pondweeds, water lilies, pickerelweed, and tall rushes that die back in winter.

## Associated Herbs & Shrubs

autumn water-starwort (*Callitriche hermaphroditica*), hard-stemmed club-bulrush (*Schoenoplectus acutus*), marsh-felwort (*Lomatogonium rotatum*), hairy hedge-nettle (*Stachys pilosa*), whorled marsh-pennywort (*Hydrocotyle verticillata*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 2% | 6,717 | 7% | 7% | 18% | 32% | 68% |
| Above average | 18% | 67,429 | 7% | 6% | 20% | 33% | 67% |
| Slightly above average | 39% | 141,544 | 2% | 4% | 18% | 24% | 76% |
| Average | 25% | 92,775 | 1% | 4% | 13% | 18% | 82% |
| Slightly below average | 7% | 23,899 | 1% | 4% | 13% | 18% | 82% |
| Below average | 3% | 12,784 | 1% | 4% | 12% | 17% | 83% |
| Far below average | 1% | 2,019 | 1% | 2% | 11% | 13% | 87% |
| Developed | 6% | 20,339 | 1% | 2% | 9% | 12% | 88% |
| TOTAL | 100% | 367,506 | 3% | 4% | 16% | 23% | 77% |




**Predicted Loss to Development by 2050**

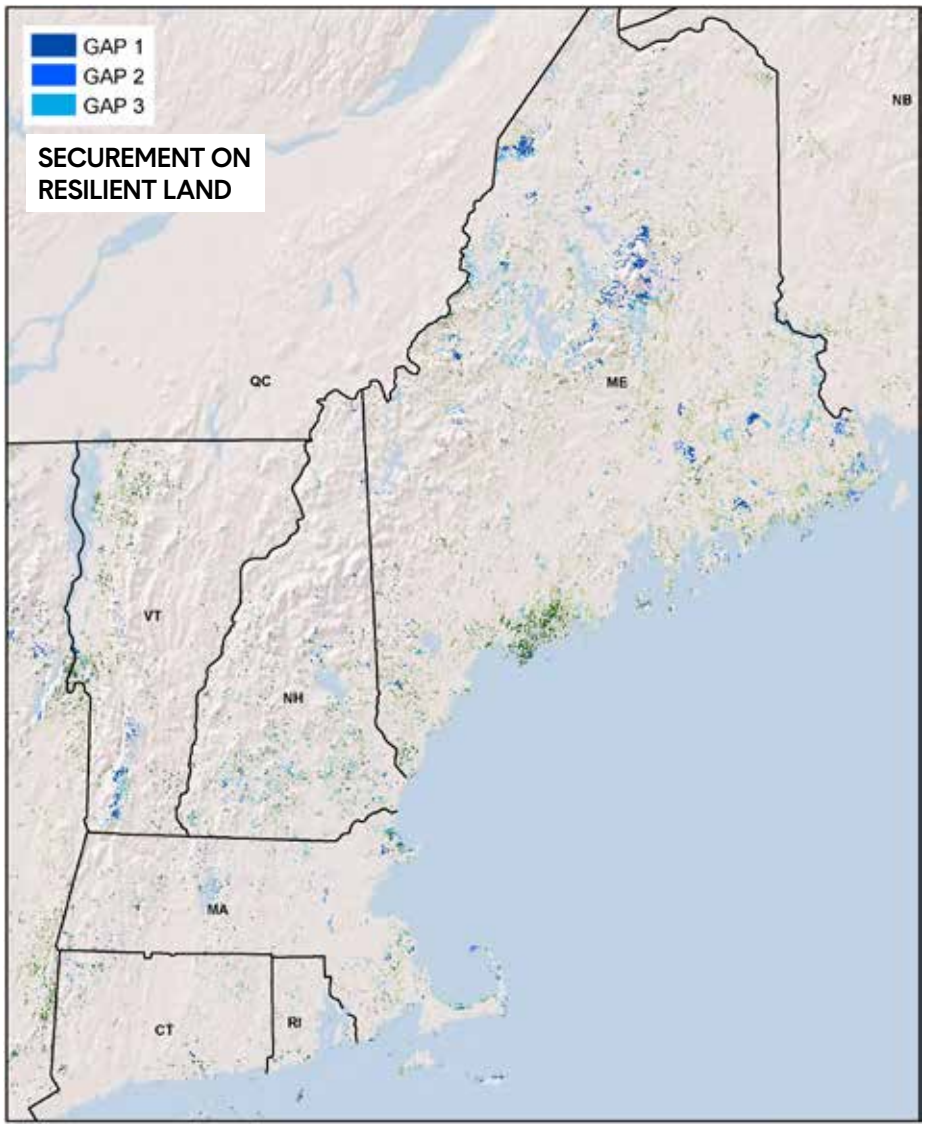
Moderately low 4%

This community is somewhat threatened by development, with 14,428 acres (4%) likely to be lost over the next 30 years.

## Resilience & Securement

59% of this habitat scores high for resilience, and 23% of the total acreage is secured against conversion, with the resilient areas having the highest proportion of securement.

# Laurentian-Acadian Freshwater Marsh




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 367,506 | 23% |
| CT | 14,698 | 27% |
| MA | 50,638 | 32% |
| ME | 213,591 | 20% |
| NH | 46,252 | 28% |
| RI | 4,321 | 30% |
| VT | 38,007 | 20% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 215,690 | 27% |
| CT | 5,917 | 35% |
| MA | 15,450 | 40% |
| ME | 144,533 | 24% |
| NH | 27,559 | 32% |
| RI | 1,468 | 44% |
| VT | 20,763 | 29% |

## Rare or Uncommon Plants Associated with this Habitat

New England thoroughwort (*Eupatorium novae-angliae*)

Plymouth rose-gentian (*Sabatia kennedyana*)

quill-leaved arrowhead (*Sagittaria teres*)

northeastern bulrush (*Scirpus ancistrochaetus*)

southern agrimony (*Agrimonia parviflora*)

wheat sedge (*Carex atherodes*)

Emory's sedge (*Carex emoryi*)

Mitchell's sedge (*Carex mitchelliana*)

Walter's sedge (*Carex striata*)

collared dodder (*Cuscuta indecora* var. *indecora*)

American waterwort (*Elatine americana*)

horsetail spikesedge (*Eleocharis equisetoides*)

square-stemmed spikesedge (*Eleocharis quadrangulata*)

dwarf burhead (*Helanthium tenellum*)

large grass-leaved rush (*Juncus biflorus*)

many-fruited water-primrose (*Ludwigia polycarpa*)

round-pod water-primrose (*Ludwigia sphaerocarpa*)

foxtail bog-clubmoss (*Lycopodiella alopecuroides*)

cut-leaved water-milfoil (*Myriophyllum pinnatum*)

golden-club (*Orontium aquaticum*)

Puritan smartweed (*Persicaria puritanorum*)

crested orange bog-orchid (*Platanthera cristata*)

Maryland meadow-beauty (*Rhexia mariana* var. *mariana*)

narrow-fruited beaksedge (*Rhynchospora inundata*)

short-beaked beaksedge (*Rhynchospora nitens*)

toothcup (*Rotala ramosior*)

slender rose-gentian (*Sabatia campanulata*)

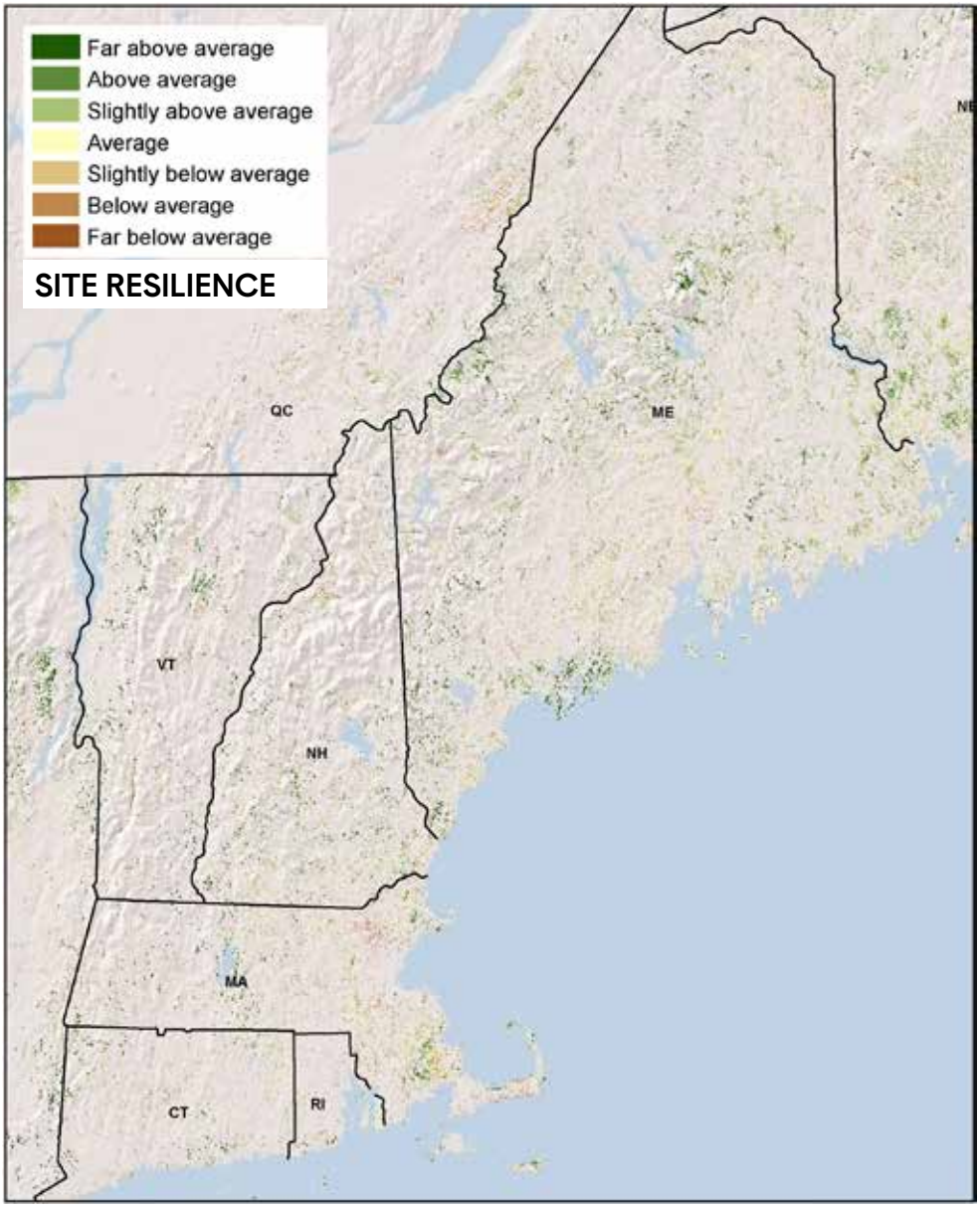
lizard's-tail (*Saururus cernuus*)

whip nutsedge (*Scleria triglomerata*)

sclerolepis (*Sclerolepis uniflora*)

swamp wedgescale (*Sphenopholis pensylvanica*)

# Laurentian-Acadian Wet Meadow-Shrub Swamp




© Maine Natural Areas Program

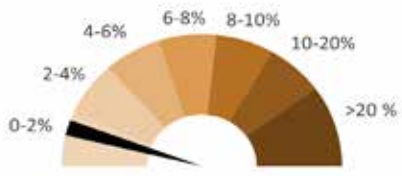
## Description

A shrub-dominated swamp or wet meadow on mineral soils. Examples occur in association with waterbodies and can be small and solitary or part of a larger wetland. Typical species include willow, red-osier dogwood, alder, buttonbush, meadowsweet, bluejoint grass, tall sedges, and rushes.

## Associated Herbs & Shrubs

northern adder's-tongue fern (*Ophioglossum pusillum*), auricled twayblade (*Neottia auriculata*), marsh bellflower (*Campanula aparinoides*), swamp birch (*Betula pumila*), swamp lousewort (*Pedicularis lanceolata*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 1% | 6,428 | 8% | 6% | 21% | 35% | 65% |
| Above average | 17% | 81,369 | 5% | 5% | 21% | 30% | 70% |
| Slightly above average | 42% | 204,641 | 2% | 3% | 20% | 25% | 75% |
| Average | 25% | 121,444 | 1% | 3% | 13% | 16% | 84% |
| Slightly below average | 7% | 33,117 | 1% | 3% | 13% | 17% | 83% |
| Below average | 4% | 18,811 | 1% | 3% | 12% | 16% | 84% |
| Far below average | 0% | 2,349 | 2% | 2% | 8% | 12% | 88% |
| Developed | 5% | 24,582 | 1% | 3% | 9% | 12% | 88% |
| TOTAL | 100% | 492,741 | 2% | 3% | 17% | 22% | 78% |




**Predicted Loss to Development by 2050**

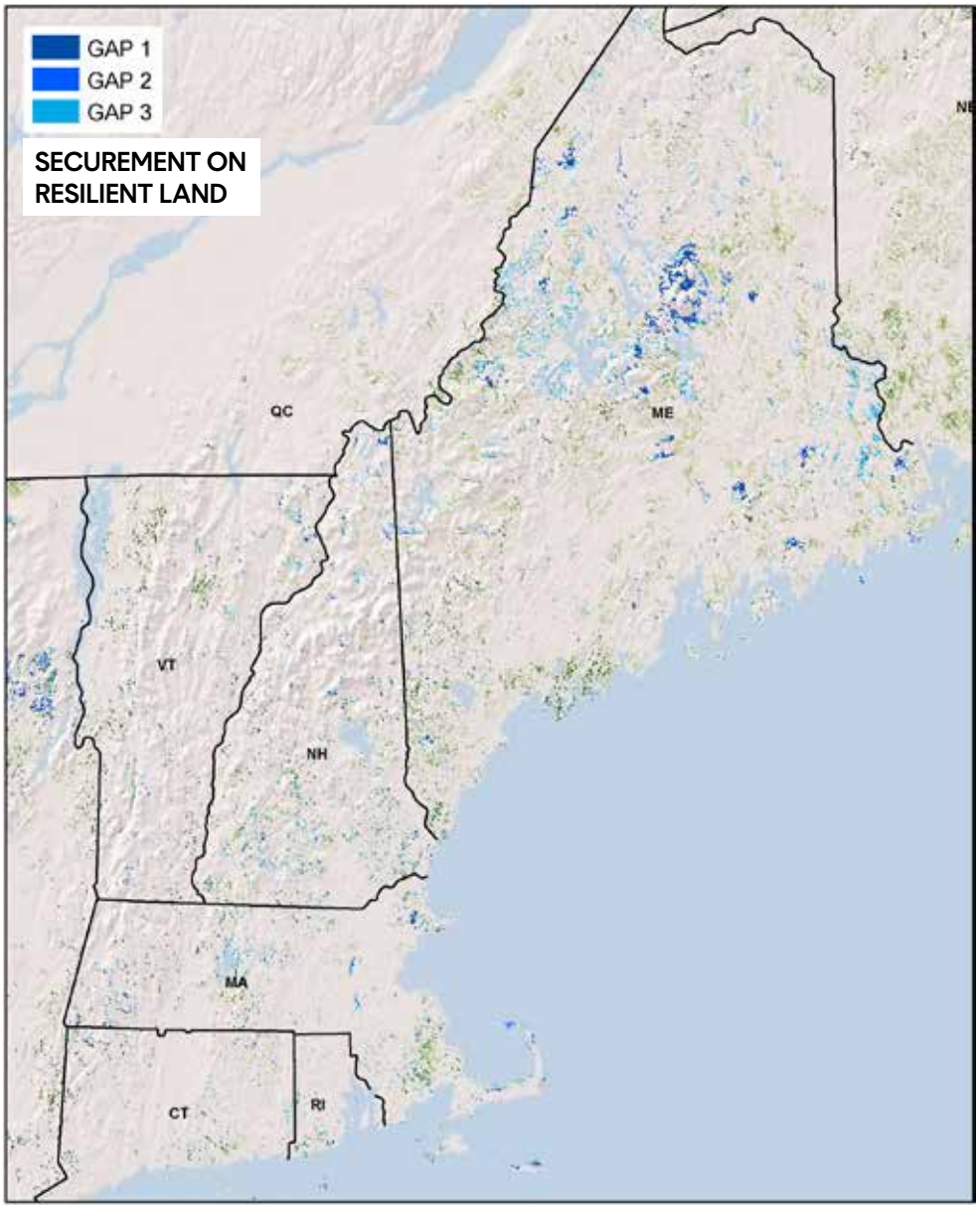
Low 2%

This community is somewhat threatened by development, with 12,556 acres (2%) likely to be lost over the next 30 years.

## Resilience & Securement

61% of this habitat scores high for resilience, 22% of the total acreage is secured against conversion, and 5% is protected.

# Laurentian-Acadian Wet Meadow-Shrub Swamp




| LOCATION | TOTAL ACRES | % SECURED |
|---|---|---|
| New England | 492,741 | 22% |
| CT | 22,747 | 22% |
| MA | 75,212 | 31% |
| ME | 289,424 | 20% |
| NH | 58,432 | 28% |
| RI | 5,028 | 37% |
| VT | 41,898 | 16% |

| LOCATION | RESILIENT ACRES | % SECURED |
|---|---|---|
| New England | 292,438 | 27% |
| CT | 8,619 | 29% |
| MA | 27,185 | 39% |
| ME | 197,211 | 24% |
| NH | 34,525 | 32% |
| RI | 2,135 | 47% |
| VT | 22,764 | 23% |

## Rare or Uncommon Plants Associated with this Habitat

bog Jacob's-ladder (*Polemonium van-bruntiae*)

Long's bulrush (*Scirpus longii*)

wheat sedge (*Carex atherodes*)

Barratt's sedge (*Carex barrattii*)

white-edged sedge (*Carex debilis* var. *debilis*)

blue sedge (*Carex glaucodea*)

wiry panicgrass (*Panicum flexile*)

field beadgrass (*Paspalum laeve*)

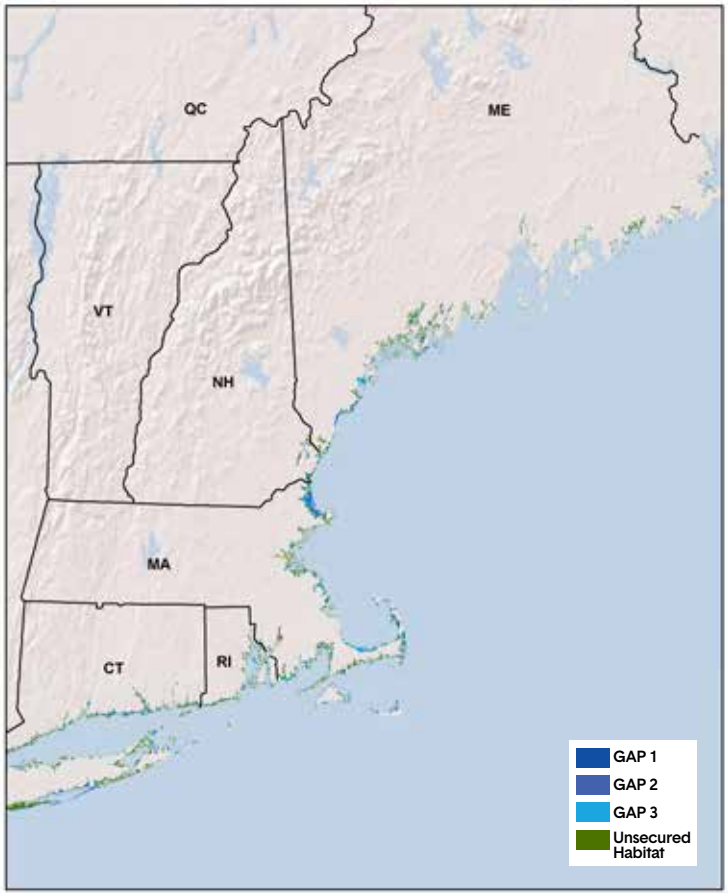
bristly smartweed (*Persicaria setacea*)

orange fringed bog-orchid (*Platanthera ciliaris*)

crested orange bog-orchid (*Platanthera cristata*)

water-plantain crowfoot (*Ranunculus ambigens*)

# MACROGROUP
# TIDAL MARSH


**Tidal Marsh**
Here two habitats, Acadian Coastal Salt & Estuary Marsh (ME only) and North Atlantic Coastal Plain Tidal Salt Marsh (CT, ME, NH, MA, RI), are treated as one.

**Acres in New England**
111,748

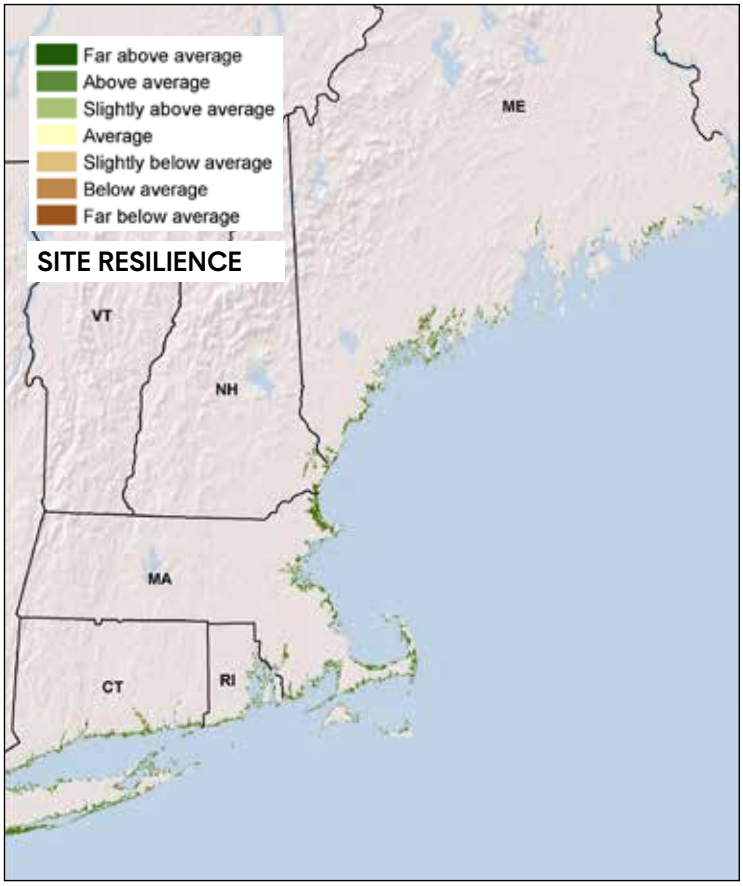
**Percent Secured**
GAP 1 = 2%
GAP 2 = 15%
GAP 3 = 24%

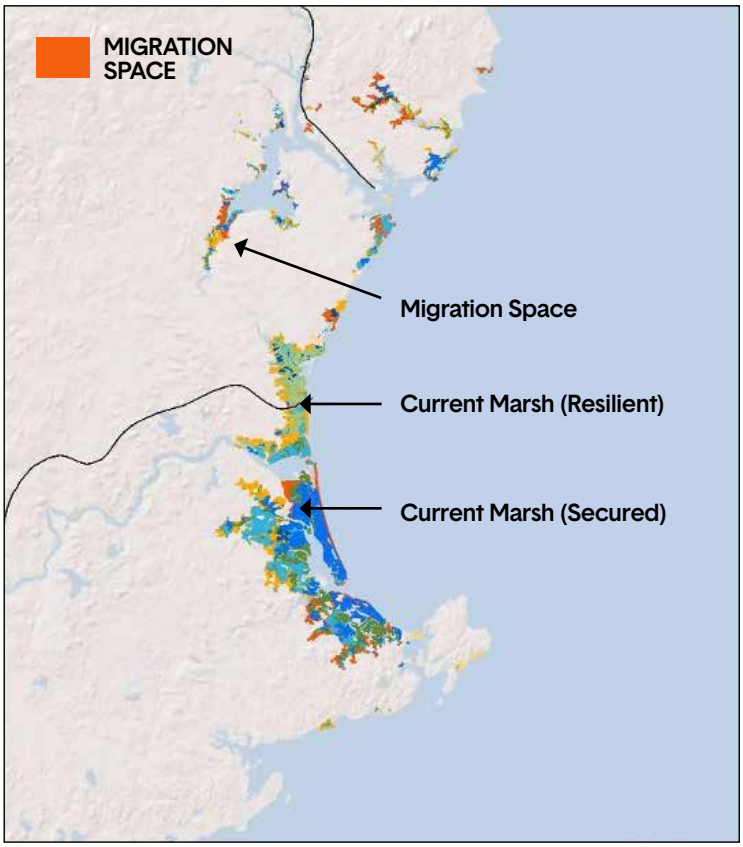
**Predicted Loss**
Although the land on which they occur is fairly well protected, these marshes are succumbing to sea-level rise, which inundates the marsh and causes die-off.

| | ACRES | GAP 1 | GAP 2 | GAP 3 | UNSECURED | IMPORTANT PLANT AREAS TOTAL | P | S | U |
|---|---|---|---|---|---|---|---|---|---|
| **Tidal Marsh** | **111,748** | **2%** | **15%** | **24%** | **58%** | **15** | | **1** | **14** |
| Connecticut | 15,084 | 4% | 15% | 24% | 58% | 2 | | | 2 |
| Massachusetts | 57,071 | 2% | 16% | 29% | 53% | 11 | | | 11 |
| Maine | 26,907 | 1% | 16% | 17% | 66% | | | | |
| New Hampshire | 6,443 | 4% | 4% | 17% | 74% | | | | |
| Rhode Island | 6,244 | 3% | 16% | 17% | 65% | 2 | | 1 | 1 |
| **New England** | **111,748** | **2,427** | **17,002** | **26,958** | **65,361** | | | | |

P = Protected S = Secured
U = Unsecured

# TIDAL MARSH




© Josh Royte (The Nature Conservancy, Maine)

## Description

A complex of tidally influenced marshes from the coastal shore to the tidal rivers. This habitat includes salt marsh, brackish marsh, and freshwater tidal marsh. A salt marsh profile features a low, regularly flooded marsh dominated by salt marsh cordgrass; a higher irregularly flooded marsh dominated by salt meadow cordgrass and saltgrass; low hypersaline pannes characterized by saltwort; and a salt scrub ecotone characterized by marsh elder, groundsel-tree, and switchgrass. Brackish areas support salt marsh cordgrass, giant cordgrass, narrowleaf cattail, and bulrush.

## Associated Herbs & Shrubs

American sea-blite (*Suaeda calceoliformis*), dwarf glasswort (*Salicornia bigelovii*), big cordgrass (*Spartina cynosuroides*), saltmarsh tuber-bulrush (*Schoenoplectus maritimus*), saltmarsh agalinis (*Agalinis maritima*), sea pink (*Sabatia stellaris*), sea coast Angelica (*Angelica lucida*)

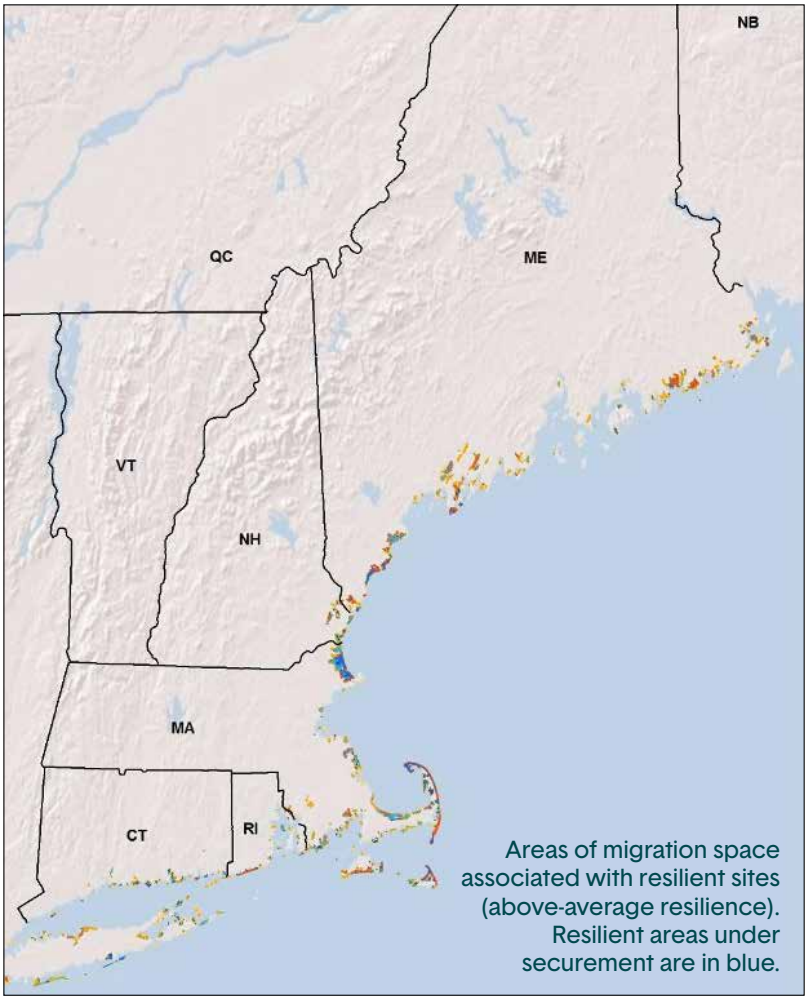
## Migration Space

A key concept for estimating the resilience of tidal habitats is whether they have:

**1) Migration space:** available adjacent lowlands suitable for the formation of future marsh under rising sea levels

**2) Intact processes:** the processes needed to facilitate migration: sediments, freshwater, and an absence of barriers.

# TIDAL MARSH




Areas of migration space associated with resilient sites (above-average resilience). Resilient areas under securement are in blue.

## Rare or Uncommon Plants Associated with this Habitat

Eaton's beggar-ticks (*Bidens eatonii*)

Long's bitter-cress (*Cardamine longii*)

tidal spikesedge (*Eleocharis aestuum*)

Parker's pipewort (*Eriocaulon parkeri*)

herbaceous sea-blite (*Suaeda maritima* ssp. *richii*)

New England tuber-bulrush (*Bolboschoenus novae-angliae*)

American waterwort (*Elatine americana*)

beaked spikesedge (*Eleocharis rostellata*)

whorled marsh-pennywort (*Hydrocotyle verticillata*)

Torrey's rush (*Juncus torreyi*)

bearded sprangletop (*Leptochloa fusca* ssp. *fascicularis*)

immigrant pond-lily (*Nuphar advena*)

golden-club (*Orontium aquaticum*)

swamp lousewort (*Pedicularis lanceolata*)

awl-leaved arrowhead (*Sagittaria subulata*)

Annual sea-purslane (*Sesuvium maritimum*)

hairy hedge-nettle (*Stachys pilosa* var. *arenicola*)

yellow thistle (*Cirsium horridulum* var. *horridulum*)

winged monkey-flower (*Mimulus alatus*)

| SITE RESILIENCE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 11% | 15,031 | 0% | 2% | 4% | 7% | 5% |
| Above average | 42% | 55,630 | 1% | 7% | 8% | 16% | 27% |
| Slightly above average | 18% | 24,064 | 0% | 1% | 3% | 4% | 14% |
| Average | 18% | 23,415 | 0% | 1% | 3% | 4% | 14% |
| Slightly below average | 3% | 4,076 | 0% | 0% | 0% | 0% | 3% |
| Below average | 3% | 3,724 | 0% | 0% | 0% | 0% | 2% |
| Far below average | 4% | 5,552 | 0% | 0% | 0% | 1% | 4% |
| TOTAL | 100% | 131,492 | 2% | 12% | 19% | 33% | 67% |

| MIGRATION SPACE | RESILIENT | ACRES | GAP 1 | GAP 2 | GAP 3 | TOTAL SECURED | TOTAL UNSECURED |
|---|---|---|---|---|---|---|---|
| Far above average | 35% | 24,496 | 0% | 8% | 6% | 15% | 20% |
| Above average | 33% | 23,432 | 1% | 5% | 5% | 11% | 23% |
| Slightly above average | 12% | 8,690 | 0% | 1% | 2% | 4% | 9% |
| Average | 15% | 10,467 | 0% | 1% | 2% | 3% | 12% |
| Slightly below average | 3% | 2,075 | 0% | 0% | 0% | 0% | 3% |
| Below average | 2% | 1,138 | 0% | 0% | 0% | 0% | 1% |
| Far below average | 0% | 132 | 0% | 0% | 0% | 0% | 0% |
| TOTAL | 100% | 70,429 | 2% | 15% | 16% | 33% | 67% |

**Total Acres of Tidal Complex** = 131,492

**Resilient Tidal Complex** = 94,724 (72%)

**Total Acres Migration Space** = 70,429 acres

**Resilient Migration Space** = 56,618 acres (80%)

**Secured Resilient Tidal Complex** = 23%

**Secured Resilient Migration Space** = 29%

*These statistics are from "Resilient Sites for Coastal Conservation in the Northeast" (Anderson and Barnett 2017). They summarize the area of Tidal Complex, a slightly broader habitat than tidal marsh that includes brackish marsh and tidal flat. See the full study and web tool here.*

PART THREE

# SUPPORTĪNG MATERĪAL

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# Appendices

## APPENDIX 1
## Divisions of *Flora Conservanda* (Brumback and Gerke 2013)

Flora Conservanda is divided into five Divisions.

**Division 1: Globally Rare Taxa occurring in New England.**
Taxa included in this Division have a global conservation status rank (GRank) of G1 through G3 or T1 through T3 (see Appendix 2); they are critically imperiled, imperiled, or vulnerable (NatureServe 2012). Usually only a few occurrences of these taxa exist within our region, but for some species, the majority of occurrences of these highly ranked taxa occur in New England. GRanks for taxa in this Division appear under each relevant taxon in the list.

**Division 2: Regionally Rare Taxa.**
Within New England, these taxa have 20 or fewer current (observed within the last 20–25 years) occurrences. This Division includes taxa that are rare or uncommon throughout their entire range as well as taxa that reach the edge of their distributional range in our region. It is important to conserve these edge-of-range occurrences as part of New England's natural heritage as well as to avoid shrinkage of these species' ranges. All taxa in Division 2 have G Ranks of G4 or G5 (apparently secure to secure globally). A taxon with slightly more than 20 occurrences in New England might also be included in Division 2 if it is vulnerable to extirpation due to other important factors (population size and trends, area of occupancy, overall viability, geographic distribution, habitat rarity and integrity, and/or degree of protection). These taxa are denoted as 2(a).

**Division 3: Locally Rare Taxa**
These taxa may be declining in a significant part of their range in New England, or may have one or more occurrences of biological, ecological, or possible genetic significance. Division 3(a) includes those taxa that have declined in a substantial portion of their range in New England (e.g., southern New England). Each state in the declining portion of the range is listed following the Division designation in the List (e.g., MA, NH). Division 3(b) taxa are those that, based on their biology and geography within New England, have populations that are disjunct to such a degree that genetic isolation is suspected. Each state with one or more disjunct occurrence is noted following the Division designation in the List, and the county of each disjunct occurrence is listed in the notes under the taxon. For Division 3(b), only selected occurrences in a particular state are of conservation concern for the purposes of the Flora Conservanda list, not all occurrences of the taxon throughout New England. A taxon may be listed as Division 3 in one or more states (designated by an asterisk following the state data), but not considered to be regionally rare.

**Division 4: Historic Taxa**
This Division consists of taxa that once existed in New England but have not been observed in natural occurrences on the landscape in the last 20–25 years (depending upon each NHPs methodology). The purposes of this division are to generate interest in re-locating these taxa if they still exist and to illustrate the level at which species have been lost from the region.

**Division Indeterminate (IND.): Presumed Rare but Confirmation Required**
These taxa are under review for inclusion in one of the above divisions, but due to issues of taxonomy (at least for New England occurrences) or nomenclature, or because their status in the wild is not confidently understood, they cannot yet be designated to a particular division. The purpose of this division is to stimulate interest in taxonomic research and/or field surveys for these taxa to bolster our knowledge and understanding.

## APPENDIX 2
## Definitions of Conservation Status Ranks per NatureServe (2014)

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, pre-ceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere.

Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct; not having been observed for the past 20–25 years) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks (the lower the number, the "higher" the rank, and therefore the conservation priority). On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

bearberry willow *(Salix uva-ursi)*
Liza Green © Native Plant Trust

## APPENDIX 2

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups; thus, G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks.

Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.

## APPENDIX 3
## Important Plant Areas by State and Protection Status

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| **MATRIX FOREST** | | | | | | | | | |
| **Boreal Upland Forest** | | | | | | | | | |
| **Acadian Low-Elevation Spruce-Fir-Hardwood Forest** | | | | | | | | | |
| 81632 | ME | 2 | 2,681 | Soubunge Mountain | S | 0% | 100% | 100% | |
| 90329 | ME | 2 | 13,237 | No Name | U | 0% | 0% | 0% | |
| 52265 | ME | 6 | 25,411 | White Pond Acidic Fen | U | 3% | 54% | 57% | |
| 106862 | ME | 2 | 6,734 | Horan Head | U | 3% | 23% | 26% | |
| 44810 | ME | 2 | 37,997 | Gardner Brook | U | 0% | 41% | 41% | |
| 77427 | ME | 6 | 194 | Name Excluded | U | 16% | 0% | 16% | |
| 38769 | ME | 5 | 286 | Name Excluded | S | 0% | 77% | 77% | |
| 89343 | ME | 5 | 43,820 | Dwinal Pond | U | 2% | 6% | 9% | |
| 35477 | ME | 4 | 11,889 | No Name | U | 2% | 7% | | |
| 59487 | ME | 4 | 21,269 | Burntland Bend | P | 99% | 0% | 99% | 1 |
| 138016 | ME | 3 | 3,530 | Cadillac Mountain South And East | P | 99% | 0% | 99% | 1 |
| 73227 | ME | 3 | 13,666 | Marble Pond Fen | U | 4% | 0% | 4% | |
| 49075 | ME | 3 | 71,551 | Dead Horse Bog | U | 1% | 1% | 1% | |
| 40218 | ME | 2 | 41 | Name Excluded | U | 0% | 0% | 0% | |
| 64291 | ME | 2 | 93 | Name Excluded | P | 100% | 0% | 100% | 1 |
| 53841 | ME | 2 | 5,454 | Sixmile Brook, St. John River | U | 21% | 51% | 71% | |
| 68704 | ME | 2 | 9,359 | Eagle Lake | S | 20% | 70% | 90% | |
| 32792 | ME | 2 | 22,557 | Deer Lake Fen | U | 0% | 8% | 8% | |
| 64224 | ME | 2 | 36,111 | Bluffer Preserve | U | 2% | 65% | 67% | |
| **Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest** | | | | | | | | | |
| 166592 | NH | 24 | 106,908 | Mt Eisenhower/Jackson/ Crawford/Webster | S | 62% | 32% | | 1 |
| 177296 | NH | 12 | 142,457 | Mt Lincoln/Lafayette | S | 73% | 26% | 99% | 1 |
| **Central Oak-Pine Forest** | | | | | | | | | |
| **North Atlantic Coastal Plain Hardwood Forest** | | | | | | | | | |
| 430026 | CT | 2 | 1,707 | Pequot Swamp Pond | U | 0% | 21% | | |
| 423446 | CT | 3 | 682 | No Name | U | 38% | 0% | 38% | |
| 439507 | CT | 3 | 1,287 | Old Quarry Road | U | 16% | 13% | 29% | |
| 425573 | CT | 2 | 2,039 | No Name | U | 26% | 14% | 40% | |
| 425882 | CT | 2 | 117 | Name Excluded | U | 15% | 2% | 16% | |
| 427590 | CT | 2 | 570 | Lieutenant River | U | 23% | 0% | | |
| 314974 | MA | 2 | 365 | Name Excluded | S | 0% | 97% | 97% | |
| 337564 | MA | 2 | 116 | Name Excluded | U | 0% | 28% | 28% | |
| 401894 | MA | 2 | 1,604 | No Name | U | 2% | 6% | 8% | |
| 411365 | RI | 2 | 222 | Name Excluded | U | 47% | 0% | 47% | |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| 407472 | RI | 5 | 1,364 | Hot House Pond, Strange Pond | U | 31% | 6% | 37% | |
| 411644 | RI | 2 | 1,589 | No Name | U | 0% | 2% | 2% | |
| **North Atlantic Coastal Plain Maritime Forest** | | | | | | | | | |
| 391895 | MA | 3 | 500 | Name Excluded | U | 0% | 0% | | |
| 423756 | CT | 3 | 543 | Mumford Cove, Bluff Point Coastal Reserve | P | 84% | 0% | 84% | 1 |
| **North Atlantic Coastal Plain Pitch Pine Barrens** | | | | | | | | | |
| 320209 | MA | 2 | 344 | Name Excluded | P | 100% | 0% | | 1 |
| 338857 | MA | 2 | 5 | Name Excluded | U | 0% | 0% | 0% | |
| 370398 | MA | 2 | 74 | Name Excluded | U | 0% | 43% | 43% | |
| 347201 | MA | 3 | 9 | Name Excluded | U | 0% | 33% | 33% | |
| 337417 | MA | 2 | 3 | Name Excluded | U | 0% | 0% | 0% | |
| 339917 | MA | 2 | 119 | Name Excluded | S | 0% | 100% | 100% | |
| 345735 | MA | 2 | 72 | Name Excluded | S | 0% | 84% | 84% | |
| **Northeastern Interior Dry-Mesic Oak Forest** | | | | | | | | | |
| 422809 | CT | 5 | 1,163 | Eightmile River | U | 7% | 50% | 58% | |
| 392816 | CT | 3 | 1,564 | Daphne Swamp | U | 19% | 3% | 21% | |
| 423955 | CT | 3 | 831 | No Name | U | 5% | 8% | 13% | |
| 426168 | CT | 3 | 2,308 | No Name | U | 8% | 2% | 10% | |
| 445892 | CT | 3 | 422 | Name Excluded | U | 61% | 13% | 74% | |
| 396247 | CT | 2 | 192 | Name Excluded | U | 0% | 0% | 0% | |
| 411029 | CT | 2 | 335 | Name Excluded | U | 0% | 0% | 0% | |
| 419559 | CT | 2 | 72 | Name Excluded | U | 0% | 0% | 0% | |
| 420874 | CT | 2 | 408 | Name Excluded | U | 14% | 0% | 14% | |
| 428347 | CT | 2 | 459 | Name Excluded | P | 95% | 0% | 95% | 1 |
| 317574 | MA | 2 | 14 | Name Excluded | S | 0% | 100% | 100% | |
| 352810 | MA | 2 | 2,427 | No Name | U | 0% | 19% | 19% | |
| **Northern Hardwood & Conifer Forest** | | | | | | | | | |
| **Appalachian (Hemlock)-Northern Hardwood Forest** | | | | | | | | | |
| 381217 | CT | 5 | 1,488 | Toms Hill | U | 5% | 0% | 5% | |
| 385916 | CT | 4 | 10,866 | Bear Swamp, Great Mountain Forest | U | 6% | 7% | 14% | |
| 383349 | CT | 5 | 8,548 | Canaan Mountain | U | 20% | 33% | 53% | |
| 408686 | CT | 4 | 14,405 | Bulls Bridge | U | 18% | 2% | 21% | |
| 430052 | CT | 3 | 124 | Name Excluded | U | 0% | 0% | 0% | |
| 390426 | CT | 2 | 1,784 | Beebe Hill Swamp | U | 3% | 23% | 26% | |
| 442665 | CT | 2 | 1,672 | Lees Brook Valley | U | 24% | 23% | 46% | |
| 387603 | CT | 2 | 572 | Wangum Lake Brook | U | 0% | 24% | 24% | |
| 416346 | CT | 2 | 460 | Name Excluded | P | 78% | 7% | 85% | 1 |
| 299057 | MA | 2 | 4,656 | No Name | U | 0% | 4% | 4% | |
| 315708 | MA | 7 | 4,292 | No Name | U | 3% | 34% | 37% | |
| 379959 | MA | 4 | 496 | Name Excluded | U | 3% | 0% | 3% | |
| 332418 | MA | 12 | 3,445 | No Name | S | 48% | 27% | 75% | 1 |
| 331473 | MA | 11 | 4,068 | No Name | U | 41% | 31% | 71% | |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| 347186 | MA | 6 | 663 | No Name | U | 0% | 64% | 64% | |
| 339393 | MA | 6 | 535 | No Name | U | 0% | 64% | 64% | |
| 301208 | MA | 4 | 11,117 | No Name | U | 12% | 8% | 20% | |
| 317672 | MA | 4 | 704 | No Name | U | 0% | 64% | 64% | |
| 379783 | MA | 4 | 44 | Name Excluded | U | 58% | 0% | 58% | |
| 330110 | MA | 3 | 12,966 | No Name | U | 18% | 41% | 59% | |
| 348273 | MA | 3 | 1,438 | No Name | U | 0% | 34% | 34% | |
| 350275 | MA | 3 | 974 | No Name | U | 0% | 49% | 49% | |
| 317150 | MA | 3 | 240 | Name Excluded | S | 0% | 100% | 100% | |
| 317566 | MA | 3 | 92 | Name Excluded | U | 0% | 37% | 37% | |
| 352768 | MA | 2 | 5,844 | No Name | U | 12% | 55% | 67% | |
| 313220 | MA | 2 | 3,353 | No Name | U | 0% | 17% | 17% | |
| 353161 | MA | 2 | 2,105 | No Name | U | 0% | 67% | 67% | |
| 376472 | MA | 2 | 632 | No Name | U | 31% | 7% | 38% | |
| 303191 | MA | 2 | 614 | No Name | S | 0% | 94% | 94% | |
| 369688 | MA | 2 | 493 | Name Excluded | U | 8% | 0% | 8% | |
| 312622 | MA | 2 | 337 | Name Excluded | U | 0% | 24% | 24% | |
| 304784 | MA | 2 | 322 | Name Excluded | U | 13% | 47% | 60% | |
| 316503 | MA | 2 | 309 | Name Excluded | U | 0% | 8% | 8% | |
| 375762 | MA | 2 | 302 | Name Excluded | U | 0% | 0% | 0% | |
| 339530 | MA | 2 | 271 | Name Excluded | S | 24% | 75% | 99% | |
| 308362 | MA | 2 | 185 | Name Excluded | U | 0% | 21% | 21% | |
| 316633 | MA | 2 | 175 | Name Excluded | S | 0% | 100% | 100% | |
| 320576 | MA | 2 | 158 | Name Excluded | U | 0% | 21% | 21% | |
| 337093 | MA | 2 | 49 | Name Excluded | U | 28% | 0% | 28% | |
| 299544 | MA | 2 | 8 | Name Excluded | U | 0% | 0% | 0% | |
| 184692 | ME | 2 | 5,861 | Pleasant Mountain | U | 31% | 18% | 49% | |
| 218520 | ME | 2 | 5,407 | Abbott Mountain | U | 4% | 51% | 56% | |
| 209171 | ME | 3 | 3,705 | Cedar Mountain | U | 0% | 45% | 45% | |
| 241174 | NH | 3 | 103 | Name Excluded | U | 0% | 60% | 60% | |
| 223024 | NH | 2 | 16,052 | No Name | U | 0% | 29% | 29% | |
| 266278 | NH | 2 | 3,529 | No Name | U | 0% | 23% | 23% | |
| 175457 | VT | 2 | 1,115 | Adlum's Ridge | U | 23% | 25% | 48% | |
| 214100 | VT | 2 | 212 | Name Excluded | U | 0% | 0% | 0% | |
| 243370 | VT | 9 | 3,506 | Massachusetts Ledge | U | 13% | 0% | 13% | |
| 245357 | VT | 8 | 6,792 | Bald Mountain-West Haven | U | 50% | 6% | 56% | |
| 300520 | VT | 6 | 339 | Name Excluded | U | 28% | 0% | 28% | |
| 168001 | VT | 5 | 1,315 | Eagle Mountain | U | 17% | 0% | 17% | |
| 304216 | VT | 4 | 633 | Waterleaf Cliffs | U | 0% | 0% | 0% | |
| 234854 | VT | 3 | 23,691 | Hubbardton Battlefield Wma | U | 9% | 7% | 16% | |
| 296065 | VT | 3 | 5,928 | Pownal Hills-Peckham Hill | U | 0% | 0% | 0% | |
| 239529 | VT | 3 | 852 | Doughty Hill | U | 0% | 0% | 0% | |
| 202063 | VT | 2 | 9,069 | Baldwin Creek | U | 1% | 0% | 1% | |
| 216316 | VT | 2 | 3,040 | Rivers | U | 3% | 29% | 31% | |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| 242530 | VT | 2 | 2,408 | Red Rock Bay Cobble | U | 11% | 0% | 11% | |
| 171199 | VT | 2 | 2,049 | Bear Trap Road Site | U | 0% | 20% | 20% | |
| 246074 | VT | 2 | 1,989 | Coggman Creek Marsh | U | 0% | 0% | 0% | |
| 205580 | VT | 2 | 1,001 | Shellhouse Mountain | U | 0% | 12% | 12% | |
| 253247 | VT | 2 | 743 | Connecticut River | U | 0% | 0% | 0% | |
| 230403 | VT | 2 | 647 | Burnell Pond Marsh | U | 0% | 0% | 0% | |
| 241098 | VT | 2 | 299 | Name Excluded | U | 10% | 0% | 10% | |
| 251930 | VT | 2 | 119 | Name Excluded | P | 97% | 0% | 97% | 1 |
| **Laurentian-Acadian Northern Hardwood Forest** | | | | | | | | | |
| 371951 | CT | 4 | 14,813 | Bear Mountain | U | 41% | 26% | 66% | |
| 319131 | MA | 2 | 2,814 | No Name | U | 40% | 24% | 64% | |
| 309129 | MA | 5 | 6,734 | No Name | U | 31% | 40% | 71% | |
| 314533 | MA | 3 | 7,197 | No Name | U | 0% | 4% | 4% | |
| 319905 | MA | 2 | 10,129 | No Name | U | 42% | 26% | 68% | |
| 309928 | MA | 2 | 7,762 | No Name | U | 48% | 14% | 62% | |
| 315599 | MA | 2 | 2,956 | No Name | U | 33% | 30% | 63% | |
| 336454 | MA | 2 | 2,038 | No Name | U | 37% | 27% | 64% | |
| 316630 | MA | 2 | 1,182 | No Name | S | 3% | 88% | 90% | |
| 317868 | MA | 2 | 517 | No Name | S | 0% | 79% | 79% | |
| 39751 | ME | 12 | 101,523 | St John River-Basford Rips-Blue Brook | U | 2% | 12% | 14% | |
| 149027 | ME | 4 | 107,173 | Carlo Col, Mount Carlo | U | 18% | 21% | 39% | |
| 38277 | ME | 3 | 52 | Name Excluded | U | 0% | 0% | 0% | |
| 32946 | ME | 2 | 35,653 | Pinette Brook | U | 0% | 1% | 1% | |
| 88239 | ME | 2 | 26,662 | Carry Bog | S | 0% | 99% | 99% | |
| 74690 | ME | 20 | 231,550 | Mt Katahdin | P | 86% | 6% | 92% | 1 |
| 49094 | ME | 8 | 28,493 | St John River-Blue Brook | U | 2% | 0% | 2% | |
| 106397 | ME | 7 | 208,662 | Bigelow Brook | U | 2% | 10% | 12% | |
| 35309 | ME | 6 | 133,530 | St Francis Rd | U | 5% | 10% | 15% | |
| 40193 | ME | 5 | 64 | Name Excluded | U | 0% | 0% | 0% | |
| 162195 | ME | 4 | 106,857 | East Royce Mountain | S | 52% | 38% | 90% | 1 |
| 160733 | ME | 3 | 61,632 | Kneeland Pond Road | U | 26% | 42% | 68% | |
| 44904 | ME | 3 | 5,967 | 175 T14 Rno Name7 Wels | U | 0% | 0% | 0% | |
| 83560 | ME | 3 | 4,290 | Ripogenus Gorge | S | 0% | 97% | 97% | |
| 36490 | ME | 3 | 123 | Name Excluded | U | 0% | 0% | 0% | |
| 95716 | ME | 2 | 268 | Name Excluded | U | 64% | 0% | 64% | |
| 42855 | ME | 2 | 2 | Name Excluded | U | 0% | 0% | 0% | |
| 157380 | NH | 2 | 5,457 | No Name | U | 6% | 33% | 39% | |
| 195019 | NH | 4 | 108,760 | Bolles Preserve | S | 58% | 34% | 92% | 1 |
| 208723 | NH | 2 | 34,044 | Bald Knob | U | 24% | 34% | 58% | |
| 187968 | NH | 2 | 23,812 | Albany Haystack | S | 45% | 45% | 90% | 1 |
| 376250 | MA | 3 | 14,737 | Alander Mountain | U | 30% | 37% | 67% | |
| 153805 | VT | 12 | 3,664 | Mount Pisgah | U | 0% | 37% | 37% | |
| 221314 | VT | 3 | 14,850 | Bryant Mountain Hollow | U | 1% | 72% | 73% | |
| 222323 | VT | 2 | 34,860 | Monastery Mountain | S | 36% | 45% | 81% | 1 |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| 215104 | VT | 2 | 12,577 | East Middlebury | U | 5% | 55% | 60% | |
| 170730 | VT | 14 | 62,857 | Mount Mansfield | U | 23% | 33% | 56% | |
| 150311 | VT | 6 | 21,853 | Bald Mountain-Westmore | U | 0% | 9% | 9% | |
| 267687 | VT | 4 | 38,738 | Mount Equinox-Cook's Hollow | U | 7% | 9% | 16% | |
| 153262 | VT | 4 | 30,408 | Belvidere Quarry | U | 30% | 6% | 36% | |
| 166123 | VT | 4 | 29,210 | Smugglers' Notch, Elephants Head | U | 8% | 37% | 45% | |
| 154635 | VT | 4 | 6,072 | Kings Pond Marsh | S | 0% | 84% | 84% | |
| 190680 | VT | 3 | 51,386 | Beaver Meadow-Duxbury | U | 18% | 29% | 47% | |
| 159626 | VT | 3 | 8,302 | No Name | U | 8% | 1% | 9% | |
| 152921 | VT | 3 | 1,661 | No Name | U | 6% | 0% | 6% | |
| 209810 | VT | 2 | 43,732 | Blue Banks South Introduction | S | 57% | 29% | 87% | 1 |
| 255356 | VT | 2 | 37,989 | Mount Tabor Floodplain Swamps | S | 50% | 32% | 83% | 1 |
| **Laurentian-Acadian Pine-Hemlock-Hardwood Forest** | | | | | | | | | |
| 167837 | ME | 5 | 10,134 | Abagadasset Point | U | 0% | 22% | 22% | |
| 179940 | ME | 2 | 6,035 | Back River Marshes | U | 12% | 14% | 26% | |
| 174376 | ME | 4 | 2,280 | West Chops Point | U | 0% | 0% | 0% | |
| 171660 | ME | 3 | 3,553 | No Name | U | 0% | 9% | 9% | |
| 114663 | ME | 3 | 221 | Name Excluded | U | 0% | 0% | 0% | |
| 164059 | ME | 2 | 306 | Name Excluded | U | 0% | 2% | 2% | |
| 160450 | ME | 2 | 239 | Name Excluded | U | 0% | 6% | 6% | |
| 175039 | ME | 2 | 212 | Name Excluded | U | 0% | 73% | 73% | |
| 222095 | NH | 2 | 5,537 | No Name | U | 15% | 5% | 21% | |
| 235577 | VT | 3 | 2,552 | Quechee Gorge | U | 0% | 13% | 13% | |
| 152156 | VT | 2 | 963 | Benedictine Cliffs | U | 0% | 0% | 0% | |
| **Northeastern Coastal & Interior Pine-Oak Forest** | | | | | | | | | |
| 319602 | MA | 2 | 468 | Name Excluded | S | 0% | 79% | 79% | |
| 32875 | ME | 3 | 9 | Name Excluded | U | 0% | 0% | 0% | |
| 229555 | NH | 2 | 2,612 | No Name | U | 6% | 17% | 23% | |
| 207218 | VT | 3 | 2 | Name Excluded | U | 0% | 0% | 0% | |
| **PATCH-FORMING HABITATS** | | | | | | | | | |
| **Grassland & Shrubland** | | | | | | | | | |
| **Agricultural Grassland** | | | | | | | | | |
| 376942 | MA | 2 | 94 | Name Excluded | U | 0% | 0% | 0% | |
| 374696 | MA | 2 | 173 | Name Excluded | U | 0% | 0% | 0% | |
| 379181 | MA | 2 | 7 | Name Excluded | U | 0% | 0% | 0% | |
| 40304 | ME | 2 | 14 | Name Excluded | U | 0% | 0% | 0% | |
| 36003 | ME | 2 | 68 | Name Excluded | U | 0% | 0% | 0% | |
| 234649 | VT | 3 | 2,546 | Catfish Bay | U | 18% | 6% | 24% | |
| 202478 | VT | 2 | 1,273 | Mountain Road-Monkton | U | 14% | 2% | 16% | |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| **Atlantic Coastal Plain Beach & Dune** | | | | | | | | | |
| 394361 | MA | 2 | 1,183 | No Name | U | 15% | 9% | 24% | |
| 382776 | MA | 3 | 77 | Name Excluded | U | 0% | 0% | 0% | |
| 394810 | MA | 2 | 244 | Name Excluded | U | 28% | 9% | 37% | |
| **North Atlantic Coastal Plain Heathland & Grassland** | | | | | | | | | |
| 395136 | MA | 2 | 892 | No Name | S | 0% | 97% | 97% | |
| 393508 | MA | 3 | 166 | Name Excluded | P | 100% | 0% | 100% | 1 |
| 398403 | MA | 2 | 1,599 | No Name | U | 8% | 7% | 15% | |
| **WETLAND HABITATS** | | | | | | | | | |
| **Central Hardwood Swamp** | | | | | | | | | |
| **North-Central Interior Wet Flatwoods** | | | | | | | | | |
| 378199 | MA | 3 | 67 | No Name | U | 0% | 0% | 0% | |
| **Freshwater Marsh & Shrub Swamp** | | | | | | | | | |
| **Laurentian-Acadian Freshwater Marsh** | | | | | | | | | |
| 425408 | CT | 2 | 126 | Name Excluded | U | 6% | 3% | 9% | |
| 392122 | MA | 2 | 663 | No Name | U | 20% | 3% | 23% | |
| 370503 | MA | 2 | 356 | Name Excluded | U | 25% | 23% | 47% | |
| 320161 | MA | 2 | 403 | Name Excluded | U | 0% | 18% | 18% | |
| 395521 | MA | 2 | 901 | No Name | U | 47% | 24% | 71% | |
| 128579 | ME | 3 | 32 | Name Excluded | U | 71% | 0% | 71% | |
| **Laurentian-Acadian Wet Meadow-Shrub Swamp** | | | | | | | | | |
| 321861 | MA | 2 | 254 | Name Excluded | S | 9% | 82% | 91% | |
| 391424 | CT | 2 | 93 | Name Excluded | U | 0% | 0% | 0% | |
| **Large River Floodplain** | | | | | | | | | |
| **North-Central Appalachian Large River Floodplain** | | | | | | | | | |
| 334496 | MA | 2 | 52 | Name Excluded | U | 0% | 70% | 70% | |
| 270532 | MA | 2 | 113 | Name Excluded | U | 0% | 16% | 16% | |
| 368302 | MA | 2 | 56 | Name Excluded | S | 0% | 89% | 89% | |
| **Northern Peatland** | | | | | | | | | |
| **Boreal-Laurentian Bog** | | | | | | | | | |
| 119055 | ME | 2 | 12,990 | Great Heath | U | 37% | 1% | 38% | |
| **Northern Swamp** | | | | | | | | | |
| **North-Central Appalachian Acidic Swamp** | | | | | | | | | |
| 382379 | MA | 17 | 4,675 | No Name | U | 53% | 4% | 57% | |
| 391955 | MA | 5 | 404 | Name Excluded | U | 30% | 8% | 38% | |
| 313428 | MA | 2 | 12 | Name Excluded | S | 0% | 100% | 100% | |
| 404439 | RI | 2 | 2,064 | Queen's River | U | 5% | 66% | 71% | |
| 409738 | RI | 2 | 632 | Woodville | U | 0% | 34% | 34% | |
| 411379 | RI | 4 | 1,393 | No Name | U | 19% | 49% | 67% | |
| 431453 | CT | 3 | 22 | Name Excluded | U | 0% | 0% | 0% | |
| **North-Central Interior & Appalachian Rich Swamp** | | | | | | | | | |
| 374009 | MA | 3 | 139 | Name Excluded | U | 0% | 32% | 32% | |
| 374680 | MA | 2 | 77 | Name Excluded | S | 0% | 76% | 76% | |
| 375896 | MA | 2 | 1,184 | No Name | U | 34% | 12% | 46% | |

APPENDIX 3

| IPA ID | MAJORITY STATE | # FLOCO SPECIES | ACRES | APPROXIMATE SITE NAME | PROTECT CODE | PROTECTED (GAP 1–2) | MULTIPLE USE (GAP 3) | SECURED (GAP 1–3) | NE TARGET 30 / 75 |
|---|---|---|---|---|---|---|---|---|---|
| **Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp** | | | | | | | | | |
| 40429 | ME | 2 | 1,420 | Salmon Brook Lake | U | 48% | 9% | 57% | |
| **Tidal Marsh** | | | | | | | | | |
| **North Atlantic Coastal Plain Tidal Salt Marsh** | | | | | | | | | |
| 437555 | CT | 2 | 1,126 | Hammonasset State Park | U | 65% | 1% | 66% | |
| 453068 | CT | 2 | 470 | Name Excluded | U | 0% | 71% | 71% | |
| 277479 | MA | 2 | 290 | Name Excluded | U | 2% | 3% | 6% | |
| 354799 | MA | 2 | 165 | Name Excluded | U | 0% | 42% | 42% | |
| 317423 | MA | 4 | 876 | No Name | U | 2% | 30% | 32% | |
| 340769 | MA | 2 | 721 | No Name | U | 2% | 59% | 61% | |
| 349758 | MA | 2 | 768 | No Name | U | 0% | 22% | 22% | |
| 348863 | MA | 4 | 6,515 | No Name | U | 1% | 69% | 70% | |
| 381361 | MA | 4 | 4,657 | No Name | U | 6% | 40% | 46% | |
| 275986 | MA | 3 | 5,660 | No Name | U | 42% | 14% | 56% | |
| 270568 | MA | 2 | 4,777 | No Name | U | 66% | 4% | 70% | |
| 335351 | MA | 2 | 554 | No Name | U | 14% | 36% | 50% | |
| 346911 | MA | 2 | 2,164 | No Name | U | 0% | 48% | 48% | |
| 412715 | RI | 3 | 290 | Name Excluded | U | 70% | 0% | 70% | |
| 380956 | RI | 2 | 667 | Nbnerr North Prudence Unit | S | 16% | 65% | 81% | |

## APPENDIX 4
## *Flora Conservanda* Taxa on Secured Lands

| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Adiantum viridimontanum | 1 | G2 | 7 | 14% | | | 14% | 86% |
| Agalinis acuta | 1 | G1 | 49 | 4% | 16% | 37% | 57% | 43% |
| Amelanchier nantucketensis | 1 | G3 | 99 | 3% | 15% | 22% | 40% | 60% |
| Astragalus alpinus var. brunetianus | 1 | G3 | 20 | | | 5% | 5% | 95% |
| Astragalus robbinsii var. jesupii | 1 | G1 | 5 | | 40% | 20% | 60% | 40% |
| Bidens eatonii | 1 | G2 | 40 | | | 10% | 10% | 90% |
| Carex oronensis | 1 | G2 | 61 | 2% | 3% | 7% | 11% | 89% |
| Carex polymorpha | 1 | G3 | 72 | | 1% | 11% | 13% | 88% |
| Carex schweinitzii | 1 | G3 | 39 | 3% | 5% | 26% | 33% | 67% |
| Coreopsis rosea | 1 | G3 | 113 | 4% | 3% | 26% | 32% | 68% |
| Cystopteris laurentiana | 1 | G3 | 2 | | | 100% | 100% | |
| Eleocharis aestuum | 1 | G3 | 2 | | 50% | | 50% | 50% |
| Eleocharis diandra | 1 | G1 | 11 | | | 9% | 9% | 91% |
| Eriocaulon parkeri | 1 | G3 | 53 | | 2% | 11% | 13% | 87% |
| Geum peckii | 1 | G2 | 38 | 61% | 21% | 13% | 95% | 5% |
| Hieracium robinsonii | 1 | G2 | 2 | | | | 0% | 100% |
| Hypericum adpressum | 1 | G2 | 22 | 9% | 41% | 14% | 64% | 36% |
| Isoetes acadiensis | 1 | G3 | 11 | 18% | | 55% | 73% | 27% |
| Isoetes prototypus | 1 | G2 | 4 | | 25% | | 25% | 75% |
| Isotria medeoloides | 1 | G2 | 112 | 4% | 1% | 26% | 30% | 70% |
| Malaxis bayardii | 1 | G1 | 6 | 17% | | 33% | 50% | 50% |
| Mimulus ringens var. colpophilus | 1 | G45 | 22 | | 5% | 9% | 14% | 86% |
| Minuartia marcescens | 1 | G2 | 1 | 100% | | | 100% | |
| Panax quinquefolius | 1 | G3 | 382 | 10% | 9% | 31% | 50% | 50% |
| Pedicularis furbishiae | 1 | G1 | 46 | | 7% | | 7% | 93% |
| Pityopsis falcata | 1 | G3 | 21 | | | 29% | 29% | 71% |
| Platanthera leucophaea | 1 | G2 | 1 | 100% | | | 100% | |
| Polemonium vanbruntiae | 1 | G3 | 15 | 7% | | 40% | 47% | 53% |
| Polygonum glaucum | 1 | G3 | 41 | 10% | 10% | 10% | 29% | 71% |
| Potamogeton hillii | 1 | G3 | 80 | 5% | | 11% | 16% | 84% |
| Potamogeton ogdenii | 1 | G1 | 14 | 7% | | | 7% | 93% |
| Potentilla robbinsiana | 1 | G1 | 2 | 100% | | | 100% | |
| Pycnanthemum torrei | 1 | G2 | 4 | 25% | 50% | | 75% | 25% |
| Sabatia kennedyana | 1 | G3 | 212 | 2% | 1% | 19% | 22% | 78% |
| Sagittaria teres | 1 | G3 | 103 | 3% | 3% | 17% | 22% | 78% |
| Scirpus ancistrochaetus | 1 | G3 | 39 | | 3% | 15% | 18% | 82% |
| Scirpus longii | 1 | G2 | 74 | 1% | 32% | 38% | 72% | 28% |
| Suaeda maritima ssp. richii | 1 | G45 | 20 | | 20% | 15% | 35% | 65% |
| Symphyotrichum anticostense | 1 | G2 | 3 | | | | 0% | 100% |

APPENDIX 4

| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Triglochin gaspensis | 1 | G3 | 6 | | | 33% | 33% | 67% |
| Trollius laxus | 1 | G45 | 6 | 17% | 17% | | 33% | 67% |
| Adiantum aleuticum | 2 | G45 | 3 | 33% | | 33% | 67% | 33% |
| Agalinis neoscotica | 2 | G2 | 6 | 17% | 67% | | 83% | 17% |
| Agastache nepetoides | 2 | G45 | 6 | | 17% | | 17% | 83% |
| Agastache scrophulariifolia | 2 | G4 | 10 | | | 40% | 40% | 60% |
| Ageratina aromatica | 2 | G45 | 18 | 6% | 17% | 44% | 67% | 33% |
| Agrimonia parviflora | 2 | G45 | 38 | | 13% | 13% | 26% | 74% |
| Amaranthus tuberculatus | 2 | G4 | 6 | | | 17% | 17% | 83% |
| Amerorchis rotundifolia | 2 | G45 | 15 | 13% | | 7% | 20% | 80% |
| Aplectrum hyemale | 2 | G45 | 14 | 21% | 7% | 29% | 57% | 43% |
| Aristida tuberculosa | 2 | G45 | 29 | | 10% | 14% | 24% | 76% |
| Asclepias purpurascens | 2 | G45 | 45 | 4% | 11% | 22% | 38% | 62% |
| Asclepias viridiflora | 2 | G45 | 2 | | | | 0% | 100% |
| Asplenium montanum | 2 | G45 | 27 | 4% | 26% | 26% | 56% | 44% |
| Astragalus robbinsii var. minor | 2 | G45 | 7 | 29% | | 43% | 71% | 29% |
| Betula glandulosa | 2 | G45 | 13 | 100% | | | 100% | |
| Betula minor | 2 | G3 | 23 | 70% | 22% | 9% | 100% | |
| Blephilia ciliata | 2 | G45 | 13 | 8% | | 62% | 69% | 31% |
| Botrychium lunaria | 2 | G45 | 6 | | 17% | 33% | 50% | 50% |
| Botrychium oneidense | 2 | G4 | 14 | 7% | 14% | 29% | 50% | 50% |
| Calamagrostis stricta ssp. stricta | 2 | GU | 16 | 6% | | 6% | 13% | 88% |
| Cardamine douglassii | 2 | G45 | 22 | 9% | 5% | 9% | 23% | 77% |
| Cardamine longii | 2 | G3 | 28 | | | 18% | 18% | 82% |
| Carex adusta | 2 | G45 | 13 | | 38% | 8% | 46% | 54% |
| Carex alopecoidea | 2 | G45 | 48 | | 17% | 15% | 31% | 69% |
| Carex atherodes | 2 | G45 | 10 | | | | 0% | 100% |
| Carex atratiformis | 2 | G45 | 23 | 22% | 9% | 4% | 35% | 65% |
| Carex barrattii | 2 | G3 | 2 | | 50% | | 50% | 50% |
| Carex bicknellii | 2 | G45 | 15 | 7% | | 27% | 33% | 67% |
| Carex capillaris ssp. capillaris | 2 | GU | 3 | 100% | | | 100% | |
| Carex capillaris ssp. fuscidula | 2 | TNR | 2 | 100% | | | 100% | |
| Carex collinsii | 2 | G4 | 4 | | | 50% | 50% | 50% |
| Carex crawei | 2 | G45 | 9 | 22% | 11% | | 33% | 67% |
| Carex davisii | 2 | G4 | 52 | 2% | 17% | 15% | 35% | 65% |
| Carex debilis var. debilis | 2 | T5 | 2 | | 50% | | 50% | 50% |
| Carex gracilescens | 2 | G5 | 4 | | | 50% | 50% | 50% |
| Carex gynocrates | 2 | G45 | 15 | 13% | 7% | 20% | 40% | 60% |
| Carex livida | 2 | G45 | 11 | 36% | 18% | 27% | 82% | 18% |
| Carex mitchelliana | 2 | G3 | 31 | 3% | | 45% | 48% | 52% |
| Carex molesta | 2 | G4 | 3 | | | | 0% | 100% |
| Carex oligocarpa | 2 | G4 | 18 | 6% | 6% | 11% | 22% | 78% |
| Carex richardsonii | 2 | G45 | 2 | 100% | | | 100% | |
| Carex rostrata | 2 | G5 | 15 | 33% | | 27% | 60% | 40% |

APPENDIX 4

| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Carex saxatilis | 2 | GU | 2 | 100% | | | 100% | |
| Carex striata | 2 | (blank) | 19 | | 11% | | 11% | 89% |
| Carex tenuiflora | 2 | G45 | 34 | 6% | 12% | 35% | 53% | 47% |
| Carex vacillans | 2 | GNR | 7 | | | 29% | 29% | 71% |
| Castilleja coccinea | 2 | G45 | 27 | 4% | | 7% | 11% | 89% |
| Ceanothus herbaceus | 2 | G45 | 1 | | | | 0% | 100% |
| Chamaelirium luteum | 2 | G45 | 13 | 8% | 8% | 15% | 31% | 69% |
| Cheilanthes lanosa | 2 | G45 | 2 | | 50% | | 50% | 50% |
| Chenopodium foggii | 2 | G2 | 9 | | 11% | 56% | 67% | 33% |
| Chrysopsis mariana | 2 | G45 | 1 | | 100% | | 100% | |
| Claytonia virginica | 2 | G45 | 36 | 3% | 19% | 36% | 58% | 42% |
| Corydalis aurea | 2 | G45 | 18 | 11% | | 11% | 22% | 78% |
| Corydalis flavula | 2 | G45 | 4 | | | 25% | 25% | 75% |
| Crataegus bicknellii | 2 | G1 | 8 | 13% | 13% | | 25% | 75% |
| Crataegus schizophylla | 2 | G1G2 | 6 | | | 17% | 17% | 83% |
| Cryptogramma stelleri | 2 | G45 | 31 | 6% | 6% | 39% | 52% | 48% |
| Cuscuta coryli | 2 | G45 | 8 | 13% | 13% | 38% | 63% | 38% |
| Cuscuta polygonorum | 2 | G45 | 1 | | | 100% | 100% | |
| Cypripedium arietinum | 2 | G3 | 65 | 8% | 9% | 14% | 31% | 69% |
| Cypripedium parviflorum var. makasin | 2 | T4 | 9 | 22% | | 44% | 67% | 33% |
| Desmodium cuspidatum | 2 | G45 | 44 | 27% | 2% | 36% | 66% | 34% |
| Desmodium glabellum | 2 | G45 | 23 | | 4% | 57% | 61% | 39% |
| Desmodium sessilifolium | 2 | G45 | 6 | | | 17% | 17% | 83% |
| Dichanthelium scabriusculum | 2 | G4 | 4 | | | 75% | 75% | 25% |
| Diospyros virginiana | 2 | G45 | 1 | | | 100% | 100% | |
| Diphasiastrum sitchense | 2 | G45 | 5 | 40% | 40% | 20% | 100% | |
| Doellingeria infirma | 2 | G45 | 15 | | | 67% | 67% | 33% |
| Draba cana | 2 | G45 | 4 | 75% | | 25% | 100% | |
| Draba glabella | 2 | G4 | 10 | | | 30% | 30% | 70% |
| Draba reptans | 2 | G45 | 12 | | 25% | 8% | 33% | 67% |
| Drosera anglica | 2 | G5 | 3 | 67% | | 33% | 100% | |
| Drosera linearis | 2 | GU | 1 | 100% | | | 100% | |
| Elatine americana | 2 | G4 | 14 | | | 36% | 36% | 64% |
| Eleocharis equisetoides | 2 | G4 | 12 | | 8% | 25% | 33% | 67% |
| Eleocharis microcarpa var. filiculmis | 2 | (blank) | 4 | | | 25% | 25% | 75% |
| Eleocharis nitida | 2 | GU | 3 | | | 33% | 33% | 67% |
| Eleocharis quadrangulata | 2 | G45 | 2 | | | | 0% | 100% |
| Eleocharis rostellata | 2 | G45 | 20 | | 15% | 30% | 45% | 55% |
| Eleocharis tricostata | 2 | G4 | 4 | | 50% | | 50% | 50% |
| Elymus macgregorii | 2 | GNR | 3 | | | | 0% | 100% |
| Epilobium anagallidifolium | 2 | G5 | 2 | 100% | | | 100% | |
| Erigeron hyssopifolius | 2 | G45 | 25 | 4% | 4% | 24% | 32% | 68% |
| Euphrasia oakesii | 2 | G4 | 4 | 100% | | | 100% | |
| Festuca prolifera | 2 | GU | 1 | 100% | | | 100% | |

APPENDIX 4

| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Floerkea proserpinacoides | 2 | G45 | 6 | | 33% | 17% | 50% | 50% |
| Gentiana andrewsii var. andrewsii | 2 | T5 | 3 | | | | 0% | 100% |
| Gentianella amarella ssp. acuta | 2 | T5 | 1 | | | 100% | 100% | |
| Goodyera oblongifolia | 2 | G5 | 16 | | | 19% | 19% | 81% |
| Hieracium umbellatum | 2 | G45 | 1 | | | 100% | 100% | |
| Huperzia selago | 2 | G45 | 16 | 25% | 13% | 38% | 75% | 25% |
| Hybanthus concolor | 2 | G45 | 1 | | | 100% | 100% | |
| Hydrastis canadensis | 2 | G4 | 12 | 8% | 8% | | 17% | 83% |
| Hydrocotyle verticillata | 2 | G45 | 24 | | 13% | 8% | 21% | 79% |
| Hydrophyllum canadense | 2 | G45 | 14 | | | 29% | 29% | 71% |
| Juncus biflorus | 2 | G45 | 13 | | 31% | 15% | 46% | 54% |
| Juncus debilis | 2 | G45 | 13 | | 15% | 15% | 31% | 69% |
| Juncus stygius ssp. americanus | 2 | G45 | 6 | 17% | | 33% | 50% | 50% |
| Juncus subtilis | 2 | G4 | 8 | | | 25% | 25% | 75% |
| Juncus torreyi | 2 | G45 | 11 | | | 9% | 9% | 91% |
| Juncus vaseyi | 2 | G5 | 7 | 14% | 14% | 29% | 57% | 43% |
| Lathyrus ochroleucus | 2 | G4 | 10 | | | 20% | 20% | 80% |
| Leptochloa fusca ssp. fascicularis | 2 | G45 | 21 | 5% | 5% | 5% | 14% | 86% |
| Lespedeza repens | 2 | G45 | 3 | | 33% | | 33% | 67% |
| Linum sulcatum var. sulcatum | 2 | G45 | 1 | | | | 0% | 100% |
| Liparis liliifolia | 2 | G45 | 78 | 12% | | 46% | 58% | 42% |
| Liquidambar styraciflua | 2 | G45 | 9 | 11% | 11% | 33% | 56% | 44% |
| Lomatogonium rotatum | 2 | G5 | 12 | 42% | | | 42% | 58% |
| Lonicera hirsuta | 2 | G4 | 28 | 7% | | 18% | 25% | 75% |
| Ludwigia polycarpa | 2 | G4 | 20 | 20% | 10% | 15% | 45% | 55% |
| Ludwigia sphaerocarpa | 2 | G45 | 10 | | 30% | 30% | 60% | 40% |
| Luzula confusa | 2 | GU | 5 | 80% | 20% | | 100% | |
| Luzula spicata | 2 | G45 | 21 | 67% | 24% | 10% | 100% | |
| Lycopodiella alopecuroides | 2 | G45 | 12 | | 33% | | 33% | 67% |
| Lycopus rubellus | 2 | G45 | 9 | | 33% | 22% | 56% | 44% |
| Minuartia rubella | 2 | G5 | 2 | 50% | 50% | | 100% | |
| Moehringia macrophylla | 2 | G45 | 27 | 11% | | 4% | 15% | 85% |
| Montia fontana | 2 | G5 | 19 | 11% | 11% | | 21% | 79% |
| Morus rubra | 2 | G45 | 21 | 24% | 5% | 19% | 48% | 52% |
| Muhlenbergia capillaris | 2 | G45 | 7 | | 14% | 43% | 57% | 43% |
| Myriophyllum pinnatum | 2 | G45 | 17 | | | 18% | 18% | 82% |
| Nabalus serpentarius | 2 | G45 | 7 | 29% | 43% | 29% | 100% | |
| Nuphar advena | 2 | G45 | 2 | 50% | | | 50% | 50% |
| Nymphaea leibergii | 2 | G5 | 20 | | 5% | 10% | 15% | 85% |
| Oligoneuron album | 2 | G45 | 20 | 5% | | 5% | 10% | 90% |
| Oligoneuron rigidum var. rigidum | 2 | G45 | 1 | | | | 0% | 100% |
| Oxalis violacea | 2 | G45 | 40 | 15% | 13% | 13% | 40% | 60% |
| Oxyria digyna | 2 | GU | 6 | 67% | 33% | | 100% | |
| Oxytropis campestris var. johannensis | 2 | T4 | 2 | | | | 0% | 100% |

APPENDIX 4

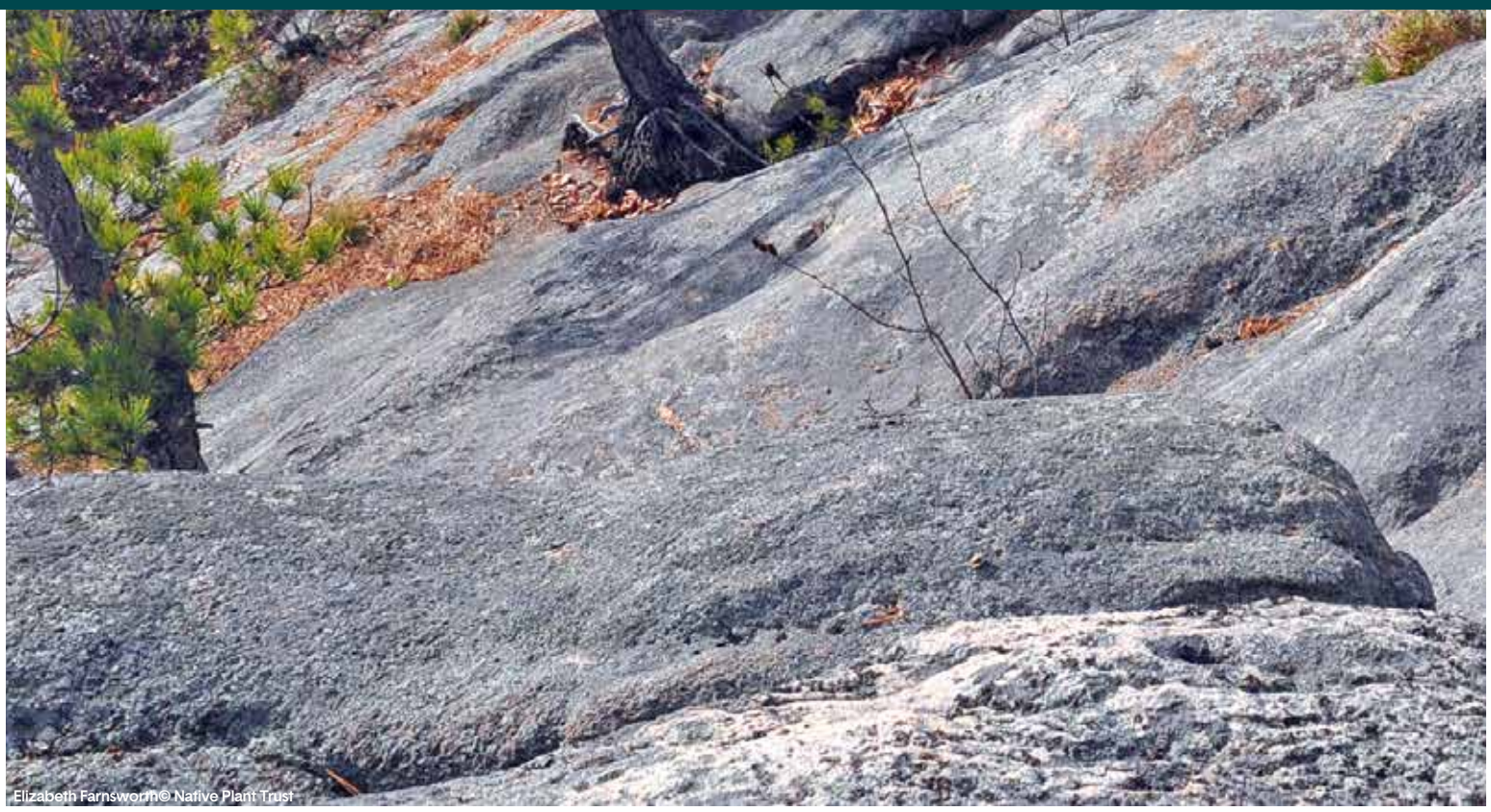
| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Panicum flexile | 2 | G45 | 2 | 50% | | | 50% | 50% |
| Paronychia fastigiata var. fastigiata | 2 | G5T5 | 5 | | | 20% | 20% | 80% |
| Paspalum laeve | 2 | G4 | 8 | 13% | 25% | | 38% | 63% |
| Paspalum setaceum var. psammophilum | 2 | G45 | 15 | | 13% | | 13% | 87% |
| Pedicularis lanceolata | 2 | G45 | 26 | | | 38% | 38% | 62% |
| Persicaria setacea | 2 | G45 | 6 | | 17% | 17% | 33% | 67% |
| Phleum alpinum | 2 | GU | 18 | 28% | 28% | | 56% | 44% |
| Phyllodoce caerulea | 2 | GU | 12 | 100% | | | 100% | |
| Piptatherum canadense | 2 | G45 | 7 | | 29% | 29% | 57% | 43% |
| Plantago virginica | 2 | G45 | 8 | | 13% | 25% | 38% | 63% |
| Platanthera ciliaris | 2 | G45 | 21 | | 5% | 10% | 14% | 86% |
| Platanthera cristata | 2 | G45 | 3 | | | 67% | 67% | 33% |
| Poa pratensis ssp. alpigena | 2 | GU | 5 | 60% | 40% | | 100% | |
| Podophyllum peltatum | 2 | G45 | 9 | | 33% | 11% | 44% | 56% |
| Polymnia canadensis | 2 | G45 | 4 | | 25% | | 25% | 75% |
| Populus heterophylla | 2 | G45 | 14 | | 14% | 29% | 43% | 57% |
| Primula laurentiana | 2 | G5 | 11 | | 9% | | 9% | 91% |
| Pterospora andromedea | 2 | G45 | 5 | | | | 0% | 100% |
| Ranunculus ambigens | 2 | G4 | 13 | | 23% | | 23% | 77% |
| Ranunculus gmelinii | 2 | GU | 4 | | | | 0% | 100% |
| Ranunculus micranthus | 2 | G45 | 11 | | | 64% | 64% | 36% |
| Rhynchospora capillacea | 2 | G4 | 14 | 29% | | 14% | 43% | 57% |
| Rhynchospora inundata | 2 | G3 | 14 | 7% | 7% | 7% | 21% | 79% |
| Rhynchospora nitens | 2 | G4 | 16 | 25% | | 31% | 56% | 44% |
| Rhynchospora torreyana | 2 | G4 | 14 | 21% | 7% | 21% | 50% | 50% |
| Ribes rotundifolium | 2 | G45 | 6 | 17% | | 33% | 50% | 50% |
| Rosa acicularis ssp. sayi | 2 | G45 | 5 | | | 100% | 100% | |
| Rotala ramosior | 2 | G45 | 49 | | 2% | 55% | 57% | 43% |
| Rubus cuneifolius | 2 | G45 | 11 | | 9% | | 9% | 91% |
| Sabatia campanulata | 2 | G45 | 9 | 11% | 22% | 22% | 56% | 44% |
| Sabatia stellaris | 2 | G45 | 11 | | 9% | 36% | 45% | 55% |
| Sagittaria subulata | 2 | G4 | 17 | 6% | 6% | | 12% | 88% |
| Salix arctophila | 2 | G5 | 1 | 100% | | | 100% | |
| Salix argyrocarpa | 2 | GU | 5 | 80% | 20% | | 100% | |
| Salix herbacea | 2 | G45 | 6 | 100% | | | 100% | |
| Salix myricoides | 2 | G4 | 18 | | | | 0% | 100% |
| Salix uva-ursi | 2 | G45 | 21 | 86% | 10% | | 95% | 5% |
| Saururus cernuus | 2 | G45 | 7 | | 14% | | 14% | 86% |
| Saxifraga aizoides | 2 | G45 | 2 | | | 100% | 100% | |
| Saxifraga cernua | 2 | GU | 1 | | 100% | | 100% | |
| Schoenoplectus heterochaetus | 2 | G45 | 4 | | | 50% | 50% | 50% |
| Scleria pauciflora var. caroliniana | 2 | G45 | 3 | | | 33% | 33% | 67% |
| Scleria triglomerata | 2 | G45 | 25 | 4% | 32% | 8% | 44% | 56% |
| Sclerolepis uniflora | 2 | G4 | 15 | 20% | | 13% | 33% | 67% |

APPENDIX 4

| SCIENTIFIC NAME | DIVISION | G RANK | TOTAL EOs IN GAP STUDY | GAP 1 | GAP 2 | GAP 3 | % SECURED | % UNSECURED |
|---|---|---|---|---|---|---|---|---|
| Scutellaria integrifolia | 2 | G45 | 8 | | 63% | | 63% | 38% |
| Selaginella selaginoides | 2 | GU | 3 | | 33% | 33% | 67% | 33% |
| Senna hebecarpa | 2 | G45 | 24 | 4% | 17% | | 21% | 79% |
| Sibbaldia procumbens | 2 | GU | 1 | 100% | | | 100% | |
| Silene stellata | 2 | G45 | 21 | | 5% | 24% | 29% | 71% |
| Sphenopholis obtusata | 2 | G45 | 3 | 33% | 33% | 33% | 100% | |
| Sphenopholis pensylvanica | 2 | G4 | 17 | | 6% | 29% | 35% | 65% |
| Sporobolus clandestinus | 2 | G45 | 2 | | | | 0% | 100% |
| Sporobolus heterolepis | 2 | G45 | 8 | | 25% | 25% | 50% | 50% |
| Sporobolus neglectus | 2 | G45 | 16 | 13% | 6% | 13% | 31% | 69% |
| Strophostyles umbellata | 2 | G45 | 1 | | | | 0% | 100% |
| Suaeda calceoliformis | 2 | G45 | 28 | | 18% | 14% | 32% | 68% |
| Symphyotrichum prenanthoides | 2 | G45 | 88 | 7% | | 28% | 35% | 65% |
| Taenidia integerrima | 2 | G45 | 18 | 6% | | | 6% | 94% |
| Tanacetum bipinnatum ssp. huronense | 2 | T4 | 12 | | | 8% | 8% | 92% |
| Tipularia discolor | 2 | G4 | 10 | | | 60% | 60% | 40% |
| Trichophorum clintonii | 2 | G4 | 14 | 14% | | 7% | 21% | 79% |
| Trichostema brachiatum | 2 | G45 | 8 | | | 13% | 13% | 88% |
| Triosteum angustifolium | 2 | G45 | 2 | | | | 0% | 100% |
| Triosteum perfoliatum | 2 | G45 | 19 | 5% | 5% | 37% | 47% | 53% |
| Utricularia subulata | 2 | G45 | 27 | 4% | 22% | 19% | 44% | 56% |
| Vahlodea atropurpurea | 2 | G45 | 1 | 100% | | | 100% | |
| Valeriana uliginosa | 2 | G4 | 21 | 19% | 5% | 10% | 33% | 67% |
| Verbena simplex | 2 | G45 | 15 | 7% | 7% | | 13% | 87% |
| Veronica catenata | 2 | G45 | 4 | 25% | | | 25% | 75% |
| Viburnum prunifolium | 2 | G45 | 12 | 8% | 25% | 8% | 42% | 58% |
| Viola brittoniana | 2 | G45 | 29 | | 3% | 45% | 48% | 52% |
| Viola novae-angliae | 2 | G4 | 19 | 11% | 11% | | 21% | 79% |
| Woodsia alpina | 2 | G4 | 14 | 21% | 36% | 21% | 79% | 21% |
| Zizia aptera | 2 | G45 | 4 | | | | 0% | 100% |

CONSERVING PLANT DIVERSITY IN NEW ENGLAND

# STATE SUMMARĪES



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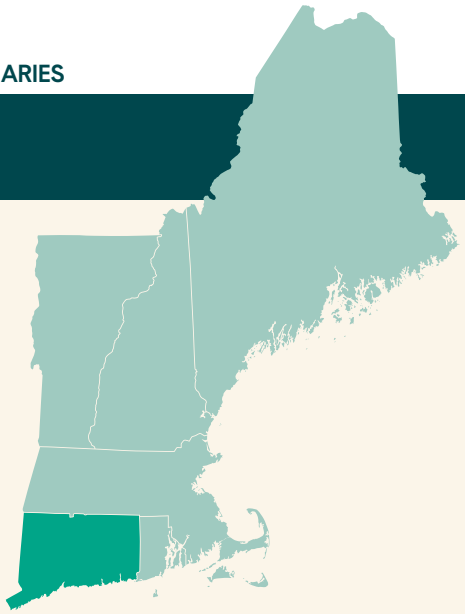
# CONNECTICUT



Connecticut has 24 mapped habitats covering 2 million acres. On average, each habitat is 4% protected for nature (0-15%) and 23% secured against conversion to a different land use (5-55%), but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are 47% resilient. Three habitats cover less than 100 acres and are excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **32**, 3 Protected, 0 Secured
- **Acres to meet GSPC for all habitats**: 245,979
- **Acres to meet NET for all habitats**: 224,691
- **Habitats meeting targets**: 1 GSPC, 1 NET
  - Acidic Cliff & Talus (GSPC)
  - North-Central Interior & Appalachian Acidic Peatland (NET)
- **Habitats partially meeting NET**: 4
  - Laurentian-Acadian Northern Hardwood Forest
  - Circumneutral Cliff & Talus
  - Acidic Cliff & Talus
  - North Atlantic Coastal Plain Tidal Salt Marsh
- **Opportunity**
  - North Atlantic Coastal Plain Tidal Salt Marsh: Migration Space

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# CONNECTICUT

CONTINUED

**Unprotected Habitats Threatened by Conversion**

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| **North-Central Interior Wet Flatwoods** | 11% | 1% | 16% | 1 K | 1 K | 1 K |
| Atlantic Coastal Plain Beach & Dune | 6% | 1% | 27% | 327 | 80 | 44 |
| Northeastern Coastal and Interior Pine-Oak Forest | 9% | 1% | 23% | 5 K | 3 K | 6 K |
| North Atlantic Coastal Plain Heathland & Grassland | 18% | 1% | 28% | 186 | 29 | 158 |
| **Northeastern Interior Dry-Mesic Oak Forest** | 8% | 2% | 18% | 126 K | 121 K | 197 K |
| North Atlantic Coastal Plain Hardwood Forest | 18% | 3% | 14% | 24 K | 32 K | 49 K |
| North-Central Appalachian Acidic Swamp | 7% | 3% | 22% | 14 K | 9 K | 29 K |
| Appalachian (Hemlock)-Northern Hardwood Forest | 5% | 3% | 20% | 68 K | 56 K | 160 K |
| North Atlantic Coastal Plain Maritime Forest | 16% | 7% | 26% | 461 | 220 | 628 |

**P** = Protected, **S** = Secured, **R** = Resilient
**Unprotected** = less than 10% protected & resilient
**TOC** = threat of conversion by 2050
**%PR** = % protected & resilient
**%S** = % secured
**GSPC** = Global Strategy for Plant Conservation target
**NET** = New England Target
**R ac** = resilient acres available

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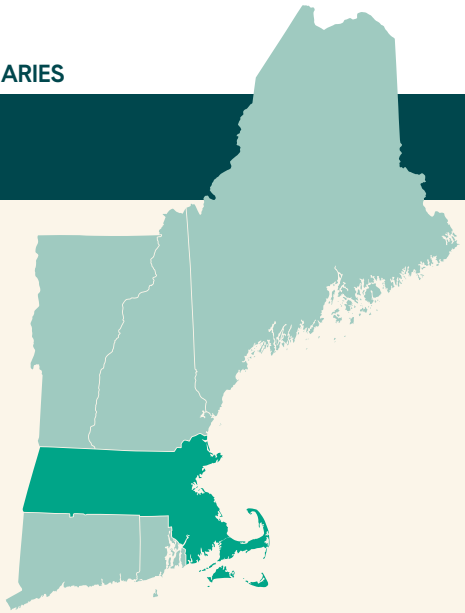
# MASSACHUSETTS



Massachusetts has 35 mapped habitats covering 3.7 million acres. On average, each habitat is 9% protected for nature (0-59%) and 38% secured against conversion to a different land use (3-100%), but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are 52% resilient. Two habitats cover less than 100 acres and are excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **88**, 2 Protected, 17 Secured
- **Acres to meet GSPC for all habitats**: 382,153
- **Acres to meet NET for all habitats**: 75,577
- **Habitats meeting targets**: 7 GSPC, 4 NET
  - Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (GSPC, NET)
  - Laurentian-Acadian Red Oak-Northern Hardwood Forest (GSPC, NET)
  - Acidic Cliff & Talus (GSPC)
  - Calcareous Cliff & Talus (GSPC)
  - Atlantic Coastal Plain Beach & Dune (GSPC)
  - Acidic Rocky Outcrop (GSPC)
  - Laurentian-Acadian Alkaline Fen (GSPC, NET)
  - Laurentian-Acadian Northern Hardwood Forest (NET)
- **Habitats meeting NET for Protection & Securement but not Resilience**
  - North Atlantic Coastal Plain Maritime Forest
  - North Atlantic Coastal Plain Pitch Pine Barrens
  - Atlantic Coastal Plain Beach & Dune
  - North Atlantic Coastal Plain Heathland & Grassland
  - Atlantic Coastal Plain Northern Bog
  - North Atlantic Coastal Plain Basin Peat Swamp
  - Laurentian-Acadian Alkaline Conifer-Hardwood Swamp
  - North Atlantic Coastal Plain Tidal Salt Marsh

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# MASSACHUSETTS

CONTINUED

**Unprotected Habitats Threatened by Conversion**

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| Northeastern Coastal & Interior Pine-Oak Forest | **9%** | 1% | 24% | 57 K | 25 K | 34 K |
| **North-Central Interior Wet Flatwoods** | **11%** | 1% | 20% | 1 K | <1 K | 1.3 K |
| **North Atlantic Coastal Plain Hardwood Forest** | **18%** | 1% | 26% | 36 K | 12 K | 47 K |
| **North-Central Appalachian Acidic Swamp** | **7%** | 2% | 29% | 35 K | 2 K | 58 K |
| Appalachian (Hemlock)-Northern Hardwood Forest | **5%** | 2% | 30% | 145 K | 2 K | 367 K |
| Northeastern Interior Dry-Mesic Oak Forest | **8%** | 3% | 17% | 30 K | 31 K | 44 K |
| **North-Central Interior & Appalachian Rich Swamp** | **5%** | 3% | 27% | 12 K | 3 K | 25 K |
| North-Central Interior & Appalachian Acidic Peatland | **5%** | 3% | 39% | 447 | 268 | 987 |
| **North Atlantic Coastal Plain Pitch Pine Barrens** | **15%** | 5% | 46% | 11 K | 11 K | 7K |
| **North Atlantic Coastal Plain Heathland & Grassland** | **18%** | 6% | 36% | 2 K | 2 K | 3 K |
| **North Atlantic Coastal Plain Maritime Forest** | **16%** | 9% | 30% | 2 K | – | 6 K |

**P** = Protected, **S** = Secured, **R** = Resilient
**Unprotected** = less than 10% protected & resilient
**TOC** = threat of conversion by 2050
**%PR** = % protected & resilient
**%S** = % secured
**GSPC** = Global Strategy for Plant Conservation target
**NET** = New England Target
**R ac** = resilient acres available

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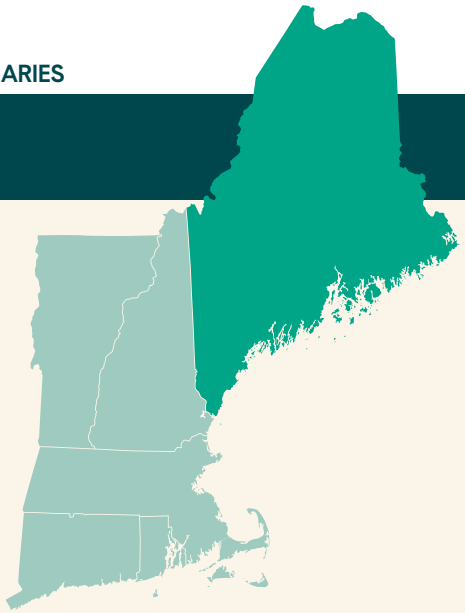
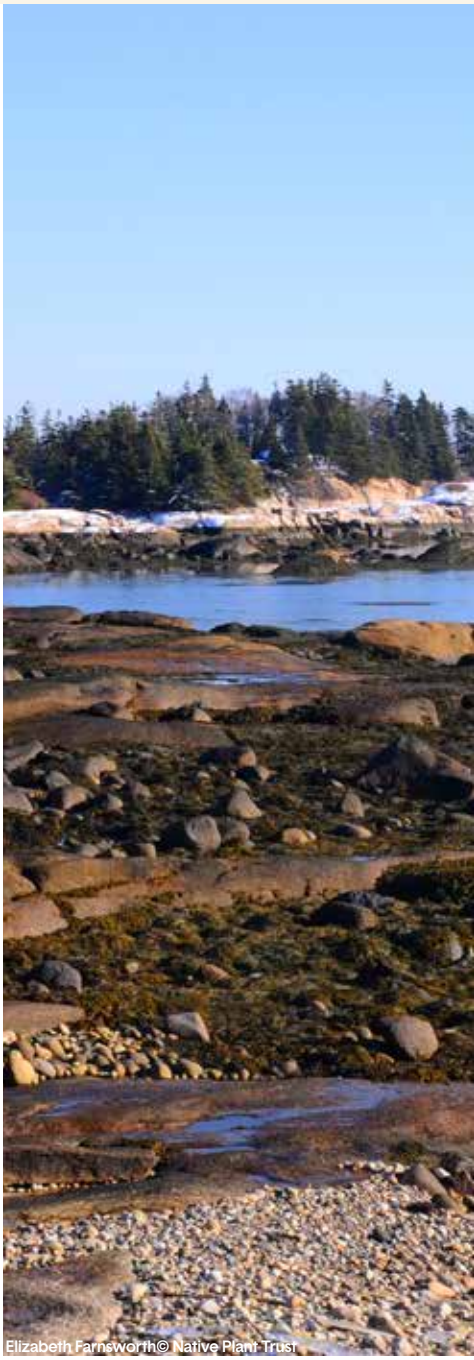
# MAINE



Maine has 37 mapped habitats covering 18.8 million acres. On average, each habitat is 9% protected for nature (1-69%) and 27% secured against conversion (1-99%) to a different land use, but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are and 78% resilient. Two habitats cover less than 100 acres and are excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **52**, 4 Protected, 6 Secured
- **Acres to meet GSPC for all habitats**: 1,948,619
- **Acres to meet NET for all habitats**: 1,169,825
- **Habitats meeting GSPC target**: 8
- **Habitats meeting NE target**: 6
  - Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (GSPC, NET)
  - Acidic Cliff & Talus (GSPC, NET)
  - Calcareous Cliff & Talus (GSPC, NET)
  - Circumneutral Cliff & Talus (GSPC, NET)
  - Acadian-Appalachian Alpine Tundra (GSPC, NET)
  - Acidic Rocky Outcrop (GSPC, NET)
  - Acadian Maritime Bog (GSPC)
  - Boreal-Laurentian Bog (GSPC)
- **Habitats meeting NET for Protection & Securement but not Resilience**
  - Northeastern Interior Pine Barrens
  - Boreal-Laurentian Bog
  - Acadian Coastal Salt & Estuary Marsh
  - North Atlantic Coastal Plain Tidal Salt Marsh



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# MAINE

CONTINUED

### Unprotected Habitats Threatened by Conversion

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| Northeastern Coastal & Interior Pine-Oak Forest | **9%** | 1% | 9% | 53 K | 81 K | 146 K |
| North-Central Interior & Appalachian Rich Swamp | **5%** | 2% | 11% | 6 K | 10 K | 27 K |
| North-Central Interior & Appalachian Acidic Peatland | **5%** | 3% | 25% | 534 | 225 | 2 K |
| **North Atlantic Coastal Plain Maritime Forest** | **16%** | 4% | 15% | 4 K | 5 K | 12 K |

### Unprotected Habitats with Low Threat, High Responsibility

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| **Laurentian-Acadian Pine-Hemlock-Hardwood Forest** | **2%** | 1% | 12% | 366 K | 492 K | 1,013 K |
| **Laurentian-Acadian Alkaline Conifer-Hardwood Swamp** | **1%** | 2% | 16% | 66 K | 73 K | 232 K |
| **Laurentian-Acadian Red Oak-Northern Hardwood Forest** | **1%** | 3% | 12% | 72 K | 109 K | 354 K |
| **Acadian Sub-boreal Spruce Flat** | **0%** | 4% | 28% | 143 K | 22 K | 597 K |
| **Laurentian-Acadian Northern Hardwood Forest** | **1%** | 4% | 25% | 499 K | 255 K | 2,598 K |
| **NA-Acadian Conifer-Hardwood Acidic Swamp** | **0%** | 4% | 23% | 68 K | 43 K | 327 K |
| **Laurentian-Acadian Wet Meadow-Shrub Swamp** | **2%** | 4% | 20% | 31 K | 30 K | 150 K |
| **Acadian Low Elevation Spruce-Fir-Hardwood Forest** | **1%** | 5% | 26% | 492 K | 180 K | 2,086 K |
| **Laurentian-Acadian Large River Floodplain** | **1%** | 6% | 24% | 24 K | 15 K | 133 K |
| **Laurentian-Acadian Freshwater Marsh** | **4%** | 6% | 20% | 19 K | 22 K | 109 K |
| **Boreal-Laurentian-Acadian Acidic Basin Fen** | **0%** | 8% | 28% | 23 K | 5 K | 170 K |

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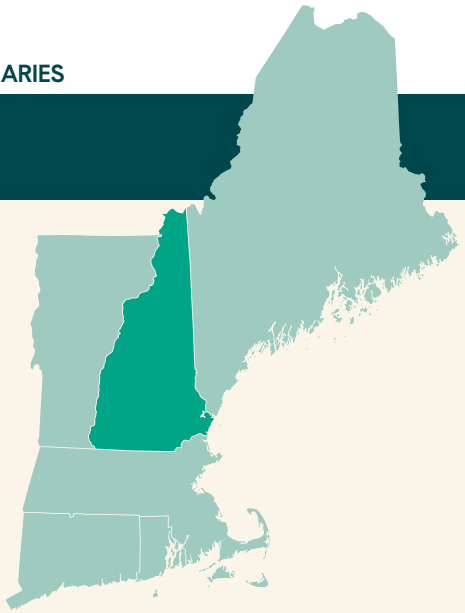
**%S** = % secured
**GSPC** = Global Strategy for Plant Conservation target
**NET** = New England Target
**R ac** = resilient acres available

# NEW HAMPSHIRE



New Hampshire has 36 mapped habitats covering 5.2 million acres. On average, each habitat is 17% protected for nature (1-99%) and 38% secured against conversion to a different land use (10-99%), but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are 84% resilient. Three habitats cover less than 100 acres and are excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **11**, 0 Protected, 4 Secured
- **Acres to meet GSPC for all habitats**: 409,357
- **Acres to meet NET for all habitats**: 342,172
- **Habitats meeting targets**: 10 GSPC, 8 NET
  - Laurentian-Acadian Northern Hardwood Forest (GSPC, NET)
  - Laurentian-Acadian Red Oak-Northern Hardwood Forest (GSPC, NET)
  - Calcareous Cliff & Talus (GSPC, NET)
  - Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (GSPC)
  - Boreal-Laurentian-Acadian Acidic Basin Fen (GSPC)
  - Calcareous Rocky Outcrop (GSPC, NET)
  - Acidic Cliff & Talus (GSPC, NET)
  - Acidic Rocky Outcrop (GSPC, NET)
  - **Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest** (GSPC, NET)
  - **Acadian-Appalachian Alpine Tundra** (GSPC, NET)
- **Habitats meeting NET for Protection & Securement but not Resilience**
  - North Atlantic Coastal Plain Basin Peat Swamp
  - Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp
  - Acadian Sub-boreal Spruce Flat
  - Acadian Low Elevation Spruce-Fir-Hardwood Forest
  - Laurentian-Acadian Alkaline Conifer-Hardwood Swamp
  - Boreal-Laurentian-Acadian Acidic Basin Fen

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# NEW HAMPSHIRE

CONTINUED

### Unprotected Habitats Threatened by Conversion

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| **Northeastern Coastal & Interior Pine-Oak Forest** | 9% | 1% | 16% | 93 K | 89 K | 173 K |
| North-Central Appalachian Acidic Swamp | 7% | 2% | 23% | 12 K | 6 K | 29 K |
| Appalachian (Hemlock)-Northern Hardwood Forest | 5% | 2% | 16% | 158 K | 167 K | 608 K |
| N-Central Interior & Appalachian Acidic Peatland | 5% | 2% | 39% | 338 | – | 1 K |

**P** = Protected, **S** = Secured, **R** = Resilient
**Unprotected** = less than 10% protected & resilient
**TOC** = threat of conversion by 2050
**%PR** = % protected & resilient
**%S** = % secured
**GSPC** = Global Strategy for Plant Conservation target
**NET** = New England Target
**R ac** = resilient acres available

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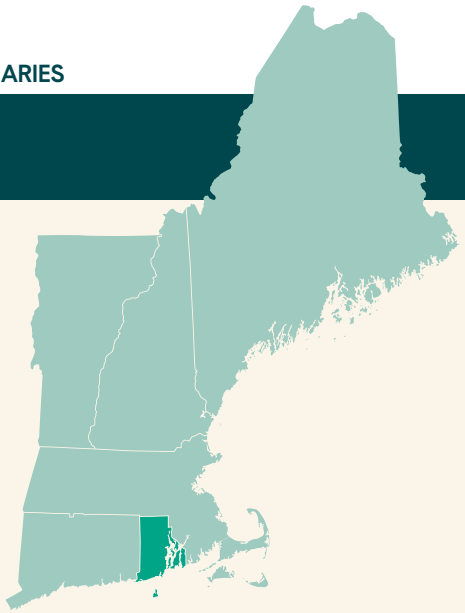
# RHODE ISLAND



Rhode Island has 21 mapped habitats covering 462,000 acres. On average, each habitat is 6% protected for nature (0-18%) and 28% secured against conversion to a different land use (0-73%), but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are 37% resilient. Three habitats cover less than 100 acres and are excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **8**, 0 Protected, 1 Secured
- **Acres to meet GSPC for all habitats**: 50,509
- **Acres to meet NET for all habitats**: 25,329
- **Habitats meeting targets**: 2 GSPC, 0 NET
  - North Atlantic Coastal Plain Tidal Salt Marsh (GSPC)
  - North Atlantic Coastal Plain Pitch Pine Barrens (GSPC)
- **Habitats meeting NET for Protection & Securement but not Resilience**
  - North Atlantic Coastal Plain Tidal Salt Marsh

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# RHODE ISLAND

CONTINUED

### Unprotected Habitats Threatened by Conversion

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| NA Coastal Plain Heathland & Grassland | 18% | 1% | 24% | 0.4 K | 0.2 K | 0.2 K |
| Northeastern Interior Dry-Mesic Oak Forest | 8% | 1% | 21% | 24.5 K | 15.6 K | 18.1 K |
| Atlantic Coastal Plain Beach & Dune | 6% | 3% | 17% | 0.4 K | 0.4 K | 0.4 K |
| North Atlantic Coastal Plain Maritime Forest | 16% | 3% | 26% | 1.0 K | 0.3 K | 0.9 K |
| North Atlantic Coastal Plain Hardwood Forest | 18% | 4% | 18% | 7.1 K | 7.8 K | 14.4 K |
| North-Central Appalachian Acidic Swamp | 7% | 6% | 30% | 6.1 K | 0.1 K | 18.4 K |

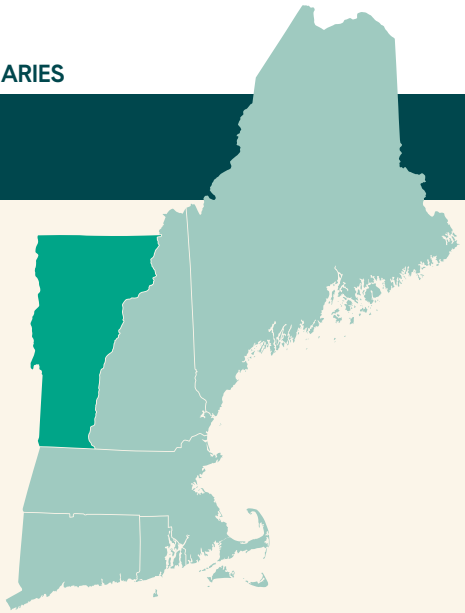
### Unprotected Habitats with Low Threat, High Responsibility

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| Northeastern Interior Pine Barrens | 3% | 0% | 69% | 334 | 273 | 80 |
| Laurentian-Acadian Freshwater Marsh | 4% | 4% | 30% | 492 | 20 | 823 |
| Laurentian-Acadian Wet Meadow-Shrub Swamp | 2% | 5% | 37% | 519 | 378 | 1.1 K |
| North Atlantic Coastal Plain Basin Peat Swamp | 2% | 6% | 34% | 149 | 131 | 464 |

**P** = Protected, **S** = Secured, **R** = Resilient
**Unprotected** = less than 10% protected & resilient
**TOC** = threat of conversion by 2050
**%PR** = % protected & resilient
**%S** = % secured
**GSPC** = Global Strategy for Plant Conservation target
**NET** = New England Target
**R ac** = resilient acres available

# VERMONT



Vermont has 30 mapped habitats covering 5.5 million acres. On average, each habitat is 5% protected for nature (0-100%) and 28% secured against conversion to a different use (1-100%), but open to multiple uses, including logging, mineral extraction, and recreation. The conserved lands are 90% resilient. One habitat covers less than 100 acres and is excluded here.

The metrics below refer to Global Strategy for Plant Conservation (GSPC) targets calling for protecting 15% of each habitat for nature and New England targets (NET) to achieve 30% of each habitat secured against conversion on climate-resilient land, with 5-15% protected for nature. The Important Plant Area numbers are total in the state, followed by how many meet the GSPC thresholds of 75% protected for nature or secured on resilient land.

- **Important Plant Areas** (IPAs): **39**, 1 Protected, 4 Secured
- **Acres to meet GSPC for all habitats**: 466,707
- **Acres to meet NET for all habitats**: 484,365
- **Habitats meeting targets**: 7 GSPC, 5 NET
  - Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (GSPC, NET)
  - Acidic Cliff & Talus (GSPC, NET)
  - Acadian-Appalachian Alpine Tundra (GSPC, NET)
  - Acidic Rocky Outcrop (GSPC, NET)
  - Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (GSPC, NET)
  - Boreal-Laurentian-Acadian Acidic Basin Fen (GSPC)
  - North-Central Interior & Appalachian Acidic Peatland (GSPC)
- **Habitats meeting NET for Protection & Securement but not Resilience**
  - Boreal-Laurentian-Acadian Acidic Basin Fen
  - North-Central Interior & Appalachian Acidic Peatland

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# VERMONT

CONTINUED

### Unprotected Habitats Threatened by Conversion

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| North-Central Appalachian Acidic Swamp | 7% | 1% | 7% | 1.4 K | 2.4 K | 4.9 K |
| North-Central Interior & Appalachian Rich Swamp | 5% | 1% | 9% | 1.2 K | 1.9 K | 3.8 K |
| Appalachian (Hemlock)-Northern Hardwood Forest | 5% | 2% | 8% | 81.8 K | 137.4K | 358.9K |
| North-Central Interior Wet Flatwoods | 11% | 2% | 6% | 0.2 K | 0.4 K | 0.7 K |
| **Circumneutral Cliff & Talus** | 7% | 4% | 15% | 0.7 K | 1.0 K | 5.1 K |

### Unprotected Habitats with Low Threat, High Responsibility

**Bold** indicates a high responsibility to conserve, as > 33% of the regional habitat is in this state.

| HABITAT | TOC | %PR | %S | GSPC | NET | R ac |
|---|---|---|---|---|---|---|
| **Laurentian-Acadian Alkaline Fen** | 0% | 0% | 1% | 14 | 27 | 25 |
| **L-A Red Oak-Northern Hardwood Forest** | 1% | 2% | 15% | 46.6K | 52.1K | 235.3K |
| **Glacial Marine & Lake Mesic Clayplain Forest** | 4% | 2% | 7% | 4.1K | 7.5K | 11.9K |
| **Glacial Marine & Lake Wet Clayplain Forest** | 3% | 2% | 12% | 1.8K | 2.5K | 3.7K |
| **Calcareous Rocky Outcrop** | 0% | 7% | 23% | 1.4K | 1.1K | 11.4K |
| **Calcareous Cliff & Talus** | 1% | 8% | 31% | 1.1K | – | 10.3K |

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