SQUAM ROCK RESTORATION AND STEWARDSHIP PLAN

Prepared for the

Squam Rock Land Trust

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Mass Audubon's Ecological Extension Service

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Mass Audubon

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Contents

Introduction

The Squam Rock Pasture in the Annisquam area of Gloucester is an almost thirteen-acre open space located at 20 Walnut Street.

This document aims to provide an ecological restoration and stewardship plan for Squam Rock Pasture including an ecological assessment, re-establishment and restoration of native vegetation, invasive species management, visitor experience, and overall stewardship including prioritization of volunteer and contractor efforts.

Gloucester at a Glance

- Total Land Area: 17,088 acres (26.7 square miles)
- Human Population in 2022: 29,729
- Open space protected in perpetuity: 5,558 acres, or 32.5% percent of total area*

*Calculated using MassGIS open space data

Why have an ecological stewardship plan? Gloucester is fortunate to have a beautiful setting and much protected open space. Many conservation commissions, land trusts, and private landowners are concerned about and often overwhelmed with forces that are degrading their open spaces. The concerns include unintended consequences of past management; the impacts of unmanaged use; invasive species; maintaining biodiversity; and effects of climate change, including sea-level rise and impacts from more frequent and intense storms. Every effort to manage land responsibly is important and benefits everyone. Being good stewards of the land is a responsibility, but more importantly it forms a relationship between the land and the stewards that nourishes both.

The Squam Rock Land Trust is fortunate to have more than 500 shareholders who join to enjoy a unique and beautiful site. The limited scale of the site and the dedication of the trustees and shareholders makes doing the work to implement an ecological restoration and stewardship plan much more feasible than the challenges facing many other conservation groups who often struggle to have the recourses to manage hundreds of acres.

Land Acknowledgement

Land that is well managed sustains us in many ways – often referred to as ecosystem services. A few examples of what land provides when it is managed sustainably include:

- The air we breathe,
- The water we drink,
- The food we eat,
- Sequestration of carbon,
- Climate moderation,
- Protection from flooding,
- Recreation that renews our spirits.
- Health benefits from being in nature,
- The lumber we use to build our shelters,

- Filtration and decomposition of our wastes, and
- Habitats for a diversity of plants and animals.

Squam Rock Pasture and the rest of Cape Ann are situated within the ancestral lands of the Native American families and tribes of the Pawtucket Confederation who lived in New England from around 3,000 years ago, descendants of Algonquian-speaking people who predated them, some dating back to Paleolithic times. Evidence of their presence can be found throughout Cape Ann. Ancient shell piles or "middens" on the shores of the Essex River and the Annisquam River mark the sites of summer encampments visited over centuries[1].

These lands were taken from the Indigenous people, creating a legacy of trauma that persists to this day. Indigenous stewardship of the land kept its ecological communities vibrant, strong, and interconnected for thousands of years, but far from being relics of the past, Indigenous peoples, including 37,000 individuals who currently reside in Massachusetts, are still at the forefront of environmental protection, ecological stewardship, and climate mitigation. This land helped sustain them for thousands of years before its occupation by Europeans. How we care for the land will determine how well it will sustain us and our descendants.

General Character and Landscape Context of Squam Rock Pasture

Cape Ann is essentially an island with a predominantly rocky shoreline

FIGURE 1 - USGS MAP OF ANNISQUAM AREA OF CAPE ANN. SQUAM ROCK PASTURE HIGHLIGHTED.

[1] https://www.capeannmuseum.org/native-americans-cape-ann/

connected to the mainland by a railroad bridge and two vehicle bridges. Cape Ann sits at the southern end of the Great Marsh Area of Critical Environmental Concern (ACEC), a coastal habitat for birds and wildlife. The Great Marsh is approximately 25,500 acres and extends north through Ipswich and Newbury. At Cape Ann's western border, a semi-continuous woodland extends from Beverly north and east through Manchester, Essex, Gloucester to Rockport[2]. Annisquam, a word coming from Algonquian meaning "top of the rock," is primarily a residential village. Its only businesses include a restaurant and marina, a small shop called The Exchange, and the Annisquam Yacht Club, founded in 1896. The Annisquam Village Hall Association provides many community resources, such as a small library and art gallery. Because of its small size, historic architecture and secluded geography, Annisquam remains a popular summer refuge[3].

Physical History.

Cape Ann with the rest of much of the east coast of North America, south-west Great Britain, and southern Ireland were parts of the microcontinent Avalonia more than 550 million years ago. By the movements of plate tectonics, the microcontinent collided with other microcontinents and eventually formed the basement rock of eastern Massachusetts. The forces of these collisions metamorphosed new rocks from sediments, created uplifts and faults and resulted in widespread volcanic activity. The economically and architecturally prized granite of Cape Ann formed long ago deep in the interior of Avalonia's volcanoes. Uplifts raised mountains a mile or two high that have since been scraped away and eroded. Later still, glaciers eroded more and deposited boulders, till, and moraine – the current material overlaying Cape Ann's bedrock. About 12,000 years ago the last of the ice ages receded and Indigenous Peoples began to explore and eventually settle in the area.

FIGURE 2 - 1900S PHOTO WITH SQUAM ROCK IN DISTANT CENTER

[2] 2022 Gloucester Open Space and Recreation Plan, page 9. https://gloucester-ma.gov/DocumentCenter/View/8851/2022-2029-Gloucester-Open-Space-and-Recreation-Plan?bidId=

[3] https://en.wikipedia.org/wiki/Annisquam,_Massachusetts

Cultural History

When the first European explorers reached what we know as Cape Ann they commented on the many Indigenous villages along its shores. Samuel de Champlain's 1606 map of Gloucester Harbor shows Pawtucket wigwams, gardens, and woodlots in parkland. The name, Wigwam Point, is current evidence of his observations.

The first European settlement in Annisquam was established in 1631. In the late 19th century, Annisquam was an important area for granite quarrying, fishing, and shipbuilding, launching vessels into the cove from hefty granite piers.[4]

The Squam Rock Pasture was used for sheep grazing and much of the surrounding area was cleared land. Squam Rock Land Trust was established in 1935, at the height of the Great Depression, when Mr. Quincy Bent decided he wanted to dispose of the property. A group of three men, Mr. Henry Worcester, Mr. Arthur Wiggin, and Mr. Adolph Leeds purchased the whole property of twelve acres from Mr. Bent for $10,000. They set up the Squam Rock Land Trust in which the title was vested. [5]

Current Landscape

Today the former pasture has a more diverse landscape consisting of cultural grassland (upland meadow), forested wetland, upland deciduous forest, small stands of evergreen trees, a coastal bank, a coastal beach, and scattered outcrops of granite, including Squam Rock, and glacially deposited boulders. A network of trails crosses the site, some leading from Walnut Street to the beach. Like many private and public open spaces, much of the site has been infested with invasive species of plants.

FIGURE 3 - VIEW OF SQUAM ROCK

[4] https://readelysian.com/cape-ann-annisquam/

[5] From Annisquam Historical Journal No. 4. Fall, 2016.

Natural Resource Inventory and Assessment

The following section will describe and assess the site's natural resources including physical features such as topography and soils and natural communities.

Topography

As shown in Figure 4, parts of Squam Rock Pasture have a steep, dramatic rise to 121 feet at the top of Squam Rock on its southeast corner along Walnut Street. A bit north along the street it rises more gently to 65 feet and then slopes down gently to sea level. Some steep areas present difficulty for locating trails.

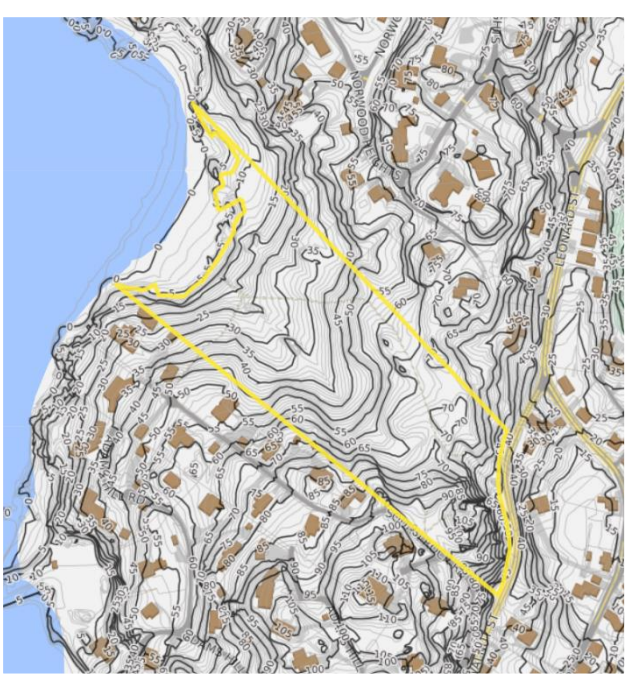

FIGURE 4 - TOPOGRAPHY - 5' CONTOURS

Soils

Squam Rock Pasture has three soil types: Chatfield-Hollis rock outcrop complex, with slopes predominately between 15% and 35%; Winsor loamy sand, with slopes predominately between 8% and 15%; and Beach sand. The Chatfield-Hollis soil is on steep side slopes and is likely to have rock outcrops. It is shallow, well drained, and severely subject to erosion. The Winsor soil is generally deep, gently sloping, and excessively drained. It often includes a considerable amount of sand. Beach sands are limited to the shore area and coastal bank. Locating or improving trails, especially on the Chatfield soils, needs to be done with care to avoid erosion.

Natural Communities

Natural communities are divisions in plant communities based on conditions determined by the entire landscape. Soil composition, slope, aspect, elevation, and land use history are all factors that determine the distribution of natural communities on a site. Interestingly, in the 1960s Edward Hubbard, a Squam Rock Land Trust trustee, inventoried 85 species of wildflowers and ferns at the at the Squam Roack Pasture. It would be an interesting project to redo his effort. The inventory is included in Appendix A – 1962 Plant List (page 43).

According to the MassGIS Coastal Natural Communities layer, the Land Cover Land Use (2016) layer, and DEP Wetlands layer, the natural communities of Squam Rock Pasture include a small amount of Intertidal Rocky Shore, Maritime Shrubland, Cultural Grassland, Deciduous Wooded Swamp, Coastal Forest, Coastal Bank, and Marine Gravel/Sand Beach.

Intertidal Rocky Shore Community[6]

The Intertidal Rocky Shore community is in two small areas at Squam Rock Pasture. It is dominated by invertebrates like barnacles, mussels, and crabs; and non-vascular plants, like seaweeds; in a high-stress environment alternately covered by tides and exposed to desiccation and thermal stress. Microhabitats may include tide pools of varying depth and sizes, rocks ranging in size from huge boulders and bedrock to cobbles, rock faces varying in degree of exposure to wave energy, and crevasses and surge channels

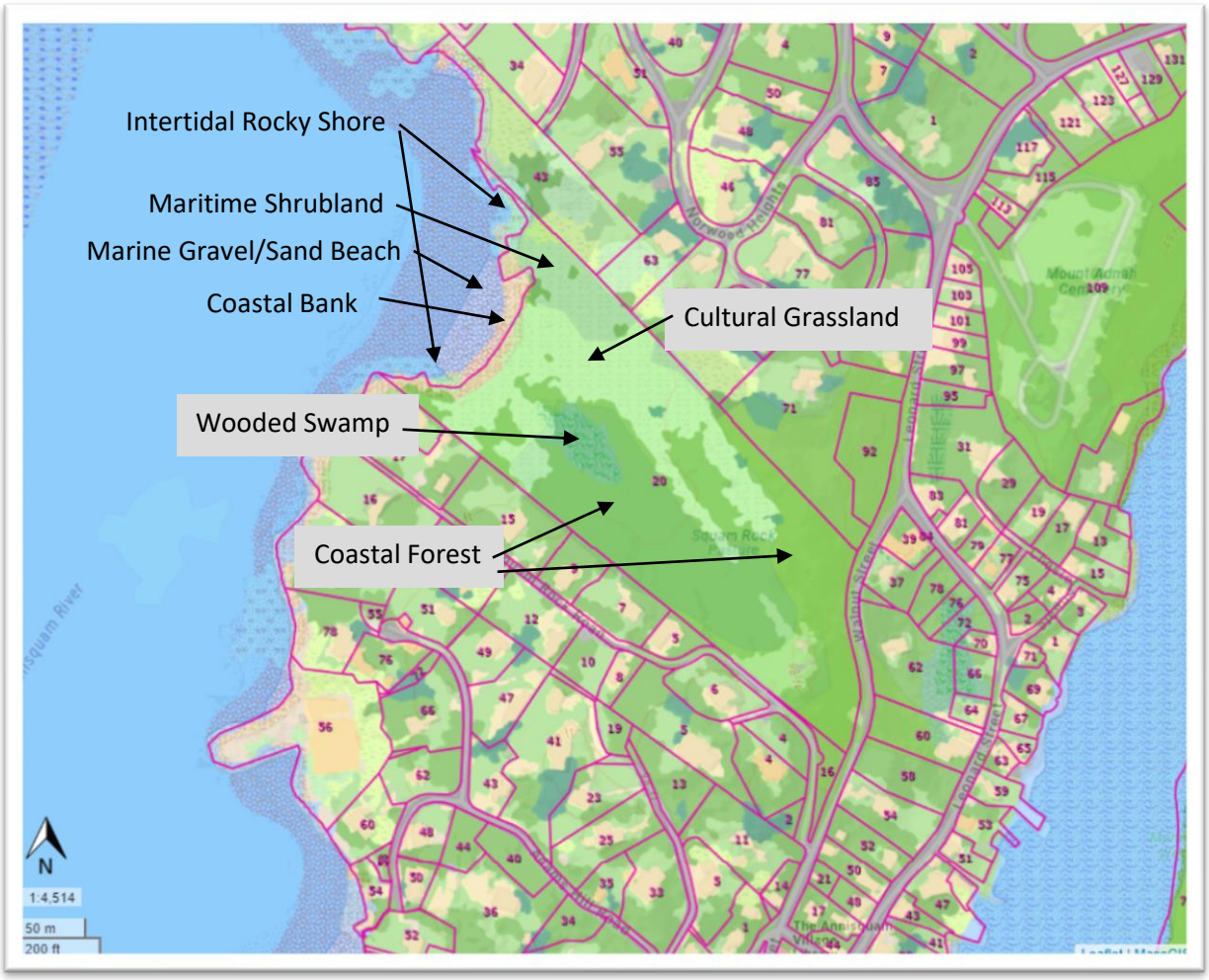

FIGURE 5 - NATURAL COMMUNITIES

within and between rocks. Wintering sea birds such as harlequin duck and **great cormorants** feed among submerged rocks close to shore. Wintering **purple sandpipers** forage among exposed rocks in low tide. This is also a foraging area for marine fish such as striped bass during high tide. Rocky shores provide habitat, including tidal pools, for many marine invertebrates that are important to community

[6] See Mass. NHESP fact sheet https://www.mass.gov/doc/marine-intertidal-rocky-shore-community-0/download

structure, including blue mussels; several species of herbivorous gastropods, especially periwinkle snails (an exotic marine species); a predatory snail, **five species of hermit crabs, razor clams, sea urchins, horseshoe crabs, tunicates, moon snails**, **sand dollars**, dog whelk; and sea stars. Note: **bold** indicates species that have been observed at either of the two nearby eBird Hotspots (see Appendix B – page 46) or noted at the site.

The shore at Squam Rock Pasture includes less than 1 acre of intertidal rocky shore habitat.

The Heritage Program's *BioMap Gloucester* town report lists an approximately 1.7-acre rocky intertidal area and coastal bank running from Squam Rock Pasture beach toward Wigwam Point as Core Habitat for a Threatened plant species – Sea-beach doc (*Rumex pallidus*), last reported in 1997. The BioMap Project was developed by Natural Heritage and Endangered Species Program (NHESP) and The Nature Conservancy as a guide for strategic biodiversity conservation in Massachusetts by focusing land protection and stewardship on the areas that are most critical for ensuring the long-term persistence of rare and other native species and their habitats, exemplary natural communities, and a diversity of ecosystems. In Massachusetts there are few truly rocky shores, so this community type is relatively rare. Any access improvements should include a high level of sensitivity to this uncommon natural resource.

Maritime Shrubland Community[7]

The Maritime Shrubland community normally occurs within the area of direct influence of the ocean and salt spray. It is generally dominated by patches of dense shrubs with scattered areas of more open low growth or bare ground and usually has less than about 25% tree canopy. Plants in this community are exposed to the direct influences of salt and constant ocean wind, which select for stress-tolerant species. The species of Maritime Shrublands do not withstand flooding by saltwater, but they tolerate or recover from salt deposits on their leaves. Fire was an important part of this environment prior to the establishment of fire suppression regimes in settled areas. Without regular disturbance, the community may succeed to forest. This community is presently presenting as wet meadow because recent mowing and brush-hogging has greatly reduced the shrub component.

Species found in the Maritime Shrubland Community are the same as those of oak forests. They often have dense patches of shrubs, up to about 3m (10 ft.) tall, with various species dominating in different areas. Huckleberry, **bayberry**, or **red cedar** areas are often distinctive. **Black cherry**, beach plum, chokeberry, **lowbush blueberry**, and **bearberry** may be abundant. **Catbrier** and **poison ivy** often cover other plants or grow in dense patches on their own. Invasive non-native species are often abundant including **Asiatic bittersweet** and **honeysuckle**. The herbaceous layer (grasses and wildflowers) is usually sparse because of shade.

Shrub thickets provide nesting areas for **northern harriers**, **eastern towhees**, and **song sparrows**. Maritime Shrublands are heavily used during fall migrations for cover and forage; many of the plants have fruit attractive to migrants. White-footed mice can also be very abundant, and in the openings,

[7] See Mass. NHESP factsheet https://www.mass.gov/doc/maritime-shrubland-0/download

meadow voles may be common. Long-tailed weasels occur in the grass-dominated areas where they hunt meadow voles.

Squam Rock Pasture includes approximately .75 acre of shrubland (in 2021 being maintained as wet meadow by frequent mowing). Much of this area, especially along the stone wall, has been invaded by non-native invasive species of plants including **Asiatic bittersweet**, **porcelain berry**, and **bindweed**. A volunteer effort cut back many of these invasives in the fall of 2022.

Cultural Grassland Community[8]

The Cultural Grassland community (also sometimes referred to erroneously as meadow) at Squam Rock Pasture is maintained by frequent mowing and is primarily of conservation interest as habitat for the grassland bird community (if large enough) and/or pollinators. The approximately 3 acres of grassland at Squam Rock Pasture has value as habitat for pollinators – insects that are food for many species of birds and mammals.

The grasslands at Squam Rock Pasture are too small to attract most grassland nesting birds like bobolinks. Grassland birds could include killdeer and wintering horned larks. Meadow voles, meadow jumping mice, and northern short-tailed shrews would be expected in most grasslands. They would be hunted by **garter snakes**, long-tailed weasels, American kestrels, and wintering **northern harriers**, **snowy owls,** and **snow buntings**.

Wooded Swamp-Community[9]

The Wooded Swamp community is usually dominated by **red maples**. Other species may include yellow birch, black gum, white ash, **white pine**, hemlock, **red oak**, swamp white oak, and pin oak. **Sweet pepperbush** and swamp azalea are often the dominant shrubs, often dense and bound together by **greenbriers**. Other common shrubs are **highbush blueberry**, common winterberry, along with spicebush. Ferns are usually abundant in the herbaceous layer. Skunk cabbage is often one of the most common herbaceous species. Wooded swamp associated with groundwater seepage, like at Squam Rock Pasture, are often more diverse.

The dense shrub layers provide excellent nesting locations for birds of thickets. The amount of cover and availability of water make this area an important habitat for many species of small mammals. Reptiles and amphibians are attracted by the moist soils and will use them for breeding and feeding. One of the most important management needs is to control **glossy buckthorn** and **Norway maple**. There are approximately .4 acres of wooded swamp at Squam Rock Pasture.

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[8] See Mass. NHESP factsheet https://www.mass.gov/doc/cultural-grassland-0/download

[9] See Mass Wildlife Classification of the Natural Communities of Massachusetts – Red Maple Swamp https://www.mass.gov/doc/red-maple-swamp/download

Coastal Forest Community[10]

Coastal Forest has a mixture of deciduous and evergreen trees in the canopy that is lower than typical in more inland areas, averaging about 30 feet (10m) tall. Many trees are multiple-stemmed and contorted from pruning by winds carrying salt and sand. Black oak, red oak, scarlet oak, white oak, **other oaks**, **Norway maple**, **hickories**, American holly, sassafras, black gum, **black cherry**, and **red maple** are commonly present. Pitch pine and **red cedar** occur in variable, generally low, amounts. Vines may be dense, especially on the edges of openings; vines often include **greenbrier**, **poison ivy**, Virginia creeper, grape, and the non-native invasive **Asiatic bittersweet**. The shrub and herbaceous components can be diverse and include species usually found in less acidic areas. Shrubs may include **bayberry**, inkberry, **winged sumac**, **shadbush**, and **sweet pepperbush**. The understory often includes non-native shrubs that can form dense thickets of Japanese barberry, **honeysuckles**, common and **glossy buckthorn**, and/or **multiflora rose**. The herbaceous layer is also highly variable and may include bracken fern, Canada mayflower, partridgeberry, starflower, Pennsylvania sedge, and other **sedges and grasses.** Microtopography and local conditions strongly influence the species assemblage.

There are no animal species known to be restricted to Maritime Forests/Woodlands. Animal species are those of typical coastal oak areas such as the birds **eastern towhee**, **gray catbird**, **common yellowthroat**, **ovenbird**, and black-and-white warbler. Small mammals such as meadow voles, white-footed mice, and **gray squirrels** are common. Moths, butterflies, and other insects of the southeastern oak and oak-pine forest occur in maritime forests and their caterpillars are important sources of food for baby birds. Generally, in more salt-influenced environments like Squam Rock Pasture, fewer animals will be expected. As in all communities on peninsulas, the more remote occurrences have fewer species than those closer to the mainland sources. High **white-tailed deer** densities may have an impact on the abundance of native species, particularly woody seedlings such as oaks, as well as on herbaceous plants.

There are about 6 acres of this community within the boundary of Squam Rock Pasture. Some of the areas classified as shrubland are trending toward becoming forest.

With the Wooded Swamp Community there is a total of about 10 acres of forest on the site (or just over 75%). Forests provide carbon sequestration, shade, local temperature moderation, and improved air quality. Maintaining a balance of forest and grassland communities contributes to the diversity of the site and its values for wildlife and people.

Coastal Bank

The area designated as Coastal Bank by DEP is defined in 310 CMR 10.30(2) as “the seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach”. Ocean-facing coastal banks, like the one at Squam Rock Pasture, are fragile environments threatened by intensifying storm events, and sea level rise. Coastal erosion is a natural process, but new mapping projections by FEMA indicate its pace is likely to accelerate with sea level rise as storms can attack higher and higher land elevations. This designation does not represent a natural community type as defined by the Natural Heritage and Endangered Species Program. At this site it is a narrow boundary

[10] See Mass. NHESP factsheet https://www.mass.g/maritime-forestwoodland/download

between the upland and the beach. It consists of silt, sand, or unconsolidated rocks and soil that eroded down from the upland or was deposited by ocean storms. Banks like this that are exposed to wave and wind energy are subject to erosion. A small stream flows from the wooded swamp and passes through the coastal bank in a stone culvert.

Healthy Coastal Banks in situations like the one at Squam Rock Pasture are dynamic, subject to movement as the level of the sea rises. Currently the invasive shrubs and vines and their roots prevent the natural movement of sand, locking the bank in place and contributing to its erosion by preventing a gradual build-up. The bank is being undermined by the rising sea and left alone it is likely to collapse. The existing vegetation is dominated by non-native invasives including **Asiatic bittersweet**, **bindweed**, **multiflora rose**, **privet**, **honeysuckle**, **purple loosestrife**, and **phragmites** and have little value for native wildlife. Without these invasives, rows of thick drought-tolerant native beach grasses along the face of a bank and native shrubs at the top would create a natural barrier that slows water runoff and allows sediment to be deposited, allowing the bank to gradually build up. Other plants noted along the coastal bank include **evening primrose, raspberry, jewelweed, aster, curly doc, bayberry, Virginia rose,** and **common yarrow.**

Marine Gravel/Sand Beach Community[11]

The Marine Intertidal Gravel/Sand Beach is exposed between high tides; it occurs below the wrack line and above permanent water. It can often have intertidal pools in low areas. Wave action combined with alternating exposure to salt water and desiccation produces a highly stressful environment. Nonvascular plants, like seaweeds; and invertebrates, like mussels; are the dominate organisms. Shorebirds are often the most visible animals. **Semipalmated** and **least sandpipers**, **sanderling**s, **semipalmated plover**, and ruff, red knots forage along shorelines during migrations. Exposed intertidal beaches are part of important resting areas for shorebirds. Piping plovers nest on the beach strand and forage in the wrack line in undisturbed locations. Gulls are ubiquitous in all shore and shallow water environments. **Canada Geese** and **Brant** are seen off the beach and sometimes come ashore. Tiger beetles also forage on exposed portions of the intertidal beach.

Wildlife

These natural communities contribute to the diversity of wildlife at the site and in the surrounding areas. As noted above, part of the Squam Rock Pasture is a part of a BioMap2 Core for a threatened plant species – Seabeach Dock, meaning the area (the Marine Intertidal Rocky Shore and Coastal Bank) is important for protection and careful stewardship to assure the long-term persistence of this native species. The site

FIGURE 6 - SEMIPALMATED PLOVER

[11] https://www.mass.gov/doc/marine-intertidal-gravelsand-beach-community

also faces the ocean, and the open water is also a BioMap Critical Tern Foraging Habitat and BioMap Critical Natural Landscape. Squam Rock Pasture is also near two "hotspots" in the Cornell University eBird project which encourages birdwatchers to enter their observations into a database.

Gloucester has 11 "species of conservation concern" 4 birds (Saltmarsh sharp-tailed sparrow, Seaside sparrow, **Common tern**, and Piping plover), 3 reptiles (Eastern ribbon snake, Northern black racer, and Spotted turtle), 2 amphibians (Four-toed salamander and Blue-spotted salamander), and 3 plants (Sea Lyme-grass, Sweetbay magnolia, and Seabeach doc). Only the Seabeach doc and **common tern** have been reported at or near Squam Rock Pasture.

The Massachusetts State Wildlife Action Plan[12] (SWAP) lists grasslands and rocky coastlines as two of 24 habitats that protect Species of Greatest Conservation Need (SGCN). Grasslands have 71 SGCN (2 reptiles, 15 birds, 1 mammal, 2 beetles, 9 lepidoptera (butterflies and moths), 5 bees, and 38 plants) and rocky coastlines are habitat for 4 SGCN, all birds.[13]

Birds

Birdwatchers have reported a total of 123 species (see Appendix B – eBird Hotspots for complete list, page 46). Sixty-four species of birds have been reported during the breeding season (June and July) indicating that many of them may breed at the site or nearby. Shrublands and fields are critical wildlife habitats that are essential for the survival of many wildlife species. The loss of these habitats through conversion to other land uses, residential development or through succession, is resulting in the decline and disappearance of some wildlife dependent on early successional habitats. See Mass Audubon's report on the State of The Birds for more details on these declines (https://www.massaudubon.org/content/download/21633/304821/file/mass-audubon_state-of-the-birds-2017-report.pdf).

Shrubland species including **eastern towhee**, **brown thrasher**, and **white-throated sparrow** have all been reported nearby. Although not all of these are regularly seen at Squam Rock Pasture, they too have seen dramatic declines in the Northeast and the rest of the country as the amount of shrubland has decreased. Some have noted the presence of more bird species since the frequency of mowing the grassland has been reduced.

Amphibian and Reptiles

There are no inventories of amphibians or reptiles at Squam Rock Pasture. The Massachusetts Herpetological Atlas Project[14], an ongoing effort, originally running from 1992 through 1998, has reported 21 species, including American toad, Blanding's turtle, Bullfrog, Common snapping turtle, Eastern box turtle, **Eastern garter snake**, Eastern milk snake, Eastern ribbon snake, Green frog, Northern black racer, Northern brown snake, Northern ringneck snake, Northern two-lined salamander, Painted

[12] https://www.mass.gov/service-details/state-wildlife-action-plan-swap

[13] See Appendix C State Wildlife Action Plan Habitats at Squam Rock Pasture for complete lists.

[14] https://massherpatlas.org/

turtle, Pickerel frog, Red-backed salamander, Red-spotted newt, Spotted salamander, Spotted turtle, Spring peeper, and Wood frog in the Gloucester US Geological Survey Quadrangle map – the area that includes Squam Rock Pasture. Some have noted the presence of more snakes at the site since the frequency of mowing the grassland has been reduced.

Insects

It is estimated that 40% of all insect species are in decline globally due to habitat loss, pollution (pesticides, light), and climate change[15]. Insects are rarely thought of as an intrinsically beautiful part of the natural world, nevertheless they are indispensable to the survival of all life on earth. Insects serve as a food source for many animals such as birds and frogs, bats, and small vertebrates. Some insects help keep other insects in check. For instance, dragonflies are voracious eaters of mosquitos. Insects play an important role in aerating the soil and help replenish nutrients in the earth by breaking down plant and animal debris. Last but not least, insects play a vital role as pollinators. Without insects to pollinate them most flowering plants would die out. Cataloging the insects present in the SRLT would be an overwhelming task but it is important to note the benefits of sustaining a healthy and diverse population on the property by providing appropriate habitats of native plants as well as dead and decaying organic material.

Other Wildlife

Squam Rock Pasture may provide some habitat for generalist species. Common generalist mammals that are likely to occur within the area include: Virginia opossum, racoon, eastern gray squirrel, red squirrel, eastern chipmunk, meadow vole, white-footed deer mouse, eastern cottontail, **coyote**, **red fox**, long-tailed weasel, striped skunk, and **white-tailed deer**. Migratory bird species use a mix of forest, edge, and field habitats that are available within the site and surrounding habitats. Butterflies, bees, and other insects help pollinate the wildflowers and are food for many of the small mammals and birds that use the habitats. **Whales** are sometimes seen offshore, and **harbor seals** have been seen in the waters around Gloucester.

The waters and tidepools around Annisquam are full of marine aquatic species including fish, crabs, lobsters, snails, and a host of other invertebrates.

Regulated Areas

Some areas of Squam Rock Pasture are subject to local and state regulations including the Massachusetts Wetlands Protection Act (M.G.L. c. 131 §40) which covers wetlands, rivers, streams, ponds and their banks, floodplains, isolated land subject to flooding, buffer zones adjacent to these resources, and a 200-foot Riverfront buffer. See Figure 7.

[15] Bringing Nature Home: Doug Tallamy, Silent Earth:Dave Goulson, National Geographic, United States Department of Agriculture, WWF

Wetlands and Buffers

The Massachusetts Wetlands Act requires permission from the Gloucester Conservation Commission for projects in wetlands and associated areas including the 100-foot buffer zone (green) that involve any of the following:

- Alteration including any activity other than minor activities identified in 310 CMR 10.02(2)(b)2. Including vegetation removal, regrading, etc.
- Rehabilitation (maintenance) or resurfacing of existing trails,
- Widening existing trails, and
- Creation of new trails or boardwalks.

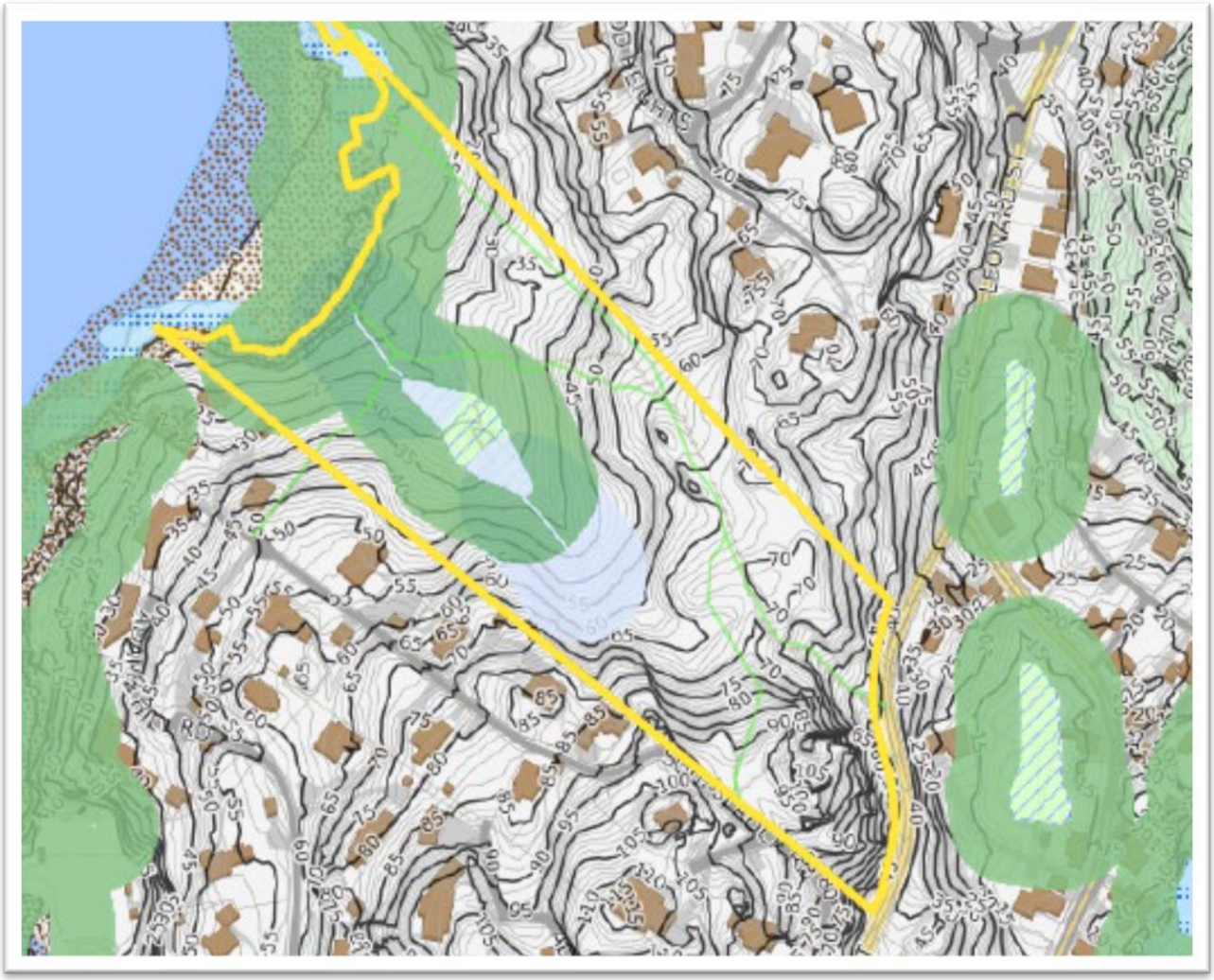


FIGURE 7 - REGULATED AREAS

As shown in Figure 7, almost one half of the site is within the wetland resource areas (Wooded Swamp/Marsh, Coastal Bank, and Beach) or their buffers (shown in green) and a 100-foot buffer for the Intermittent Stream (shown in very light blue) to the south of the wetland buffer and will require

submission of a Request for Determination of Applicability or Notice of Intent to the Gloucester Conservation Commission for any work occurring in these areas. Minor activities not requiring a permit include the creation or maintenance of unpaved paths less than 30 inches wide; fencing, provided it will not constitute a barrier to wildlife movement; stonewalls; vista pruning, provided the activity is located more than 50 feet from Bordering Vegetated Wetland, plantings of native species of trees, shrubs, or groundcover, but excluding turf lawns; among certain other activities that are not likely to apply to Squam Rock Pasture.

A more accurate delineation of the wetlands was done by DeRosa Environmental and is included in the Appendix D (page 55).

A site walk in June 2023 with The Gloucester Conservation Agent, Chuck Schade, and Assistant Conservation Agent, Devon Harrington, resulted in a recommendation that a Request for Determination of Applicability (RDA) should suffice for gaining permission for mechanical control of invasive species and minor trail alterations to move some existing trails farther away from resource areas. Restoration of the coastal bank would require a full Notice of Intent (NOI).

Trails

A well-designed, comfortable, and safe trail network facilitates enjoyment of an area and protects the conservation values of the site. The existing trail network is an integral part of the site's passive recreational value, providing shareholders with a means for exploring and enjoying the site. Trails should be located to minimize redundancy and enhance the visitor experience by not exceeding the capacity of the site to accommodate trails. To the greatest extent possible, all trails should be located outside of sensitive natural resource areas, such as habitat for sensitive wildlife, steep slopes, or soils that are too wet or prone to erosion. Edward Hubbard, in his 1962 report on wildflowers noted erosion problems on several trails.

Sustainable Trails

Climate change is having a big impact on trails because of more intense weather events. Northeastern U.S. saw a 55% increase in the amount of rain or snow falling in the heaviest 1% of storms between 1958 and 2016. Some climate models project monthly precipitation between December and April will increase 1 inch by the end of this century. Both the Appalachian Mountain Club and the Long Trail Club have noted the impacts on trails of extreme weather events. Trail managers have noted more erosion, more frequent blowdowns, and more wet trail areas that stay wet longer. These factors can all have a big impact on the visitor experience and on maintenance.

The US Forest Service defines a sustainable trail as one that will:

- withstand the impacts of normal use and natural elements,
- cause negligible soil loss,
- encourage users to stay on the trail,
- not adversely affect area's natural or cultural resources, and
- require minimal maintenance.

Trail Assessment

Periodic assessment of the trails is recommended. Trail assessments provide a detailed evaluation of tread conditions that can be used for planning and budgeting purposes. They provide detailed information of each section of trail which is useful in developing trail restoration plans as well as seeking funds for the restoration of trails. They can help managers see the larger picture so that sound restoration or maintenance priorities can be developed. Like buildings, trails should be viewed as assets which depreciate and thus need periodic refurbishment or structural upgrading. Any structures on trails such as benches, guardrails, and viewpoints will deteriorate over time and will need regular inspection to ensure that they are sound. Comprehensive trail assessments are usually done every 5 to 10 years to evaluate conditions.

A trail assessment like the one in Appendix E (page 56) evaluates the existing trail network, section by section. Problem areas are identified and alternatives for solving those problems are presented for discussion. Based on that discussion each solution can be described in detail (i.e., width, linear feet of trail, materials, permitting requirements, and costs, etc.). The assessment of the trails at Squam Rock Pasture indicates many areas with problems including areas of erosion and trail widening to avoid steps and water bars. Most of these problems are the result of poor trail design and lack of maintenance.

Design, construction, and maintenance of the trail network should be guided by the standards and guidelines in *Trail Solutions: IMBA's Guide to Building Sweet Singletrack*[16] and the *U.S. Forest Service Trail Construction and Maintenance Notebook.* The particulars of trail design will vary based on site conditions and use. Nevertheless, the Trustees and volunteers should pursue the following principles in trail design.

> **Trail width** – Major trails should be 4-6 feet wide in areas of heavy use like access to beach and other favorite destinations so that shareholders can walk side by side or pass. Lesser used trails should be 3-4 feet wide to minimize impacts to natural resources and to encourage a closer experience with nature, with the expectation that some width expansion may be inevitable with use. Vegetation along the edge of the trail should be regularly clipped back (or mowed with the mower height set at 12 inches) 2 feet beyond the tread width to accommodate use so that it does not grow into the trail and present an opportunity for ticks to attach to visitors. Selected trails through rapidly encroaching vegetation may need to be trimmed wider.
> **Trail Layout** – many of the existing trails run perpendicular to the contours. These "fall line" trails almost guarantee erosion if they are more than 5% grade in the soils at this site. Trails should cross contours at an angle and have "out-slope" and "grade reversals" to move water off the trail treadway. "Trail anchors", and "corralling" should be used to help keep users on the trails. See Appendix E – Trail Assessment (page 56) for more information on existing trails and on design.

[16] For an on-line version of much of the same information see http://www.crgov.com/DocumentCenter/View/1430/Sustainable-Trail-Development-Guidelines-PDF?bidId=

Trail surface – trails should normally retain a natural soil surface. Trails through grasslands will be maintained with periodic mowing and need not be cleared down to mineral soil. In rare circumstances where the existing substrate cannot be made into a sustainable surface, supplemental surfacing material may be used. Accessible trails, if any, should meet standards set by the *U.S. Forest Accessibility Guidelines Service*[17].

A comprehensive trail design was recommended and is being prepared under a separate contract.

Non-native Invasive Plants

Like many open spaces Squam Rock Pasture has become infested with non-native invasive plants. Non-native plants are species introduced since the Colonial Period. More than 2,200 plant species have been documented in Massachusetts, and some 725 of them are non-natives that are considered naturalized (established). Of those, 72 plant species have been categorized by the Massachusetts Invasive Plant Advisory Committee (MIPAG) as "Invasive," "Likely Invasive," or "Potentially Invasive." The Squam Rock Trustee Edward Hubbard, in his 1962 report noted the presence of Asiatic bittersweet as a "bothersome weed."

Why Are Non-native Invasive Plants a Problem?

Non-native invasive species cause or are likely to cause economic harm, environmental harm, or harm to human health. The term "invasive" is used for the most aggressive species. These species grow and reproduce rapidly, causing major disturbance to the areas in which they occur.

- Invasive plants are one of the greatest threats to the nature of Massachusetts (Mass Audubon)
- These non-native plants can out-compete, displace, and kill our native species.
- Invasive plants are the bullies of the natural world.
- They grow fast and produce a lot of seeds.
- They're often the first plants to leaf out in the spring, and the last to lose their leaves in the fall.
- They often grow in dense patches and use up moisture and nutrients that are then not available for more desirable plants.
- They also lack the insects or diseases of their place of origin that might keep them in check.

Why Does It Matter?

If we don't act, invasive plants may replace our native plants. Invasives compete with native plants and wildlife for resources, disrupt beneficial relationships, spread disease, cause direct mortality, and can significantly alter ecosystem function. We may lose some of the things we love about our natural places, such as:

- Native forest types,
- Rare plants – think of New England wildflowers,
- Wildlife that depends on native species – think of Monarch butterflies that depend on native milkweed plants.

[17] https://www.americantrails.org/images/documents/FSTAG_2013-Update_190413_201340.pdf

It's been shown that our native bird species that evolved over thousands of years eating the insects that feed on our native plants (and their seeds) do not obtain the same nourishment from non-natives. Many insects are only able to feed on native plants and the presence of the invasive non-natives reduces the abundance of food sources for our birds[18].

Non-native Invasive Plants at Squam Rock Pasture

As noted in the natural communities' descriptions invasive species are everywhere at Squam Rock Pasture. Some of the worst actors are Asiatic bittersweet, porcelain berry, multi-flora rose, honeysuckles, and buckthorns.

[18] Tallamy, Douglas w., Nature's Best Hope, Timber Press, Portland, Oregon, 2019 pp. 110-117

Squam Rock Pasture Rehabilitation & Stewardship Plan

Goals for the Rehabilitation and Stewardship of Squam Rock Pasture

At its 2022 Annual Meeting the Trustees presented the following principles for the future of Squam Rock Pasture.

- **HARMONY** between human enjoyment and ecological preservation
- **RESPECT** for the legacy of the Trust and shareholder interests
- **PHASED, THOUGHTFUL** approach that remains dynamic
- **PASSION** for nature and responsible stewardship
- **OPTIMISM** about sustaining a vibrant, ecologically healthy property
- **COMMUNITY** of leaders, volunteers and shareholders working together

The goals that were articulated include:

- **Improve the resiliency and ecological health of the property:** Restore and nurture rich biodiversity of the natural communities and prevent excess human use of environmentally sensitive areas to safeguard the property for present and future residents of Annisquam.
- **Create a simplified path system:** Reduce the number of paths and locate them in such a way as to prevent disturbance of protected areas, mitigate erosion of the soil and maintain ease of access.
- **Follow conservation best practices:** Ensure that all restoration and maintenance work, including but not limited to, removal of invasives and planting of native species is guided by updated environmental science expertise.
- **Preserve ample recreation space**: Maintain safe access to the beach and provide mowed area(s) where people can recreate as they do now.
- **Follow Local, State, and Federal Regulations**: Obtain all the necessary permitting to perform any restoration activities advisable within the wetland borders and corresponding buffer zones.

Management Recommendations

The following section will address land management in a time of climate change, past management efforts, stewardship of natural communities, invasive species management, enhancement of wildlife habitat, recreation uses including path system. It will also recommend a schedule of management and restoration activities and distinguish between contractor and volunteer implementation efforts.

Management of Natural Areas with Regard for Changing Climate

The management of natural resources has largely assumed a stable climatic background. Now there is widespread agreement among scientists and the public that the climate is changing because of human activities – largely attributed to the burning of fossil fuels resulting in the production of carbon dioxide. Massachusetts is already experiencing the effects of climate change, from hotter summers with more periods of drought, warmer winters with less snow cover but more precipitation, rising sea levels, more frequent severe weather events, and inland flooding in winter and spring.

Climate impacts that may affect conservation land are predicted to:

- Increase the number of extremely hot days and degraded air quality
- Compromise infrastructure like trails (e.g., more erosion, blowdowns, and flooding)
- Increase the risks from storm events
- Changes in the composition of species
- Increase non-native plants and pests
- Increase vector-borne illnesses (like West Nile and Lyme disease).

Some of these impacts are likely to affect the future management of public open space in complex ways. Manomet Center for Conservation Science and the Massachusetts Division of Fisheries and Wildlife have published a study[19] promoting two primary objectives for the management of sites and habitats – managing resilience and managing change. Unfortunately, the report does not address the management of grasslands. Still, the concepts of resilience and managing change may be useful to keep in mind.

Management for Resilience and Managing Change

Mass Audubon generally pursues four principles for increasing the resilience of conservation land.

1. **Reduce non-climate stressors** – for example, controlling invasive plants and pests.
2. **Restore form and function** – for example, removing a dam to promote spawning of diadromous fishes.
3. **Increase complexity** – for example, increasing diversity and microclimates.
4. **Create linkages** – for example connecting to adjacent land and creating corridors.

The previously mentioned Manomet report does make recommendations for forests and freshwater wetlands.

FORESTED HABITATS

The maps on the next page show recent and projected forest types. Major changes are projected for many regions. For example, in the Northeast, under a lower emissions scenario, the currently dominant maple-beech-birch forest type (red shading) is projected to be completely displaced by the oak-hickory forest type in a warmer future. Source: USGCRP (2009). To respond to climate change:

- **Diversify the age structure and species composition** of the forested landscape in advance of climate change, this could increase resilience of forested ecosystems and overall resistance to the impacts of a changing climate.

[19] Manomet Center for Conservation Sciences & Massachusetts Division of Fisheries and Wildlife, Habitat Management, April 2010 (https://www.manomet.org/wp-content/uploads/old-files/Climate%20Change%20and%20Massachusetts%20Fisheries%20and%20Wildlife%20Reports,%20Vol.%203%20April%202010.pdf)

- **Control of white-tailed deer densities**. High levels of browsing by white-tailed deer have adversely affected the structure, composition, and functioning of Massachusetts forested ecosystems, particularly through the elimination of preferred food species such as red oak, and thereby reduced their diversity and resilience. Also, overgrazing by deer has opened the way for increased rates of infestation by non-native plants.

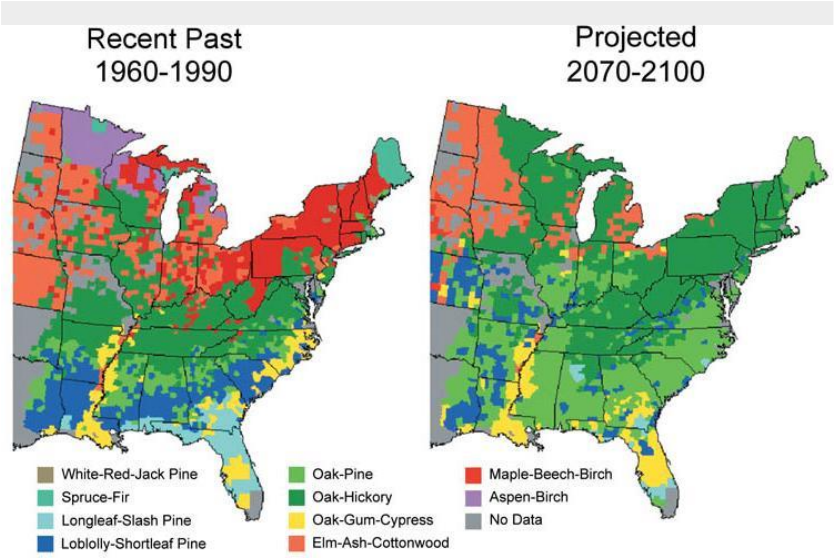


FIGURE 8 - PROJECTED CHANGE IN FOREST TYPES

- **Control invasive species and pests.** Damage caused by non-native plants and insect pests will become more serious under climate change. Forest managers will need to:
    - detect and track infestations and outbreaks in their early stages, and
    - take aggressive actions to eliminate these problems before they escape control.
- **Manage change**. Past management has been primarily guided by the concept of preserving natural habitats and associated species. Adaptive management is recognizing that preserving the status quo may not always be possible. When preservation of a habitat or species is no longer feasible, we will need to adapt management practices to guide change. One strategy may be to plant more southern species that will help maintain diversity or other ecological values.

FRESHWATER WETLANDS

The main threats to freshwater wetlands in Massachusetts are likely to be impaired hydrology and habitat loss, and ecological injuries caused by non-native pest species, the same threats that currently affect wetland quality and function. The regulations that currently protect wetlands have been extraordinarily successful. However, the Manomet report notes that climate change may require us to rethink how these regulations are applied. It goes on to say that active management of wetlands may be an important tool under climate change. For example, it may become beneficial to alter wetland hydrology, or expand their boundaries as sea level rises. If such management is impeded by the way some regulations are currently applied, they may have to be modified to reflect changing circumstances.

Control of Invasives. It is likely that the problems that are currently posed by invasive plant species to wetlands will be exacerbated by the higher levels of environmental stress introduced by climate change (droughts, extreme events, etc.). To continue to protect valued wetlands will require three things:

- **More active monitoring**. It will be essential to detect pest outbreaks in their earlier stages, rather than later when they have secured a foothold. This can only be accomplished if active detection and monitoring schemes are implemented.
- **Aggressive control activities**. More resources will be needed to eliminate or control outbreaks of pests in their early stages.
- **Education on and enforcement of best management practices.** Many pests are transported from site to site by humans. To reduce this hazard, it will be necessary to educate users of wetland resources (e.g., anglers, hunters, nature viewers) about the dangers posed by invasives and to provide them with guidance and facilities to reduce off-site transport.

Watershed Protection. Wetlands are impacted by what happens within the entire watershed. The nexus of expanding human populations, land-use change, and climate change requires that we adopt a watershed focus when considering how to protect wetlands. Land protection within the watershed is also watershed protection.

Description of Past Management Efforts at Squam Rock Pasture

There have been two prior management plans prepared for Squam Rock Pasture – one in 1997 and another in 2013. These plans identified goals and organized maintenance activities. The 2013 report stated that "The state of the Land Trust in 1997 was essentially a mass of dense, overgrown, impenetrable woodlands and thickets traversed by a few central paths leading through sparse scattered clearings and linking property entrances and Lighthouse Beach. Most of the overgrowth has been cleared or thinned, bringing the property into a far more accessible, and manageable state." The 2013 report detailed recommended management activities for each season (see Appendix F, page 69).

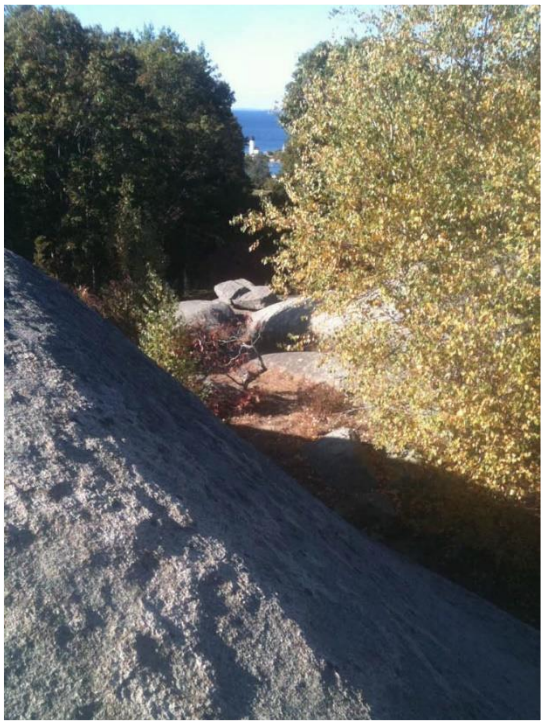


FIGURE 9 - VIEW CORRIDOR

In the most recent several years, it seems the main goal has been to clear the pasture and cut the fields "as if it were a park." The property has been mainly managed under an agreement with a landscaping company. There was an aggressive mowing schedule for the entire property as well as a volunteer effort to clear out invasives from an area with **high bush blueberries** as well as planting low bush blueberries where some large trees were removed to give them more sun. Any fallen limbs or brush were regularly cleared from the woods and surrounding areas whether they posed a hazard or not to keep things neat and tidy and easier to mow and dumping at least some of the vegetive debris within the wetland. There have been quite a few trees and low growing shrubs cut down within the south side of the wetlands. Some **Norway maples** have been removed in the upper forest area. During this past year volunteer efforts have removed some of a stand

of phragmites at the coastal bank and cleared **bittersweet** and **porcelain-berry** from the stonewall along the eastern boundary.

Past Grassland Management

The approach to the management of the cultural grassland at the site has been to maintain an open "meadow" primarily for passive recreation. The 2013 management plan recommended two types of grassland management – field areas primarily for passive recreation purposes to be mowed at least twice annually and "meadows" primarily for conservation and habitat purposes to be mowed annually in the fall.

Past Visitor Experience

In addition to the passive recreation activities of walking, painting, photography, picnicking, birdwatching, sunbathing, swimming, and simply enjoying nature and the view, there have been occasional events like weddings. Recent efforts to manage the impacts of people on the site have included closing off an eroded, redundant access to the beach and improving the existing beach access with steps and a handrail. It is noted that several shareholders believe there are too many trails and that trails in general need attention. See the section on Trails.

Another aspect of management for visitor experience has been maintaining the view from Squam Rock to the lighthouse at Wigwam Point.

Stewardship of Natural Communities

The SRLT recognizes that one of the primary benefits the property provides to the residents of Annisquam is its biodiverse habitat for wildlife. This section will discuss management and recommended strategies for restoration over time of the various natural communities and recommendations for other wildlife enhancements.

Cultural Grassland Management

Periodic mowing of the vegetation is necessary to maintain open fields. Grasslands can range from grass-dominated, frequently mown hayfields to infrequently mown, wildflower-dominated fields. Each type provides habitat for a different suite of species based on plant composition, size, moisture, and other factors. This open habitat type has become less common in Massachusetts as agricultural land has grown into forest or been developed for housing or commercial use. As a result, remaining grasslands are valuable habitat for a range of plants and animals that are also becoming less common. Several rare birds make use of grassland for nesting however they prefer very large fields, generally 50 acres or larger with the most uncommon grassland birds found only in sites over 100 acres. Fields as small as 10 acres may host breeding bobolinks and other ground nesting species and should be managed for bird habitat. While Squam Rock Pasture's small field (total of 3 acres) provides habitat for occasional use of some more common species of birds, it should be managed for plants and invertebrates, both of which provide cover and food for a variety of birds and small mammals.

Challenges to grassland management include succession, encroachment by shrubs, impacts to wildlife, and invasive species. In the absence of some form of disturbance, most New England grasslands will naturally transition to an old field, a young forest, and eventually a mature forest. This process is

termed succession. Encroachment is a more insidious form of succession where even well-tended fields slowly shrink as shrubby vegetation on the field edge grows further into the field year-by-year.

Grassland management will generally be limited to mowing. Grazing can be an appropriate method for grassland management; however, it requires a dedicated farmer willing to take on all aspects of animal husbandry including erecting and maintaining fencing and providing water for the animals. A field being actively grazed would be inaccessible to the general user, and conflicts between livestock and dogs may arise. For these reasons, mowing will be the more appropriate grassland management technique at Squam Rock Pasture.

There are two types of grasses.

Cool-season grasses—grow best in spring and fall when cool nights follow warm days. Kentucky bluegrass, fescue, timothy, and orchard grass, all introduced species, are commonly grown, and are often planted with cool season legumes like alfalfa and clover. June grass, bluejoint and Canada wildrye are native cool-season grasses. These grasses form a dense cover that provides poorer habitat for some ground-nesting birds.

Warm-season grasses—develop most rapidly during the warm summer months. They include native prairie and Northeast species such as big bluestem, little bluestem, Indiangrass and switchgrass and are often planted with native wildflowers such as aster, black-eyed Susan, and blazing star to increase diversity and to provide additional food and cover. They grow in summer when cool season grasses are inactive, and they can be harvested (or mowed) later in the year providing a long period of time for ground-nesting birds to fledge.

Mowing variables include timing, frequency, type of equipment, blade height, and fate of the mown material.

- Timing and Frequency – A field that is mown earlier in the season and more frequently in a season will tend to be dominated by cool season grasses. This more frequent mowing regime is appropriate for more park-like areas for recreational or event uses (**R** on grasslands management areas map).
- A field mown once every two or even three years will tend to have a higher component of warm season grasses and wildflowers. Thus, the fields (**F** on the management areas map) at Squam Rock Pasture can be mown in late fall or early spring to provide nectaring plants for invertebrates.
- Mass Audubon and others are now recommending not mowing until early spring (March or April) as the dry stems of grasses and wildflowers provide wintering habitat for a variety of insects. See the Massachusetts Butterfly Club website for more details (https://www.naba.org/chapters/nabambc/butterfly-conservation.asp#mowing). Warm season grasses tend to require less frequent mowing.

- Type of equipment – Fields can be mown with a rotary deck mower or a sickle bar mower. A rotary mower tends to leave clumped material which can inhibit re-sprouting in the spring and may smother some insect larvae.

FIGURE 9 - GRASSLAND MANAGEMENT MAP

- Blade height – Any mowing should leave roughly 6 inches of standing material to provide habitat for invertebrate larvae.
- Treatment of mown material – Small wildflower fields, like those at Squam Rock Pasture, can be managed for invertebrate habitat and the cuttings left in place.

Grassland management should include removal of woody shrubs growing in the field or on the field edge to resist their natural expansion into the field. If necessary, a heavy mower (or hand removal) should be used to clear back shrubs on field edges. Management should include removing shrubs and trees growing into the grassland to maintain its size and prevent colonization by woody plants.

How the mowing is done also influences wildlife. Mowing from the outside toward the center has the potential to trap small mammals, fledgling birds, reptiles, and amphibians in the center. Mowing from the middle and working outward allows more wildlife to have a chance to escape.

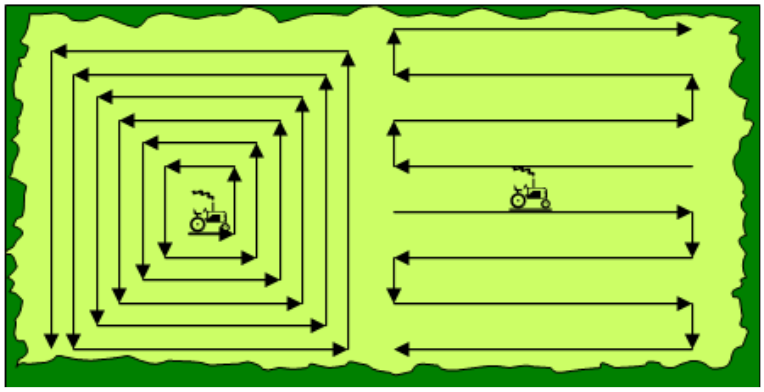


FIGURE 10 - MOW FROM THE CENTER - OUT

Regular mowing should prevent colonization by woody invasive species, although once they are established, invasive shrubs and vines can persist even in a mown field. Once woody species such as **Asiatic bittersweet**, **glossy buckthorn**, **porcelain berry**, or **multi-flora rose** are established within a field, the most effective approach for their control in small areas like the fields at Squam Rock Pasture is targeted hand removal. Targeted use of a broad-leaf herbicide which affects the shrubs but does not impact grasses can also be used. Any use of herbicides should be carefully planned and carried out only by a certified professional.

FIGURE 11 - LITTLE BLUE STEM GRASS, AN EXAMPLE OF A NATIVE WARM SEASON GRASS

Vines such as **Asiatic bittersweet, porcelain berry,** and **swallowworts** can be pernicious grassland invaders. These species can be removed by hand and kept at bay with regular work parties dedicated to their removal. It is particularly important to control **black swallowwort** as soon as it is discovered since this species, related to milkweeds, spreads its wind-dispersed seeds far and wide, expanding in a field relatively quickly and reducing habitat quality for butterflies. In fact, the plant is toxic to some butterflies including Monarchs. If manual control is not successful, herbicides may be necessary.

The characteristics of the field and the intended management routine should be reviewed each year. Property stewards should meet annually to review the condition of fields, identify threats that are not being addressed by the current management approach, and formulate adjustments to management to reduce those threats. Efforts should be made to survey the field for breeding bird activity and use by butterflies, perhaps by using volunteer efforts such as the annual Xerces Society butterfly count or members of the Massachusetts Butterfly Club.

AREAS TO BE MOWED FOR RECREATION

Maintaining some of the grassland areas for recreation and events will require frequent mowing (once every 2 to 3 weeks depending on rainfall and season). To accommodate recreational uses these areas need to be relatively flat (meaning there are few suitable areas). Overuse can lead to too much wear and tear on the grasses and will require rotating their location to allow areas to "rest and recover" from use. The area mowed for recreation use in 2023 can be shifted east or west to allow some of the area to recover. More frequent mowing of some areas may also help control invasives. Decisions on frequency of mowing and location of recreation areas will need to be made annually based on the level of use, amount of invasives, and the weather. Cool season grasses generally benefit from frequent mowing while warm season grasses tolerate mowing. Iti is advisable to lightly reseed these recreation areas early in the spring with a mixture of grasses and wildflowers (see next section for recommendations on seeds).

GRASSLAND RESTORATION[20]

The goal of restoration is to reduce invasive, non-native species and increase native species. Restoration involves much more work and expense than consistent management. Warm-season grasses, many of which are native to the U.S., may be a viable alternative to (non-native) cool-season grasses. Warm-season grasses are more difficult to establish, but they offer some important benefits. They require less fertilizer, lime, and herbicides, and are more tolerant of drought. Their extensive root systems help combat erosion. They also offer better cover (growing in bunches, with space between for movement and nests), a more dependable food source, and better winter cover, since they don't mat down during heavy snows. The Natural Resources Conservation Service and UMass Cooperative Extension may provide advice and possible cost-share funds to plant warm-season grasses.

Squam Rock Pasture already has some areas of warm season grasses. Expanding the warm season grassland with a mixture of native wildflowers is desirable. The soil is well drained, the seaside location should provide a long-enough growing season (100 to 140 days), and the relatively flat aspect should all contribute to the growth of the desired species. Still, the process of establishing a more native grassland will involve a degree of experimentation.

STRATEGY FOR RESTORATION

The recommended strategy for restoration of heavily degraded areas would be to work in small areas over a period of several years. Before planting an area, it will need to be prepared by reducing the existing growth and mulch. This can be done by burning, tilling, covering with black felt for two growing seasons, and/or application of herbicide (SRLT does not intend to use herbicides unless as a last resort), or a combination of some or all of these. While burning was not recommended for management it may be worth considering for restoration because the areas will be relatively small and easy to control. A burn plan would need to be prepared and implemented by trained personnel.

Once an area is prepared, a seed selection of warm season grasses and native wildflowers that follows the recommendations of Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife,

[20] See Chapter 3 of Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife https://www.wildlife.state.nh.us/nongame/documents/ne-guide.pdf

Chapter 3, would then be applied to the areas. (For more on control of invasives see the section on Invasive Species Management).

See Appendix H (page 84) for a list of recommended plants for the grassland areas.

Each year another area would be selected for preparation and each year areas already treated would be managed to control invasives.

Wooded Swamp Restoration and Management

The wooded swamp has been degraded by the spread of invasive species including **Norway maple**, **black locust, bittersweet, privet, burning bush**, and **buckthorn** and by the prior management practice of dumping some debris from clearing activities.

Manually weeding out **Norway maples** and other invasives will help open the canopy and encourage **red oak**, **beech**, and **hickory**. Most of this work can be accomplished by volunteers. Much of the removed material can be placed in brush piles in less used areas in uplands to encourage wildlife and define pathways. This material can also be used to close off unnecessary trails. It should be noted that it is desirable to leave some downed limbs and other debris as this decomposing material is habitat for many invertebrates and other animals. See Appendix H (page 84) for a list of species that can be planted in this area.

Once work is completed the wooded swamp will need on-going monitoring and management to assure that invasives do not recolonize the area.

Forest Management

The approximately 6 acres of forest has several invasive species including **Norway maple, honeysuckle**, **privet**, and **bittersweet**. Control of these and other invasives will be an on-going effort. Management of this area can include:

FIGURE 12 - BRUSH PILES FOR WILDLIFE AND AESTHETIC INTEREST

- Planting a dense groundcover of red fescue and oak sedge to deter the establishment of invasive woody plants (**glossy buckthorn**, **multiflora rose**, etc.). The fescue and sedge can be planted by volunteers as they remove invasives.
- Plant **low bush blueberry**, woodland aster, American cranberry viburnum, sheep laurel, witch-hazel, and hay scented fern for wildlife cover and food. Again, this can be done by volunteers.
- Encourage **red oak**, **beech**, and **hickory** in the canopy. Beech bark disease is a concern. Hickory and red oak are good choices for sustainability as we experience the effects of climate change,

- View enhancement by selective pruning,
- Risk assessment concentrated on trails and property boundaries,
- Brush piles to enhance wildlife and as a means of on-site use of woody debris, and
- Evaluation of species that are likely to do well as climate changes.

See Appendix H (page 84) for a list of species that can be planted in the forested area as invasives are removed. Many of these efforts can be implemented by volunteers.

Increasing species diversity and structural diversity should be a forest management goal. Species diversity can be increased by planting native trees and shrubs. Structural diversity can be increased by assuring the forest has a range of different ages and sizes of trees and shrubs including dead or dying snags. There has been some success using "girdling" to kill large Norway maples.

Most of this work can be done by volunteers but cutting large Norway maples is likely to be a task for contracted specialists. Leaving some dead snags that can become woodpecker habitat and provide denning sites for a variety of wildlife is a good practice.

Mass Audubon has two forest management programs – Forestry for the Birds (Managing-Forests-for-Trees-and-Birds-MA.pdf) and Climate Smart Forestry (https://www.massaudubon.org/our-conservation-work/ecological-management/habitat-management/climate-smart-forestry) that generally apply to larger areas of forest.

Maritime Shrubland Management

Since mowing stopped in 2022 the shrubland has begun to regrow. In the spring of 2023, a couple of shrubs were planted including choke cherry (*Prunus virgininana*). Ongoing management will require control of invasives and periodic cutting of trees that grow beyond 1 ½" in diameter.

Coastal Bank Restoration and Management

The SRLT has consulted with DeRosa Environmental and is giving consideration to a proposal to restore this area by using a mini excavator to dig up the existing material, removing the invasives and their roots, re-grading the bank, and replanting with native species to stabilize the area and allow it to have a more natural build-up as well as enhance its value for wildlife. This seems to us to be the best approach. As noted in the assessment section the coastal bank is locked in place by the invasives and unable to move as the sea level rises. Continued erosion from winter storms is undermining the bank and is likely to lead to its collapse sometime in the future.

At the same time as the coastal bank restoration is done it would be environmentally beneficial to "day-light" the stream by removing the stone culvert and planting the edges with wetland species.

During the preparation of this management plan, we and the Trustees discussed possible alternatives to the DeRosa recommendation. These included: Use of herbicides, hand pulling by volunteers, and doing nothing.

> **Herbicides** – Using herbicides could be an effective way of killing the invasives, but it would require multiple applications over several years. The dead and dying roots would begin to weaken and hasten the collapse of the undermined bank. All the dead and dying material would

end up at the rack line or be washed away by high tides and much of the bank's soil would also be washed away by storms. Eventually a new bank would form. Herbicides may also wash into the sea water and inadvertently kill some desirable plants that are habitat or food sources for marine creatures.

Hand pulling – The invasives are too big and intertwined to be pulled by volunteers. Even if it were possible, much of the disturbed soil would be washed away by high tides and storms.

Doing nothing – As described in the assessment, rising sea level and more frequent and intense storms will continue to undermine the bank because the invasive plants have locked it in place and prevent its natural migration upslope. At some point it is likely to collapse and much of the soil will be washed away.

Massachusetts Wildlife has a Climate Acton Tool on bioengineering for coastal banks that illustrates the recommended work[21]. Proceeding with the restoration of the coastal bank will require permits from the Gloucester Conservation Commission. The Massachusetts Office of Coastal Zone Management (CZM) has a webpage on landscaping a coastal bank.[22] It has specific recommendations for plants that are appropriate for the rugged conditions of a coastal bank.[23]

Once the restoration work is complete the area will need on-going monitoring to ensure that only desirable plants are allowed.

Restoration of the coastal bank is an expensive proposition and will require expenses for the drawings, the preparation of permits, and the actual removal of the invasives and the restoration of the area. Whether or not a full Coastal Bank restoration is embarked upon, it would be wise to daylight the stream.

Invasive Species Management

Invasive plants are non-native species that have spread into native plant communities. Invasive species pose one of the greatest threats to biodiversity, natural landscapes, agricultural interests, recreational activities, and scenic beauty of conservation properties. Invasives have left behind the herbivores and diseases that control their populations in their native habitats. These plants cause economic or environmental harm by developing self-sustaining populations that dominate and/or disrupt native ecosystems.

There are many ways to deal with this threat including initial prevention, early detection, and control through manual removal, mechanical treatment, pesticide application, biological control, grazing and fire. Invasive species are difficult to eradicate and without multiple seasons of dedicated management, infestations will rebound despite one's best efforts. Prioritization of targeted management is essential

[21] https://climateactiontool.org/content/restore-natural-coastal-buffers-bioengineering-coastal-banks

[22] https://www.mass.gov/service-details/landscaping-a-coastal-bank

[23] See Appendix G

to successfully managing an area for invasive species. Any effort to control invasives in regulated areas subject to the Wetlands Protection Act requires submitting a Request for Determination of Applicability or Notice of Intent to the Conservation Commission. Some Conservation Commission will provide "Administrative Approval" for invasives removal in regulated areas, but this may vary from town to town.

The goals for invasive species management at Squam Rock Pasture should be:

- Establishing invasives-free zones,
- Restricting the spread and reducing the extent of heavily invaded zones.

Management of invasives species should follow an adaptive approach – a continuous process that allows for flexibility in management based on the inclusion of the most recent management options. As new information becomes available on plant biology and treatment methods, it will be incorporated into future management decisions. An adaptive approach will also allow property managers to learn from the efficacy of current treatment methods and adjust future management actions.

Prevent Spread of Existing Invasives and Introduction of New Invasions

The primary element of a proactive prevention plan is limiting the introduction of new invasive species. Spread of existing invasives will be reduced by limiting soil disturbance and implementing restoration when soils are disturbed, by washing equipment that has been used in heavily invaded areas before moving to an un-invaded area, and by implementing practices to reduce likelihood of seed spread by individuals working on invasives control projects. Soil disturbance from plowing, tree removal, trail building, etc., should be limited and all disturbed soil should be covered with leaf litter at the very least with larger areas restored with a fast-growing native seed mix. All equipment used for maintenance operations in heavily invaded areas should be cleaned (e.g., with a leaf blower) before moving to non-invaded areas; and staff and volunteers should take special care to pat down, wipe, and/or rinse clothes and shoes after working with invasive plants.

EARLY DETECTION/RAPID RESPONSE

Any comprehensive invasive species control program must also include early detection (ED) of new invaders and rapid response (RR) to eliminate new invasions before they become well-established. ED efforts will be directed at the list of early detection species identified by the Massachusetts Invasive Plants Advisory Group (MIPAG). MIPAG's current ED list is presented in Table 1, and updates can be found on the MIPAG website: http://www.massnrc.org/mipag/. Land Stewards should be trained to identify the ED species which are not yet well-known in this part of the state such as Japanese stiltgrass and mile-a-minute vine. The stewards should be prepared to collaborate on planning and implementing the rapid response element to eliminate new invasions as quickly as possible.

Table 1. Early Detection (ED) invasive plants as identified by the Massachusetts Invasive Plant Advisory Group (MIPAG).

Common name(s)	Species	Comments
Flowering Rush	*Butomus umbellatus*	Aquatic perennial herb
Brazilian waterweed	*Egeria densa*	Submerged aquatic
Tall mannagrass, Reed mannagrass	*Glyceria maxima*	Perennial grass
Giant Hogweed	*Heracleum mantegazzianum*	Biennial or short-lived perennial herb
Hydrilla	*Hydrilla verticillata*	Submerged aquatic
Parrotfeather	*Myriophyllum aquaticum*	Submerged aquatic
Yellow floating heart	*Nymphoides peltata*	Floating-leaved perennial aquatic herb
Mile-a-minute	*Persicaria perfoliate, Polygonum perfoliatum*	Once established this species spreads rapidly; annual herbaceous vine
Kudzu	*Pueraria montana* ssp. *lobata*	Woody vine
Tansy ragwort, Stinking willie, Stinking Billy	*Senecio jacobaea*	injurious to livestock; biennial herb
Tall pepperweed, Broadleaved pepperweed	*Lepidium latifolium*	Perennial herb
Japanese stiltgrass	*Microstegium vimineum*	Annual grass

LIMIT SPREAD OF HIGHLY NOXIOUS INVADERS

Special attention should be paid to particularly aggressive invaders, such as those species with wind-dispersed seeds, aggressive root suckering, allelopathic characteristics, rapid growth, and high resistance to control. Species in this category are shown in Table 2.

Table 2. Particularly aggressive invasive species. (Bold indicates species included in Squam Rock Pasture plant inventory or reported by others.)

Black swallowwort	*Cynanchum louiseae*
Common reed	*Phragmites autralis*
Garlic mustard	*Alliaria petiolata*
Japanese knotweed	*Fallopia japonica*
Japanese stiltgrass	*Microstegium vimineum*
Purple loosestrife	***Lythrum salicaria***
Tree of heaven	*Ailanthus altissima*
Water chestnut	*Trapa natans*
Porcelain-berry	*Ampelopsis brevipedunculata*

CONTROL SPECIES WITH RECENT OR LIMITED PRESENCE

Early invasions are much more easily eradicated than well-established stands of any species. Removing young woody plants before they reach a fruiting size prevents further spread, and it is critical to remove aggressively rooting species before they establish a dense underground network. Vining species are more easily removed before they tangle with native shrubs and trees.

CONTROL RELATIVELY EASILY MANAGED SPECIES

Japanese barberry and garlic mustard are examples of species that can be controlled with dedicated manual effort. Such species should be the focus of eradication efforts before they spread.

LIMIT EXPANSION OF HEAVILY INVADED AREAS

An area that is completely covered in invasive species or has several species of invasive plants growing in the same location should be contained to prevent further spread of the infestation. This can be done by identifying the boundary of the heavily invaded area(s) and creating a treatment area buffer zone (e.g., 50 feet around the perimeter of infestation) for targeting management efforts. This allows conservation stewards to prevent encroachment of invasives in cleaner areas without getting overwhelmed or tackling a project that is too big for the available resources.

If highly noxious species are present in the densely invaded area extra measures may need to be taken to really prevent further spread of the infestation. Some options include increasing the treatment area to a 100-foot buffer zone or hiring outside contractors to treat the infestation by mechanical means (whole plant removal) or chemically.

FIGURE 13 - WEED WRENCH

Treatment Methods

Different invasive species respond to different management techniques, several of which are summarized here and detailed in Appendix G (page 74). Manual control, pulling plants by hand or with light tools such as loppers or weed wrenches, is preferred and may be effective for small infestations and where volunteer capacity permits repeated effort. Large infestations and certain problematic species may require more intensive management, sometimes involving the use of herbicides[24] **as a last resort**. Herbicides can only be applied by an individual duly licensed by the Department of Agricultural Resources. Because licensure requires liability insurance coverage, while volunteers could obtain this license, it is more likely that herbicide will be applied by a contracted professional. Management plans should identify infestations and recommend approaches for control. The property managers should plan and budget for the involvement of professionals as necessary. Table 3 provides information on species that can be managed at various times of year.

[24] Note the most common ingredient in many herbicides is glyphosate. It has been linked to non-Hodgkin lymphoma, a type of cancer, in numerous studies.

Table 3: Season-specific Management for Commonly Found Invasive Plant Species.

Common Name	Spring	Summer	Fall
Autumn Olive	manual		chemical
Black swallowwort		**chemical/manual**	
Burning Bush	**manual**		**chemical**
Bush honeysuckle	**manual**	**chemical**	
Common reed (Phagmites)			**chemical**
Garlic mustard	chemical/manual		
Glossy Buckthorn	**manual**		**chemical**
Japanese Barberry	manual		chemical
Japanese knotweed		chemical	
Japanese stiltgrass		chemical/manual	chemical
Multiflora rose	**manual**	**chemical**	
Asiatic Bittersweet	**manual**		**chemical**
Purple loosestrife		**biological**	
Porcelain-berry	**manual**	**manual**	
Spotted knapweed		chemical/manual	
Tree-of-Heaven	manual		chemical

DISPOSAL OF REMOVED INVASIVES

Invasive plants that have been hand pulled or cut can be piled on site to decompose or bagged and brought to an area for invasive plant containment. The site(s) used to dump invasives should be monitored to ensure that invasive plants are not establishing themselves from the materials deposited there. Trustees and volunteers should take extreme care to avoid spreading seed or other material from which plants can resprout, (e.g., Japanese knotweed and phragmites can sprout from any stray plant part).

Restoration

Many of the invasive species are adapted to pioneer disturbed soils. For this reason, all control efforts and general site work that results in exposed soil should incorporate restoration with fast-growing native species. Small patches of exposed soil, for example from root wrenching a shrub, should be tamped down by foot, and covered with leaf litter from on-site. Non-forested sites such as fields, should be seeded with a grass mix including annual rye (*Lolium perenne*) which can provide a quick cover to open soils and allow non-invasives time to self-germinate.

Record-Keeping

All invasive plant species management actions (contractor, or volunteers) should be documented with a field datasheet and records kept in a central file (a shared Google drive). Information collected should include the location, date, species targeted, phenology of plant (vegetative, flowering, fruiting), type of management used (manual, mechanical, chemical), the size of the infestation and an estimate of what percent of the area was managed (See Appendix G, page 74 for a sample field sheet). Recording these data allows Town staff and volunteer stewards to track progress in management efforts, adapt tactics in future years if needed, and have a sense of the expanse of targeted invasive species.

Wildlife Enhancement Recommendations

There are several actions that can enhance wildlife habitat quality and make Squam Rock Pasture a more interesting destination.

Brush piles

Strategically placed piles of brush in the forested areas can be assembled to provide resting/escape cover and den sites for wildlife. They may also help block access to off-trail areas. Brush piles are used for cover by eastern cottontails and other small mammals. Songbirds may use brush piles for perch sites, especially if the piles are located near feeding or nest sites. See https://extension.psu.edu/management-practices-for-enhancing-wildlife-habitat for more information on steps for enhancing wildlife habitat.

Snags

Leaving dead or partially dead standing trees provide several important benefits to a variety of wildlife. Snags provide cavities for nesting and resting, perches for hunting and displaying, and an abundant supply of food for insect eaters. There are numerous species of birds and mammals that use snags at some point in their life cycles. The best method to provide snags for wildlife is to retain existing snags in places where they will not create a dangerous situation for people using the nearby area.

Nest boxes

Nest boxes, platforms, and other types of nesting structures provide nest sites for wildlife in areas where natural nest sites (particularly cavities) are absent or available only in low numbers. They are also used to attract wildlife to specific areas even when nest sites are not limited. Nest boxes can be used to provide nest sites for birds such as bluebirds, tree swallows, wrens, and wood ducks. Nest boxes also provide nest sites for mammals like squirrels and bats. Platforms and other structures are used to provide nest sites for species like ospreys, eastern phoebe, barn swallow, and some waterfowl. Special colonial nest boxes can be erected for purple martins. Bat boxes can also be erected along the field edges. See Mass Audubon's website shttps://www.massaudubon.org/learn/nature-wildlife/birds/birdhouses for instruction for building and placing nest boxes.

FIGURE 14 – PURPLE MARTIN NEXT BOXES

Nest boxes can be monitored by volunteers, and results shared with Cornell Lab of Ornithology.[25]

[25] See https://nestwatch.org/

Pollinator Plantings

Pollinator-friendly plantings support numerous kinds of native bees, as well as non-native honeybees, native butterflies, hummingbirds, and other pollinators. Planting a diverse mix of flowering plants that provides a sequence of blooms from early spring to late fall will have the most impact. Even a small patch of the right flowers can help, as it adds to the larger landscape mosaic in which the pollinators live and search for food. For a list of plants and guidelines for planting see https://extension.unh.edu/resources/files/Resource005973_Rep8387.pdf. Also, see the plant list for native declining pollinators from the MCA Native Pollinator Task Force, https://www.svtweb.org/mca-native-pollinator-task-force .

FIGURE 10 - EXAMPLE OF PASSIVE RECREATION

Recreational Uses

A vital role of the trustees is to provide all stakeholders with ample opportunity to engage in a range of recreational uses. At the same time, Squam Rock Pasture is small and from its inception has been dedicated to the enjoyment of the site's nature, views, and beauty. As always there needs to be a balance between responsible stewardship and intensity of use. Passive recreation means leisure activities commonly practiced by an individual or small group that are usually unorganized and noncompetitive, including, but not limited to, picnicking, birdwatching, nature observation, kite flying, and walking. These activities generally have no or minimal impact on the site's natural resources. Other uses involving more people, such as parties, are subject to a permit from the Trustees.

Current Regulations

Access is restricted to Card Holders and Shareholders only. The current rules and regulations are posted at the entrance and include the following:

- NO DOGS permitted on the beach BETWEEN 9 AM and 6PM May thru Sept.
- Owners have sole responsibility for their pets.
- Present Beach Card to Guard when entering beach.
- Parties are ONLY allowed with Trustees' permission.
- Boating is prohibited. No public landing. No public launching.
- Fires are NEVER permitted.

FIGURE 11 - RULES AND REGULATIONS

- Pasture is patrolled at night.
- Pack in, pack out
- No Lifeguard/Swim at your own risk

Safety Issues

Aside for the normal risks of enjoying the out-of-doors like sunburn, insect bites, heat stroke, etc. there are few safety issue at Squam Rock Pasture. The stairs to the beach are difficult for most. Railroad ties meant to help control erosion are too high to step and most walk around them causing additional erosion. Rock climbing could result in a fall. Safety in or on the water is a potential risk for those that are not competent. A risk assessment for danger from trees was recommended by DeRosa Environmental.

Ticks

Tick-borne diseases are a safety concern. Tick exposure can occur year-round, but ticks are most active during warmer months (April-September). Squam Rock Pasture is a likely place to be in contact with a tick. Not all tick bites will result in a disease. To help prevent tick bite diseases a warning sign (https://www.cdc.gov/lyme/resources/toolkit/2ColorTrailSign.pdf)might include:

- Stay on trails
- Apply repellant
- Check for ticks after each outing
- Shower soon after being in tick habitat
- Call your doctor if you get a fever or rash

Prevention and Remediation of Human Impacts

Having a cadre of volunteers who look after Squam Rock Pasture can be a great help.

Dumping/Pollution

Litter or dumped materials should be cleaned up as soon as possible. Delayed cleanup gives the impression that a property is not well-monitored and well-cared for, which is discouraging to users and invites further misuse. Volunteers should monitor the parking area and road frontage at least monthly and immediately inform the Trustees of new dumping that they can't pick up themselves. Each report should include a photograph, some indication of location, and an assessment of what materials have been dumped. Small piles of innocuous materials such as paper or household trash should be removed as soon as possible by the volunteers. Removal of larger piles or anything including potentially hazardous material should be coordinated by the Trustees with DPW or another appropriate partner. Locations experiencing repeated dumping should be posted with signs reading "No Dumping Including Yard Waste". If dumping continues, it should be reported to Gloucester police with a request for more frequent patrol of the site.

Prohibited and Illegal Use

Volunteers should regularly inspect Squam Rock Pasture including areas off trail with an eye for unpermitted uses. Such use should be reported immediately to the Trustees, no matter how minor. Trustees should develop an appropriate response focused on:

- Repair of impacts, including cleaning litter, etc., which demonstrates that the site is being cared for.
- Education about permitted uses.
- Outreach to users, e.g., through letters to shareholders and/or neighbors or information distributed in local media or the SRLT website.

More problematic illegal and offensive uses such as drinking parties, drug use, and casual assignations should lead to involvement of Gloucester police and a specific plan to add patrols until the activities are driven out.

Travel off Official Trails

Travel off official trails should be minimized by clearly stating on all signs that visitors should remain on trails. In those areas where unofficial trails become apparent, large sticks and branches can be placed on the trail to indicate that travel is not allowed. Where needed, "*Area Closed*" or "*Ecological Restoration Area. Do Not Enter*" signs can be posted.

Property stewards should endeavor to understand the use of the site for geocaching or other informal activities that specifically involve leaving official trails. Stewards should engage these user groups to understand the use and make a recommendation to staff regarding potential impacts of off-trail use. If any such use is determined to have a specific impact on a known resource, action should be taken in cooperation with the specific user group to minimize impact, or if deemed necessary, to alter or discontinue this use.

User Conflicts

If conflicts between user groups arise, the Trustees will make reasonable efforts to engage the involved parties and reach a resolution that accommodates the users while adhering to the purposes of the site.

Dogs and Dog Waste

Gloucester has a dog leash law. Many visitors to Squam Rock Pasture still allow their dogs off-leash. Dogs that are not under control can be dangerous to other dogs and people. The presence of dogs is also known to reduce the use of a property by wildlife, especially mammals and birds. Signs should be posted to encourage dog owners to clean up after their pets. Signs should include information about impacts to wildlife and water quality and the safety of visitors as well as other pets. A culture of picking up dog waste often evolves based on the behaviors of others: when a dog owner sees others picking up, s/he will adopt this as standard behavior; when a dog owner observes uncollected dog waste, s/he often assumes that this is the local practice and follows suit. Stewards should work to identify local, dog-owning 'ambassadors' who would be willing to speak with other dog walkers about the importance of picking up their dog's waste. In addition, stewards should endeavor to clean up uncollected dog waste on a regular basis to avoid giving the impression that it is okay to leave your dog's waste.

Safety/Education

Emergency Vehicle Access

The Trustees strive to provide a safe experience for all its visitors, yet visitors must assume a certain degree of risk when visiting Squam Rock Pasture. Risks inherent in use of the site include, but are not

limited to, uneven ground, falling tree limbs, wildlife encounters, and the fact that not every part of every open space will be accessible to emergency vehicles.

To facilitate emergency response, the Trustees and volunteers should schedule annual meetings with the Gloucester Fire and Police Departments to discuss emergency situations and vehicle access issues.

Outreach and Education

The Trustees and volunteers may coordinate with others to offer annual walks and educational activities to engage the shareholders about the natural resources at Squam Rock Pasture and the many benefits it provides, including passive recreation, mitigation of climate change, wildlife habitat, and a variety of ecosystem services.

Regulations that May Affect Management Decisions

All open space land management activities are required to follow all local, state, and federal laws, bylaws, codes, rules, and regulations as well as property-specific easements or terms. These include, but may not be limited to:

Federal	Clean Water Act (Section 404)
State	Massachusetts Wetlands Protection Act
	Massachusetts Pesticide Control Act
	Article 97
	Forest Cutting Practices Act
Town	Gloucester Wetlands Code
	Gloucester Wetlands Protection Bylaw
	Gloucester General Bylaws
Property-specific	Purpose statement
	Easements

Recommended Schedule of Annual Maintenance Activities

There will be a variety of management activities.

Annual Maintenance

Entrances and Trails should be trimmed and cleaned of litter as necessary (approximately every 3 weeks), between May and October to maintain clear, safe trails and minimize pedestrian contact with ticks.

Manicured Field Areas (Selected portions of Zone 4 and Zone 1) and trail edges should be mowed at least two times annually to maintain an area for passive recreation and/or events and minimize pedestrian contact with ticks. Moving the sections to be mowed as areas for recreation can help the areas “recover” from more intensive uses.

Grassland Mowing (Stewardship Zone 4) should be mowed once every couple of years to prevent growth of woody species and invasives in late fall or early spring (early spring is preferred but wetness may dictate some areas be mowed in the fall). The primary rationale for grassland maintenance is the

conservation and regeneration of grassland flora and fauna, especially pollinators, and the prevention of ecological succession to shrub land and forest.

Grassland Edges (Edges of Stewardship Zone 4) should be trimmed back during winter caretaking activities. Vegetation which impedes safety or desired aesthetics, such as hazards, plants which encroach into grasslands and/or view sheds, and aggressive (invasive) or competing plants which compromise ecological health should be removed. A secondary, but important goal, is to preserve the integrity and visual beauty of the stone walls, a special part of the heritage of the property.

FIGURE 12 - STEWARDSHIP ZONES

Coastal Bank (Stewardship Zone 6) Once restored this area will require annual monitoring and management to keep out invasives and occasional replanting of desirable shrubs and beech grass to repair winter storm damage.

The Beach (Stewardship Zone 7) should be kept clean; trash and/or debris should be removed during weekly path maintenance activities or daily as part of the duties of the beach patrol staff. Salt marsh hay and other vegetative debris in the wrack line may be used for mulch for seeded areas as it does not contain seeds that will sprout in upland areas.

The Wooded Swamp (Stewardship Zone 3) should be maintained during winter caretaking activities, focusing on removing hazards and aggressive (invasive) vegetation, such as **Norway maple**. Cuttings can largely be left to let lay, used for brush piles, or used to close off unwanted trails. Care should be taken to identify and leave enough desirable saplings to replace the present canopy in the future and/or planting of native replacement trees. On-going invasives control should occur as recommended in the section on invasives and Appendix G (page 74).

Marine Shrubland (Stewardship Zone 5) This relatively small area can be let to succeed to shrubland. This will reduce the area to be mowed and provide some potentially valuable habitat for nesting and migrating birds. It will need annual monitoring and occasional control of non-native invasives. Any tree species that become more than 1 ½ inch in diameter should be cut to prevent the area from succeeding to forest.

Coastal Forest (Stewardship Zone 2) areas should be maintained during winter caretaking activities after any restoration efforts are completed. Cuttings can largely be left to let lay, used for brush piles, or used to close off unwanted trails. Care should be taken to identify and leave enough desirable saplings (oaks, hickories, maples) to replace the present canopy in the future and/or planting of native replacement trees. On-going invasives control should occur as recommended in the section on invasives and Appendix G (page 74).

The following table shows the major management activities throughout an annual cycle.

	Winter Dec- Feb	Spring Mar- May	Summer Jun - Aug	Fall Sep- Nov
Weekly Property Visits	X	X	X	X
Permitting (trails, invasive control, etc.)	X			
Annual Work Plan Review Meeting with Trustees and volunteers	X			
Safety Meeting with Trustees, Police and Fire Dept.		X		
Trail Walk/Clean Up (downed limbs, drainage issues, signage needs)		X		
Invasive Plant Management	X	X	X	X
Building Projects (signposts, trails, boardwalks, etc.)		X	X	X
Mowing for Manicured Areas			X	
Mowing for Grassland Fields	to mid-April			mid-late Sept
Boundary monitoring for encroachments, signage, etc.	X			X
Year-in-review meeting with Trustees and volunteers	X			

Prioritizing Stewardship Actions

Management activities should be prioritized according to the following considerations.

- **Safety issues** – any actions related to the safety of visitors will be given highest priority in terms of decision-making, contractor and volunteer resources, field work scheduling, and funding. The entire or a portion of site or trail system may be closed until a specific safety issue is remedied.
- **Passive recreational access** – The original purpose of the Trust is to provide an area for recreation and enjoyment of the shareholders. Improvements and maintenance activities for all approved passive recreational uses will be reviewed, planned, funded, and implemented, to the extent possible.
- **Stewardship of natural assets** – a major goal of Squam Rock Pasture is to "nurture a rich biodiverse habitat for wildlife," thus natural resource stewardship activities will be a high ongoing priority. Trustees and volunteer efforts will be directed to addressing natural resource management needs, as appropriate; and the volunteers and Trustees will allocate funding, as appropriate, to address natural resource management needs.
- **Stewardship of cultural resources** – elements of Squam Rock Pasture that embody the cultural heritage of the site like stone walls will be protected and managed to the extent they do not interfere with visitor safety or natural resources.

Safety issues can be brought to attention by volunteers, but most will need to be addressed by the Trustees. Some may require outside contractors to implement fixes. Volunteers may be instrumental in seeking funding and doing some of the work.

Addressing natural asset stewardship issues will require an on-going commitment from both the Trustees and volunteers. Some actions like downing large trees or application of herbicides will require a contractor. Protecting cultural resources and managing recreational uses will likewise require Trustees and volunteers and depend on the needs as they arise.

Appendix A – 1962 Plant List

The Following list of plants was compiled by Edward B. Hubbard, Vice Chairman of the Squam Rock Beach Committee. He and others had been actively inventorying and planting mostly native species of wildflowers and ferns. Scientific names have been updated based on Ted Elliman's 2016 Wildflowers of New England.

Common Name	Scientific Name	Native to NE
Wood-anemone	*Anemone quinquefolia*	Y
Flax-leaved stiff aster	*Ionactis linariifolia*	Y
Heart-leaved American aster	*Symphyotichum dumosum*	Y
Small white aster	*Symphyotrichum racemosum*	Y
Yellow bartonia	*Bartonia virginica*	Y
Beach pea	*Lathyrus japonicus*	Y
Bearberry	*Arctostaphylos uva-ursi*	Y
Beggar-ticks	*Bidens frondose*	Y
Bindweed, hedge (trailing)	*Calystegia sepium*	Y
Blue-curls	*Trichostema dichotomum*	Y
Blue-eyed grass	*Sisyrinchium angustifolium*	Y
Bluets	*Houstonia caerulea*	Y
Blue-flag	*Iris prismatica*	Y
Blue toadflax	*Nuttallanthus canadensis*	Y
Burdock	*Artium minus*	N
Butter-and-eggs	*Linaria vulgaris*	N
Buttercup	*Ranunculus caricetorum*	Y
Butterfly-weed	*Asclepias tuberosa*	Y
Canada mayflower	*Maianthemum canadense*	Y
Checkerberry, wintergreen	*Gaultheria procumbens*	Y
Cinquefoil, dwarf	*Potentilla canadensis*	Y
Cinquefoil, wine-leaved	*?*	?
Corydalis	*Capnoides sempervirens*	Y
Daisy, ox-eye	*Leucanthemum vulgare*	N
Black-eyed Susan	*Rudbeckia hirta*	Y
Dusty miller	*Artemisia stelleriana*	N
Clammy everlasting	*Pseudognaphalium macounii*	Y
Frostweed	*Crocanthemum canadense*	Y
American germander	*Teucrium canadense*	Y
Seaside goldenrod	*Solidago sempervirens*	Y

Common Name	Scientific Name	Native to NE
Swamp (Bog) goldenrod	*Solidago uliginosa ?*	Y
Lance-leaved goldenrod	*Euthamia graminifolia*	Y
Silverrod	*Solidago bicolor*	Y
Canada hawkweed	*Hieracium kalmia*	Y
Tawny (Orange) hawkweed	*Hieracium* aurantiacum	N
Hedge-mustard	*Sisybrium officnale*	N
Water hemlock	*Cicuta maculata*	Y
Herb Robert	*Geranium r*obertianum	Y
Summer (Bush) honeysuckle	*Diervilla lonicera*	Y
Indian pipe	*Monotropa unifloa*	Y
Jewelweed	*Impatiens pallida*	Y
Joe-pye weed	*Eutrochium purpureum*	Y
Ladies' tresses	*Spieranthes cernua*	Y
Four-leaved loosestrife	*Lysimachia quadrifolia*	Y
Swamp yellow loosestrife	*Lysimachia terrestris*	Y
Purple loosestrife	*Lythrum salicaria*	N
Marsh rosemary (Sea-lavender)	*Limonium carolinianum*	Y
Heath American aster	*Symphyoyrichum ericoides*	Y
Common milkweed	*Asclepias syriaca*	Y
Great (Common) mullein	*Verbascum Thapsus*	N
Ragged fringed orchid	*Planthera lacera*	Y
Partridge-berry	*Mitchella repens*	Y
Evening primrose	*Oenothera biennis*	Y
Queen Anne's lace	*Daucus carota*	N
Rattlesnake weed	*Hieracium venosum*	Y
Common St. Johnswort	*Hypericum perfoatum*	N
Wild sarsaparilla	*Aralia nudicaulis*	Y
Sea milkwort	*Lysimachia maritima*	Y
Silverweed	*Argentina egedii*	Y
Skullcap	*Scutellaria sp ?*	?
Snake mouth (White turtlehead)	*Chelone glabra*	Y
Common speedwell	*Veronica officinalis*	N
Sand spurry	*Spergularia rubra*	N
Starflower	*Lysimachia borealis*	Y
Tansy	*Tanacetum vulgare*	N
Common thistle	*Cirsium vulgare*	N
Boneset	*Eupatorium perfoliatum*	Y
Canada violet	*Viola canadensis*	Y
Common violet	*Viola pubescens*	Y
Common vetch	*Vicia sativa*	N
Common yarrow	*Achilla millefolium*	Y
Ferns		
Cinnamon fern	*Osmundastrum cinnamomeum*	Y

Dissected grape fern	*Botrychium dissececium*	Y
Hay-scented fern	*Dennstaedtia punctilobula*	Y
Marsh fern	*Thelypteris palustris*	Y
Sensitive fern	*Onoclea sensibilis*	Y

Appendix B – eBird Hotspots

Annisquam Light

The following list of 88 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, the adjacent Ipswich Bay, and flying over the area. Underlined species (30) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl	**Gulls, Terns, and Skimmers**	**Falcons and Caracaras**
Brant	Laughing Gull	Peregrine Falcon
Canada Goose	Ring-billed Gull	**Jays, Magpies, Crows, Ravens**
Mute Swan	Herring Gull	Blue Jay
Mallard	Great Black-backed Gull	American Crow
American Black Duck	Least Tern	Fish Crow
Common Eider	Common Tern	Common Raven
Harlequin Duck	**Loons**	**Tits, Chickadees, and Titmice**
Surf Scoter	Red-throated Loon	Black-capped Chickadee
White-winged Scoter	Common Loon	Tufted Titmouse
Black Scoter	**Storm-Petrels**	**Martins and Swallows**
Long-tailed Duck	Wilson's Storm-Petrel	Purple Martin
Bufflehead	**Frigatebirds, Boobies, Gannets**	**Kinglets**
Common Goldeneye	Northern Gannet	Ruby-crowned Kinglet
Hooded Merganser	**Cormorants, and Anhingas**	**Nuthatches**
Red-breasted Merganser	Great Cormorant	Red-breasted Nuthatch
Grouse, Quail, and Allies	Double-crested Cormorant	White-breasted Nuthatch
Wild Turkey	**Herons, Ibis, and Allies**	**Wrens**
Grebes	Great Blue Heron	House Wren
Horned Grebe	Great Egret	Carolina Wren
Pigeons and Doves	Green Heron	**Starlings and Mynas**
Rock Pigeon	**Vultures, Hawks, and Allies**	European Starling
Mourning Dove	Cooper's Hawk	**Catbirds, Mockingbirds, Thrashers**
Goatsuckers	Bald Eagle	Gray Catbird
Common Nighthawk	Broad-winged Hawk	Brown Thrasher
Shorebirds	Red-tailed Hawk	Northern Mockingbird
Black-bellied Plover	**Owls**	**Thrushes**
Semipalmated Plover	Eastern Screech Owl	American Robin
Ruddy Turnstone	Snowy Owl	**Waxwings**
Sanderling	**Kingfishers**	Cedar Waxwing
Dunlin	Belted Kingfisher	**Old World Sparrows**
Purple Sandpiper	**Woodpeckers**	House Sparrow
Short/Long-billed Dowitcher	Red-bellied Woodpecker	**Finches, Euphonias, and Allies**
Common/Thick-billed Murre	Downy Woodpecker	House Finch
Alcids	Hairy Woodpecker	American Goldfinch
Razorbill	Northern Flicker	

Longspurs and Snow Buntings	Blackbirds	Wood Warblers
Snow Bunting	Baltimore Oriole	**Ovenbird**
New World Sparrows	Red-winged Blackbird	**Common Yellowthroat**
Field Sparrow	Brown-headed Cowbird	Yellow Warbler
Dark-eyed Junco	Common Grackle	Yellow-rumped Warbler
White-throated Sparrow		**Cardinals, Grossbeaks, & Allies**
Song Sparrow		Northern Cardinal
Eastern Towhee		

Annisquam River

The following list of 104 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, the adjacent Annisquam River and Ipswich Bay, and flying over the area. Underlined species (59) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl	**Shorebirds** (cont.)	**Pelicans**
Brant	Dunlin	Brown Pelican
Canada Goose	Least Sandpiper	**Herons, Ibis, and Allies**
Mallard	Semipalmated Sandpiper	Great Blue Heron
American Black Duck	Short-billed Dowitcher	Great Egret
King Eider	Greater Yellowlegs	Snowy Egret
Common Eider	Willet	Little Blue Heron
Surf Scoter	Lesser Yellowlegs	Black-crowned Night Heron
White-winged Scoter	**Alcids**	Glossy Ibis
Black Scoter	Thick-billed Murre	**Vultures, Hawks, and Allies**
Long-tailed Duck	Black Guillemot	Turkey Vulture
Bufflehead	**Gulls, Terns, and Skimmers**	Osprey
Common Goldeneye	Bonaparte's Gull	Northern Harrier
Red-breasted Merganser	Laughing Gull	Sharp-shinned Hawk
Grebes	Ring-billed Gull	Cooper's Hawk
Horned Grebe	Herring Gull	Bald Eagle
Pigeons and Doves	Lesser Black-backed Gull	Red-tailed Hawk
Rock Pigeon	Great Black-backed Gull	**Kingfishers**
Mourning Dove	Least Tern	Belted Kingfisher
Swifts	Common Tern	**Woodpeckers**
Chimney Swift	**Loons**	Downy Woodpecker
Hummingbirds	Red-throated Loon	Pileated Woodpecker
Ruby-throated Hummingbird	Common Loon	Northern Flicker
Shorebirds	**Storks**	**Falcons and Caracaras**
Black-bellied Plover	Wood Stork	Peregrine Falcon
Semipalmated Plover	**Frigatebirds, Boobies, Gannets**	**Jays, Magpies, Crows, Ravens**
Killdeer	Northern Gannet	Blue Jay
Marbled Godwit	**Cormorants, and Anhingas**	American Crow
Sanderling	Great Cormorant	Fish Crow
	Double-crested Cormorant	Common Raven
Tits, Chickadees, and Titmice	New World Sparrows	Wood Warblers
Black-capped Chickadee	Chipping Sparrow	Common Yellowthroat
Tufted Titmouse	Field Sparrow	Yellow-rumped Warbler
Larks	American Tree Sparrow	**Cardinals, Grossbeaks, & Allies**
Horned Lark	Dark-eyed Junco	Northern Cardinal
Martins and Swallows	White-throated Sparrow	
Northern Rough-winged Swallow	Song Sparrow	
Tree Swallow	Eastern Towhee	

Bank Swallow	**Blackbirds**	
Barn Swallow	Baltimore Oriole	
Nuthatches	Red-winged Blackbird	
White-breasted Nuthatch	Brown-headed Cowbird	
Wrens	Rusty Blackbird	
House Wren	Common Grackle	
Carolina Wren		
Starlings and Mynas		
European Starling		
Catbirds, Mockingbirds, Thrashers		
Gray Catbird Brown Thrasher Northern Mockingbird		
Thrushes		
American Robin		
Waxwings		
Cedar Waxwing		
Old World Sparrows		
House Sparrow		
Finches, Euphonias, and Allies		
House Finch		
American Goldfinch		

Appendix C – State Wildlife Action Plan Habitats at Squam Rock Pasture

Beaches

Species of Greatest Conservation Need in Coastal Dunes, Beaches, and Small Islands

Taxon Grouping	Scientific Name	Common Name
Birds	*Ardea alba*	Great Egret
	Arenaria interpres	Ruddy Turnstone
	Calidris alba	Sanderling
	Calidris canutus	Red Knot
	Calidris pusilla	Semi-palmated Sandpiper
	Charadrius melodus	Piping Plover
	Chordeiles minor	Common Nighthawk
	Egretta thula	Snowy Egret
	Eremophila alpestris	Horned Lark
	Haematopus palliatus	American Oystercatcher
	Larus argentatus	Herring Gull
	Larus atricilla	Laughing Gull
	Larus marinus	Great Black-backed Gull
	Limnodromus griseus	Short-billed Dowitcher
	Numenius borealis	Eskimo Curlew
	Numenius phaeopus	Whimbrel
	Nycticorax nycticorax	Black-crowned Night-Heron
	Oceanodroma leucorhoa	Leach's Storm-Petrel
	Phalacrocorax auratus	Double-crested Cormorant
	Plegadis falcinellus	Glossy Ibis
	Progne subis	Purple Martin
	Riparia riparia	Bank Swallow
	Somateria mollissima	Common Eider
	Sterna dougallii	Roseate Tern
	Sterna hirundo	Common Tern
	Sterna paradisaea	Arctic Tern
	Sternula antillarum	Least Tern
	Tringa semipalmata	Willet
Beetles	*Cicindela dorsalis dorsalis*	Northeastern Beach Tiger Beetle
	Cicindela limbalis	Claybank Tiger Beetle
Lepidoptera	*Cingilia catenaria*	Chain-dotted Geometer
	Sympistis riparia	Dune Sympistis

Taxon Grouping	Scientific Name	Common Name
Plants	*Amaranthus pumilus*	Seabeach Amaranth
	Aristida tuberculosa	Seabeach Needlegrass
	Corema conradii	Broom Crowberry
	Crocanthemum dumosum	Bushy Rockrose
	Juncus debilis	Weak Rush
	Lathyrus palustris	Marsh-pea
	Leymus mollis ssp. mollis	Sea Lyme-grass
	Liatris novae-angliae	New England Blazing Star
	Mertensia maritima	Oysterleaf
	Opuntia humifusa	Eastern Prickly Pear
	Polygonum glaucum	Sea-beach Knotweed
	Rumex pallidus	Seabeach Dock
	Setaria parviflora	Bristly Foxtail
	Suaeda calceoliformis	American Sea-blite
	Suaeda maritima ssp. richii	Rich's Sea-blite

Grasslands

Species of Greatest Conservation Need in Grasslands

Taxon Grouping	Scientific Name	Common Name
Reptiles	*Heterodon platirhinos*	Eastern Hog-nosed Snake
	Opheodrys vernalis	Smooth Greensnake
Birds	*Ammodramus savannarum*	Grasshopper Sparrow
	Asio flammeus	Short-eared Owl
	Asio otus	Long-eared Owl
	Bartramia longicauda	Upland Sandpiper
	Chaetura pelagica	Chimney Swift
	Circus cyaneus	Northern Harrier
	Colinus virginianus	Northern Bobwhite
	Dolichonyx oryzivorus	Bobolink
	Eremophila alpestris	Horned Lark
	Falco sparverius	American Kestrel
	Pooecetes gramineus	Vesper Sparrow
	Progne subis	Purple Martin
	Scolopax minor	American Woodcock
	Sturnella magna	Eastern Meadowlark
	Tyto alba	Barn Owl

Taxon Grouping	Scientific Name	Common Name
Mammals	*Synaptomys cooperi*	Southern Bog Lemming
Beetles	*Cicindela purpurea*	Purple Tiger Beetle
	Nicrophorus americanus	American Burying Beetle
Lepidoptera	*Abagrotis nefascia*	Coastal Heathland Cutworm
	Callophrys irus	Frosted Elfin
	Cycnia inopinatus	Unexpected Cycnia
	Erynnis persius persius	Persius Duskywing
	Euchlaena madusaria	Scrub Euchlaena
	Dargida rubripennis	The Pink-streak
	Grammia phyllira Phyllira	Tiger Moth
	Heterocampa varia	Sandplain Heterocampa
Bees	*Anthophora walshii*	Walsh's Anthophora
	Epeoloides pilosula	Macropis Cuckoo Bee
	Macropis ciliata	Ciliary Oil-collecting Bee
	Macropis nuda	Naked Oil-collecting Bee
	Macropis patellata	Patellar Oil-collecting Bee
Plants	*Agalinis acuta*	Sandplain Gerardia
	Aristida purpurascens	Purple Needlegrass
	Asclepias purpurascens	Purple Milkweed
	Calystegia spithamaea	Upright False Bindweed
	Carex bushii	Bush's Sedge
	Carex mesochorea	Midland Sedge
	Carex polymorpha	Variable Sedge
	Corema conradii	Broom Crowberry
	Crataegus bicknellii	Bicknell's Hawthorn
	Crocanthemum dumosum	Bushy Rockrose
	Cyperus houghtonii	Houghton's Flatsedge
	Dichanthelium ovale ssp. pseudopubescens	Commons' Panic-grass
	Dichanthelium scabriusculum	Rough Panic-grass
	Eleocharis microcarpa var. filiculmis	Tiny-fruited Spike-sedge
	Gamochaeta purpurea	Purple Cudweed
	Hypericum hypericoides ssp. multicaule	St. Andrew's Cross
	Gentiana linearis	Narrow-leaved Gentian
	Lathyrus palustris	Marsh-pea
	Lechea pulchella var. moniliformis	Beaded Pinweed

Taxon Grouping	Scientific Name	Common Name
	Liatris novae-angliae	New England Blazing Star
	Linum intercursum	Sandplain Flax
	Linum medium var. texanum	Stiff Yellow Flax
	Lupinus perennis	Wild Lupine
	Malaxis bayardii	Bayard's Adder's Mouth
	Nabalus serpentarius	Lion's Foot
	Panicum philadelphicum ssp. gattingeri	Gattinger's Panic-grass
	Scleria pauciflora	Papillose Nut-sedge
	Scleria triglomerata	Tall Nut-sedge
	Senna hebecarpa	Wild Senna
	Silene caroliana ssp. pensylvanica	Wild Pink
	Sisyrinchium fuscatum	Sandplain Blue-eyed Grass
	Spiranthes vernalis	Grass-leaved Ladies'-tresses
	Symphyotrichum concolor	Eastern Silvery Aster
	Triosteum perfoliatum	Broad Tinker's-weed
	Viola adunca	Sand Violet
	Symphyotrichum praealtum	Willow Aster
	Veronicastrum virginicum	Culver's-root
	Verbena simplex	Narrow-leaved Vervain

Rocky Coastlines

Species of Greatest Conservation Need in Rocky Coastlines

Taxon Grouping	Scientific Name	Common Name
Birds	*Calidris maritima*	Purple Sandpiper
	Clangula hyemalis	Long-tailed Duck
	Histrionicus histrionicus	Harlequin Duck
	Somateria mollissima	Common Eider

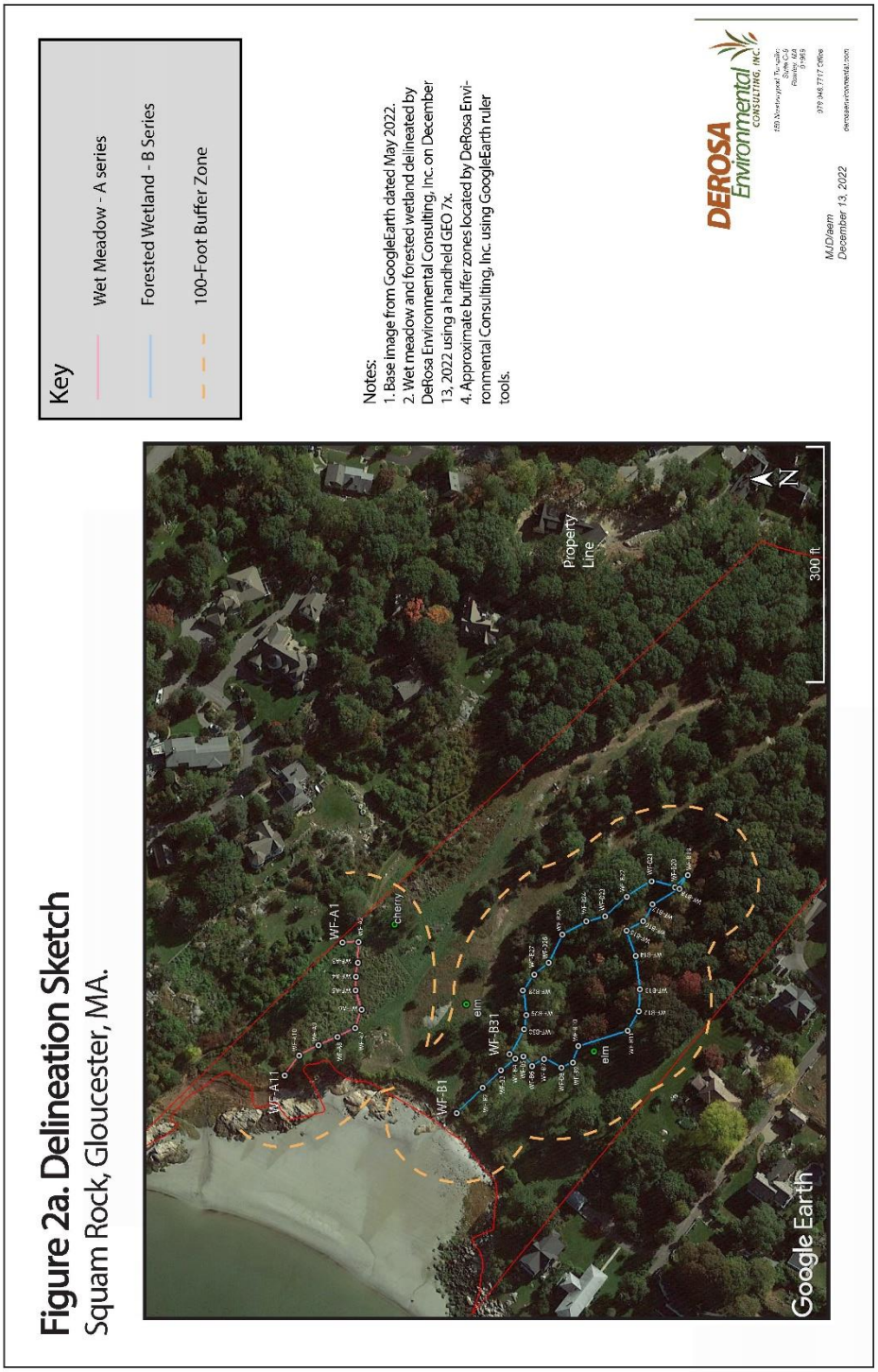
Forested Swamp

Species of Greatest Conservation Need in Forested Swamps

Taxon Grouping	Scientific Name	Common Name
Reptiles	*Clemmys guttata*	Spotted Turtle
	Thamnophis sauritus	Eastern Ribbonsnake

Taxon Grouping	Scientific Name	Common Name
Birds	*Anas rubripes*	American Black Duck
	Buteo platypterus	Broad-Winged Hawk
	Cardellina canadensis	Canada Warbler
	Euphagus carolinus	Rusty Blackbird
	Setophaga americana	Northern Parula
	Zonotrichia albicollis	White-throated Sparrow
Mammals	*Sorex palustris*	Water Shrew
	Sylvilagus transitionalis	New England Cottontail
Crustaceans	*Synurella chamberlaini*	Coastal Swamp Amphipod
Lepidoptera	Callophrys hesseli	Hessel's Hairstreak
	Callophrys lanoraieensis	Bog Elfin
	Catocala pretiosa pretiosa	Precious Underwing
	Lithophane viridipallens	Pale Green Pinion
	Pieris oleracea	Mustard White
Plants	*Botrychium tenebrosum*	Swamp Moonwort
	Cardamine douglassii	Purple Cress
	Carex baileyi	Bailey's Sedge
	Carex castanea	Chestnut-colored Sedge
	Carex formosa	Handsome Sedge
	Cypripedium parviflorum	Yellow Lady's-slipper
	Cypripedium reginae	Showy Lady's-slipper
	Linnaea borealis ssp. americana	American Twinflower
	Lycopus rubellus	Taper-leaf Water-horehound
	Lygodium palmatum	Climbing Fern
	Magnolia virginiana	Sweet Bay
	Malaxis monophyllos var. brachypoda	White Adder's Mouth
	Malaxis unifolia	Green Adder's Mouth
	Moneses uniflora	One-flowered Pyrola
	Neottia bifolia	Southern Twayblade
	Orthilia secunda	One-sided Pyrola
	Petasites frigidus var. palmatus	Sweet Coltsfoot
	Platanthera aquilonis	North Wind Orchid
	Platanthera macrophylla	Large Round-leaved Orchid
	Platanthera orbiculata	Round-leaved Orchid
	Populus heterophylla	Swamp Cottonwood
	Pyrola asarifolia ssp. asarifolia	Pink Pyrola
	Quercus macrocarpa	Bur Oak
	Rhododendron maximum	Great Laurel
	Rumex verticillatus	Swamp Dock
	Sanicula canadensis	Canadian Sanicle
	Thuja occidentalis	Arborvitae

Appendix D – DeRosa Environmental Wetlands Delineation



Appendix E – Trail Assessment

The aerial photo shows the current trails at Squam Rock Pasture.

All waypoints are from cell phone and are approximate locations. Rise and fall elevations determined from Gloucester GIS topography (1').

Trail Segment	**Squam Rock Main Trail**		
Length:		**Bill Giezentanner**	**12/20/2022**
Distance	**Location**	**Condition**	**Comments/Work Needed**
0'	Beginning of paved path at entrance		
238'	End of asphalt paved path (Waypoint 42.65811, -70.67741)	Asphalt paved path 3 to 4 feet wide. Some eroded edges and crumbling pavement. Rises 15+ feet (10% grade)	A longer, well-designed, relocated, more curved path could avoid pavement.
293'	Intersection on left with trail from Squam Rock (Waypoint 42.65815, -70.67748)	Natural surface some signs of pooling. Widening of trail in places to avoid wet spots. Almost level.	Consider curving and adding "trail anchors" to better define trail. "Corralling"
353'	First water bar (Waypoint 42.65840, -70.67760)	Natural surface some signs of erosion. Widening of trail in places to avoid wet spots. Almost level.	Consider curving and adding "trail anchors" (stones, logs, shrubs, or other obstacles) to better define trail. Add "grade reversals" where possible.
414'	Intersection with obscure trail to Woodland (Waypoint 42.65855, -70.67766)	Natural surface some signs of pooling. Widening of trail in places to avoid wet spots and steps created by water bars. Falls 10 feet (15% grade).	Consider curving and adding "trail anchors" (stones, logs, or other obstacles) to better define trail. Add "grade reversals" where possible.

Distance	Location	Condition	Comments/Work Needed
508’	Trail splits around patch of juniper (Waypoint 42.65878, -70.67783)	Natural surface some signs of pooling. Widening of trail in places to avoid wet spots. Falls 5 feet (5% grade)	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
592’	Intersection with trail to right and granite bench (Waypoint 42.65901, -70.67799)	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots. Falls 5 feet (6% grade).	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
663’	Beginning of series of wooden water bars	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots. Almost level.	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
719’	End of series of water bars	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots and to avoid steps created by water bars. In some places the trail is up to 10’ wide. Falls 5 feet (9% grade).	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.

Distance	Location	Condition	Comments/Work Needed
765’	Beginning of another series of wooden water bars	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots and to avoid steps created by water bars. Falls 9 feet (20% grade).	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
835’	End of series of water bars. Intersection with trail from woodland.	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots and to avoid steps created by water bars. Falls 7 feet (10% grade).	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
865’	Trail splits with both going to beach. (Waypoint 42.65921, -70.67904)	Natural surface some signs of pooling and much erosion to right. Widening of trail to avoid wet spots. Falls 3 feet (10% grade).	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible. Eliminate redundant trail to beach.
1,000’	Intersection with trail to left (Waypoint 42.65926, -70.67957)	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots. Falls 8’ (6% grade)	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.

Trail Segment	Squam Rock Trail along NE side of Wooded Swamp (green on map)		
Length:		**Bill Giezentanner**	**1/7/2023**
Distance	**Location**	**Condition**	**Comments/Work Needed**
1.090’	Stairs to beach (waypoint 42.65937, -70.67971)	Natural surface some signs of pooling and erosion. Widening of trail in places to avoid wet spots. Some grass surfaces. Falls 10’ (11% grade)	Consider curving and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” where possible.
0’	Intersection with Main Trail heading toward Squam Rock (Waypoint 42.65915, -70.67888)		
128’	Beginning of eroded area (Waypoint 42.65884, -70.67857)	Natural grass surface in good condition. Rises 9’ (7% grade)	
222’	Large American beech tree (Waypoint 42.65866, -70.67834)	Natural grass surface much erosion. Rises 6’ (6% grade)	Improve drainage with “grade reversals”, and out-slopes toward wetland

Distance	Location	Condition	Comments/Work Needed
343	Beginning of steep area with steps (Waypoint 42.65861, -70.67824)	Too steep to be sustainable without constant repair. Eroded. Rises 15' (12% grade)	Consider relocating with curves and adding "trail anchors" (stones, logs, or other obstacles) to better define trail. Add "grade reversals" and out-slopes where possible.
388'	Beginning of steps (Waypoint 42.65836, -70.67814)	Too steep to be sustainable without constant repair. Badly eroded. Rises 12' (26% grade)	Consider relocating with curves and adding "trail anchors" (stones, logs, or other obstacles) to better define trail. Add "grade reversals" and out-slopes where possible.
412'	Intersection with trail along south side of wooded swamp (Waypoint 42.65823, -70.67809)	Too steep to be sustainable without constant repair. Badly eroded. Rises 12' (50% grade)	Consider relocating with curves and adding "trail anchors" (stones, logs, or other obstacles) to better define trail. Add "grade reversals" and out-slopes where possible.
511'	Beginning of another steep area with steps (Waypoint 42.65800, -70.67776)	Too steep to be sustainable without constant repair. Badly eroded. Rises 7' (7% grade)	Consider relocating with curves and adding "trail anchors" (stones, logs, or other obstacles) to better define trail. Add "grade reversals" and out-slopes where possible.

Distance	Location	Condition	Comments/Work Needed
629’	Intersection with other obscure trail from Squam Rock (Waypoint 42.65772, -70.67751)	Too steep to be sustainable without constant repair. Badly eroded. Rises 9’ (8% grade)	Consider relocating with curves and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” and out-slopes where possible.
786’	Gateway to Squam Rock Road	Some erosion some mowed trail on flatter area. Rises 22’ (14% grade)	Consider relocating with curves and adding “trail anchors” (stones, logs, or other obstacles) to better define trail. Add “grade reversals” and out-slopes where possible.

Trail Segment	Squam Rock Trail along south side of Wooded Swamp (green on map)		
Length:		**Bill Giezentanner**	**1/7/2023**
Distance	**Location**	**Condition**	**Comments/Work Needed**
0’	Intersection with trail along south side of wooded swamp (Waypoint 42.65823, -70.67809)		
91’	Large American beech tree (Waypoint 42.65814, -70.67837)	Natural surface. Some berm buildup. Rises 10’ (6% grade)	Remove berm and add “grade reversals” and out-slope where possible.
184’	Trail crosses rock (Waypoint 42.65828, -70.67867)	Natural surface little erosion. Rises 3’ (4% grade)	Remove berm and add “grade reversals” and out-slope where possible.
231’	Trail enters field (Waypoint 42.65821, -70.67884)	Natural surface little erosion. Falls 4’ (8% grade) Maintenance shed on left. Some erosion up to shed.	Remove berm and add “grade reversals” and out-slope where possible.
372’	Tree on right with Fortune’s spindle vine (Waypoint 42.65846, -70.67925)	Natural surface little erosion. Falls 18’ (12% grade)	Remove berm and add “grade reversals” and out-slope where possible.

Distance	Location	Condition	Comments/Work Needed
591’	Intersection with trail from neighborhood (Waypoint 42.65889, -70.67986	Mowed grass trail. Good condition. Falls 10’ (5% grade)	

Trail Segment	Squam Rock Trail from neighbor entrance through stone wall (brown on map)		
Length:		**Bill Giezentanner**	**1/7/2023**
Distance	**Location**	**Condition**	**Comments/Work Needed**
0’	Squam Rock Road		
150’	Entrance from neighborhood	Erosion down from stone entrance to left. Water channeled between stone walls spills onto trail. Falls 12’ (8% grade)	?
228’	Trail intersection to right. (Waypoint 42.65889, -70.67986)	Mowed grass trail, some erosion caused by drainage between stone walls. Falls 6’ (9% grade)	Add “grade reversals” and out-slope where possible to prevent water from flowing in trail
300’	Beginning of badly eroded area (Waypoint 42.65905, -70.67967)	Mowed grass trail some erosion, Falls 8’ (11% grade)	Add “grade reversals” and out-slope where possible to prevent water from flowing in trail
388’	Intersection with Main Trail (Waypoint 42.65926, -70.67957)	Section of badly eroded trail. Falls 5’ (6% grade)	Add “grade reversals” and out-slope where possible to prevent water from flowing in trail

Trail Segment	Squam Rock Trail to lighthouse along north boundary stone wall (brown on map)		
Length:		**Bill Giezentanner**	**1/7/2023**
Distance	**Location**	**Condition**	**Comments/Work Needed**
0’	Boundary		
200’	Break in stone wall and trail to left adjoining property (Waypoint 42.66013, -70.67931)	Natural surface some on ledge, some on mowed grass. Area flooded with fresh water flowing from uphill. Rise 5’ (2.5% grade)	?
422’	Trail along stone wall	Natural surface on mowed grass. Area flooded with fresh water flowing from uphill. Rise 20’ (9% grade – some areas steeper)	? Seasonally closed? Boardwalk?
555’	Intersection with mowed trail to right into field (Waypoint 42.65939, -70.67856)	Natural surface on mowed grass. Rise 6’ (5% grade)	? Seasonally closed?
752’	Intersection with Main Trail at granite bench (Waypoint 42.65901, -70.67799	Natural surface on mowed grass. Rise 22’ (11% grade)	? Seasonally closed?

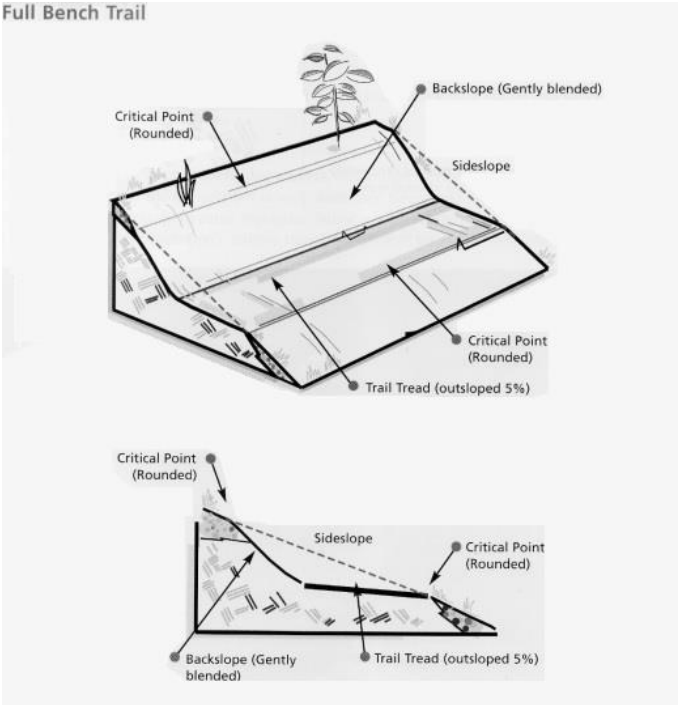


Diagram of Bench Cut showing out-slope.

Note that the edge of the trail indicated as “critical point” is where one wants to prevent the build-up of a berm.

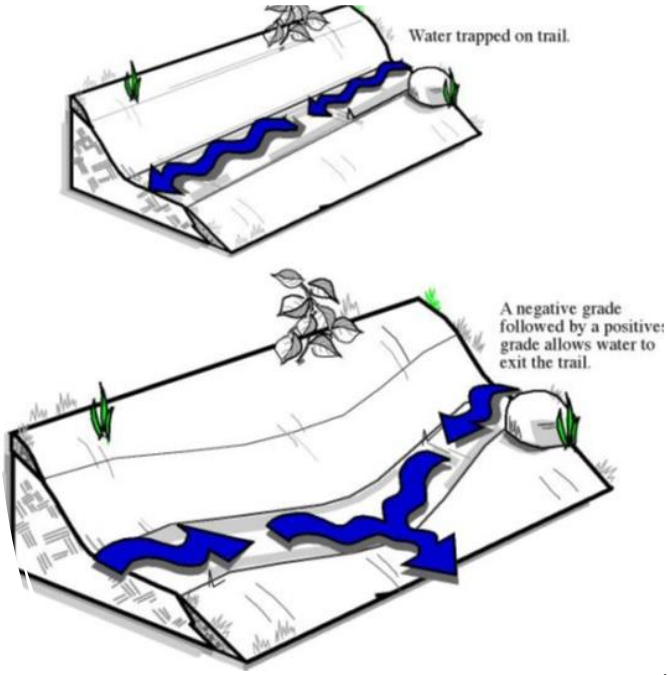


Diagram of Grade Reversal

Note that grade reversals can be so subtle as to not be noticed. A dip of an inch or two can redirect water off the trail.

They are recommended on a trail every 20 to 50 ft.

Slough and Berms

On hillside trails, ***slough*** (pronounced ***sluff***) is soil, rock, and debris that has moved downhill to the inside of the tread, narrowing the tread. Slough needs to be removed (figure 30). Doing so is hard work. Slough that doesn't get removed is the main reason trails "creep" downhill.

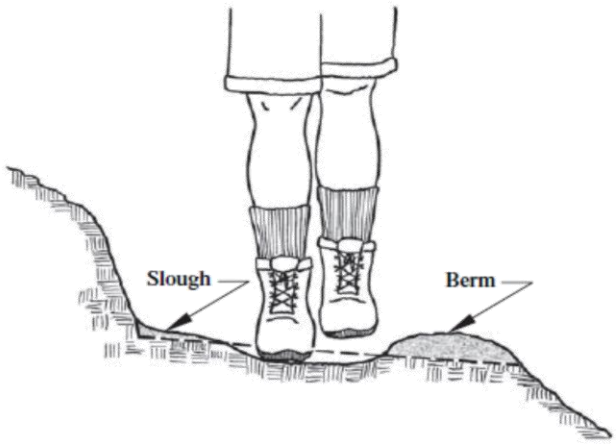
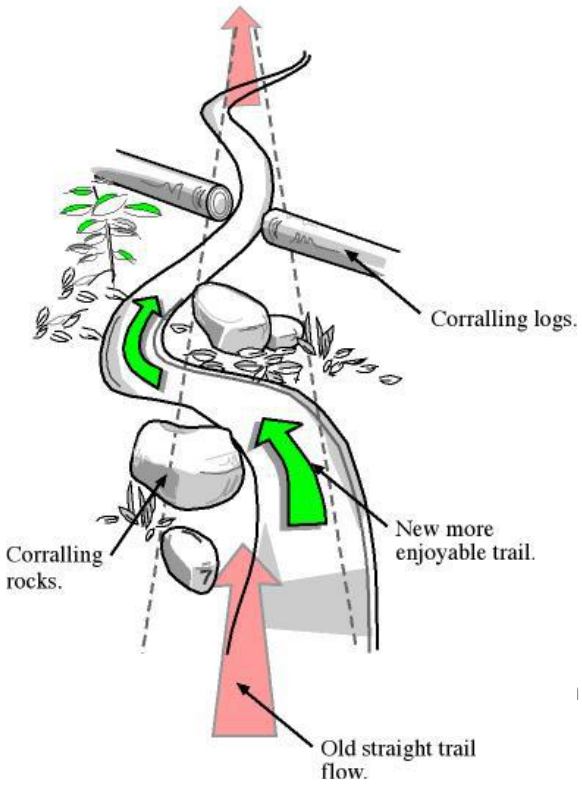


Diagram Showing Slough and Berm

Regular maintenance needs to focus on removing slough (material that has fallen into the trial from above) and berm to prevent water from flowing in trail depression created by compaction.

Corralling



Corralling

Using "trail anchors" (stones, shrubs, logs, or other obstacles) to redirect and keep users on the trail and prevent spread. Make sure the narrowing flows naturally with the trail. Otherwise, users could find it annoying and may create a new route around it.

Appendix F – Summary of Recommendation from 2013 Management Plan

Zone Management Plans

1. Entrances and Paths

   Annual Maintenance
   All entrances and paths should be trimmed and cleaned of litter as necessary (approximately every 3 weeks), between May and October to maintain clear, safe trails and minimize pedestrian contact to ticks. Water breaks/steps should be repaired as necessary to prevent erosion and maintain safe conditions.

2. Grasslands and Edges

   a. Fields
      Field areas should be mowed at least two times annually paying attention to the seasonal nature of some nesting birds.
   b. Meadows
      As field areas are the grasslands designated primarily for recreational use, meadows are the grasslands designated primarily for ecological conservation. The primary criteria governing meadow maintenance are the conservation and regeneration of grassland flora and fauna and the prevention of ecological succession to shrub land and forest. These dual objectives are best accomplished through an annual mowing scheduled around ground nesting bird activities (the primary wildlife concern for grasslands). The primary mowing should be performed in mid-August to allow for ground-nesting birds to complete nesting and fledgling activities. * Annual mowing is more than sufficient to prevent tree and shrub species from invading the grassland. Cutting at this time is also beneficial because it allows many grasses and wildflowers to seed, gives ample time for vegetation to re-grow before winter thus preventing erosion and providing wildlife cover, and allowing for easier mowing of wet meadow areas.
   c. Vegetation Islands and Edges
      Vegetation islands and edges surrounding grasslands should be maintained during winter caretaking activities. Vegetation which impedes safety or desired aesthetics, such as hazards, plants which encroach into grasslands and/or view sheds, and aggressive (invasive) or competing plants which compromise ecological health should be removed.

3. Ocean Buffer Zone and Beach

   The beach should be kept clean; trash and/or debris should be removed during regular path maintenance activities. View shed should be maintained during Winter caretaking. Boardwalk should be reviewed for damage in the Spring and repaired as necessary.

*Source: Managing Small Grasslands for Grassland Birds
www.massaudubon.org/Birds_and_Birding/grassland/small.php (out of date)

4. Woodlands

    a. Upland Woodlands
    With a few exceptions, the upland woodlands exhibit an open character which is both aesthetically desirable and ecologically healthy for this habitat. Such areas should be mowed as feasible to reduce labor costs and then maintained during winter caretaking activities. The few overgrown areas should be reclaimed and then maintained as the rest of the upland woodlands. A path through the woodland behind Squam Rock might be created to give access to this area of the property.
    b. Lowland Woodlands
    The lowland and woodlands are still largely unmanaged and overgrown. These areas should be thinned during winter caretaking activities, focusing on removing the many hazards and aggressive (invasive) vegetation, such as Norway Maple. Paths could be created through this woodland to create greater access.
    c. Woodland Plantings
    Upon completion of restoration efforts, with very careful consideration, native plants might be installed to fill vacant forest structure in all woodland areas.

Zone Management Overview

1. Entrances and Paths

    Winter
    – remove hazards and cutback vegetation away from paths

    Spring
    – clean-up and mulch main entrance

    June – October
    – remove hazards as necessary
    - mow all paths and string trim around all entrances and walls as necessary (approximately every 3 weeks)
    – remove trash and debris as necessary

    Fall
    - install marker stakes around timbers and wall at Walnut Street entrance to minimize plow damage
    - repair steps/water breaks as necessary, ideally with materials from the property
    - repair damaged stonewalls

2. Grasslands and Edges
    a. Fields
        - mow with finish mower in June and September and as necessary for events.

- remove hazards and debris as necessary

b. Meadows
- mow with rough-cut mower annually in mid-August

c. Vegetation Islands and Edges

Winter
Remove hazards and undesirable vegetation; undesirable vegetation is defined as: 1) plants which encroach into grasslands and stonewalls 2) plants which block or will mature to block view sheds 3) plants which detract from ecological health, such as aggressive (invasive) or competing vegetation.

3. Ocean Buffer Zone and Beach
   a. Remove hazards and debris as necessary
   b. Maintain boardwalk and two other access openings to beach area.

   Winter
   - maintenance view shed

4. Woodlands
   a. Upland Woodlands

   Winter Maintenance
   Remove hazards and undesirable vegetation; undesirable vegetation is defined as any plants which detract from the open character or ecological health of these woodlands. Cuttings can largely be left to let lay. Open areas of these woodlands should be mowed annually or bi-annually, in early Spring or late Summer, as necessary or desired, to minimize necessary hand cutting. Care should be taken to identify and leave sufficient number of saplings to replace the present canopy in future.

   Possible Path Creation
   A path could be created to give access to the woodland to the south of Squam Rock. One possible route might begin in the field along Squam Rock Road, dip south along the top of the slope towards Leonard Street and finish in the Squam Rock clearing.

   Winter Renovation
   The areas surrounding Squam Rock and between the Squam Rock field and equipment sheds, should be thinned according to ecological and aesthetic goals. Clear access should be created while leaving unique and/or ecologically important vegetation. The woodland between the central path and the Squam Rock lighthouse view shed should be thinned to maintain the early successional quality. Tall deciduous trees should be cut away from Juniper trees and vegetation should largely be cleared away from **low bush blueberry** patch.

   b. Lowland Woodlands

   Winter Restoration
   Remove hazards and undesirable vegetation; undesirable vegetation is defined as plants which detract from ecological health because of their aggressive growth habit (invasives), or overcrowded populations. Invasive plants should be removed and overcrowded areas thinned to

healthy densities. Care should be taken to leave sufficient vegetation to maintain all possible levels of a mature forest structure, i.e. a canopy, under canopy, future canopy and shrub level. Because of the large volume of vegetation to be removed during this first phase, cuttings will need to be removed or burned.

Path Creation
New paths could be established through this area.

Winter Maintenance
Hazards and vegetation which detracts from ecological health should be removed. Care should be taken to leave all levels of mature forest structure intact. Cuttings can largely be left to let lay.

Mowing
Open areas can be annually or bi-annually mowed in the early Spring to late Summer, as desired. Care should be taken to identify emergent vegetation and leave plants which in the future will fill gaps in mature forest structure.

Management Calendar

January – caretake

February – caretake

March – caretake

April – caretake

May – mow paths
- clean-up entrance

June - mow path
- mow fields

July - mow paths

August - mow paths
- mow meadows

September - mow paths
- mow fields

October - mow paths
- maintenance equipment

November - annual review

December - planning

Summary

The Squam Rock Land Trust is an extraordinary resource. Through the creation and application of the 1997 management plan the property was gradually reclaimed from the overgrowth of years of under-management. The new report has reviewed and revised the original management plan in accordance with progress achieved and updated goals. The implementation of this management plan will optimize the utility, beauty and health of the property allowing it to truly come into its own.

Appendix G – Invasive Plant Management Options

Some invasive species and small infestations can be managed manually or mechanically, others more extensive areas may best be managed with targeted, careful use of herbicides, **as a last resort**, applied by a licensed herbicide applicator.

Herbicide Application Options

Foliar spray- This method is usually applied with a type of sprayer (backpack, mist blower, or tank). The percent of solution depends on the target species, the time of year, and type of sprayer. Glyphosate will target all species while Triclopyr will only target broadleaf plants and will have minimal impact if any on grasses.

Bloody glove- A more intensive method of herbicide application often used in place of foliar spray when impacts to non-target species is a concern. Herbicide is applied directly to leaves and stems of target species from a soaked cotton glove worn over a rubber glove.

Cut and paint- The stem of the plant is cut so a cross section is showing. The outer edge of the stem is then painted in herbicide; if the stem is hollow herbicide can be injected into the hollow stem. Triclopyr or Glyphosate can be used for treatment.

Girdling- This method used for trees involves making a shallow cut through the bark and outer cambium tissue; the plant is slowly killed due to the inability to transport water and nutrients up the trunk. Girdling is particularly effective for species that sprout aggressively from root suckers, particularly black locust, since it seems to bypass the signal to respond to a dead main stem by sprouting from root suckers. Care must be taken not to cut too deeply into the trunk as too deep a cut can sever all phloem tissue which transports nutrients down into the roots of the plant and is necessary to transport herbicide into the roots. If the phloem is all cut, downward transport will cease, and black locust will respond by sprouting aggressively from root suckers.

Basal bark- Herbicide is applied to the outer surface of the stem. Triclopyr is used because glyphosate will not penetrate the stem. There should not be any standing water present or moisture on the stem. The application can be made with a paint brush or backpack sprayer from the base of the stem to about 1 foot up the stem.

Recommended herbicides:

Triclopyr- Triclopyr is a selective herbicide that will affect broad leaf plants and will have minimal to no impact on monocots. This is since it stimulates cell growth elongation. Since monocots grow naturally by elongating their cells it will have little to no effect where since dicots grow laterally, they burst their cell walls and cause damage to the plant when they are stimulated for cell elongation. Since this herbicide can be mixed with water or oil it can be used for foliar sprays, cut and paint, or basal bark applications. It is recommended to use this herbicide when there is a dense native grass understory surrounding a target plant.

Glyphosate- Glyphosate is a broad-spectrum herbicide meaning it will kill most plants it is applied to. It is an amino acid inhibitor, so it inhibits the growth of plants. Foliar sprays should be applied while the

plant is actively growing but cut and paint applications can be done during the fall/winter months. This herbicide can be used for foliar sprays and cut and paint applications. Since water is used as the base of the solution it cannot be used for basal bark treatments because water-based solutions will not penetrate the bark layer. During cut and paint treatments the herbicide will need to be applied before the cambium layer seals for it to be effective.

Table E-1. General Management Options.

Bold indicates species included in the plant inventory or other source.

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Cut and paint	Yes Under supervision of a licensed applicator	Late August to November	Preferably done in the fall when woody plants are translocating energy towards roots. Can be done to all trees/ shrubs except black locust (signals root suckering). Preferred treatment for multiflora rose. If berries are present, take extra precaution to not spread seed. Best when left in local area and burned in brush pile. Good for volunteers working together with staff: have volunteers cut and haul brush while licensed applicator paints herbicide.	Common Reed (stem injection) **Japanese knotweed** (stem injection) **Burning Bush** **Asiatic bittersweet** **Multiflora rose** (preferred) **Bush Honeysuckle** (fall) Glossy buckthorn **Autumn olive**
Hand pull	Yes	Spring and Summer	Great for herbaceous plants with taproot and shallow root system. Best for small infestations. All trees/ shrubs can be hand-pulled when in seedling stage. Garlic mustard should be hand-pulled when second year plants start sending up seed stalk and all plant parts should be bagged and kept out of the sun (seeds can still develop if sunlight is available).	Spotted knapweed **Garlic mustard** All seedlings for trees and shrubs

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Mechanical (weed wrench/ shovel)	Yes	Spring through Fall, although better before seed set.	Great for small shrubs/ trees. Best when done in early spring when leaves start coming out but before berries develop. Shovels can be used to dig up herbaceous plants with fibrous root systems (black swallowwort) care needs to be taken to make sure all root system is dug up. Soil should be tamped down after removal or native species planted soon after disturbance to keep additional invasives from re-colonizing area.	**Japanese knotweed** **Burning Bush** Japanese barberry **Black swallowwort** **Autumn olive** Tree of heaven
Basal bark herbicide	No	August through October	This method is best when done in late summer mid fall (Aug- Oct) when flow is towards roots. Can be performed on all trees/ shrubs.	**Burning Bush** **Autumn olive**
Biological	Yes	Dependent on insect.	This method of treatment works well for purple loosestrife. It is the least disruptive method of treatment currently available. Usually agents are released in July/ August. The affect the biological agent will have on the environment should be taken into consideration and the relative easiness of other forms of treatment. Depending on infestation size this could be a good way to treat spotted knapweed.	**Purple loosestrife** (preferred) Spotted knapweed (needs research)

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Foliar spray herbicide	No	When leaves are out.	For trees/ shrubs best when done in the fall when flow is towards roots. Can be done any time for herbaceous plants. When spraying the least amount of herbicide at the smallest effective percentage should be used. The surrounding habitat (wetland vs upland), nesting/ breeding animals, and whether it is a necessary treatment should be considered.	All species
Girdling	If certified in chainsaw safety	Fall	A chainsaw is used to create a ~2" wide cut all around the tree between knee and waist height taking care to remove only the outer layer of cambium, then the fresh cut is painted with herbicide.	Larger trees
Bloody glove	No	When leaves are out.	A rubber glove is worn on the hand with an absorbent cotton glove over it. The cotton glove is dipped in a glyphosate solution (strength depending on target species) then used to directly apply herbicide to leaves, stems, and inflorescences of target plants. Herbicide is absorbed directly into the plant via the stem and leaves, however, breaking the stem aids in more rapid absorption.	Small patches of common reed, seedlings, etc. particularly in wetlands where impacts to non-target species is a concern.

Table E-2. Species Specific Management Options.

Bold indicates species at Squam Rock and preferred treatment methods.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Autumn Olive	Autumn Olive flowers in May-July (plants must be at least 3 years old to flower). Seeds are produced August – November and nuts usually ripen in September. Adults produce less seed in the shade then the sun. Autumn Olive reproduces primarily by seed.	**Seedlings can be hand-pulled. Bigger plants can be removed with weed wrenches. Care should be taken to get the entire root system. Plants re-sprout vigorously when cut without the use of herbicide.**	A foliar treatment with at 2% solution of Triclopyr or Glyphosate can be used when leaves are present. A 25% solution of Triclopyr or Glyphosate can be used for cut-and-paint. A 20% solution of Triclopyr is recommended for basal bark treatments.	3 years No information available on seed viability.
Black Swallowwort	Black swallowwort spreads vegetatively and by seed. It flowers in June-August. The seeds are released from August to October.	**Plants can be dug up with a shovel. The entire root system would need to be removed and this method is very time consuming.**	A 2% foliar spray of Glyphosate or Triclopyr is recommended before mid- July. Chemical treatment is recommended from May- June, this would be before the plants flower so there would not be a possibility of spreading seed. **Cut-paint stem and apply G20%-50% solution immediately.**	6 years Seeds remain viable up to five years
Winged Euonymus (Burning Bush)	Burning Bush reproduces by seed and vegetatively.	**Small plants can be hand pulled while a weed wrench will need to be used for larger plants. Care should be taken to remove entire root system.**	A 2% foliar solution of glyphosate is recommended when leaves are present. A 20% solution of glyphosate or triclopyr is recommended for cut and paint and a 20% solution of triclopyr should be used for basal bark application.	5 years No information on seed banking,

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Bush Honeysuckles (Tartarian and Morrows)	The berries are mildly poisonous if eaten.	**Small plants can be hand pulled or removed with a weed wrench. Care should be taken to remove all roots and not to spread berries.**	Foliar spraying can be done if there are leaves present a 2% solution of triclopyr or glyphosate is recommended. **A 25% solution for cut and paint treatments can be used, put the solution right into the hollow stem** and around the stem edge. This is best during the fall when all the plant fluids are headed towards the root system.	3 years Few seeds viable for more than one year.
Common Reed *Phragmites*	Common Reed reproduces by seed and vegetatively. Inflorescences develop in late June.	**Plants can be cut. The shoots should be removed to prevent re sprouting.**	A 2% solution of Glyphosate is recommended. Since Phragmites is an aquatic species, an aquatic safe herbicide must be used. The best results are when the herbicide is applied in the late summer or early fall when Phragmites is actively growing and in full bloom. Remove dead stems if possible, by mowing or clipping.	2 years Seed viability is typically low, although it may vary year to year.
Garlic Mustard	Garlic mustard is a biennial plant and is allelopathic.	**Basal rosettes and second year plants can be hand pulled. Plants should be pulled at base near ground to ensure that the root is removed.**	A 2% glyphosate solution can be sprayed in April/ May before the basal rosettes go to seed and in September/ October when other plants are dormant.	6 years The seed bank is viable for 5 or more years.
Glossy Buckthorn	Reproduces by seed.	**Seedlings can be hand-pulled and larger plants can be removed with a weed wrench.**	Cut and paint with a 20% solution of glyphosate or25% triclopyr. A 2% foliar spray can be used while there are leaves. Remove dead stems, if possible, by mowing or lopping.	7 years Seeds remain viable for 5-7 years.
Japanese Barberry	Japanese Barberry spreads by seeds and vegetatively. The seeds have a 90% germination rate.	**Small plants can be removed by hand pulling or using a weed wrench.**	A 2% foliar spray can be used when leaves are present (April). Both glyphosate or a triclopyr solution can be used. A 25% cut and paint solution of glyphosate or triclopyr can be used, it is most effective in the fall when sap flow is towards the root system.	2 years Do not persist in seed bank.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Japanese Knotweed	Most of the literature recommends spraying after flowering; this makes it harder for the plant to have enough reserves to re-sprout that year. When the plant is in flower (August) there are a lot of bees around this species; care should be taken to avoid spraying bees when present and if possible, efforts should be made to spray multiple times a year before flowering.	Due to its extensive root system hand pulling Japanese Knotweed is not recommended as an efficient form of control.	A 2% solution of Triclopyr or Glyphosate is recommended for foliar spraying and is recommended to be done soon after flowering. For cut and paint techniques a 25% solution of glyphosate or triclopyr is recommended.	4 years Seeds do not remain viable beyond one year, but rhizomes and other plant parts can sprout up to three years after treatment.
		A method being used in some locations has been to mow and then cover the infested areas with black felt for 2 growing seasons. This is a good approach, but some rhizomes and plant parts may still sprout. A follow up method would be to cover the areas with ¼ inch hardware cloth after the felt is removed and then seed with native grasses and wildflowers. If the knotweed does sprout the hardware cloth will cut the sprouts when they get more than ¼ inch in diameter while the grasses and wildflowers will grow through the hardware cloth. This method is experimental and may not be appropriate for all locations.			
Japanese Stiltgrass	Japanese stiltgrass emerges in late August.	**Small patches can be hand pulled and bagged. Be sure to remove entire root system.**	A 2% glyphosate or triclopyr solution can be used for foliar spray in August/September.	7 years Seeds remain viable for 5-7 years.
Multiflora Rose	It flowers from April to June and fruits seeds July-Dec. It reproduces by seed and vegetatively.	**Hand-pulling small plants are recommended as long as all the roots are removed. It is not recommended for established plants.**	Foliar application is best when near flowering time. A 2% of triclopyr or glyphosate can be used. Cut and paint or basal bark applications can also be applied in the fall. A 25% solution of triclopyr or glyphosate is recommended for cut and paint and 20% of triclopyr can be used for basal bark treatments.	20 years Seeds of multiflora rose are viable for up to 20 years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Asiatic Bittersweet	The seeds are viable for several years but can sprout from roots and runners.	**Seedlings are easy to hand-pull. Bigger vines can be removed by unwinding them from their host and using a weed wrench to uproot them. This can be done year-round, but use caution when berries are present.**	You can use a foliar spray with a 2% solution of Glyphosate or Triclopyr. A 20% solution can be used for basal bark treatment. A 25% solution is recommended for cut and paint treatments, both Glyphosate and Triclopyr can be used.	5 years Seeds do not remain viable, but resprouts from roots.
Purple Loosestrife	Galerucella spp. beetles are recommended for bio control agents.	**Plants can be removed by hand pulling. All roots should be removed.**	An aquatic safe herbicide (Rodeo) should be used. A 2 % foliar spray is recommended in late August early September.	Ongoing Produces nearly inexhaustible seed bank. Bio-control will not eliminate plant.
Spotted Knapweed	Plants may contain carcinogenic compounds and skin irritation can also occur; gloves should be worn when handling	**Plants can be hand pulled and bagged. Care should be taken to get entire root system and not to distribute seeds if present.**	A 2% Glyphosate foliar spray can be used. Plants are most susceptible if sprayed in the late stages of flower buds (late June).	10 years Seeds can survive for 8 or more years.
Tree-of-Heaven	Tree-of-heaven flowers in May-June, and fruits starting in July. It reproduces by seed and vegetatively. Plants need to be 2 or 3 years old to produce viable seed. It re-sprouts vigorously when cut without herbicide.	**Small plants can be removed by hand- pulling or using a weed wrench. Care should be taken to remove entire root system.**	A 2% solution is recommended for foliar spray. Either Triclopyr or Glyphosate can be used. Triclopyr is recommended for cut and paint (30% solution) and basal bark (20% solution) treatments.	2 years Few seeds remain viable after one year.

Property: Date:

Location: UTM (WGS84/NAD83):

Weather (include 24 hours before and after for chemical treatment)

	Current	24 hours before	24 hours after
Temp.			
Wind speed/direction			
Cloud Cover			
Precipitation			

Method: Chemical Manual Mechanical Biological

Chemical

Chemical used: % Solution Used: Amount of solution used:

Amount of herbicide used: Mix date:

Adjuvants/Carriers etc.:

Method of Application:

Name of applicators:

Biological

Biological control agent: # Released: Stage:

Mechanical/ Manual

Equipment used:

Acres/number of plants treated: % of infested area treated:

Growth stage of target:

Target Species:

Comments:

Date current treatment mapped w/ GPS:

Efficacy notes:

Date/type of last treatment:

ATTACH MAP OF TREATMENT AREA

or hand draw on back of this sheet

Appendix H – Recommended Plants

Coastal Bank

Office of Coastal Zone Management (CZM) (https://www.mass.gov/service-details/landscaping-a-coastal-bank)

Recommendations for Exposed Areas of a Coastal Bank

Grasses, Perennials, and Vines

- American Beachgrass (*Ammophila breviligulata*) (native)
- Coastal Panic Grass (*Panicum amarum* var. *amarulum*) (not native; native to New Jersey south to Mexico)
- Saltmeadow Cordgrass (*Spartina patens*) (native)
- Seaside Goldenrod (*Solidago sempervirons*) (native)
- Switchgrass (*Panicum virgatum*) (native)
- Virginia Creeper (*Parthenocissus quinquefolia*) (native)

Shrubs and Groundcovers

- Beach Heather (*Hudsonia tomentosa*) (native)
- Beach Plum (*Prunus maritima*) (native)
- Bearberry (*Arctostaphylos uva-ursi*) (native)
- Common Juniper (*Juniperus communis*) (native)
- Marsh Elder (*Iva frutescens*) (native)
- Northern Bayberry (*Myrica pensylvanica*) (native)
- Sweet Fern (*Comptonia peregrina*) (native)

Trees (only plant on low slopes or set back from the top of the bank)

- Black Cherry (*Prunus serotina*) (native)
- Eastern Red Cedar (*Juniperus virginiana*) (native)
- Pitch Pine (*Pinus rigida*) (native)
- White Oak (*Quercus alba*) (native) and other Quercus species (many native)

Upland Cultivated Meadow | *Native Grasses and Wildflower Plant List* | Squam Rock Land Trust

Common Name	Scientific Name	Native to Essex County	Drought tolerant	Bird Value	Insect Value	Height
Indian Grass	*Sorghastrum nutans*	Y	Y	y		4-5 ft.
Little Bluestem	*Schizachyrium scoparium*	Y	Y	Y	Y	3 ft.
Big Bluestem	*Andropogon gerardii*	Y	Y	Y		4-6 ft.
Purple Lovegrass	*Eragrostis Spectabilis*	Y	Y			2 ft.
Switchgrass	*Panicum virgatum*	Y	Y	Y	Y	3-6 ft.
Pennsylvania Sedge	*Carex pensylvanica*	Y	Y		Y	6-10 in.
Pussytoes	*Antennaria plantaginifolia*	Y	Y		Y	1-3 in
Black-eyed Susan	*Rudbeckia hirta*	Y	Y	Y	Y(20)	2-4 ft.
Gray Goldenrod	*Solidago nemoralis*	Y	Y		y	2-3 ft.
Butterfly milkweed	*Asclepias tuberosa*	Y	Y		y	2-3 ft.
Seaside Goldenrod	*Solidago sempervirens*	Y	Y		Y	2-6 ft.
Sundial Lupine	*Solidago puberula*	Y	Y		y	3-4 ft.
Broad-leaved Ironweed	*Panicum virgatum*	Y	Y			4-5 ft.
Showy Goldenrod	*Solidago Speciosa*	Y	Y		Y	3-4 ft.
White Goldenrod	*Solidago bicolor*	Y	Y	Y	Y	2-3 ft.
New England Aster	*Symphyotrichum novae-angliae*	Y	Y			3-6 ft.
Poverty Dropseed	*Sporobolus vaginiflorus*	Y	Y	Y		2 ft.
White Yarrow	*Achillia millefolium*	Y	Y		Y	2-3 ft.
Narrow-leaved Mountain mint	*Pycnanthemum tenuifolium*	Y	Y		Y	1-3 ft.
American Smooth Aster	*Symphiotrichum laeve*	Y	Y		Y(100)	3-4 ft.
Eastern Showy Aster	*Eurybia spectabilis*	Y	Y		Y	1-2 ft.
Hyssop-leaved boneset	*Eupatorium hyssopifolium*	Y	Y	Y	Y	2-3 ft.

Upland Cultivated Meadow | *Native Shrub and Tree List* | Squam Rock Land Trust

Common Name	Scientific Name	Native to Essex County	Drought Tolerance	Bird Value	Insect Value	Height
Common Milkweed	*Asclepias syriaca*	Y	Y		y	3-5 ft.
Wild Columbine	*Aquilegia canadensis*	Y	Y	Y	Y	12-18 in.
Golden Alexanders	*Zizia aurea*		Y		Y	1-2 ft.
Witch Hazel	*Hamamelis virginiana*	Y	somewhat		Y	6-15 ft.
American Holly	*Ilex opaca*	Y	somewhat	Y	Y	12-13 ft.
Serviceberry	*Amalenchier canadensis*	Y	Y	Y	Y	10-18 ft.
Bearberry	*Artostaphylos uva-ursi*	Y	Y	Y	Y	6-12 in.
Lowbush Blueberry	*Vaccinium angustifolium*	Y	Y	Y	Y	1 ft.
Blackberry	*Rubus alleghaniensis*			Y	Y	
Red Raspberry	*Rubus idaeus*	Y	Y	Y	Y	2-5 ft.
Common Strawberry	*Fragaria virginiana*	Y	Y	Y	Y	2-5 in.
Creeping Juniper	*Juniperus horizontalis*	Y	Y	Y		2 ft.
Black Huckleberry	*Gaylussacia baccata*	Y	Y	Y	Y	1-3 ft.
Hazelnut	*Corylus americana*	Y	Y	Y	Y	5-9 ft.
Arrowwood	*Viburnum dentatum*	Y	somewhat	Y	Y	6-10 ft.
Red Chokeberry	*Aronia melanocarpa*	Y	somewhat	Y	Y	5-12 ft.
Beach Plum	*Prunus maritima*	Y	Y	Y	Y	3-6 ft.
Bayberry	*Morella caroliniensis*	Y	Y	Y	Y	2-6 ft.
Eastern Red Cedar	*Juniperus virginiana*	Y	Y	Y		30-40 ft.
Staghorn Sumac	*Rhus typhina*	Y	Y	Y	Y	6-8 ft.
Smooth Sumac	*Rhus glabra*	Y	Y	Y	Y	8-15 ft.
Winged Sumac	*Rhus copallinum*	Y	Y	Y	Y	5-8 ft.
Northern Bayberry	*Myrica pnsylvanica*	Y		Y	Y	

Wooded Swamp | ***Native Plant List*** | **Squam Rock Land Trust**

Common Name	Scientific Name	Native to Essex County	Sun/Shade tolerance	Bird Value	Insect Value	Height
Red Osier Dogwood	*Swida sericea*	Y	FS-PSH	Y	Y	3-8 ft.
Elderberry	*Sambucus canadensis*	Y				
Spicebush	*Lindera benzoin*	Y	FS-SH	Y	Y	6-12 ft.
Flowering Dogwood	*Cornus florida*	Y	PSH-SH	Y	Y	20-30 ft.
Striped Maple	*Acer pensylvanicum*		PSH			45 ft.
Silver Maple	*Acer saccharinum*	Y	PSH		Y(238)	50-7- ft.
American Elm	*Ulmus americana*	Y	S-PSH	Y	Y	60-80 ft.
Red Maple	*Acer rubrum*	Y	FS-FSH	Y	Y	35-50 ft.
Tupelo	*Nyssa sylvatica*	Y	S-PSH	Y	Y	30-60 ft.
Swamp White Oak	*Quercus bicolor*	Y	S-PSH	Y	Y	60-8- ft.
Pin Oak	*Quercus palustrus*		Full sun	Y	Y	60-70 ft.
Black Willow	*Salix nigra*	Y	FS		Y(289)	30-40 ft.
Eastern Cottonwood	*Populus deltoides*	Y	FS		Y(249)	100 ft.
Pussy Willow	*Salix discolor*	Y	S-PSH	Y	Y	5-15 ft.
River Birch	*Betula nigra*	Y	S-PSH	Y	Y(284)	40-60 ft.
Winterberry	*Ilex verticillata*	Y	S-PSH	Y	Y	4-10 ft.
Inkberry	*Ilex glabra*	Y	S-PSH	Y	Y	3-6 ft.
Mountain Laurel	*Kalmia latifolia*	Y	PSH-SH		Y	5-12 ft.
American Cranberry	*Viburnum trilobum*	Y	S-PSH	Y	Y	5-12 ft.
Cinnamon Fern	*Osmunda cinnamomeum*	Y	S-FSH			2-4 ft.
Royal Fern	*Osmunda regalis*	Y	S-PSH			2-4 ft.
Interrupted Fern	*Osmunda claytoniana*	Y	PSH-SH			2-3 ft.
Solomon's Seal	*Polygonatum pubescens*	Y	PSH-SH	Y	Y	8-16 in.
Common Cattail	*Typhia latifolia*	Y	S			10 ft.
Eastern Woodland Sedge	*Carex blanda*	Y	PSH-SH			1-3 ft.
Jewelweed	*Impatiens capensis*	Y	PSH	Y	Y	3-5 ft.
Blue Iris	*Iris versicolor*	Y	S-PSH		y	1-3 fi.

Coastal Forest | *Native Plant List* | Squam Rock Land Trust

Common Name	Scientific Name	Native to Essex County	Sun/Shade tolerance	Bird Value	Insect Value	Height
Maple-leaved Viburnum	*Viburnum acerifolium*	Y	S-SH	Y	Y	3-6 ft.
Witch Hazel	*Hamamelis virginiana*	Y	S-SH		Y	6-15 ft.
American Holly	*Ilex opaca*	Y	S-PSH	Y	Y	12-30 ft
Mountain Laurel	*Kalmia latifolia*	Y	S-SH		Y	4-10 ft.
Pitch Pine	*Pinus Rigida*	Y	S-PSH	Y	Y(200)	30-60 ft.
Eastern White Pine	*Pinus strobus*	Y	S-PSH	Y	Y(200)	60-90 ft.
Balsam Fir	*Abies balsamea*	Y	S-PSH	Y	Y	35-60 ft.
Red Cedar	*Juniperus virginiana*	Y	S-PSH	Y	Y	15-30 ft.
Gray Birch	*Betula populifolia*	Y	S-PSH	Y	Y	20-40 ft.
White Oak	*Quercus alba*	Y	S-PSH	Y	Y(436)	60-80 ft.
Red Oak	*Quercus rubra*	Y	S-PSH	Y	Y	60-80 ft.
Black Oak	*Quercus velutina*	Y	Sun	Y	Y	50-60 ft.
Red Maple	*Acer rubrum*	Y	S-PSH	Y	Y	35-50 ft.
Linden	*Tilia americana*	Y	S-PSH	Y	Y	50-70 ft.
Quaking Aspen	*Populus tremuloides*	Y	S-PSH	Y	Y(249)	25-55 ft.
Paper Birch	*Betula papyrifera*	Y	S-PSH	Y	Y	25-45 ft.
Sassafrass	*Sassafrass albidum*	Y	S-PSH	Y	Y	20-40
Black Cohosh	*Acetaea racemosa*	Y	PSH-SH		Y	3-5 ft.
Blackberry	*Rubus allegheniensis*	Y	S-SH	Y	Y	3-5 ft.
Blue Wood Aster	*Symphyotrichum cordifolium*	Y	PSH	Y	Y	1-3 ft.
Woodland Sunflower	*Helianthus diverticatus*	Y	S-PSH	Y	Y(66)	2-4 ft.

Coastal Forest | *Spring Ephemerals* |Squam Rock Land Trust

Common Name	Latin Name	Native	Sun/Shade tolerance	Bird Value	Insect Value	Height
Red Trillium	*Trillium erectum*	Y	PSH-SH		Y	8-14 in
Bloodroot	*Sanguinaria canadensis*	Y	PSH-SH		Y	4-8 1n.
Dutchman's Breeches	*Dicentra cucullaria*	Y	PSH		Y	3-5 in.
Mayapple	*Podophyllum peltatum*	Y	PSH-SH		Y	6-12
Canada Mayflower	*Maianthemum canadense*	Y	PSH-SH	Y	Y	2-4 in.
Trout Lily	*Erythronium americanum*	Y	PS-SH		Y	2-5 in.

Maritime Shrubland | *Native Plant List* | Squam Rock Pasture

Common Name	Scientific Name	Native to Essex County	Moisture require-ments	Bird Value	Insect Value	Height
Pussy willow	*Salix discolor*	Y	Avg./wet	Y	Y	5-15 ft.
Black chokeberry	*Aronia melanocarpa*	Y	Dry/wet/ avg.	Y	Y	3-10 ft.
Black Huckleberry	*Galyussacia baccata*	Y	Avg./Wet	Y	Y	1-3 ft.
Highbush blueberry	*Vaccinium corymbosum*	Y	High	Y	Y(217)	3-8 ft.
Joe-Pye Weed	*Eutrochium purpureum*	Y	Avg./wet	Y	Y	3-8 ft.
Sweet Pepperbush	*Clethra alnifolia*	Y	Avg. /wet		Y	3-6 ft.
Swam Azalea	*Rhododendron viscosum*	Y	Wet/avg.		Y	3-5 ft.
Marsh Elder	*Iva frutescens*	Y	Avg.	Y	Y	4-8 ft.
Buttonbush	*Cephalanthus occidentalis*	Y	Wet		Y	3-8 ft.
Winterberry	*Ilex verticillata*	Y	Avg./wet	Y	Y	4-10 ft.
Sheep Laurel	*Kalmia angustifolia*	Y	Avg./wet	Y	Y	1-3 ft.
Smooth Arrowood	*Viburnum dentatum*	Y	Average	Y	Y	6-10 ft.
Sensitive Fern	*Onoclea sensibilis*	Y	Avg./wet			1-2 ft.
Swamp Milkweed	*Asclepias incarnata*	Y	Avg./wet		Y	2-3 ft.