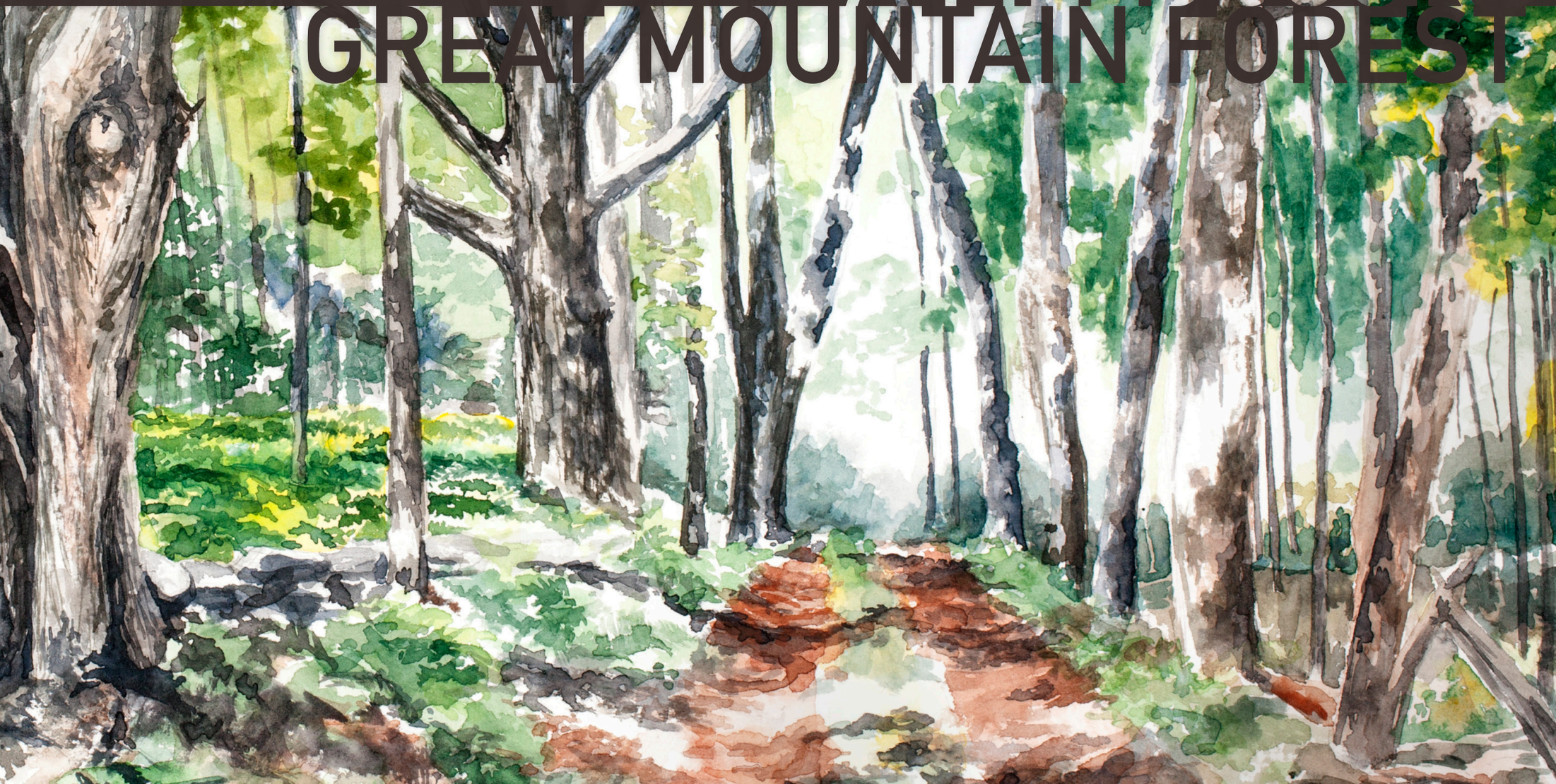
A FIELDBOOK OF THE GREAT MOUNTAIN FOREST



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SITES OF INTEREST: UNIQUE NATURAL COMMUNITIES

One approach to landscape ecology is to ask two simple questions: What here is unique? And what here is typical? In New England as a whole, alpine communities are rare and unique, as are beach dunes. And hemlock-hardwood forests are typical. In other regions, such as in the southern United States, this forest type would be unique.

Great Mountain Forest contains a number of unique natural communities as well as many unusual human-created communities (e.g. katsura-dawn redwood-tulip poplar forest, for example). While those human-created sites are interesting, and many of those are described in the *Cultural Landscape* or *Forest Management* sections, here we describe nine communities that are unique or atypical in Great Mountain Forest, or New England more generally.

The dominant natural cover type is equally important as the unusual ones. For this section we call that the *Matrix Forest*. This is the dominant forest cover type on GMF. The matrix forest of GMF contains a variety of species found in varying proportions depending on the site's topographic setting, specific substrate, and disturbance history. The following table lists species typically found in the matrix forest, albeit in mixed proportions with occasionally absent species.

The Matrix Forest dominates mid-topographic positions at GMF. In the lowest elevations, one encounters swamps (hemlock and/or red spruce dominated; see Spruce Swamps in this section) or other open wetlands. At higher elevations, forests become drier and oak-dominated with sporadic balds (see the Oak Communities and Bald Communities in this section). The Matrix Forest, therefore, is a mesic, widespread communities type occurring largely in between these two extremes.

SPECIES	COMMON NAME	NOTES
Tsuga canadensis	Eastern Hemlock	declining; rarely absent
Fagus grandifolia	American Beech	occasional
Betula alleghaniensis	Yellow Birch	occasional
Prunus serotina	Black Cherry	common, often large size
Quercus rubra	Red Oak	occasionally absent
Betula lenta	Black Birch	common
Acer saccharum	Sugar Maple	occasionally absent
Acer rubrum	Red Maple	common
Kalmia latifolia	Mountain laurel	occasionally absent
Hamamalis virginiana	Witch Hazel	common
Panax trifolius	Dwarf Ginseng	relatively common in season
Osmunda claytoniana	Interrupted fern	common
Dennstaedtia puncti-lobula	Hay scented fern	patchy

By definition, the Matrix Forest can be found almost any where in GMF. We find it in places that were not heavily agricultural (cleared), not too dry (upper slopes) or too wet (bottomlands) or too rich (lowest elevations where specific geology changes). What follows in this section are the gems in between: the sites that are too dry, too wet, too rich, or too old to be a part of the matrix forest.

Human disturbance has been a significant driver of community composition in Great Mountain Forest for centuries or millennia. It is useful to consider natural disturbance, as well as the two other forces driving community composition and structure on landscapes: topography and substrate. Together, the three of them can account for all the variability found in a forest ecosystem (Wessels 1997).

Topography drives vegetation distribution through aspect and slope. Southern aspects have warm, dry sited species, while north-facing aspects typically contain mesic, cool sited species. Substrate variability comes from soils moisture, nutrients, bedrock characteristics, etc. Disturbance can be natural and include wind throw (the most common disturbance in New England), hurricanes, fire, etc. Human caused disturbance can include fire, land cover changes to agriculture (or other), and logging from single tree selection to clear cutting. On the following page is an idealized cross section of Great Mountain Forest community types.

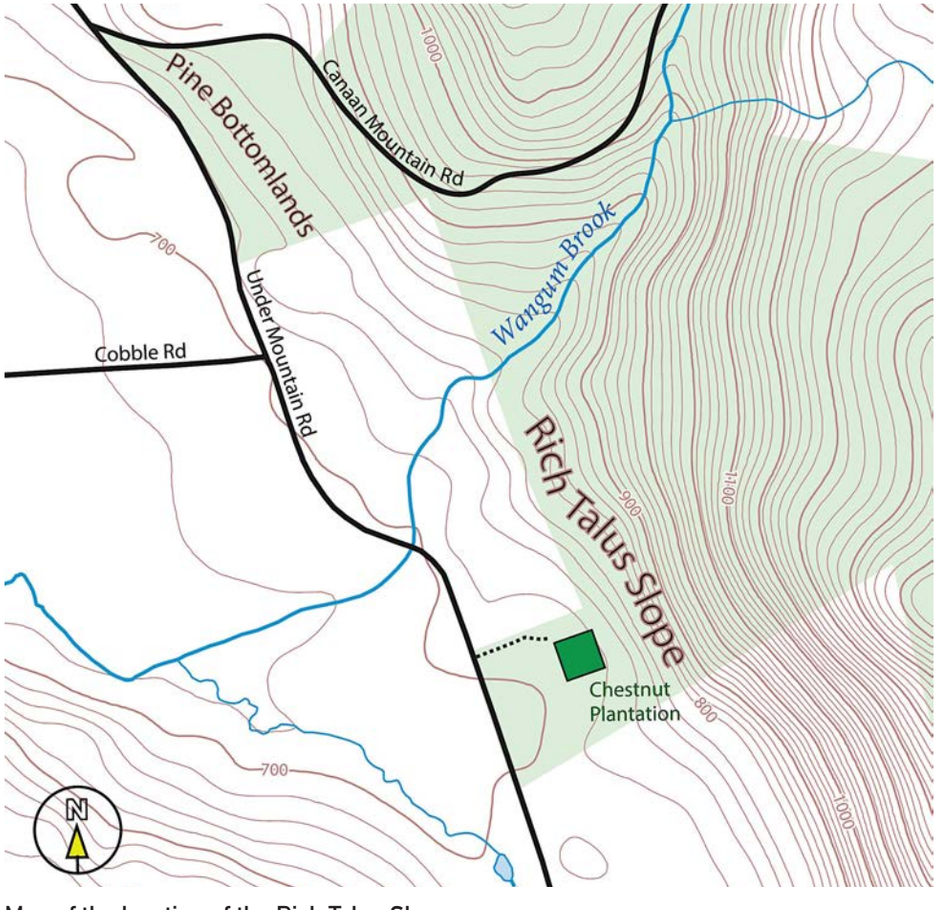
NATURAL COMMUNITIES 1: RICH TALUS SLOPE

Summary

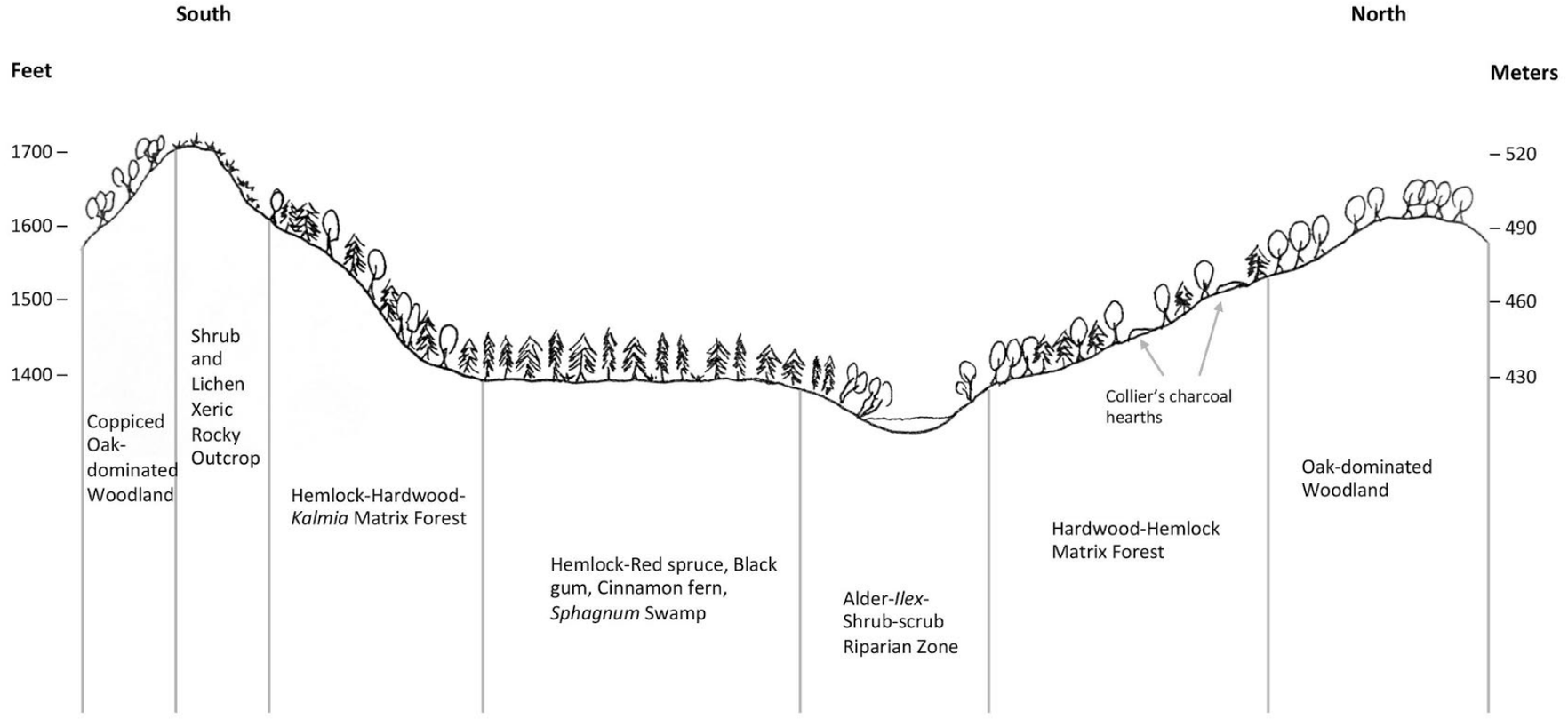
The site contains one of the richest forest herbaceous flora sites in Great Mountain Forest. Identified as a Rich Talus Slope community by Mickelson (2000), the site contains excellent to outstanding spring ephemeral diversity scattered among large blocks of calcium rich and acidic rocks. Spring ephemerals flower typically from late April to mid-May.

Access

Access is from Under Mountain Road, 0.7 miles south of Canaan Mt Road. Park in the grass at the Chestnut Orchard on Under Mountain Road. Parking coordinates: 41°56'30.90" N; 73°17'02.00"W



Map of the location of the Rick Talus Slope



Idealized Vegetation Cross-section from Great Mountain Forest. This simplified illustration of GMF vegetation shows patterns of community arrangement with regard to topographic position, aspect, hydrology, and to some degree, disturbance. The oak-dominated woodlands (far left and right) occur on ridges in sub-xeric environments with extensive previous disturbance. They are described in this section. The rare rocky outcrop communities, also described in this section, occur on summits and cliff areas lacking extensive soil development such as Stoneman, Blackberry Hill, and Collier's Cliff. The hemlock-hardwood matrix forest is described briefly in this section. It comprises the dominant community type in GMF. South facing slopes often have more oak and less hemlock. The hemlock-spruce swamp occurs at some higher elevation bottomland areas with high water table. It is described in this section as Red Spruce Swamps.

Specific Location

From Under Mountain Road parking, walk 100 meters to the Chestnut Orchard, and another 100 meters into forest. Coordinates: 41°56'33.50"N; 73°16'53.50"W

Comparative or Nearby Sites

Chestnut Orchard is adjacent.

Appalachian Forest is an extension of this community but is richer in tree diversity.

Bartholomew's Cobble, located in Canaan, CT and adjacent Mass, is a site with quartzite and marble and has the highest fern diversity in North America.

Description

This site contains one of the best floristic areas in GMF. Calciphilic vegetation (trees and herbs) occurs among large blocky rocks fallen from the steep slope above. The trees and herbs indicate rich soil and are atypical elsewhere in GMF. Controlled largely by geological differences, this site is

exceptional and unlike others in GMF. Land use history contributes to the site's richness, having not been cleared for agriculture or cleared by timber cutting. The terrain is steep and rugged with large blocks of local rock (mainly acidic schist). To a certain degree, this prevented intensive land use.

Local geology, as it pertains to the diverse flora at the Rich Talus Slope, is described below. This section also provides interpretation of the land use history based on observable features as well as a list of herbaceous plants found on the site.

Geology

The site's geology contributes to its richness. Unlike the majority of GMF, which occurs on hard, acidic, Canaan Mt. Schist, this site lies on the edge of the calcium-rich base member of the Middle Ordovician-aged Walloomsac Schist. This unit is described by the USGS as: Dark-gray to white, massive to layered schistose or phyllitic calcite-phlogopite marble. Black to dark-or silvery-gray, rarely layered schist or phyllite, composed of quartz, albite, and commonly garnet and staurolite or sillimanite (locally strongly retrograded to chlorite and muscovite). Locally feldspathic or calcareous near the base.

These units lie close to Stockbridge Marble, the dominant rock type of the Housatonic Valley in NW CT. This calcium-rich rock occurs proximal to Walloomsac Schist and forms the quarry rock of Canaan, CT. It is described by USGS as: White, pink, cream, and light-gray, generally well bedded dolomitic marble interlayered with phyllite and schist and with siltstone, sandstone, or quartzite, commonly dolomitic.

Most of GMF is comprised of Canaan Mountain Schist, as described by USGS: Dark-gray to silvery, generally rusty weathering, medium- to coarse-grained, well-foliated, massive to well-layered schist and schistose gneiss, composed of quartz, plagioclase, biotite, muscovite, and generally garnet and sillimanite; also layers of amphibolite.

Because of the different geologic substrates in GMF, and this site in paticular, we find different vegetative response. Whereas most of GMF contains plant communities of more acidic-loving nature, this site contains calciphiles and other plants indicative of rich sites.

Soils

Deeper soils occur low on the slope (toe slope), near the valley bottom. Abundant populations of *Dicentra* sp. and wild leeks occur here. Among the rocks, pockets of soil facilitate growth. However, among the rocks are shallow soil pockets, which permit plants such as columbine.

Trees

Trees indicating a rich site include: sugar maple; bitternut hickory; white ash; basswood; shagbark hickory; tulip poplar; big tooth aspen; and hop-hornbeam. Trees typically measure up to 20-inches in diameter. A few coppiced trees indicate prior land-use. Higher up the slope, where soils become thinner and the influence of nutrient-rich rocks becomes less pronounced, trees change to red oak, black birch, some white oak, and hemlock becomes dominant. Still higher, chestnut oak occurs with low-bush blueberry on thin-soiled balds and outcrops. It is a remarkable transition in such a short area, driven largely by substrate differences.

Land Use History

Two features indicate land use history on this site. Wire fences run uphill on the southern property line. This indicates grazing, though it is unclear which side of the fence the grazing occurred on (or both sides). Barbs indicate cattle (not sheep). Second, a few coppiced trees (bitternut hickory and red oak) show cutting has occurred in the past. The difficulty of the terrain, however, would have made this a challenging and infrequent activity. Malformed old growth (>250 years) black birch and white oak higher up the slope, beyond the area of outstanding flora, show the landscape was not completely cleared. Steep slopes often were not intensively exploited throughout the eastern forest and frequently contain outstanding remnants of native vegetation, including old growth trees and rich herbaceous flora. Evidence of fire, in the form of basal scars, occurred on the upper slopes. No charcoal hearths were found.

A list of herbaceous and woody vegetation (no trees) from the site is below. The list is not exhaustive. In general, a lot of these species rarely occur elsewhere in GMF, or occur in very low densities. Here, however, they are generally abundant.

Importance

This site contains rich herbaceous flora not commonly found elsewhere in GMF. The rich soil, a result of calcium-rich geology, hydrology, and the complex topography and access that prevented high levels of human disturbance, creates conditions for the site's rich flora. The site is fairly isolated from other similar sites. In eastern Forests, the ratio of tree species to herbaceous species is about 1:5 (Gillium, 2007).

SPECIES	COMMON NAME	NOTES
Trillium erectum	Wake-robin; red trillium	Common
Viola sp.	Blue Violet	
*Aquilegia canadensis**	Wild Columbine	Uncommon; on *Ca* rocks
Sambucus canadensis	Elderberry	Common among rocks
Sanguinaria canadensis	Blood Root	
Gallium sp.	Bedstraw	Occasional; near edge
Actaea pachypoda	Doll's eyes	
*Dicentra cucullaria**	Dutchman's breeches	Abundant
Ribes cynosbati	Prickly gooseberry	On rocks and cliffs
Polygonatum biflorum	Solomon's-seal	
Asarum canadense	Wild ginger	Unusually dense patches
*Allium tricoccum**	Wild leeks	Abundant; lower slope
Caulophyllum thalictroides	Blue cohosh	Could be Early Blue Cohosh
Cardamine maxima	Large Toothwort	Listed Rare; confirm
Hamamelis virginiana	Witch-hazel	
Mitella nuda	Miterwort	
Erythronium americanum	American Trout-lily	
Rubus sp.	Raspberry sp.	
Anemone americana	Blunt-lobed hepatica	
Ranunculus abortivus	Small flower crowfoot	
Maianthemum racemosum	Solomon's plume	
Viburnum acerifolium	Maple leaf viburnum	
Arisaema triphyllum	Jack-in-the-pulpit	
Uvularia sp.	Bellwort	
Maianthemum canadense	Canada mayflower; May lily	
Parthenocissus quinquefolia	Virginia creeper	Uncommon; edges
Vitis sp.	Wild grape sp.	Edge
Boechera laevigata	Smooth rock cress	Rocky sites; higher up
Trientalis borealis	Starflower	
Aralia nudicaulis	Wild sarsaparilla	
Claytonia virginica	Spring beauty	
Alliaria petiolata	Garlic mustard	Exotic; lower slope; edge
Carex hitchcockiana	Hitchcock's Sedge	Noted by Mickelson (2000)

* Indicated by McLachlan and Bazely (2001) as species particularly sensitive to forest disturbance.

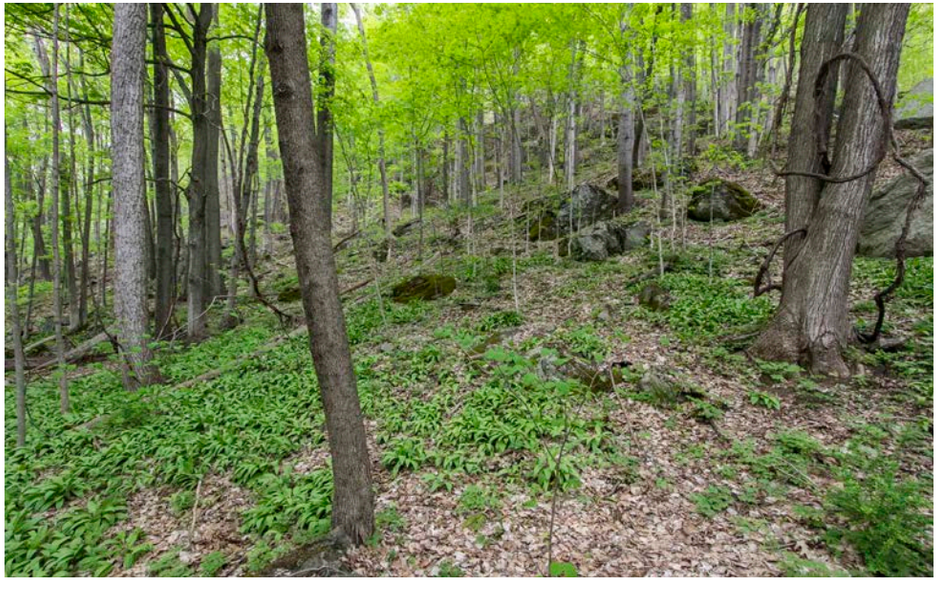
A host of spring ephemeral wildflowers at hte Rich Talus Slope. This Photo shows: Wake robin; Dutchman's breeches; Solomon's seal; round-leaved hepatica; Thalictrum; as well as sedges and Christmas fern.

The robust population of Wild leeks could be subject to exploitation. GoBotany of the New England Wildflower Society states: "a study concluded that a 10% harvest once every ten years is the maximum sustainable harvest." Please avoid the temptation to harvest wild leeks at a site of this significance.

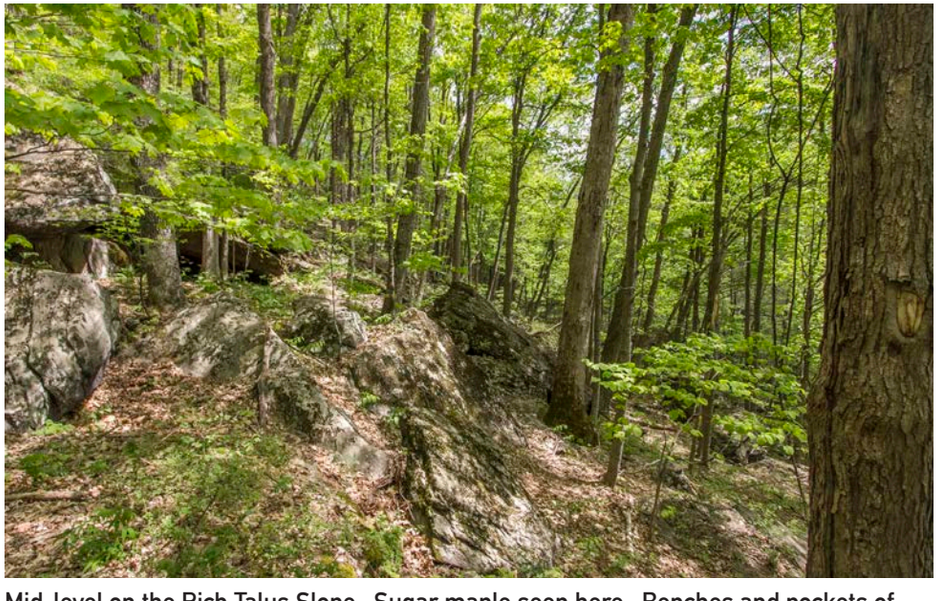
The herbaceous flora is a fascinating and beautiful group of often-overlooked significance. Their presence signifies the rich, innumerable number of relationships present in the eastern deciduous forest.

Research Questions

How will this site be affected by ash decline from the emerald ash borer?
How is garlic mustard competing with native herbaceous flora?
Do soil conditions differ in various topographic positions among the rocks? How does tis affect plant distribution?



Base of the slope at the Rich Talus Slope showing an exceptionally large patch of Wild Leeks, with sugar maple, among talus. The base of the slope is very rich with its deep soil. It is also close to the edge, indicated here by early successional wild grape (Vitis sp.)



Mid-level on the Rich Talus Slope. Sugar maple seen here. Benches and pockets of soil form among the course rocks, which forms much structure and topography for wildlife. The difficult terrain prevented historic intensive exploitation.

Resources

Field Identification

Newcomb, L. 1977. Newcomb's wildflower guide. Little, Brown, and Company.

Horn, D. et al., 2005. Wildflowers of Tennessee, the Ohio Valley and the Southern Appalachians. Lone Pine Publishers.

Review Articles

Gilliam, F. 2007. The Ecological significance of the herbaceous layer in temperate forest ecosystems. BioScience. 57(10): 845-858.

Whigham, D. 2004. Ecology of Woodland Herbs in Temperate Deciduous Forests. Annual Review of Ecology, Evolution, and Systematics. 35: 583-621.

Other Articles

Singleton, R., et al. 2001. Forest herb colonization of post-agricultural forests in central New York State, USA. Journal of Ecology. 89: 325–338.

Motzkin, G., et al. 1999. Vegetation patterns in heterogeneous landscapes: The importance of history and environment. Journal of Vegetation Science 10: 903-920.

McLachlan, S. and D. Bazely. 2001. Recovery patterns of understory herbs and their use as indicators of deciduous forest regeneration. Conservation Biology. 15(1): 98-110.

Flinn, K. and M. Vellend. 2005. Recovery of forest plant communities in post-agricultural landscapes. Frontiers in Ecology and Environment. 3(5): 243–250.

Hermy, M. and K. Verheyen. 2007. Legacies of the past in the present-day forest: a review of past land-use effects on forest plant species composition and diversity. Ecological Restoration. 22: 361–371.

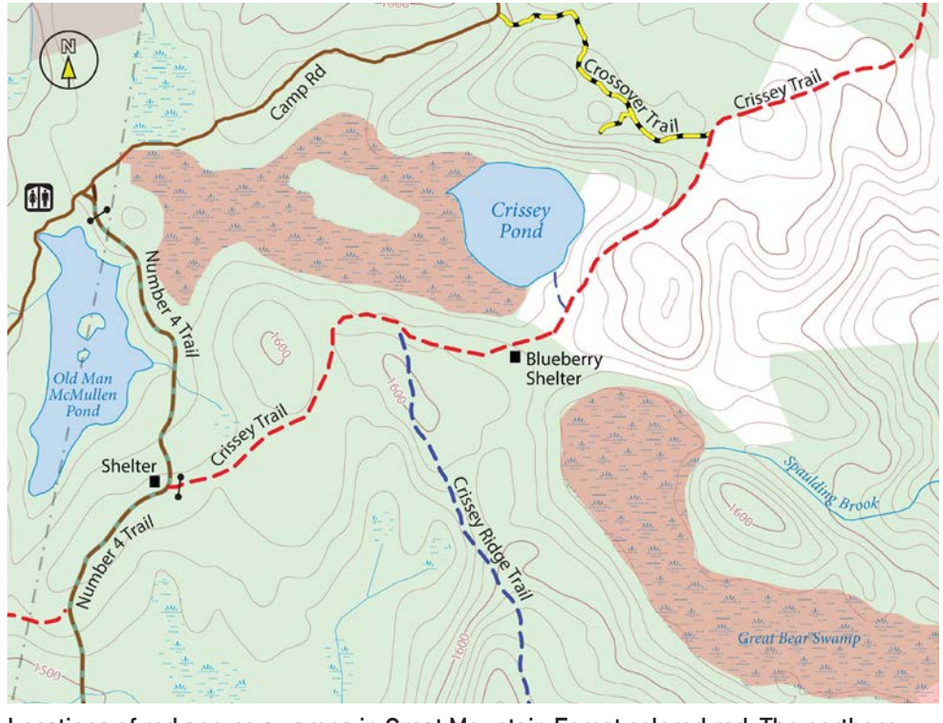
NATURAL COMMUNITIES 2: RED SPRUCE SWAMP

Summary

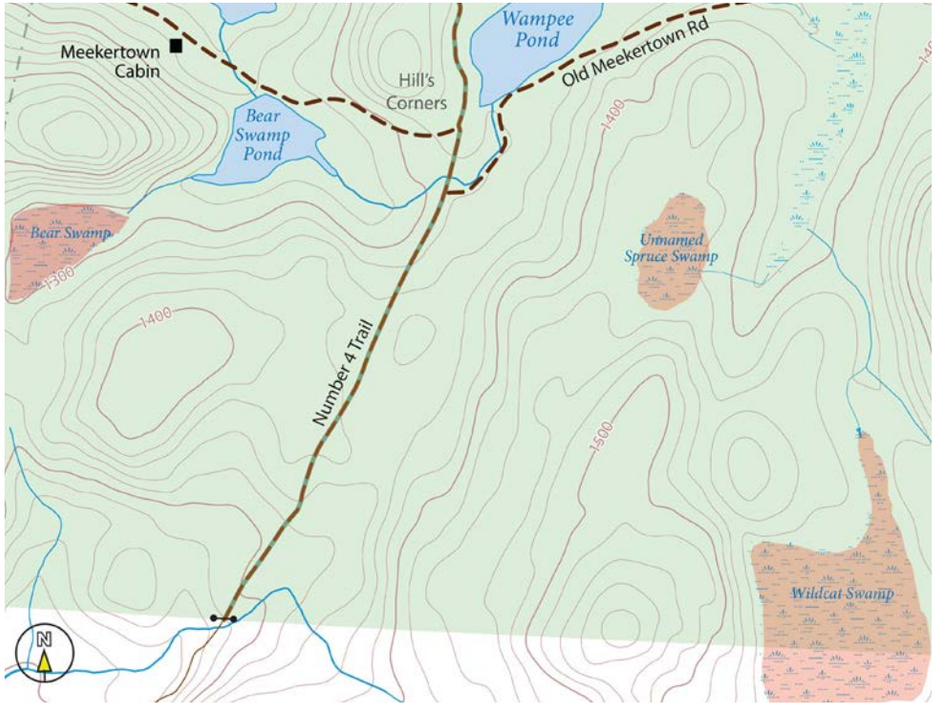
This entry describes the red spruce swamp, identified at several isolated locations in GMF. This is a southern reach for red spruce in New England found here in high-elevation acidic basins with poor drainage.

Access

Road access for all sites is via GMF internal roads and permission is required for vehicles. See specific locations below. Great Bear and Crissey Swamps are easiest to access.



Locations of red spruce swamps in Great Mountain Forest colored red. The northern swamps of Crissey and Great Bear have easiest access. Bear Swamp in south lacks spruce. The site described here is the unnamed swamp southeast of Wampee Pond.



Specific Location

Unnamed Spruce Swamp southeast of Wampee Pond: 41°55'23.67"N; 73°14'33.55"W
Wildcat Swamp: 41°54'56.52" N; 73°14'16.13" W
Great Bear Swamp: 41°57'15.93"N; 73°14'8.35"W

Description

This is a community type found in GMF at several locations, however, this entry describes specifically the small, unnamed swamp south of Wampee Pond. Although the site is termed "red spruce swamp" a more accurate descriptor for the community would be an eastern hemlock – red spruce – sphagnum swamp. Even this, however, fails to capture the nuance and beauty of these exceptional communities.

The site is located on a ridge at 1430 feet (436 m). On the ridge, however, it's situated in a shallow, poorly drained basin. The water table is at or near the surface and the ground is covered with Sphagnum spp. and other mosses, small patches of open water, and low hummocks containing trees and shrubs. Bedrock is acidic, old, Canaan Mountain Schist. The standing water and *Sphagnum* further acidifies the substrate.

On the following page is a list of species identified during our brief recognizance. The list is not complete. Several sedges and many mosses were unknown to us. Additional botanical work could be done in these communities.

It should be clear to any hiker or explorer of the Northeast's mountain landscapes that this list resembles community types or individual species typically found much farther north and at higher elevations. *Clintonia*, *Coptis*, *Sphagnum*, and red spruce, as well as the moose that frequent this site, all indicate a cold, northerly environment. Perhaps the site's topographic setting high on a ridge (cold) and also in a basin (colder) facilitates this. Nonetheless, the fact that Mountain laurel occurs here suggests temperatures do not reach those of the boreal communities in which most species here are found; laurel does not survive below -20°F (-30°C). Perhaps then, it is the site's cool, moist and acidic nature that creates the quasi-boreal composition.

SPECIES	COMMON NAME	NOTES
Tsuga canadensis	Eastern Hemlock	Dominant
Acer rubens	Red Maple	Occasional
Betula alleghaniensis	Yellow Birch	Occasional
Picea rubens	Red Spruce	Occasional; up to 15" dbh
Nyssa sylvatica	Black Gum	Uncommon; old growth
Pinus strobus	White Pine	Edges
Quercus rubrus	Red Oak	Seedlings
Nemopanthus mucronatus	Mountain Holly	Common
Ilex verticillata	Winterberry Holly	Occasional
Vaccinium coryumbosum	Highbush blueberry	Common
Kalmia latifolia	Mountain laurel	Common
Osmunda cinnamomea	Cinnamon fern	Abundant
Thelipteris simulata	Bog fern	Common
Calla palustris	Wild calla; water arum	Wet pools
Coptis trifolia	Goldthread	Common
Clintonia borealis	Blue-bead lily	Uncommon
Sphagnum spp.	Sphagnum spp.	Abundant
Cornus canadensis	Bunchberry	Common
Gaultheria hispidula	Creeping snowberry	Rare

Red Spruce Picea rubens overstory with Sphagnum spp. and graminoid ground cover. Water is near the surface and subtle variations in elevation create depressions with Sphagnum and hummocks with ferns and other herbaceous plants.

A more open area in the redspruce swamp with standing water and wild calla (Calla palustris). These pockets tend to form around the edges of the swamps.

An old-growth black gum (***Nyssa sylvatica***) tree stands in the Unnamed Red Spruce Swamp. Cinnamon ferns cover the ground, occasionally mixed with bog fern. The black gums in this swamp are ancient – perhaps 500 years old, or older.

Mickelson (2000) identified additional species in other Red Spruce Swamps at GMF that may also occur at this site. These include: Creeping snowberry (*Gaultheria hispidula*); Labrador tea (*Rhododendron groenlandicum*); Northern yellow-eyed grass (*Xyris montana*).

This swamp contained abundant sign of moose (scat and tracks). Also seen were catbird and northern junco.

It is worth noting that the old-growth black gum trees reach perhaps 500 years. A look into the canopy of these trees reveals broken tops and regrowth. This is a very typical situation for this species. Where it grows on a ridge (in a swamp) it is subject to strong winds and ice storms. The wood is brittle and the tops easily break off. But the tree persists. Several of these trees were hollow, also typical for the species when reaching ancient status.

Importance

Several of these species reach their southern-most occurrence in New England here. Mickelson (2000) listed the Red Spruce swamps of GMF as moderately high diversity. Mickelson also noted several rare/threatened/engangered plants from these communities.

It is important to note this site is fragile and exploration should be limited to small groups at infrequent intervals.

Comparative or Nearby Sites

GMF contains several Red Spruce communities. These are mapped in Mickelson (2000). There is a charcoal hearth and fireplace at the north end of this swamp in the uplands.

Interestingly, other similar swamps including Bear Swamp (south of Wampato Pond) and the swamp south of Crissey Ridge are nearly identical in composition and structure, except that they contain no red spruce.

Research Questions

Why do some swamps contain red spruce and others do not?
A complete botanical inventory of all swamps.
How has hydrology of these red spruce swamps changed in recent decades? And how will it change under future climate scenarios?
Do these swamps contain fossil pollen that would aid in uncovering paleo-ecology of GMF?
Is red spruce subject to the same atmospheric stressors occurring in high-elevation red spruce communities farther north?

Resources

Mickelson, J. 2000. Great Mountain Forest Conservation Evaluation: vegetation and natural community rapid assessment. The Nature Conservancy, Middletown CT.

NATURAL COMMUNITIES 3: OLD GROWTH

Summary

At least five small stands of old-growth forest, primarily eastern hemlock, occur in GMF. This entry describes them as well as the general context of old growth in GMF. The definition of "old growth" is fraught with ambiguity, opinion, and debate, and these sites, to some purist, may not qualify as "old growth". Nonetheless, a stand of hemlocks (and/or other species) reaching 300-400 years old qualifies as old growth or ancient forest under many definitions.

Scattered throughout GMF are also individual old growth trees, defined here as being trees over 250 years or near the maximum age for the species. Ancient hemlocks, red and white oaks, tulip poplar, black and yellow birch, black cherry, and black gum have been observed at GMF.

Access

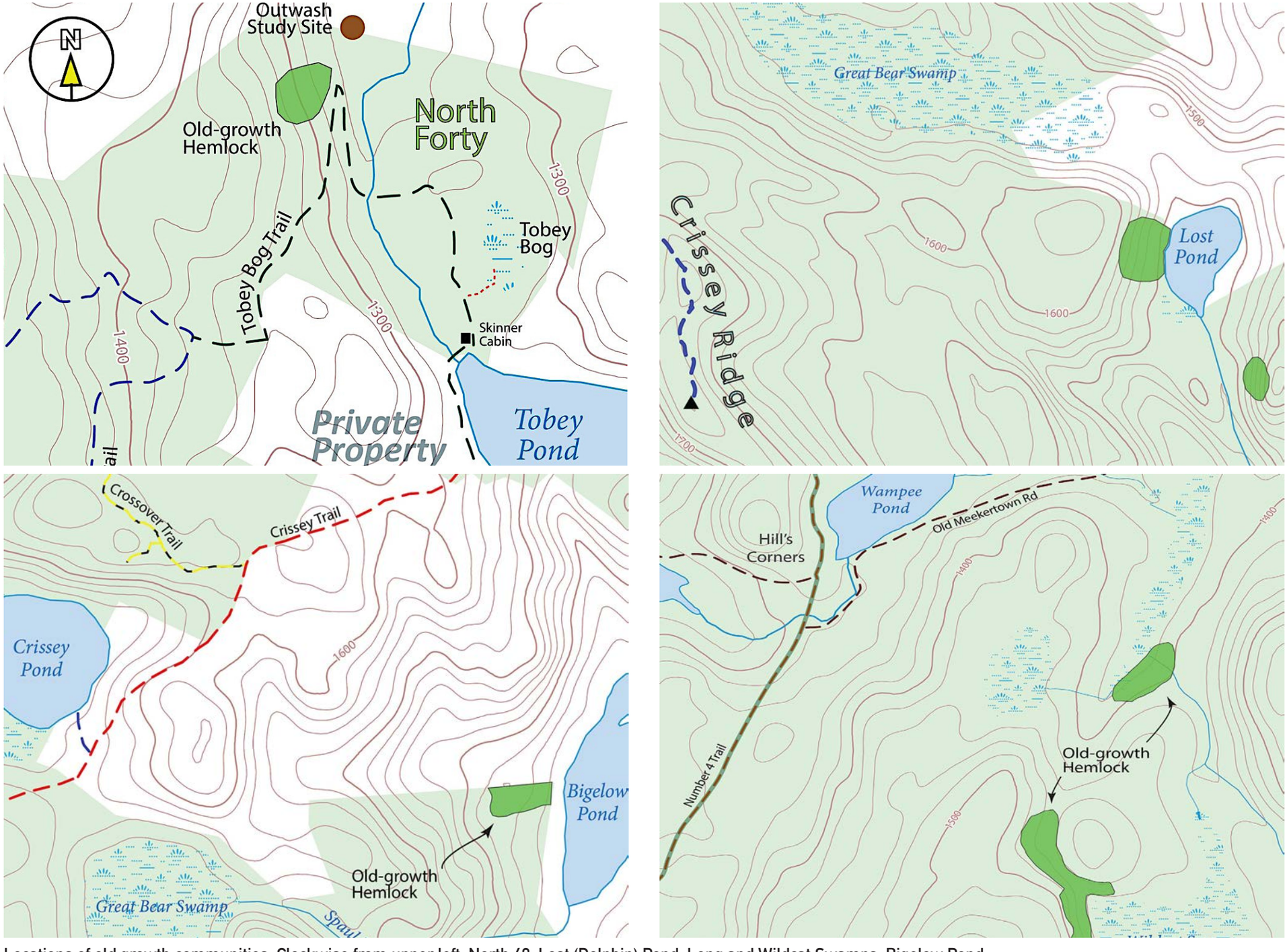
Lost (Dolphin) Pond: Access is via the Goodnow Trail to the property line at Lost Pond.
North 40: Access is via the gravel road near Tobey Pond and Tobey Bog.
Bigelow Pond: Best access via Crissey Trail and then off trail around Great Bear Swamp.
Wildcat Swamp: Access via Number 4 Trail.
Long Swamp: Access via Number 4 Trail.

Location

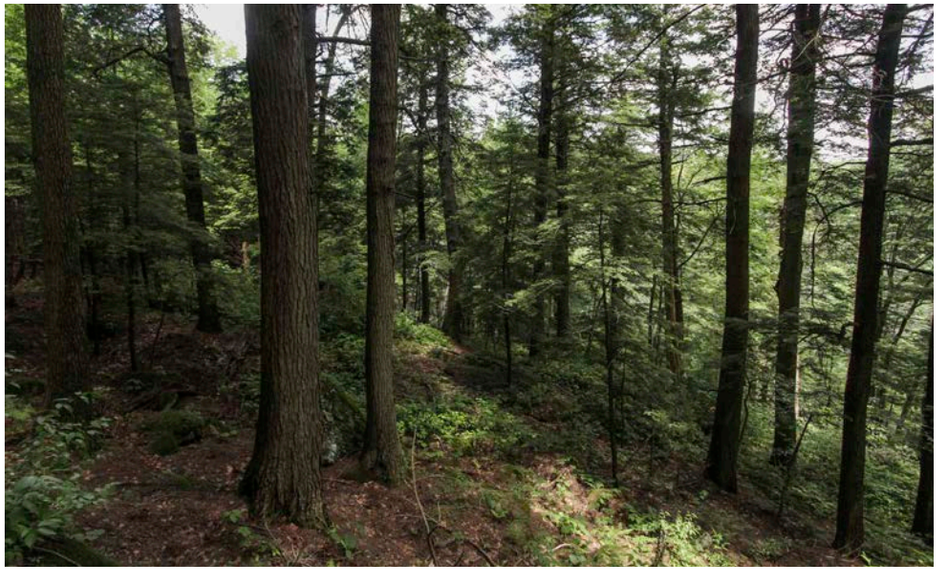
Lost (Dolphin) Pond: 41°56'54.39"N; 73°13'31.90"W
North 40: 41°58'50.13"N; 73°13'32.60"W
Bigelow Pond: 41°57'30.48"N; 73°13'41.42"W
Wildcat Swamp: 41°55'2.06"N; 73°14'28.85"W
Long Swamp: 41°55'22.31"N; 73°14'21.77"W

Description

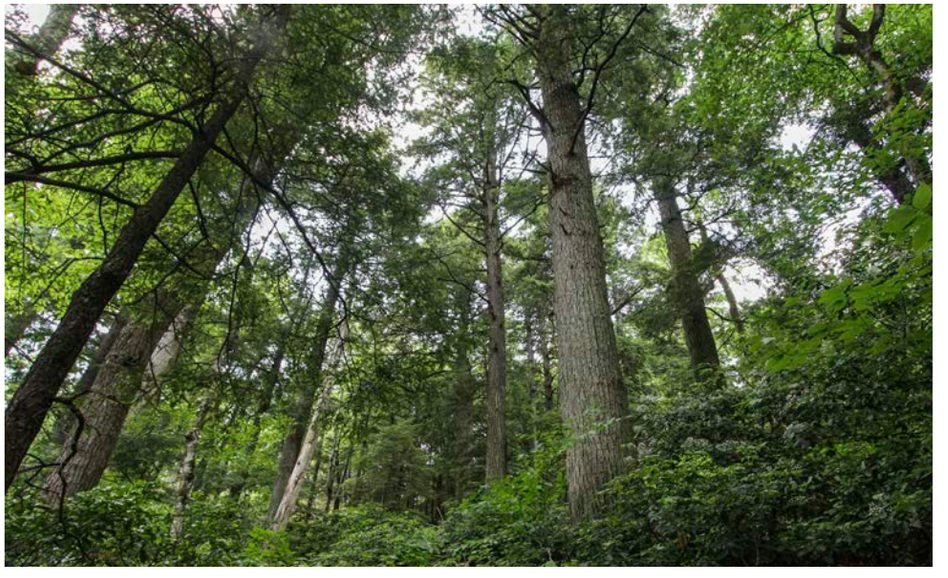
The concept of "old growth" is an ambiguous one. See Hilbert and Wiensczyk (2007) for a review of definitions. However, within the context of GMF, and the intense levels of forest exploitation and management that has occurred for over 200 years, certain characteristics elevate a forest stand to "old growth." These include structural characteristics (trees in all stages of development from seedlings to snags and downed logs), age (trees at the maximum ages for the species), and composition (species associated with



Locations of old growth communities. Clockwise from upper left: North 40; Lost (Dolphin) Pond; Long and Wildcat Swamps; Bigelow Pond.



Old Growth Hemlock forest on the west side of Wildcat Swamp. Note some of the trunks are sinuous, with gentle curves. This typically indicates trees over 250 years.



Old growth hemlocks and black birch (upper right) surrounded by mountain laurel near Wildcat Swamp.

late successional development). GMF contains several stands meeting one or all of these characteristics.

It is important to consider "old growth" as a continuum in space and time. A single 400-year old oak in a cleared meadow may be an "old growth" tree, but is clearly not a forest. Similarly, a 1000-acre forest of 200-year old trees that re-sprouted after a hurricane may also be considered "old growth."

Site Descriptions

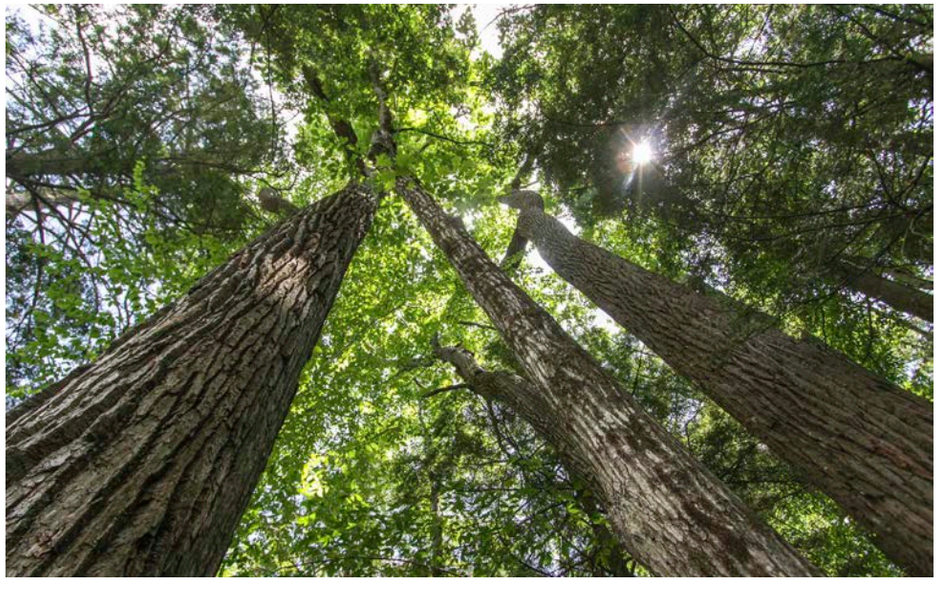
Lost (Dolphin) Pond: Winer (1955) mentions 4-acres on the west-facing-slope, SE of the pond. We encountered scattered hemlocks reaching perhaps 200-years or more. The area had been logged around 1980, though it doesn't look like a lot of hemlock was harvested. The old growth area was poorly defined and occurs on a steep slope.

The second area, suggested to us by Russell Russ, occurs on the west side of Lost Pond. These hemlocks were more impressive in stature and undoubtedly attain greater age. Tree characteristics suggest 300+ years. Several trees are large reaching close to 40" in diameter. Heights are also impressive. A few coppiced hardwoods suggest logging approximately 100-years ago. Contemporary beaver activity was also encountered. Old growth continued to the north edge of Lost Pond, though we did not map the exact extent.

North 40: This stand is probably the best known and most visited old growth site in GMF. It occurs along the gravel road near Tobey Bog. Old growth American beech and black birch also occur here. Many of the hemlock trees are tagged numerically for research. We did not map the extent of the stand but is believed to be only a few acres.

Bigelow Pond: east-facing slope on the west side of the pond. The hemlocks are impressive and old and they to spread on to adjacent TNC land. For this reason the extent of the stand was not mapped or explored thoroughly. Though the forest had been disturbed, individual old growth hemlock trees stretched away from Bigelow Pond for 100 meters or more.

Equally interesting, the entire slope to the east and southeast of Bigelow Pond contains numerous individual old growth hardwood trees and small stands of old growth hardwoods. With that in mind, the entire forest area is one of the more mature forest stands seen in GMF. Old growth tree species include: sugar maple, back cherry, red maple, yellow birch, and black birch. This area should be explored more thoroughly to determine disturbance history and stand ages.



Old growth tulip trees (left and right; young red oak in center). Tulip trees in New England are more typical on rich sites than acidic substrates, like the GMF plateau. No other mature tuplip trees have been found. It raises the question of whether tulip tree had greater importance prior to intense cutting in GMF or if these two trees are a bizarre anomaly.

LEFT: Old growth black cherry. As black cherry ages, the corn-flake bark becomes tighter and less flakey. RIGHT: Old growth eastern hemlock with green crustose lichen on the bark. Hemlock bark is exceptionally tannin rich and typically wards off epiphytic growth. After about 350 years, however, lichens are able to colonize the bark. The presence of such lichen indicates trees approximately that age or older.

Wildcat Swamp: This stand is not described by Winer (1955). It was identified during field exploration. The stand may be the best and largest old growth site in GMF. The outstanding section, located along the steep slope to the west of Wildcat Swamp, contains mainly hemlocks that reach impressive size and stature. Green lichen on the trunks suggests trees of at least 350 years. The understory contains patches of mountain laurel, and open areas. Old growth yellow birch, also in the 350-400 year range also occurs. A coppiced red oak near the upper edge of the stand suggests logging disturbance approximately 100 to 150 years ago. Basal scars on a hemlock indicate fire occurred on the site decades or centuries ago.

The old growth's extent continues to the north in a lowland area and also includes the swamp itself. The swamp is dominated by hemlock and also contains red spruce and black gum. In the center of the swamp, a highland area contains large stature hemlock, centuries old. Mature spruce also occurs, as does pink azalea (*Rhododendron periclymenoides*) only seen here at GMF.

Long Swamp: This stand occurs on a westerly slope at the SE end of Long Swamp and is 3-acres according to Winer (1955). He states this stand shows no sign of cutting. We identified an old growth stand larger than three acres, but we did not map the extent of the stand with detail. The stand is mainly hemlock with some black birch and many standing dead American chestnut snags. Tom Wessels, referring to the density of ancient trees in this site, called it "the nicest stand of old growth hemlock in New England."

Individual Old Growth Trees or Groups of Trees

Individual old growth trees occur occasionally in GMF. Features to look for include: rugose bark; crooked canopy branches; canopies resembling celery-tops; sinuous trunks; and large size. See Pederson (2010) for description on identification of old trees.

Importance

Old growth trees and forests are relatively rare in New England. With trees and small stands reaching 400-years, the sites are inspiring as much as they are interesting. Hemlocks take on a sentinel appearance more characteristic of western US forests.

Discussion concerning the dichotomy of nature and culture, what old growth is, the presettlement landscape, and whether we should manage for old growth could occur when groups explore these trees. Though such a discussion would occur in a small New England forest, the conversation is of global relevance. Philosophy and science meet here among ancient trees.

Nearby Sites

Outside GMF it is worth visiting Cathedral Pines, in nearby Cornwall, Conn. The 42-acre stand of former old growth white pine and hemlock was toppled by a tornado on July 10, 1989 although a smaller portion remains. The site was considered among the best "old growth" sites in New England. Patterson and Foster (1990) detail Cathedral Pine's human and natural disturbance history; most trees date to pasture abandonment around 1800. The site is owned and managed by The Nature Conservancy.

Research Ideas

Forest response to hemlock decline caused by the hemlock wooly adelgid.
Epiphitic lichens in old growth hemlock trees.
Soil ecology in old growth forests.
Characterization and disturbance history of mature forest (including old growth hemlocks and hardwoods) between Bigelow Pond and Great Bear Swamp.

Resources

Winer, H. 1955. History of Great Mountain Forest. Dissertation, Yale University. P.110-125 old growth.

Patterson, W. and D. Foster. 1990. Tabernacle Pines: the rest of the story. Journal of Forestry. December 1990: 23-25.

Pederson, N. 2010. External characteristics of old trees in the eastern deciduous forest. Natural Areas Journal 30(4): 396-407.

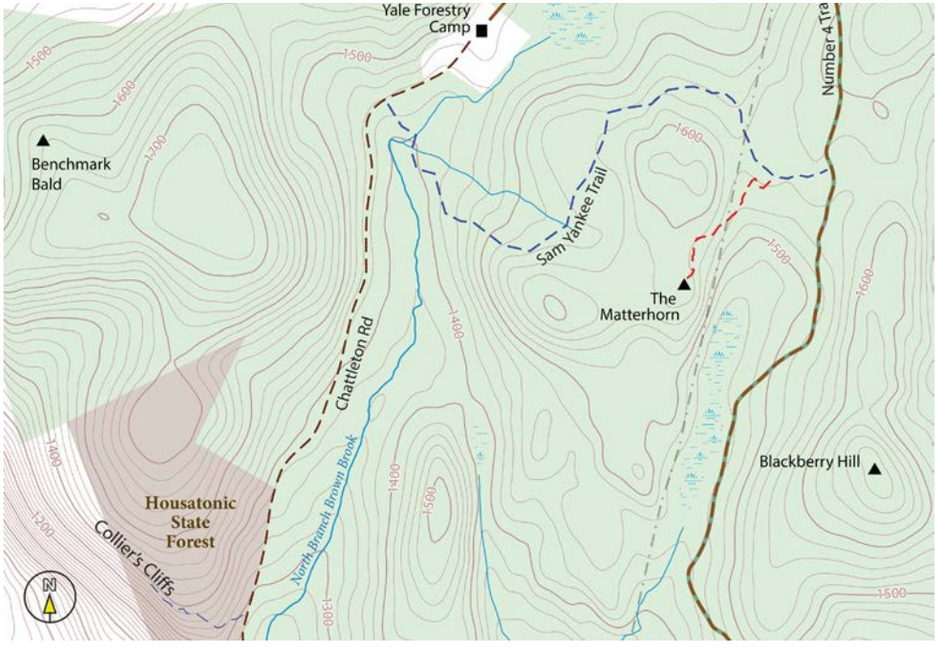
Hilbert, J and A. Wiensczyk. 2007. Old-growth definitions and management: A literature review. BC Journal of Ecosystems and Management, 8(1): 15-32.

NATURAL COMMUNITIES 4: BALDS AND ROCKY OUTCROPS

Summary

Great Mountain Forest's balds, barrens, and unique rocky outcrop communities are small in extent but provide one of the few naturally open environments found in the northeast. Such environments are characteristically dry, acidic, and offer limited soil, creating challenging conditions to which many species have adapted. And for the human visitor, they offer berries, sun, and at times, views. Some of these lichen communities are 200 years old – old growth just like the towering hemlocks.

GMF and adjacent portions of Housatonic State Forest provide 5 sites (listed here) for exploring and studying outcrop and bald communities. Each is unique and slightly different in its composition and environmental setting. Opportunities for research on these poorly understood communities abounds. Caution: These are exceptionally fragile communities and not ideal for large groups. Some contain rattlesnakes.



Map showing the four rocky outcrop communities nearest to Yale Camp. The Stoneman Mountain sites (not shown) are all located along the trail to the summit of Stoneman.

Access

The easiest sites to access include: 1) Matterhorn, via Sam Yankee Trail; 2) Blackberry Hill, via #4 Trail and bushwhack; and 3) Stoneman, via the Stoneman Trail.

Location

Stoneman:
Summit: 41°57'27.20"N 73°16'57.43"W Views of the Housatonic Valley and beyond
Lower balds: 41°57'42.11"N 73°16'55.20"W; 41°57'48.02"N 73°16'51.55"W; 41°57'50.68"N 73°16'45.48"W

Blackberry Hill: Limited views from either summit
South Bald: 41°56'16.06"N 73°14'59.65"W
North Summit: 41°56'18.26"N 73°15'0.63"W

Collier's Cliff: 41°56'8.20"N 73°16'15.87"W Excellent views of the Hollenbeck Valley

Matterhorn Area:
Matterhorn: 41°56'33.89"N 73°15'20.82"W Nice views toward Blackberry Hill
Benchmark Bald: 41°56'44.42"N 73°16'28.01"W (Not visited, views not known)

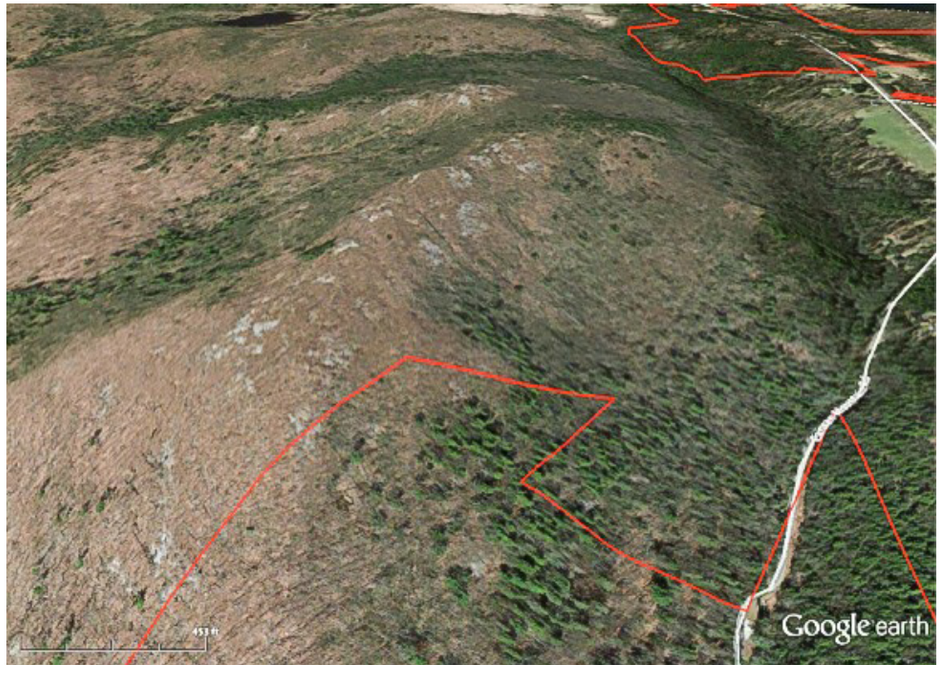
Description

The processes responsible for creating and upholding rocky outcrop communities at GMF begins with the most recent glaciation. Up until about 15,500 years ago, glaciers scoured and sculpted the hills of New England into ridges, domes, and cliffs. Disturbances, including fire, have prevented soil development ever since and it is the lack of soil that keeps rocky outcrop communities bald and barren. A lack of disturbance would allow soil to form, deepen, and provide substrate for shrubs and trees leading to the closed canopy forest we find over most of the region today.

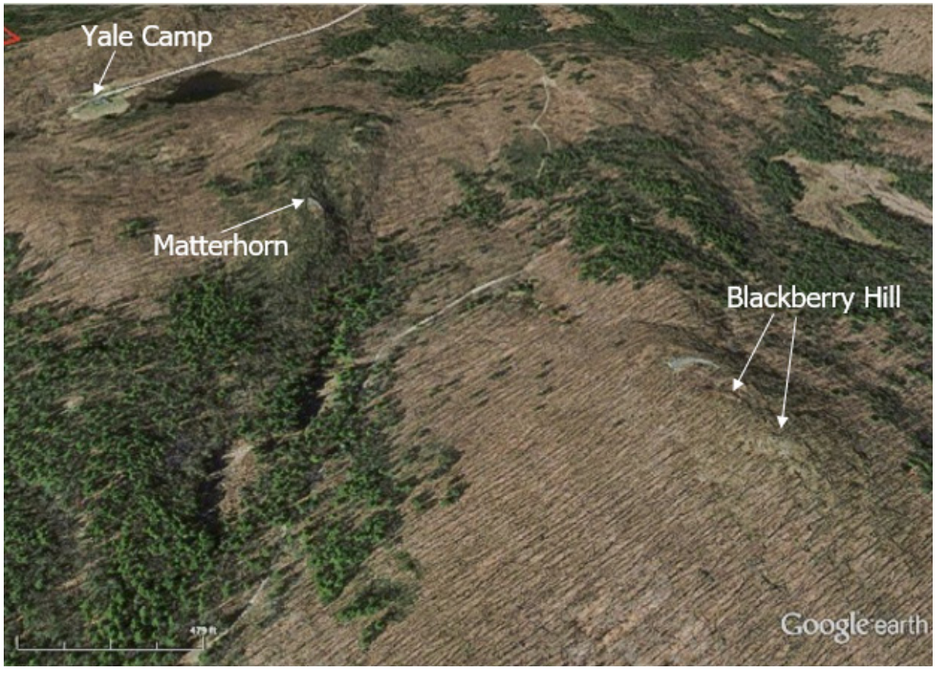
The thin soil environment does not retain moisture well and plants must adapt to these challenging conditions. They do this, in part, by emphasizing root growth over stem and branch growth. This enables plants to live within the means of the limited available moisture and low nutrients of dry, acidic, balds. We see this in the structure of the oaks and other trees on GMF balds: stunted growth, twisted branches, pruned canopies.

On the ground we see additional adaptation to the dry, thin-soil environment. Lines of vegetation traverse patches of open bedrock. These crevice communities form in bedrock cracks in which soil accumulates and moisture retained. Beginning with lichens, and then moss, graminoids, herbs, and shrubs, the degree of colonization of a crevice will depend on the depth and moisture retaining abilities of the soil. As vegetation develops, additional soil is created and trapped within the plants. This creates a feedback-loop where additional plant growth leads to additional soil, and so-on until a disturbance resets the clock. The succession process can be summed, perhaps over simplisticly with: crustose, foliose, fruticose, to forest.

The remaining bedrock is typically lichen-covered by all three common lichen forms. Crustose lichens are flat growths and nearly



Outcrops and balds on Stoneman Mountain. The red line is GMF boundary, and the bald-speckled Stoneman Mountain is largely on Housatonic State Forest. It contains a trail, which begins on GMF property. Stoneman contains the largest and best outcrop communities within the GMF area, and northwest Connecticut more generally. The road at right is Canaan Mountain Road. Orientation is looking north.



Rocky outcrops near Yale Camp. The #4 Trail bisects the image down the middle. Orientation looks north. These two balds are smaller in extent than Stoneman.

impossible to remove from the rock. Foliose lichens look more leaf or foliar-like, but are still rather two-dimensional. Fruiticose lichens are more three-dimensional in structure. All except crustose lichens are fragile and are crushed when walked on. This is especially true in dry weather when the lichens are in a stiff cryptobiotic state. When wet, lichens soften and are not as easily destroyed. Use caution when walking among lichens communities. Some pincushion lichen communities at GMF are at least 200 years old (old growth) and Tom Wessels considered them to be exemplary for New England.

One should pause to consider the processes taking place: the glacially created rock communities, slowly forming soil, with periodic setbacks by disturbance. As with most natural communities, the physical landscape (geology, topography, climate) shapes the biological response.

The human history of these communities in GMF remains unclear. Though they have been open for centuries, it's possible they were more (or less) open prior to the cultural landscape change from indigenous Americans to European-Americans. The role of fire in both cultures, and cutting in the latter culture, would have had an effect on these rocky communities. Coppiced trees, though small in diameter, show that one of the two disturbances has occurred recently. Nonetheless, both disturbances have played a role.

On the following page is a list of species identified during our brief recognizance. This list is not complete. Many graminoids and lichens were unknown. Additional botanical work should be done. Lichen diversity, in particular, should be documented.

Eastern red cedar is an interesting presence at Collier's Cliff. Cedar typically indicates more alkaline soils and it is possible that this site, on the western edge of GMF, is being influenced by the marble and/or limestone of the Hollenbeck and Housatonic Valleys.

Some characteristic bald communities found regionally, including pitch pine and scrub oak communities, do not occur on the balds of GMF. Neither of these species is found on GMF or adjacent balds. They are found locally on similar sites.

CAUTION

These sites contain fragile pin-cushion lichen communities that should be entered with caution. When stepped on during dry weather 200 year old *Cladonia* lichens can be crushed. Every effort should be made to remain on the trail, and if no trail exists one should remain only on open bedrock or other vegetation. Stoneman is inhabited by timber rattlesnakes.

Importance

Rocky Outcrop and Bald communities provide important landscape structure in an otherwise forested region. The sunny, warm, dry environment is wildlife rich. In the case of Stoneman Mountain, the community provides important habitat to timber rattlesnakes, especially during spring. Additional rare plants may also be present. Some areas of Stoneman and undescribed locations in GMF are old growth lichen communities and approximately 200 years old.

Nearby Sites

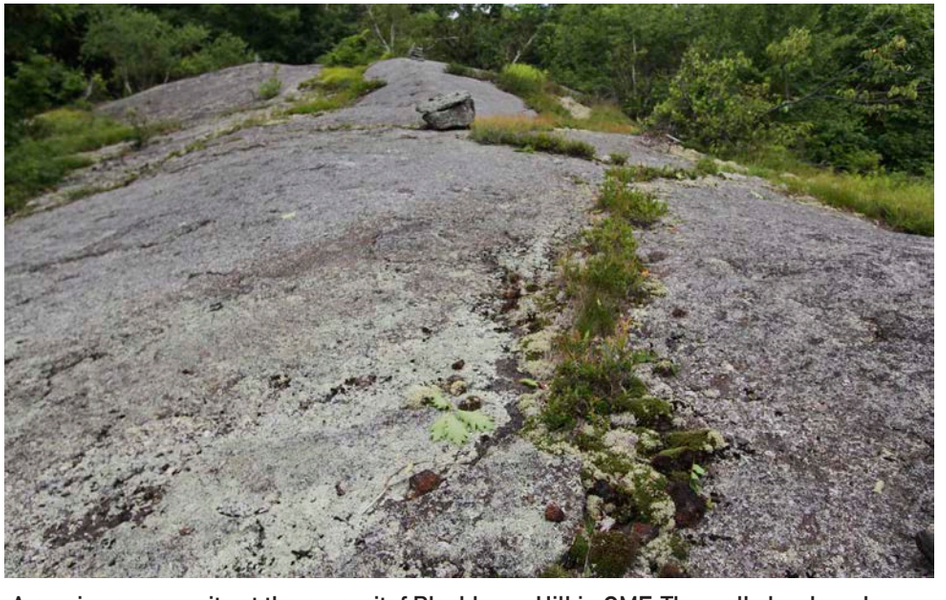
Nearby Mt Everett and Race Mountain in SW Mass., provides a similar, though higher elevation environment containing old-growth pitch pine communities. A small outcrop community occurs uphill from the Rich Talus Slope. The trail up Stoneman contains several points of interest.

Research Ideas

Fire and disturbance history on rocky outcrops and balds.
Succession on rocky outcrops.
Wildlife use of rocky outcrops and balds by patch size.
Lichen colonization and succession.
Human history of balds and outcrops in GMF or more broadly.
Trampling by humans in bald communities.

SPECIES	COMMON NAME	NOTES
Quercus rubra	Red Oak	
Quercus velutina	Black Oak	Probably most common
Quercus alba	White Oak	
Quercus montana	Chestnut oak	
Pinus strobus	White pine	
Prunus virginiana	Choke cherry	
Amelanchier sp.	Serviceberry	
Juniperus virginiana	Eastern red cedar	
Vaccinium stamineum	Deerberry	Specific to rocky sites
Vaccinium angustifolium	Low-bush blueberry	
Gaylussacia baccata	Huckleberry	
Diervilla lonicera	Bush-honeysuckle	not to be confused with exotic shrub honeysuckles (*Loncera* sp.)
Hypoxis hirsuta	Yellow star-grass	
Rubus flagellaris	Dewberry	
Schizachyrium scoparium	Little bluestem	
Tridentalis borealis	Starflower	
Polytrichum sp.	Haircap moss	Found on dry sites or mineral soil
Stereocaulon sp.		Lichen
Cladonia sp.	Reindeer lichen	several species of Cladonia occur
Xanthoparmelia sp.	Rock shield lichens	
Umbilicaria sp.	Rock tripe	

Outcrop community at Collier's Cliff on State Forest lands adjacent to GMF. Haircap moss, grows with oak seedlings and lowbush blueberry among lichen-covered bedrock. This site has excellent views of the Hollenbeck Valley.



A crevice community at the summitof Blackberry Hill in GMF. The well-developed community contains a variety of mosses, lichens, grasses, and blueberry. As plant parts and rock fragments continue to break off and become trapped among the vegetation, soil develops and more vegetation will grow.

A broad expanse of almost 2-acres of open, bedrock-dominated barren community on the Stoneman Trail. Scattered trees (oaks and pines here) grow where roots can penetrate. Lichens, mosses, herbs and grasses cover the still rocky areas. Regular disturbance from fire helps these communities thrive.

A band of ***Cladonia sp.*** lichens among graminoids and boulders on the south bald of Backberry Hill. The band of lichens spans an area lacking soil, while vascular plants cover more soil rich areas. A patch of hay-scented fern occurs in the background. The rocks were left by glaciers and are also covered in lichens.

A community of pin-cushion lichens on the Stoneman Trail. The Cladonia sp. lichens are very old and very fragile. Note the shrubs at right growing along a crevice community and the single young pine emerging in bedrock. How large can it grow?

Resources

McMullin, T. and F. Anderson. 2014. Common Lichens of Northeastern North America: A Field Guide. New York Botanical Garden Press.

Wessels, T. 2001. The Granite Landscape: A Natural History of America's Mountain Domes, from Acadia to Yosemite. Countryman Press.

Gaige, M. 2015. Short, bald, and beautiful: the New England open summit. AMC Outdoors. Link.

Swain, P.C. & J.B. Kearsley. 2001. Acidic Rocky Summit/Rock Outcrop. In: Classification of the Natural Communities of Massachusetts. Version 1.3. Natural Heritage & Endangered Species Program, Division of Fisheries& Wildlife. Westborough, MA. Link

Hale, M.E. 1950. The lichens of Aton Forest, Conn. The Bryologist 53(3): 181-213.

NATURAL COMMUNITIES 5: OAK WOODLANDS

Summary

GMF's oak woodlands form distinctive, open, park-like communities quite unlike the tall, closed canopy matrix forest. These communities tend to occur on higher, southerly aspect, slopes with low-density canopy. The oak woodlands of GMF are southern in character and reach the northern extent of their range in central New England.

Access

None are particularly close to road, nor are they close to trails. All need to be accessed by navigating off-trail.

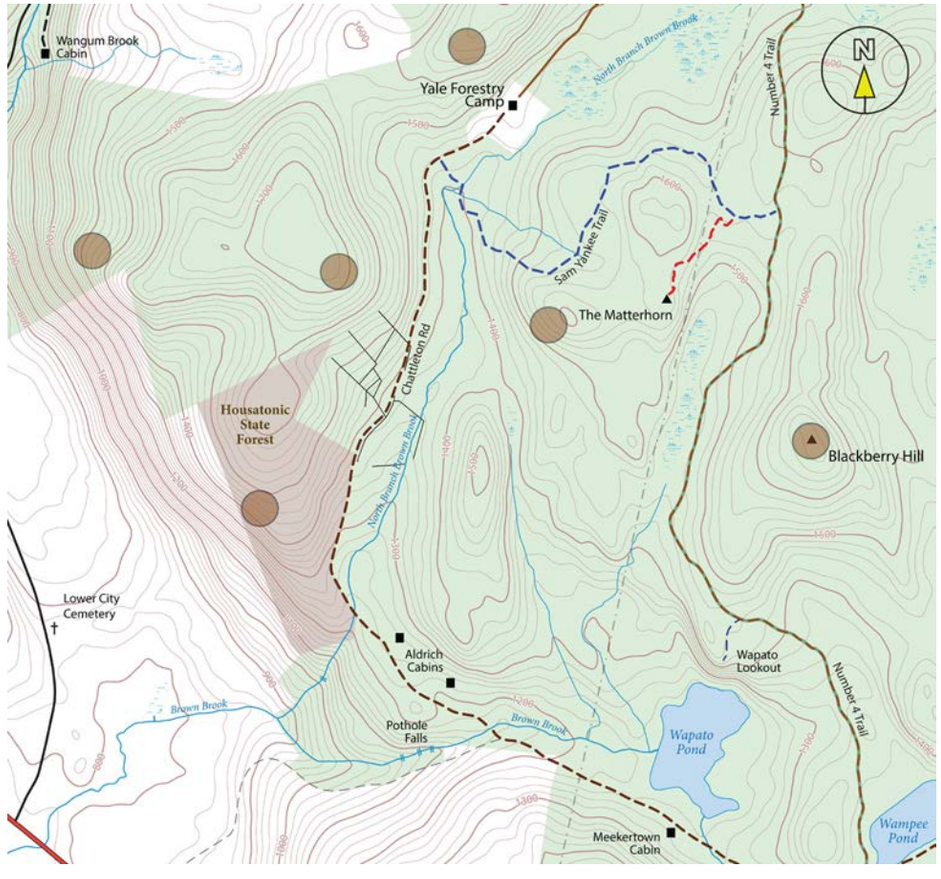
Location

1. *Across from Yale Camp*: 41°56'59.38"N; 73°15'46.07"W
2. *Near Collier's Cliff*: 41°56'8.20"N; 73°16'15.87"W
3. *Above Rich Talus Slope*: 41°56'37.73"N; 73°16'41.11"W
4. *Near summit above Dorman*: 41°56'36.97"N; 73°16'8.19"W
5. *South of Sam Yankee Trail*: 41°56'30.98"N; 73°15'32.73"W
6. *South side of Blackberry Hill*: 41°56'14.96"N; 73°15'0.66"W

Description

Natural community definitions typically divide oak woodlands, and other similar communities into distinct eco-types. For example, the Commonwealth of Massachusetts recognizes the following: Hickory-hop hornbeam forest/woodland; Oak-hickory forest; Open oak woodland/forest; and Ridge top chestnut oak woodland. Here, because such communities are somewhat uncommon, and our examination of them was cursory, we are treating them more broadly, as sub-xeric, oak-dominated woodlands. It is worth noting the distinction between woodland and forest: a forest, generally, has a denser canopy than more open woodland. Some authors rank woodlands as having 50% to 75% canopy cover while a forest would have 75% or greater cover. In GMF, the oak-dominated communities discussed here tend to have shorter, more widely spaced trees akin to woodlands by many definitions.

GMF's dry woodlands are dominated by red oaks with some areas having black oak. In the drier sites chestnut oak is common. Many of these trees are coppiced, a result of charcoaling and/or fires. Shagbark and pignut hickory can also be common, along with hop-hornbeam. At



Map of oak woodlands communities.

times, white oak can attain a significant percentage of the understory composition. Where they occur on upper slopes near summits and soil is thin and bedrock close to the surface, the trees take on an elfin and stunted appearance, an adaptation to limited soil moisture and nutrients as well as canopy damage from summit exposure.

Oak woodlands occur at higher elevation on GMF, where soils are thin and sites dry. These are best represented on higher, south-facing slopes. Fire may have been a significant ecological process in these communities prior to Euro-American settlement. Fire would maintain the sites in a dry, low soil, open understory, graminoids-oak community. Many sites today would benefit from a woodland fire.

Colliers cut oak-hickory woodlands heavily during the charcoaling days. Hearths can be found in and around them today.

Below is a list of species identified during our brief recognizance. This list is not complete. Many graminoids and lichens were unknown. Additional botanical work should be done. Lichen diversity, in particular, should be documented.

SPECIES	COMMON NAME	NOTES
Quercus rubra	Red Oak	Common, frequently coppiced
Quercus alba	White Oak	uncommon
Quercus montana	Chestnut oak	uncommon
Castanea dentata	American Chestnut	
Carya ovata	Shagbark hickory	
Carya glabra	Pignut hickory	Could be C. ovalis, C. tomentosa
Ostrya virginiana	Ironwood	
Vaccinium angustifolium	Low sweet blueberry	
Kalmia latifolia	Mountain Laurel	
Acer rubrum	Red Maple	Invading these xeric woods
Gaylussacia baccata	Black Huckleberry	
Amelanchier sp.	Serviceberry	
Deschampsia flexuosa	Hairgrass	
Carex pensylvanica	Pennsylvania sedge (aka: Oak Sedge)	common ground cover in oak woodlands

Importance

These warm-sited communities are not well understood particularly with regards to the role of fire. Their open, park-like nature offers an appealing environment for walking.

Nearby/Related Sites

In several places balds and rocky outcrops occur among oak woodlands. The balds are simply a drier more xeric community along the spectrum. Coppice and charcoal hearth sites also typically occur among oak woodlands.

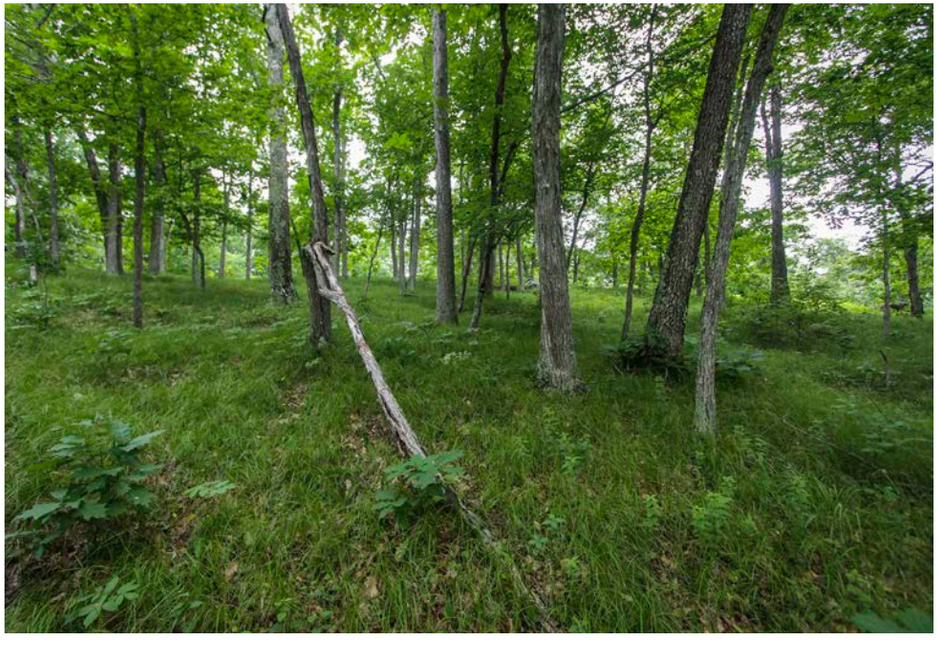
Research Ideas

The role of fire in maintaining oak woodlands.
Stand ages in oak woodlands (charcoal logging is dateable through coppice trees)
Mesification: the increase of maples and other mesic-sited plants in formerly xeric locations due to fir suppression.

Resources

Swain, P. 2011. Open oak forest/woodland. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife. Link

Mickelson, John. 2000. Great Mountain Forest Conservation Evaluation. Unpublished report by: The Nature Conservancy.

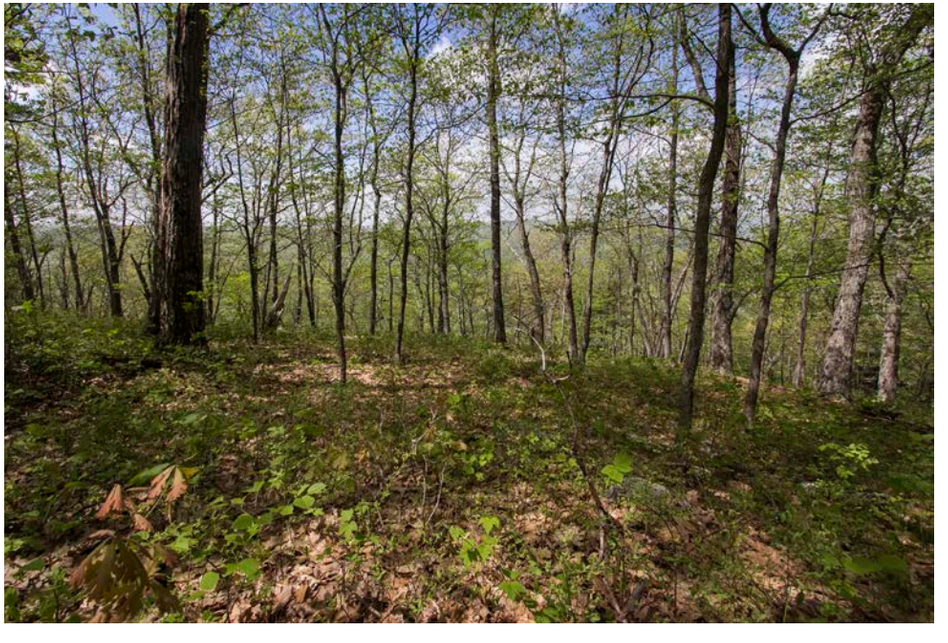


An oak-hickory woodland on the south side of Blackberry Hill. The ground is dominated by Pennsylvania sedge. Note the open understory and lack of full canopy.

Oak hickory woodland on the south side of Blackberry Hill. Note the coppiced tree in center, open understory.

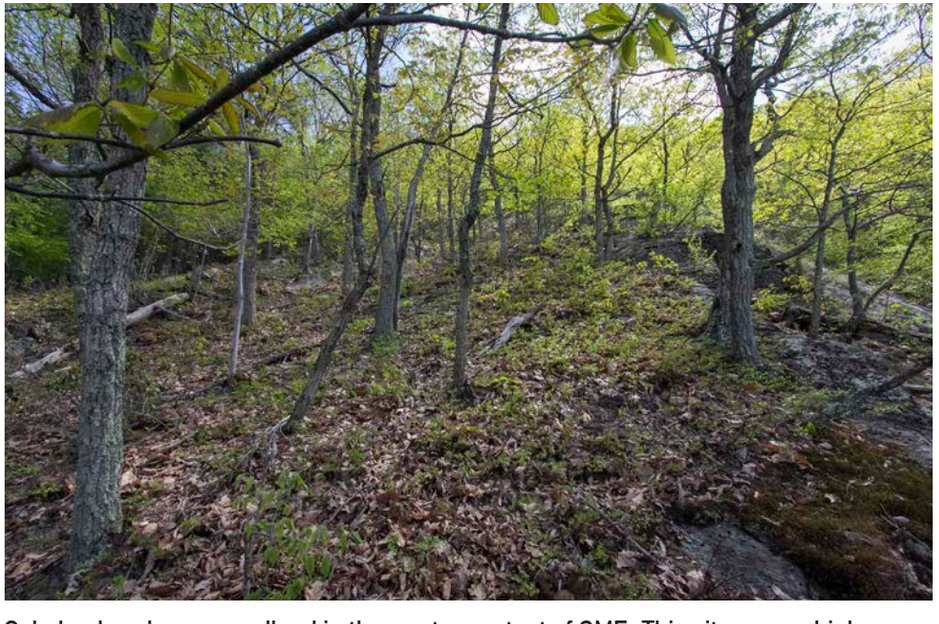
Oak–sedge woodland near the Jean Trail and the harvest along the slope to the east. Many dry oak sites occur on ridges like this one.

Open oak woodland near Yale Camp. Note the coppiced white oak in center. It was cut ~100 years ago during the charcoal days.



A chestnut oak woodland on thin bedrock soils. Trees are short stature as they invest in roots. The trees are older than is expected of their size due to the poorer conditions.

Oak woodland near the summit above the Dorman site. The bedrock emerging here shows how the soils in these dry communities are thin, and where it is too thin, trees fail and low plants, mosses, and lichens dominate.

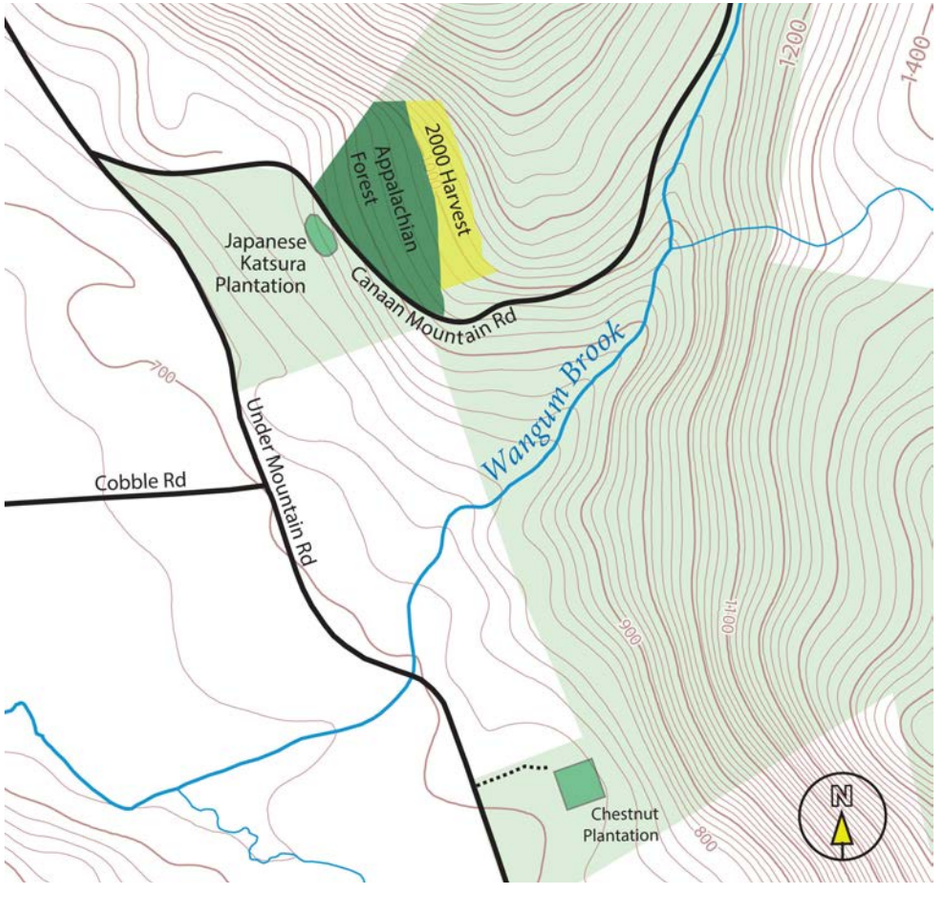


Oak–hophornbeam woodland in the western extent of GMF. This site occurs high above the talus community.

NATURAL COMMUNITIES 6: MIXED APPALACHIAN FOREST

Summary

This site probably displays the highest native tree diversity in Great Mountain Forest with at least 20 tree species over less than 10 acres (5-acres for core area). Shrub and herbaceous diversity is also high. The site could be considered an extension of the Rich Talus Community (this section), but composition and structure is different enough, and the sites are distant enough, that it is listed separately. The site also contains a large block of Stockbridge Marble, several charcoal hearths, and a timber harvest from 2000.



Location of Mixed Appalachian Forest.

Access

The site is easy to get to and has room for ~3 cars on the downhill side of Canaan Mountain Road near a bend in the road with a guardrail. Coordinates for parking are: 41°56'54.85"N; 73°17'7.52"W

Location

Site: 41°56'59.86"N; 73°17'9.65"W
Hearth: 41°57'0.75"N; 73°17'7.48"W
Hearth 2: 41°57'2.65"N; 73°17'7.12"W

Description

Geological maps indicate this site lies above the margin of Stockbridge Marble and the rich soils created by that rock type. A large marble or limestone block, however, presumably of glacial origin, occurs on site, and with the vegetation indicates rich soils. The marble block must have been glacially deposited. Mickelson (2000, p. 8) suggests these soils are richer "due to both calcareous bedrock influences and telluric (sub-surface water) nutrient input." He further sates: "Heightened soil and air temperatures exist due to west facing light and radiation gain as well as upslope air currents. These conditions favor high biodiversity due to intermixing of communities found more commonly in southerly climates with those found in cooler northern systems."

The area comprises only ~10 acres on GMF lands, though a variation of it continues upslope on a steep, rocky talus and cliff environment. Large coppiced trees (red and chestnut oaks, tulip poplar) and charcoal hearths (see hearths in Land Use section) indicate the site's use for charcoal production. The size of the trees suggests robust productivity. The trees would have been last cut in the late 1800s or earliest 1900s during the charcoal era.

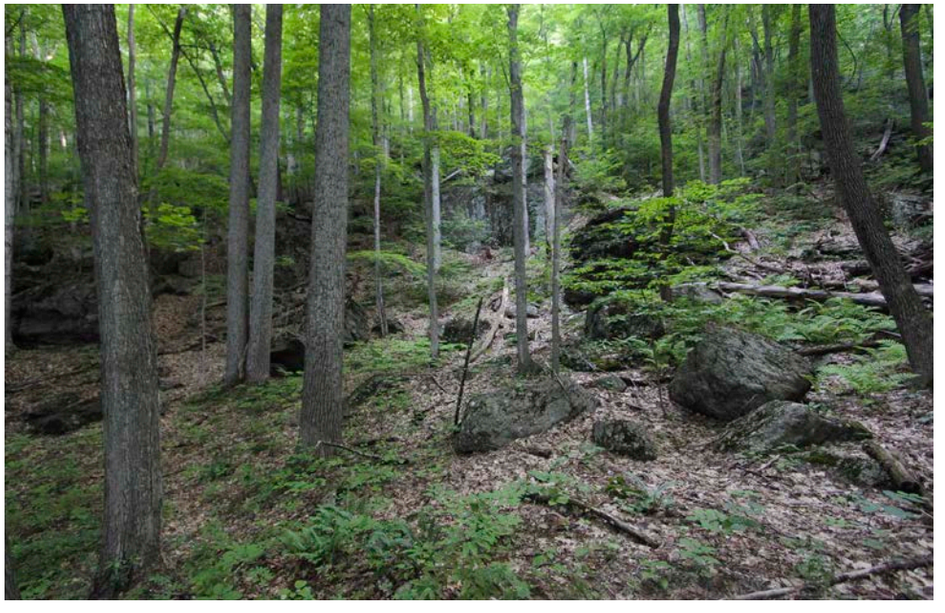
Additional disturbance occurred immediately above the site in 2000. The area was logged and now contains dense regeneration of early successional hardwoods. The cutting defines the upper limit of this community. The flatter bottomland below and Canaan Mountain Road defines the lower limit. *Wisteria* sp. is invading along the road edge and therefore believed to be exotic (Asian) and not the native species.

On this page is a partial species list from this site taken in August and therefore lacking spring ephemerals that should be present. This was a rapid assessment and a more thorough inventory on this highly diverse site should be conducted.

Species observed at the Appalachian Forest site in GMF.

COMMON NAME	SPECIES NAME
Sugar maple	*Acer saccharum*
Red maple	*Acer rubrum*
Black birch	*Betula lenta*
Shagbark hickory	*Carya ovata*
Bitternut hickory	*Carya cordiformis*
Pignut hickory	*Carya glabra*
American chestnut	*Castanea dentata*
American beech	*Fagus grandifolia*
White ash	*Fraxinus americana*
Tulip tree	*Lriodendron tulipifera*
Hop hornbeam	*Ostrya virginiana*
Black cherry	*Prunus serotina*
White Oak	*Quercus alba*
Chestnut oak	*Quercus montana*
Red oak	*Quercus rubra*
Eastern hemlock	*Tsuga canadensis*
White pine	*Pinus strobus*
Basswood	*Tilia americana*
Paper birch	*Betula papyrifera*
Sassafras	*Sassafras albidum*

COMMON NAME	SPECIES NAME
Hog peanut	*Amphiocarpaea bracteata*
Wild sarsaparilla	*Aralia nudicaulis*
Naked tick-trefoil	*Hylodesmum nudiflorum**
Wood fern sp.	*Dryopteris* sp.
Bedstraw sp.	*Gallium* sp.
Dwarf ginseng	*Panax trifolius*
Virginia creeper	*Parthenocissus quinquefolia*
Spicebush	*Lindera benzoin*
Maple-leaf vibur.	*Viburnum acerifolium*
Maidenhair fern	*Adiantum pedatum*
Witch-hazel	*Hamamelis virginiana*
Hanukkah fern	*Polystichum acrostichoides*
Grape	*Vitis* sp.
Beaked hazelnut	*Corylus cornuta*
Wisteria	*Wisteria* sp.*^
* Needs confirmation	
^ Exotic	



The Appalachian Forest. This site is the GPS point provided above. Here the forest backs up against the steep talus cliff (and also GMF property). This is a scenic, diverse, natural area and cultural landscape. Note the coppiced tulip tree at left. That, sugar maple, ash, and others showcase the site's richness.

In addition to the three charcoal hearths in the forest, there is another hearth along the road that displays a cross-section of the soil profile for a charcoal hearth. This is an interesting feature that warrants observation as charcoal hearths contain unique soil properties. See charcoal hearth discussion in the land use history section.

An old trail called the Military Road traverses this area and is discernable. Local lore has it that supplies such as canon balls and tools were delivered to Burgoyne's army.

Importance

With 20 species of trees over just a few acres, this site likely has the highest tree diversity in GMF. Herbaceous diversity should also be high, but our visit was cursory and late season. This combined with charcoal hearths and other history makes it a top site at GMF. **Caution**: this area occurs in known rattlesnake habitat.

Nearby/Related Sites

From the parking area, the opposite side of the road contains the Katsura plantation (with dawn redwoods, white fir, and tulip trees). The bottomland is an old-field white pine stand selectively thinned in the 1980s. Additional charcoal hearths occur along the road. See Charcoal Hearths in the Land Use History section.

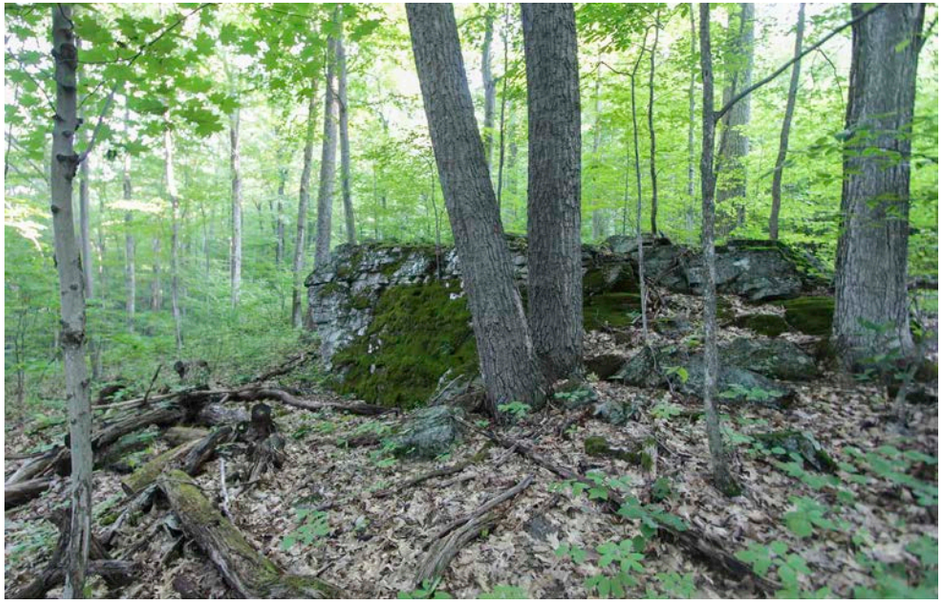
Research Ideas

How does this site compare to the Rich Talus Slope in total vegetation diversity and soil properties?
What year was the last charcoal cutting?
What are the growth rates for trees on this site and how does that compare to other sites in GMF?

Resources

Mickelson, John. 2000. Great Mountain Forest Conservation Evaluation. Unpublished report by: The Nature Conservancy.

A rich charcoal hearth site at the Appalachian Forest. Here along the margins of a charcoal hearth, maple-leaved viburnum, maidenhair and wood ferns, and oddly, an American chestnut, grow. White ash in the photo is notable as an uncommon tree in GMF.



A block of Stockbridge Marble in the Appalachian Forest. At front is a coppiced chestnut oak, cut in the charcoal era around 1900. Several hearths are nearby. The marble is covered in maidenhair fern, hepatica, and other rich site indicators. The block is located between the parking area and the GPS point listed for the site.

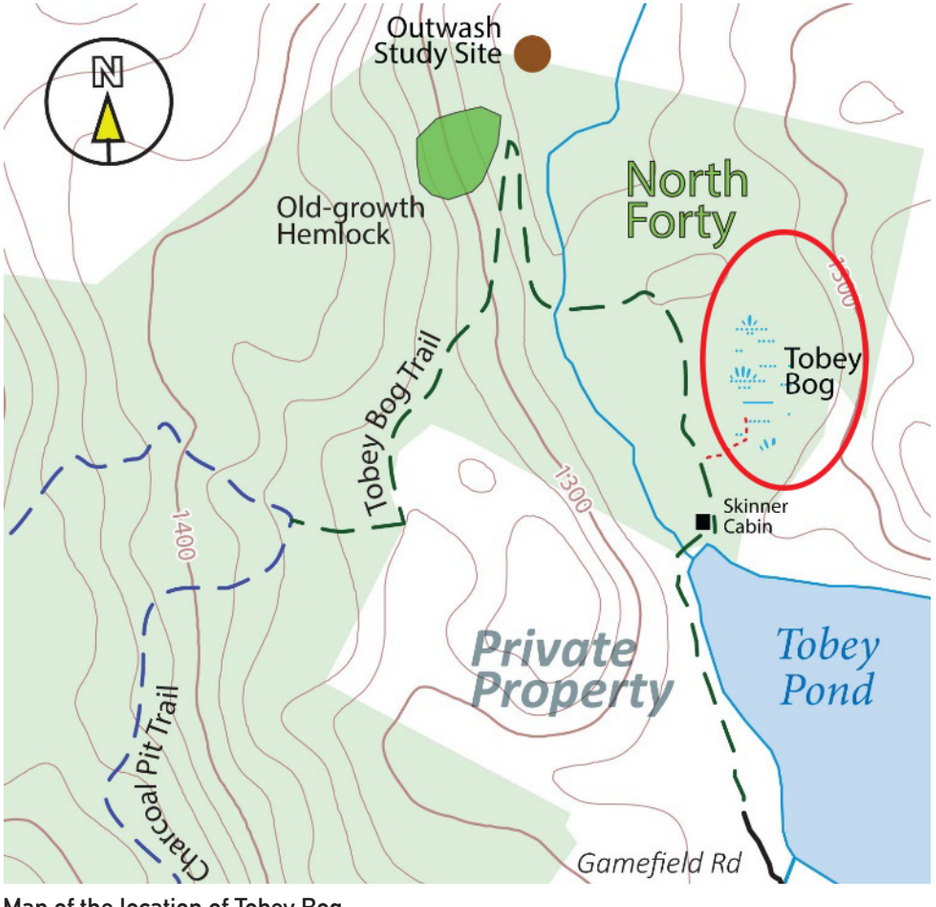
NATURAL COMMUNITIES 7: TOBEY BOG

Summary

The only true peatland within the Great Mountain Forest, and one of only a few within all of Connecticut. A floating mat of sphagnum moss hosts a fascinating array of plant species within a closed, nutrient poor system.

Access

Tobey Bog can be reached by walking through the Charcoal trail near the East Gate entrance of the Great Mountain Forest. Please contact GMF staff if vehicle access is needed, as all roads to the bog are private.



Map of the location of Tobey Bog.

Location

Tobey Bog: N 41°58'42.56"; W 73°13'32.12"

Nearby or Comparable Sites

Though a different classification of wetland, Tobey bog shares many characteristics and species in common with the red spruce swamps found elsewhere in the Great Mountain Forest (see Natural Communities 2). It is near to the Tobey Pond public beach, as well as the Norfolk Curling Club to the east.

Description

Bog Ecology

Bogs are nutrient poor wetlands that are closed (or at least mostly closed) to any source of drainage. In such environments, waste products cannot leave the system, resulting in high acidity levels and strong selection for a specialized cohort of plant species that are adapted (sometimes uniquely so) to such harsh conditions. Bogs are defined by their thick carpets of *Sphagnum* mosses—sometimes thirty feet or more deep—whose slowly decaying remains form the bulk of the substrate upon which all other plants take root and grow. Common groups of these species include stress tolerant conifers, shrubs from the heath family (*Ericaceae*), and an impressive diversity of sedges (*Carex* sp.). Together with visiting wildlife, they comprise unique ecosystems whose continued existence depends on a tenuous set of specific site conditions.

Though identified by similar characteristics, there are a number of recognized bog types, distinguished into categories by differences in plant community composition, origins, and water source. In order to continue accumulating slowly decomposing peat inputs, bogs must gain water at a faster rate than it is lost from the combined effects of evaporation and plant respiration. Ombrotrophic bogs are completely isolated systems that receive water only from the atmosphere in the form of rain or snow. These only occur from Maine northwards, where the cooler temperatures restrict the loss of water from surface evaporation. Minerotrophic bogs are a group of peatland types that receive additional water inputs from auxiliary sources, such as ground water tables (topogenous), occasional flooding from nearby lakes and slow-flowing streams (limnogenous), or from seepage water (soligenous). Minerotrophic bogs tend to have greater concentrations of nutrients than ombrotrophic bogs because water that travels along or through the ground is able to accumulate elements from eroding rocks and

A sprawling high bush blueberry (***Vaccinium corymbosum***) growing in the thickest part of the bog. It thrives in acidic, nutrient poor sites, much like other members of its family (the Ericaceae).

soil particles. They are found across a variety of landforms, often in sandy or gravel filled areas within valleys or along coastal plains where water can accumulate in landscape depressions. Elsewhere, bogs occur in depressions that are underlain with a layer of glacial till deposits atop more compacted till or metamorphic bedrock to create a raised water table.

The key to bog formation is that the level of production by the collective plant community is greater than the rate of decay. In such systems, the partially decomposed leaf litter and dead roots accumulate to form the deep peat structure. The Sphagnum moss, which tends to form the bulk of this mass, grows continually upwards and dies at the bottom, where the weight of new vegetative inputs presses it down deep below the surface. This cycle results in the formation of two distinct peat horizons. The acrotelm is the surface peat that sits above the low water table, where there is still some amount of oxygen. It is the site of water storage for vegetation throughout the year, its retention capability determined by the depth and structure of the peat itself. The catotelm is the lower peat, which

View of the walkway into Tobey Bog. The wooden planks are not nailed to anything, just lain atop the thick floating mat of ***Sphagnum*** moss. Don't worry about sinking, though it may sag a bit.

View of the pitcher plants in flower. The flowers are raised high above the pitcher mechanism, possibly to avoid accidentally trapping any potential pollinators (primarily bees).

Close up of sundew (***Drosera rotundifolia***). Insects become trapped on the glandular tentacles on its leaves, where they are then digested by the plant.

is constantly water saturated and anaerobic. Flow between these horizons occurs in the lower portion of the acrotelm, where the water table rises and falls in accordance with seasonality—lower in the hot summer months when water loss can exceed accumulation, and higher during the other seasons when the opposite is true. Through the parallel processes of gravity bringing water to percolate down through lower levels, and evaporation bringing it back up to the surface, the actively growing surfaces of bogs can usually maintain more or less average moisture saturation throughout the year.

Bog vegetation is restricted to communities of stress adapted wetland species, but they can vary in composition based on the structure and geographic location of the bog, as well as position within the bog itself. Bog forests tend to proliferate most vigorously along the borders, though individual trees of varying sizes can grow throughout. Species like red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), and northern

Panorama view of Tobey Bog from the end of the wooden walkway. Note the stunted black spruces in the foreground, unable to grow very tall due to nutrient limitations in the bog substrate. Illustration by Autumn Von Plinsky.

white-cedar (*Thuja occidentalis*) dominate in relatively eutrophic (nutrient rich) seepage water-fed bogs. In more acidic, nutrient poor bogs, American larch (*Larix laricina*), black spruce (*Picea mariana*), and red spruce (*Picea rubens*) tend to be the most abundant tree species. The shrub layer, with extensive, spreading root systems, is often the most vigorous horizon of growth. Thickets of high bush blueberry (*Vaccinium corymbosum*), clammy azalea (*Rhododendron viscosum*), mountain holly (*Nemopanthus mucronata*), huckleberries (*Gaylussacia dumosa*), leatherleaf (*Chamaedaphne calyculata*), and lambkill (*Kalmia angustifolia*), frequently flourish across the soggy peat landscape.

However, the most unique plant species exist in the bog's herb layer. To make up for the extremely low levels of nitrogen in the acidic Sphagnum substrate, these plants have developed carnivorous capabilities in order to acquire this vital nutrient from insects. The leaves of sundews (*Drosera* sp.) have sticky glandular hairs that trap and liquefy insect visitors. More sophisticated still is the selective insectivorous mechanism of the pitcher plant (*Sarracenia purpurea*). The modified leaves form a pitcher, which is filled with rainwater mixed with powerful plant exudates that attract and systematically dissolve certain species of insects. Others, such as the midge Metrocnemus knabi, are not only unaffected by the pitcher fluid, but actually develop as larvae inside, feeding on the other trapped insects.

Though less abundant than in other habitats, birds and mammals are still an important component of bog ecosystems. Moose and deer make good use of the abundant shrub forage, particularly around the bog borders. Black bears are also frequent visitors, feeding on the high bush blueberries that are so abundant, and are also attracted to the relative cover that the brambles provide. The other major large mammal species found in bogs is the beaver, who sometimes builds lodges and dams in peatland centers. The subsequent flooding can greatly damage the fragile ecosystem, and the impacts can last for many years even after the beaver population has moved on.

Among the non-mammals, there are only a few species of amphibians and reptiles that can survive the acidic conditions of bogs. These tend to be more hardy, boreal associated species such as the wood frog, bog turtle, and spotted salamander. Conversely, many bird species, both of a boreal distribution but also from surrounding habitats, spend some or all of their time in bogs. These are typically passerine (tree

perching) birds, particularly the warblers who are often drawn to open or edge habitat. Certain species, such as the palm warbler and Lincoln's sparrow, are highly site restricted, dwelling almost exclusively in bogs and related wetlands.

As with all sensitive ecosystems occurring within the Great Mountain Forest, it is important to consider the impact of human activity on the current and future health of bogs. The most immediate threat to bogs is systematic draining and destruction for the creation of resorts and housing developments, or the intentional damming to create lakes. Nutrient additions from nearby septic fields and surface fertilizers can seep into existing bogs, accelerating decomposition rates and thereby tipping the precarious balance of plant matter accumulation. The peat in bogs is also harvested in great quantities every year for mulches and potting mixes, and it can take decades for it to regenerate properly. Finally, bogs may be especially vulnerable to the impacts of anthropogenic climate change. As temperatures warm, decomposition rates within bogs may increase dramatically, even extending into the depths of the anaerobically preserved peat of the catotelm horizon. Globally, there is such a huge quantity of biomass stored in peatlands that their synchronized decomposition would release many tons of greenhouse gases into the atmosphere, thus catalyzing a dramatic feedback loop of accelerated decay and warming.

Features of Tobey Bog

Tobey Bog covers approximately 5 acres of land in GMF's "North Forty", just north of Tobey Pond. Though completely closed to aboveground water sources from stream flow and floodplains, it likely receives some nutrient rich seepage from adjacent ground water sources, as is common for peatlands that occur in southern New England. The growing substrate is a floating mat of sphagnum moss, apparently once measured to be 32 feet deep (Hamlin 1991). A wooden walkway extends about 50 feet from the road towards the center of the bog. In true bog fashion, the species composition shifts the farther one travels from the edge. The beginning of the pathway weaves through dense patches of highbush blueberry and the invasive glossy buckthorn (*Frangula alnus*). The midsummer visitor may thus treat herself to a tasty Vaccinium snack while examining the ground story vegetation of this thicket—intermingling patches of wild calla, arrow arum, with bog and fragile fern.

The pathway terminates in a more open area where the shrubbery grows less dense and the more acidic adapted species—pitcher plant, sundew, and lambkill—become more abundant. Scattered throughout are stunted trees, red maple, larch, white pine, and black spruce, which are able grow in this environment, albeit not to their ecological potentials. The black spruce is particularly notable among these species. It is typical of boreal habitats much farther north, and Tobey Bog is the only place in the Great Mountain Forest where it is known to grow. Close inspection shows that some of these black spruce are being parasitized by Arceuthobium pusillum, a species of dwarf mistletoe that obtains its nutrients from the living tissues of the tree's branches.

Tobey Bog is also the subject of "Bog Essays", a 1991 masters thesis by Erica Hamlin. It is a series of creative scientific writing pieces that detail different topics of bog ecology, interspersed with charcoal drawings and ruminations about her own experiences wandering Toby Bog. It is a good reminder that strange ecosystems like bogs have the power to inspire people across disciplines and cognitive frames. Go there when you need to find some peace in your life, albeit of the soggy, acidic variety.

COMMON NAME	SCIENTIFIC NAME
Red maple	*Acer rubrum*
Eastern White Pine	*Pinus strobus*
Black Spruce	*Picea mariana*
American Larch	*Larix laricina*
High Bush Blueberry	*Vaccinium corymbosum*
Lambkill	*Kalmia angustifolia*
Glossy Buckthorn	*Frangula alnus*
Bog Rosemary	*Andromeda glaucophylla*
Round leaved sundew	*Drosera rotundifolia*
Pitcher Plant	*Sarracenia purpurea*
Wild Calla	*Calla palustris*
Arrow Arum	*Peltandra virginica*
Dwarf Mistletoe	*Arceuthobium pusillum*
Sedges	*Carex spp.*
Fragile Fern	*Onoclea sensibilis*
Cinnamon Fern	*Osmunda cinnamomea*
Bog Fern	*Thelypteris simulate*

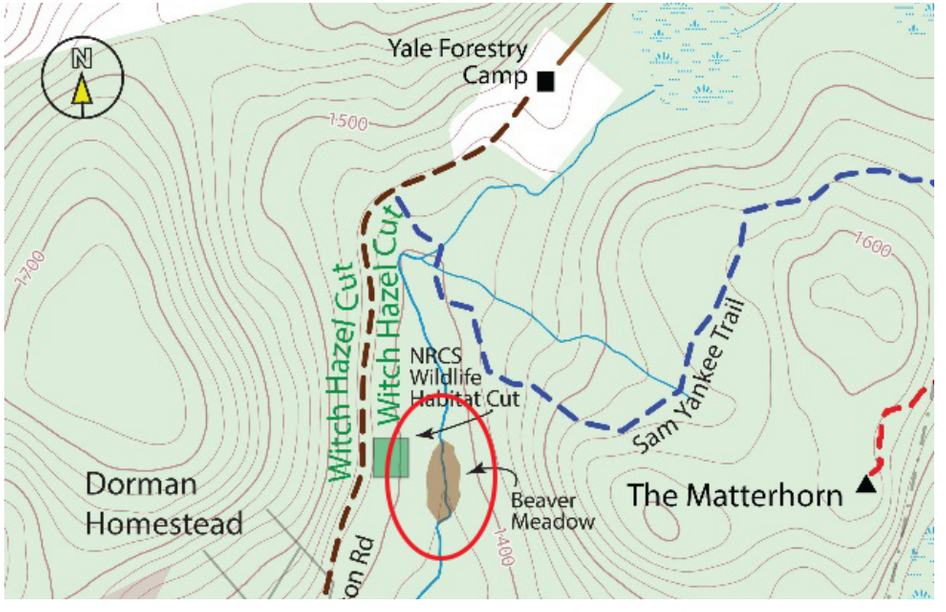
Resources

Damman, Antoni W. H., (1987) The ecology of pet bogs of the glaciated northeastern United States: a community profile. U.S. Fish and Wildlife Service Biological Report 85 (7.16)

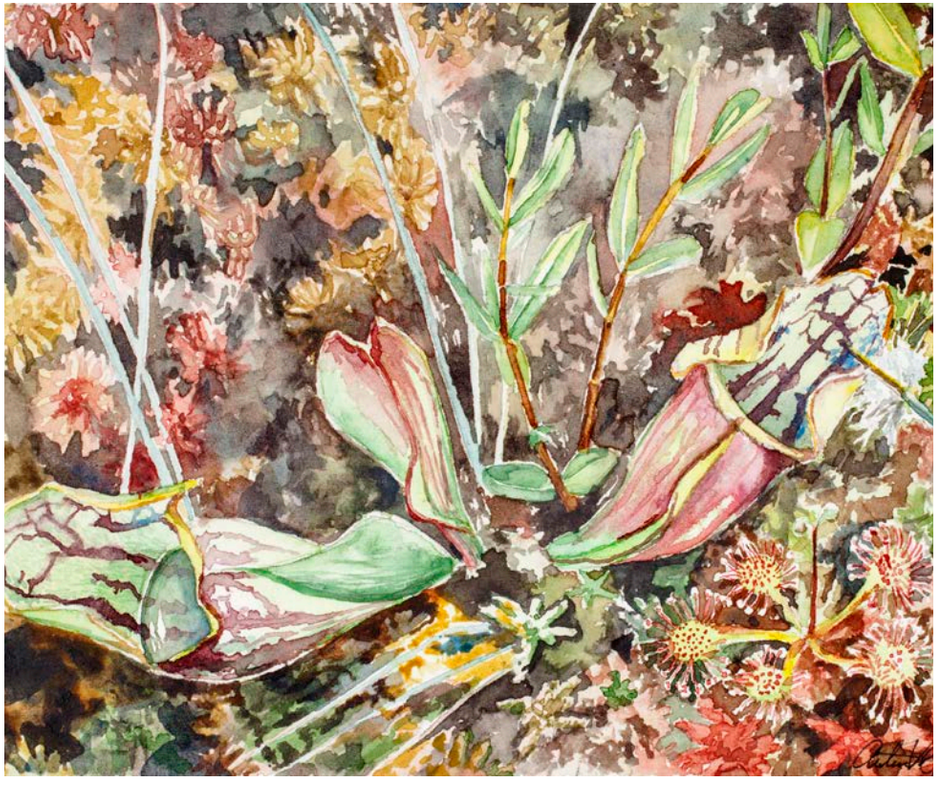
Hamlin, Erica. (1991). Bog Essays. Thesis for Wesleyan University Master of Arts in Liberal Studies.

Johnson, Charles W., and Meredith Edgecomb Young (1985) Bogs of the Northeast. University Press of New England, Lebanon.

U.S.F.S Forest Insect and Disease Leaflet: Eastern Spruce Dwarf Mistletoe http://www.na.fs.fed.us/pubs/fidls/ed_mistletoe/ed_mistletoe.pdf



ABOVE: Map of Beaver Meadow. BELOW: Detail of Pitcher Plant.



NATURAL COMMUNITIES 8: BEAVER PONDS

Summary

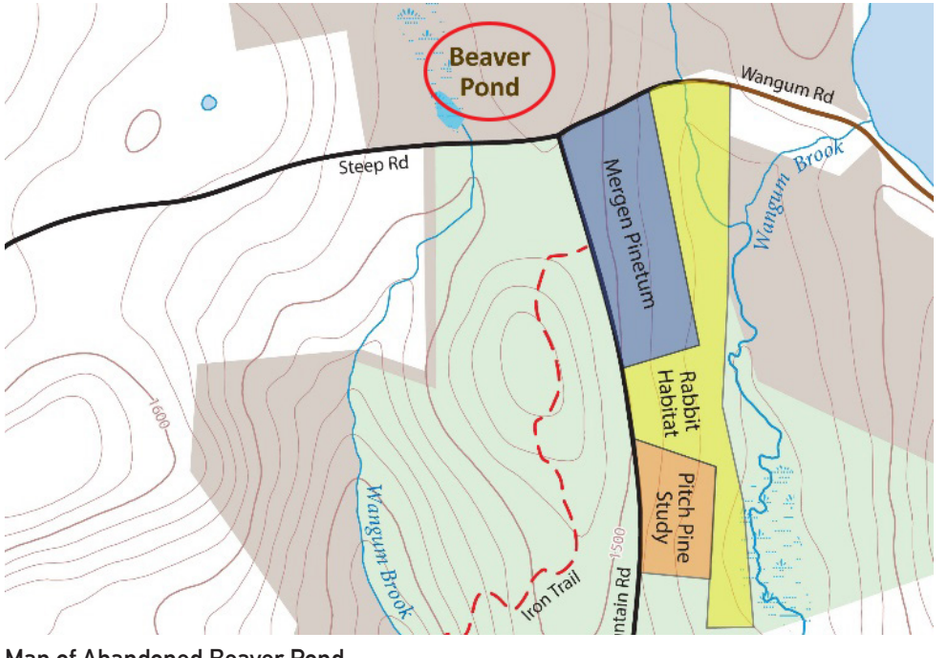
Beavers are major shapers of the environment at GMF, impacting hydrology and forest composition. The cycle of dam creation and abandonment creates a patchwork of wetland types across the landscape. This section describes several sites of beaver activity, at varying levels of use and decay.

Access

The beaver dam and lodge on Wampee Pond is accessible off the Number 4 Trail near the intersection with Old Meekertown Road in the southern part of GMF.

The recently abandoned dam sits in the middle of the wetland, located to the northwest of the Mountain House. Visitors may park on the grass near the intersection of Canaan Mountain Road and Wangum Road, and walk from there (bring muck boots!).

The beaver meadow site is east of Chattleton Road beyond the NRCS Wildlife Habitat Cut, a brief walk south from the Yale Camp.



Map of Abandoned Beaver Pond.

Though all plants and creatures at Great Mountain Forest condition the environment to some extent, none (aside from perhaps humans) modify their habitat as drastically as the North American beaver (*Castor canadensis*). As previously described (see Species of Interest 17: Beavers), the recent resurgence of beaver populations in New England (and much of the continental U.S. and Canada) has caused a dramatic restructuring of local hydrology in protected areas like GMF.

Location

Beaver Meadow
N 41°56'38.81"
W 73°15'49.38"

Abandoned Beaver Pond
N 41°58'27.23
W 71°16'30.29"

The active beaver lodge on Wampee Pond. These impressive structures feature underwater entrances to discourage predators. Beavers cover them with a fresh layer of mud every Autumn to ensure they are sound for the cold winter months.

A re-sprouting beaver-gnawed stump near the recently abandoned dam. Beavers typically prefer trunks 4-6 inches in diameter for dam construction.

View north of the wetland beaver pond. When the dam breaks down completely, the rapid lowering of water levels will lead to different plant communities, as opposed to the marshland species seen here.

Beavers create dams in existing waterways and wetlands by plugging outlets with sticks and mud. The flooded water bodies that result are rich with aquatic plants that are central to the beaver diet, and also are more optimal for their maneuverability. Beavers are ungainly on land, and will only travel about 200 feet from the pond's edge in search of tree forage—any farther, and they risk high susceptibility to predation. By raising the height of dams and digging strategic canals, beavers can expand their range of harvestable trees.

Aside from construction material for their dams and lodges, beavers rely on young trees as a source of winter nutrition. They will always preferentially gnaw certain species, such as willows, before moving on to others, like oaks, and later birches. By the time only pines and hemlocks are left, the beavers abandon their ponds to start over somewhere else, typically after only 5-20 years. Over time, the abandoned ponds deteriorate and the forest regenerates around their edges.

Great Mountain Forest contains a number of sites with evidence of beaver activity, which together constitute a patchwork representative of different periods of abandonment. Wampee Pond, in the southern portion of the forest near the intersection of the Number 4 Trail and Old Meekertown Road, is still an active site of beaver habitation. Though the pond was originally dammed by GMF forester Bill Preuss in 1937, the beavers have done their part to maintain its integrity by piling and weaving

The beaver meadow near Chattleton Road. Though long gone from this site, the legacy of beaver activity lives on in the early successional shrub habitat where their pond once lay.

One of the GMF Field Book authors, offering a dramatic beaver-gnawing reenactment. Unlike human teeth, beaver incisors are coated in a hard, iron-rich enamel that prevents chipping and decay (Gordon et al 2015).

small branches in its cracks. Though there are many gnawed stumps around its periphery, enough desirable trees of appropriate size still exist for them to stay where they are for now.

The wetland immediately northwest of Canaan Mountain Road (see map) is now technically part of the Housatonic State Forest, though until recently it belonged to GMF. The beaver pond at its center is a prime example of recent abandonment. The dam at its southern edge is still mostly intact, but is leaking in certain places to join the flow southwards into Wangum Brook. Chewed stumps are abundant, though all are at least several years old, and there is significant regrowth of swamp ash and silky dogwood around its edge. Nonetheless, it is very striking to note the differences in vegetation still regulated by the beaver legacy. In the area north of the pond where water is being held by the dam, tall marsh monocots such as the common cattail (*Typha latifolia*) and common reed (*Phragmites australis*) are the predominate species. South of the pond, where water trickles in slowly, the wetland is a mucky tangle of shrubs and vines such as sweet pepperbush (*Clethra alnifolia*), arrowwood viburnum (*Viburnum recognitum*), multifloral rose (*Rosa multiflora*), wild grape (*Vitis* sp.), and speckled alder (*Alnus incana*), with a variety of ferns and herbs crowding the understory.

Once the dam completely breaks away, water retention returns to pre-beaver levels. The damp ground fills in quickly with shrubs and herbaceous plants. A good example of one of these "beaver meadows" at GMF can be found east of Chattleton Road near Yale Camp (see map). A meandering stream runs through cut sandy banks, no longer swelled to pond-sized proportions. Without further disturbance the site will likely grow back into forest, through in the meantime it serves as beneficial early successional habitat.

By creating this patchwork of ephemeral dams, here at GMF and elsewhere, beavers can dramatically alter the hydrology of an ecosystem. A growing body of evidence demonstrates that this cycle of land use benefits a suite of other plant and animal species by allowing water to be retained for longer periods of time. Their return to the GMF landscape in the past century heralds a new era of beaver-mediated ecosystems.

A series of beaver gnawed beeches near Lost Pond. In many cases, trees are not completely felled, but girdled around the base to encourage new growth.

Resources

Lyle, Gordon M., Michael J. Cohen, Keith W. MacRenaris, Jill D. Pasteris, Takele Seda, and Derk Joester (2015) Amorphous intergranular phases control the properties of rodent tooth enamel. Science 347, 746-750

Wessels, T. 1997. Reading the Forested Landscape. Countryman Press, Woodstock, VT.

An area where the abandoned beaver dam is starting to break apart. Without continual maintenance, the sticks become dislodged and flushed downstream.