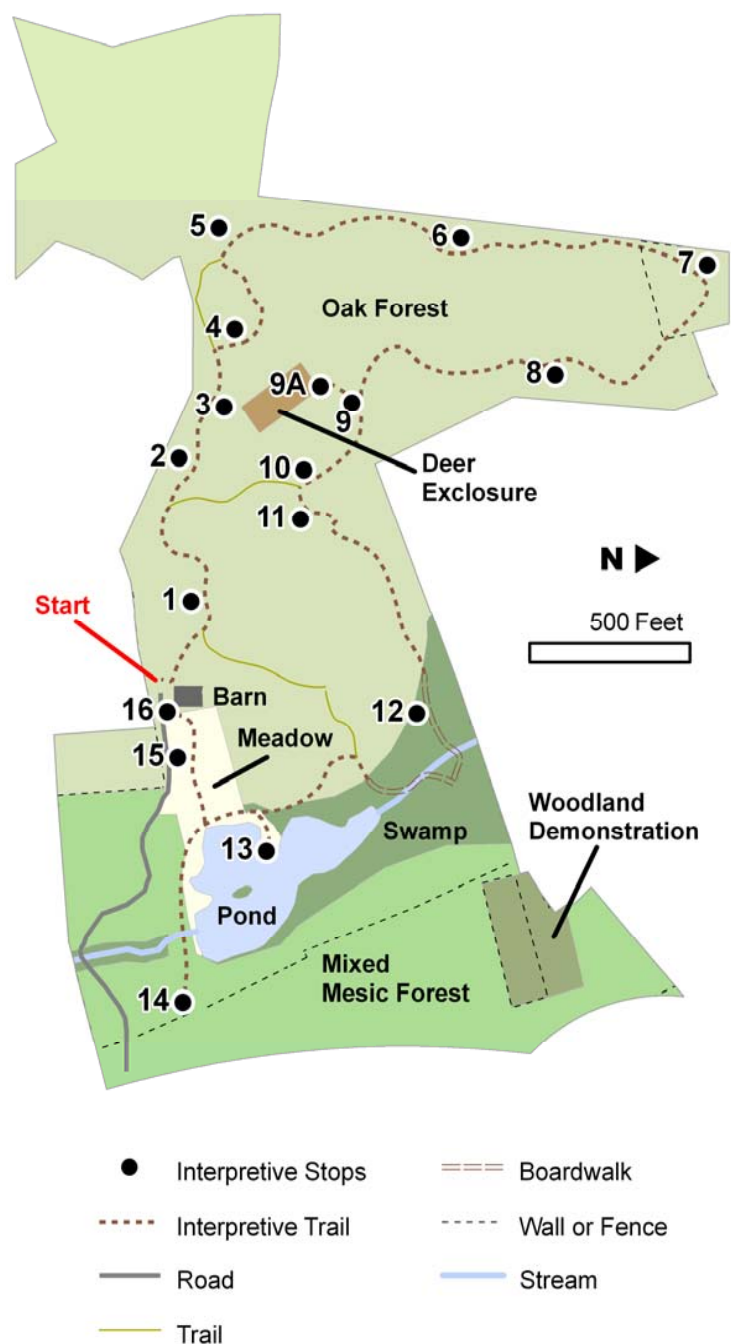


## Introduction

This trail will introduce you to a southwestern Connecticut landscape shaped by natural and human forces and to many of the scientific techniques and ecological practices we employ to understand and enhance it. An understanding of our dynamic natural environment is one of humanity's oldest and most important pursuits, critical to the procurement of food, as well as to the enhancement of our dwellings. Today, an additional purpose warrants a deep understanding of our natural surroundings: how best to conserve and manage our forestlands diminishing in extent each year to development. Thomas Jefferson recognized that the study of nature must be comprehensive, extend beyond the immediate, and be based on systematic observation. Jefferson's love of horticulture, his fascination with the natural past, and the value he placed on botanical study for the betterment of humanity epitomizes the spirit of this interpretive trail.

The trail is one and a half miles long, has 17 stops, and will take approximately one hour to complete at a leisurely pace. Enjoy your visit!



## Resilience of the New England Forest

**1** Notice the widely spaced trees and grassy understory. Open, savannah-like habitats such as this one are transient in the moist climate of the Northeastern United States, swiftly reverting back to forest without continuous human or natural disturbance such as harvesting or fire. This area was logged in 1977 and was maintained by annual mowing and selective tree removal until 2009.

**Biodiversity:** Savannahs offer diverse habitat and promote biodiversity in a forested landscape. Light demanding trees like quaking aspen (*Populus tremuloides*), red cedar (*Juniperus virginiana*), and gray birch (*Betula populifolia*) survive in these conditions but decline in closed forests. Birds such as chipping sparrow (*Spizella passerina*) and northern oriole (*Icterus galbula*) also prefer savannahs over forest and grasslands.

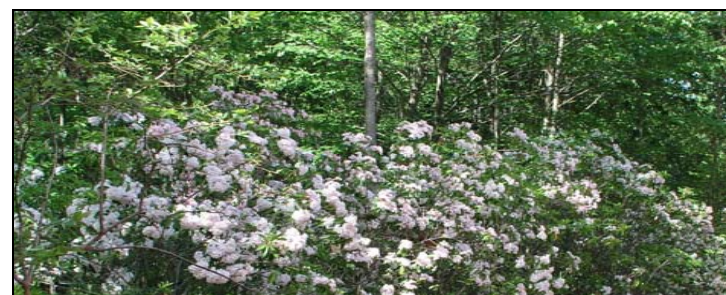
## Ridgetop Oak Forest

**2** Scarlet and chestnut oaks (*Quercus coccinea* and *Q. prinus*), mountain laurel (*Kalmia latifolia*), huckleberry (*Gaylussacia baccata*), and a sparse herb layer characterize this upper slope and ridgetop community. Soils have eroded off this ridge leaving a thin veneer and exposed granitic bedrock containing few plant nutrients. Vegetation is limited to those species adapted to dry and nutrient poor conditions.

Oaks have been the dominant tree type in this region for almost 10,000 years. Today, oaks are much less abundant than they once were and have been replaced in many areas by red maple (*Acer rubrum*) and black birch (*Betula lenta*). Only in dry sites such as this one are oaks resistant to replacement.

**Foundation of the forest:** Oak acorns are the most important food source for wildlife in the Eastern forest and are the base of many complex ecological interactions between deer, small mammals, ticks, and caterpillars that ultimately affect both forest and human health. Per capita Lyme disease rates and the severity of gypsy moth caterpillar outbreaks can be traced back to the size of annual acorn crops.

## Mountain Laurel Understory

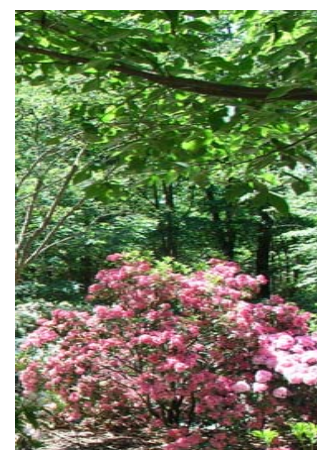


**3** Spreading across 55 acres, mountain laurel, the state flower of Connecticut, is the dominant tall shrub in this oak forest and regionally on rocky, dry ridgetops and slopes. Laurel responds vigorously to disturbance, and its abundance in these woods was likely enhanced by historical logging, the chestnut blight in the early 20<sup>th</sup> century, and gypsy moth outbreaks in the 1960s and 1980s that opened the forest canopy.

Notice the thinning foliage and the sparse sprouting at the base of this stem. Without canopy disturbance, little light reaches the forest floor causing laurel to decline. Deer also browse the lower leaves and basal sprouts of laurel heavily, contributing to the shrub's decline. To what extent the current decline of laurel is from deer browsing or reduced light is a question that Highstead researchers are studying.

## The Laurel Collection

**4** Inspired by the surrounding wild mountain laurel, this cultivated display of three laurel species showcases over 70 forms, hybrids and cultivars that emerged through the work of plant breeders and horticulturists for their specific ornamental attributes. Many cultivars are widely available through nurseries for use in home landscapes. The Collection is well-documented, and it offers opportunities for scientific inquiry and enables Highstead to participate in a network of institutions that curate and preserve plants worldwide.



Set on a previously disturbed site - a rock quarry - the laurel collection was begun in 1989. The site was filled and graded, footpaths established, and grouped plantings of laurel set out on raised beds of soil shaped to follow the contours of the site. Native trees were inserted among the laurel to restore a shade canopy. As the canopy matures, trees are pruned and thinned to increase light in the laurel understory and promote denser growth and heavier blooms.

Deer spray is applied annually in late fall - the noticeable blue coating on the leaves eventually breaks down and washes away.

## Part of Something Larger

**5** About 50 yards in front of you is the Highstead property boundary; beyond that lie conservation lands owned by the Town of Redding and the Nature Conservancy. Through the foresight of many private, municipal, and federal organizations, Highstead is part of a growing network of protected properties. From this vantage point, one sees that the forested landscape is not delineated by ownership boundaries; rather it seamlessly crosses them. Land conservation has traditionally worked within political bounds, and Highstead's regional conservation program is working to open up dialogues between groups across multiple political boundaries and points of view to facilitate future land protection.



## Mid-slope Oak Forest: logged but never cleared

**6** Red oak (*Quercus rubra*), mountain laurel, and witch hazel (*Hamamelis virginiana*) characterize this low-mid slope community. Red maple and black birch are common subcanopy trees.

Soils that have eroded off the ridgetop have accumulated on these lower slopes creating a deeper, moister substrate with more available nutrients. Red oak grows well in these conditions.

Notice the rocky soils, absence of stone walls, and large multiple stemmed trees: these are clues that this forest was not cleared for agriculture, but was logged regularly. The largest lime kiln in Connecticut was once located less than a mile away, and these forests undoubtedly provided fuel wood for the kiln. Oaks are relatively resistant to heavy cutting because they are prolific stump sprouters.

## Azalea Exclosure: an informal woodland restoration

**7** While documenting the plant material in this area, pinxterbloom azalea (*Rhododendron periclymenoides*) was found growing naturally, leading to the decision to introduce other azaleas native to Highstead and eastern North America. Over 300 deciduous azaleas representing fourteen species bloom sequentially from late April through July.



Fifty different species of native companion plants were also added to enhance aesthetics, increase the diversity of plant species for education, and lengthen the flowering season of the woodland.



Fenced since 1992, the site is presently undergoing a dramatic increase in herbs and woody plant regeneration due to the elimination of deer.

## Red Maple: a new dominant species

**8** Once largely limited to forested wetlands, red maple has today become the most abundant tree in southern New England, increasing from 1/20 of all trees prior to European settlement to almost one of every three trees today.

During the past 150 years, widespread farm abandonment and reforestation favored the colonization of red maple in old fields. More recently, fire suppression and the selective logging of oaks has favored red maple. Human land use practices have therefore shifted the composition of our forests away from oaks and toward red maple.

**An invasive species?** Because of its widespread colonization of old fields and its unmatched ability to grow in a variety of habitats, red maple has been listed as an invasive plant by some authorities. Interestingly, its current abundance in southern New England is almost identical to that of white oak in the pre-settlement forest. It may be natural for a single tree species, superbly adapted to the current environment and disturbance regime, to dominate over all others.

## Long-term Forest Dynamics Grid

9 Notice the short metal pole with brass cap; this post marks the corner of a 400 square meter permanent vegetation plot. A grid of permanent vegetation plots was surveyed and permanently marked across Highstead to (1) study the current forest conditions, including the distribution and abundance of all native and exotic plant species and (2) enable long-term monitoring of forest response to climate change, forest pathogens, deer browsing, and other disturbances.

**Science Shaping Conservation:** Permanent vegetation plots are one of the simplest and most powerful tools to document environmental change. Data from these plots are valuable for land managers, conservation groups and policymakers at a local and regional scale.



— Proceed into the woods on the blue dotted spur trail —

## Documenting the Impact of a Large Herbivore

9A Notice the twigs on the mountain laurel behind you. When abundant, white-tailed deer (*Odocoileus virginianus*) are an important forest disturbance capable of changing forest composition and reducing wildflower, shrub, and tree seedling abundance and diversity. To determine how deer are affecting this forest, we erected this exclosure in 2007 to compare the vegetation protected from deer browsing inside the fence to the vegetation exposed to browsing outside the fence. Can you notice any differences between the vegetation inside and outside of the fence?



Deer are an integral part of the Eastern forest ecosystem, and browsing damage is therefore a natural disturbance process. Deer browsing is also not the only process that limits tree regeneration and wildflower abundance. Other forces include mountain laurel shrub den-

— Return to the gravel path and turn right —

## White Oak: relict of a once-dominant species

10 Prior to European settlement, white oak (*Quercus alba*) was the most abundant tree species in the region, accounting for one of every three trees. Today it comprises only one of every 20. Colonial land clearance and logging, acorn consumption by livestock, and 20<sup>th</sup> century fire suppression likely contributed to the decline of Connecticut's state tree.

The extinction of the passenger pigeon (*Ectopistes migratorius*), once the most abundant bird on Earth, may also have contributed to the decline of the white oak. Each spring, 3-5 billion pigeons migrated to the Northeast and fed on bechnuts, chestnuts, and red oak acorns, which had lain

dormant over the winter; white oak acorns germinate in the fall and therefore escaped being eaten by the pigeons in spring.

**Forest Dynamics and Sound Stewardship:** White oak's decline is an example of a dynamic forest shaped by human activities, whereas the extinction of the passenger pigeon in 1914 from overhunting is a senseless tragedy. Distinguishing acceptable forest change from the reckless demise of a species is a central challenge in forest conservation and management.

## American Chestnut: a lesson in forest vulnerability

11 At the time of European settlement, American Chestnut (*Castanea dentata*) was the 2nd most abundant tree species in Redding and an important species across southern New England. In the early 1900s it was eliminated as a canopy tree across its entire range in the Eastern United States by the introduced Asian Chestnut fungus (*Cryphonectria parasitica*). This pathogen invades and kills the trunk but not the roots, leaving chestnut to persist as an understory sapling sprout.



Forest pests and pathogens have been introduced at an alarming rate into North America over the past century, mostly on imported nursery stock and wooden shipping containers. In addition to the chestnut blight, the butternut canker, beech bark disease, hemlock woolly adelgid, Dutch elm disease, and gypsy moth have all taken their toll on native trees in this region.

(*American Chestnuts, 1910. Photo courtesy of the Forest History Society, Durham, North Carolina.*)

## Forested Wetland

12 Notice the abrupt vegetation change from mountain laurel to sweet pepperbush (*Clethra alnifolia*) and skunk cabbage (*Symplocarpus foetidus*). Poorly drained soils define this wetland boundary. Forested wetlands such as this one are saturated with water for at least some portion of the growing season.

Wetlands act as holding basins during storms. By dispersing and reducing the velocity of water, wetlands temporarily stem runoff and release it gradually over time, lowering flood peaks and bank erosion downstream. Wetlands also support a large number of rare species. Box turtles (*Terrapene carolina*), a species of special concern in Connecticut, inhabit this wetland.

**Loss of an Important habitat:** By the 1980s an estimated 74% of the original wetlands in Connecticut had been destroyed by drainage and reclamation projects associated with agriculture and development.

## Pond

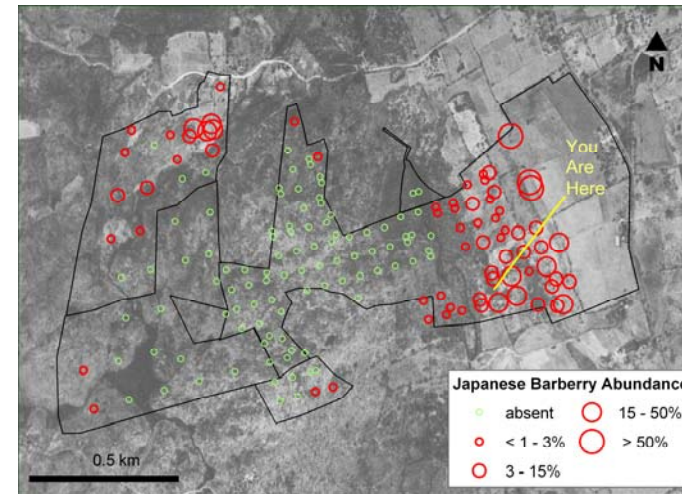
13 Created in 1986, this pond was formed by an earthen dam that impounds rainwater runoff and seepage from the surrounding hills. It is also fed by Tannery Brook, an intermittent stream flowing into the pond from the adjacent wooded swamp and out by way of an overflow.

The pond maintains a fairly stable water level and its open water and woody and herbaceous vegetation support diverse wildlife communities associated with inland ponds and marshes.

## Mixed Mesic Forest: formerly cleared/currently invaded

14 Notice the stone wall in front of you. This wall or fence marks an old field boundary. Early settlers took advantage of the deep, moist and relatively nutrient rich soils on this side of the property and cleared the original forest for pasture and crop fields. This area remained open into the 20<sup>th</sup> century before it was abandoned and reverted back to forest. The combination of soils and land use history have produced a different flora here than on the rocky and historically wooded area west of the swamp. Red maple, tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), and spicebush (*Lindera benzoin*) are characteristic native plants in this community.

**Non native invasive plants:** About 35% of Connecticut's flora is comprised of "alien" species, 5% of which are considered "invasive" or aggressive competitors with native plants. The dense understory shrub you see in this forest is Japanese barberry (*Berberis thunbergii*), one of Connecticut's most invasive plants. Notice in this 1934 aerial photo the close connection between the modern distribution of barberry and the location of historically cleared forests (denoted by the light, smooth textured areas beneath the red circles). Barberry was able to establish in the open fields but not the forests, and has persisted after a forest canopy developed on the former field.



— Turn back toward the pond and proceed to the meadow —

## Meadow

15 This meadow began as an open area covered with dredgings from the pond that was used to demonstrate the feasibility of establishing a flowering meadow from seed. Initially planted with a mix of clover and grass seed to prevent erosion, one-half of the central area of the hillside was subsequently seeded with North American native prairie grasses and forbs. Different management regimes were applied, and at the conclusion of the experiment nine years later, the seeded area yielded more than twice as many native species and was less prone to invasive species colonization than the unseeded area. Can you guess which side was seeded?

Today the meadow is maintained as habitat for wildlife, including songbirds, butterflies and other pollinating insects that depend on native wildflowers and grasses to complete their life cycle. It is mowed annually, after seed-drop, to prevent transitioning to forest.

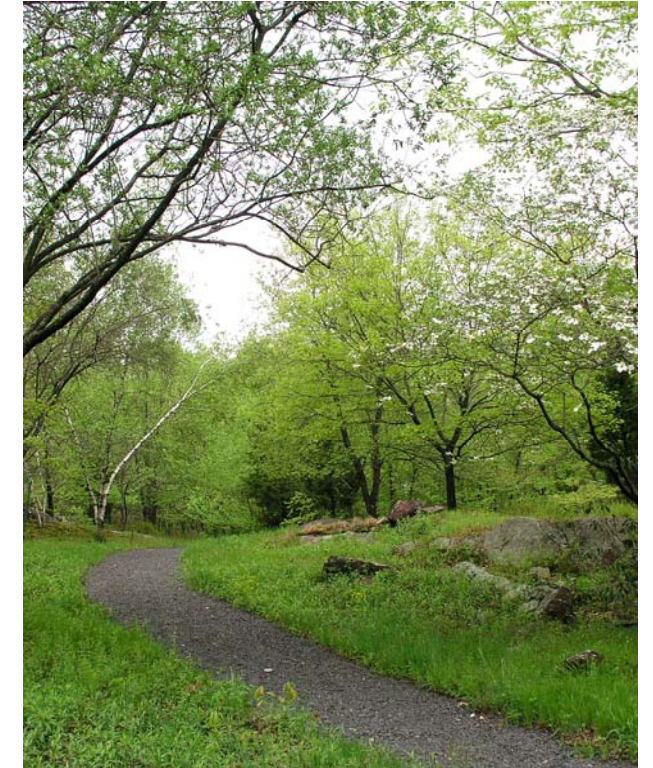
## Barn Landscape

16 Inspired by the surrounding natural landscape, the planting before you consists of species adapted to similar site conditions. The combination of trees, shrubs and ground covers of differing sizes mimics the structure of the semi-open woodland observed earlier at Stop 1.

Planting like this blends the Barn into its natural surroundings and helps maintain the look and feel of a Connecticut landscape.

# Highstead Interpretive Trail

## A Self-guided Tour of a Southwestern Connecticut Landscape



Highstead was formed in 1982 when Mr. and Mrs. James C. Dudley set aside an initial 36 acres of woodland as a sanctuary for the study and appreciation of native plants, animals, and woodland habitats. In responding to the important need for woodland conservation and education, and through additional gifts of land by the Dudleys, Highstead has grown into a center for land conservation, ecological research, and the enhancement of native landscapes.

Our mission is "to inspire curiosity and build knowledge about plants and wooded landscapes in order to enhance life, preserve nature, and advance sound stewardship practices."

For the protection of the fragile plant environment and ecological experiments, please, no dogs, bicycles, or smoking. Kindly stay on the trails.

Highstead

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