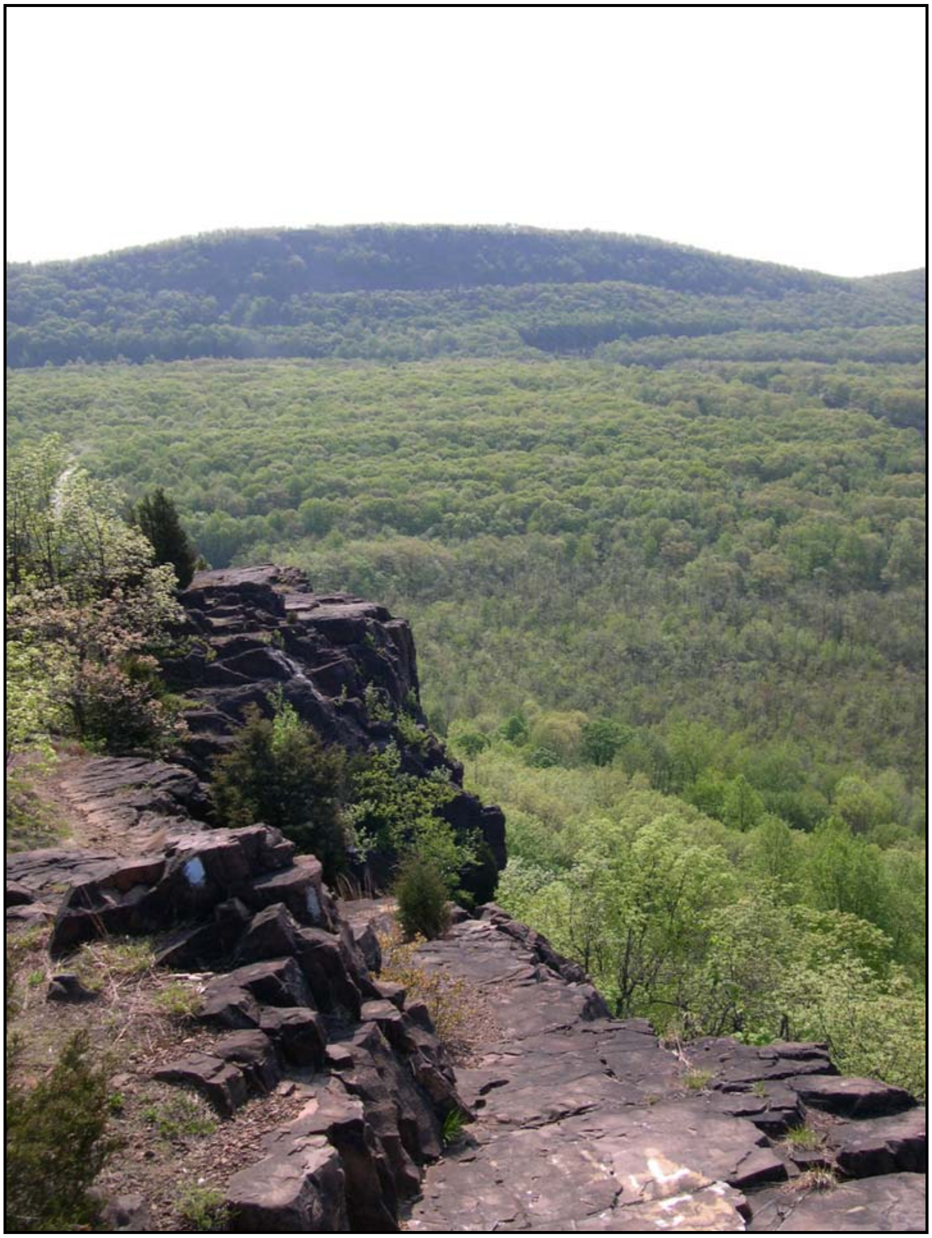
Metacomet-Mattabesett Trail Natural Resource Assessment



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All maps were produced by the author (unless otherwise credited) in ArcView from datalayers provided by the University of Connecticut Map and Geographic Information Center, the National Park Service, and the Connecticut Forest and Park Association. Photographs © Elizabeth Farnsworth unless otherwise noted.

Summary

The Connecticut portion of the Metacomet-Mattabesett Trail traverses approximately 101 miles of mountain summits, forested glades, vernal pools, lakes, streams, and waterfalls, including some of the most rugged, picturesque, and diverse landscapes of southern New England. Two of these natural communities are considered globally rare. A proposed extension of the trail through Guilford, Connecticut would encompass a rich array of coastal environments, including freshwater, brackish and saline tidal marshes and beaches that are critical habitat for uncommon breeding birds. Long vistas of rural towns, agrarian lands, extensive unfragmented forests, and large river valleys, as well as pathways through important Native American and colonial landmarks showcase some of the best examples of classic New England landscapes that are unique in the nation. Situated in one of the most densely populated areas of the United States, the Metacomet-Mattabesett Trail, with its corridor of comparatively intact habitats, offers numerous opportunities to appreciate the wild, scenic, pastoral, and cultural features of the region.

Figure 1: View of the Metacomet Range from Trail at Chauncey Peak.

Bedrock Geology

The backbone of much of the Metacomet-Mattabesett Trail consists of a series of knife-edged ridges collectively known as the Metacomet Range. This range extends in a discontinuous, roughly north-south line from New Haven, Connecticut to Greenfield, Massachusetts, a distance of over 100 miles as the crow flies. The range rises abruptly from the central lowlands of the Connecticut River valley and forms an impressive physical landmark that is visible from tens of miles away. The prominent outcrops and fascinating geology of the Metacomet range has drawn students, artists, and admirers from all over New England since the 1800's. Scientific observations made on the range have provided evidence for the existence of dinosaurs, the action of glaciers, and the impacts of plate tectonics – phenomena that have changed our fundamental thinking about the history of the earth (Hitchcock 1957, Lyell 1865).

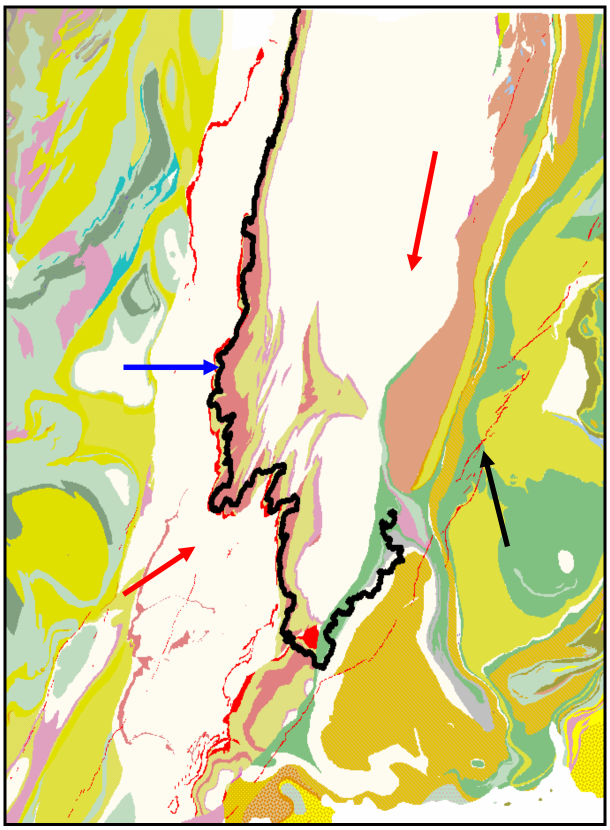

Figure 2: Bedrock geology of central Connecticut with Trail overlay in black. Red arrows point to arkose (sedimentary) formations; blue arrow points to basalt (traprock) formations. Colored areas to east form the older Iapetus terrane (black arrow). Source: University of Connecticut datalayers.

The bedrock of the range is a product of a series of three periods of violent volcanic eruptions occurring over a geologically "brief" period approximately 200 million years ago (Bell 1985).

The African and American continental plates, once joined tightly together, began to pull apart during the Triassic and Jurassic Periods, forming an enormous rift beset by numerous fault lines extending from Florida to Newfoundland (Lee 1985, Little 2003).

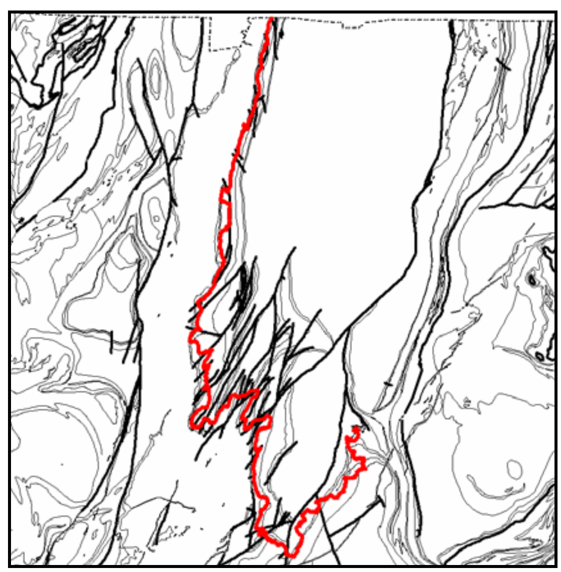

Figure 3. The Metacomet Trail (overlay in red) follows and crosses many of the fault lines (heavy lines) that create this rugged topography. Source: University of Connecticut datalayers.

Figure 4. Fault lines create many crevices and deep ravines that shelter vegetation.

Magma erupted from widening fissures as the land surface was gradually torn apart. The first and oldest of these lava flows formed a layer of Talcott Basalt some 65 m thick (McDonald 1996). A period of relative calm then ensued over the next several million years. During this respite, the basalt was eroded by seasonal tropical rains (the proto-continent, and thus Connecticut, was much closer to the equator then) and washed into lakes and streams as fine-grained sediments. These sediments were lithified into sandstones and silty shales of the Shuttle Meadow Formation. Another tumultuous period of volcanism led to the extrusion of the Holyoke Basalts, followed by a lengthy period of erosion and redeposition of more sandstone (with minor limestone elements), creating the East Berlin Formation. A third upheaval spurred the Hampden Basalt flow. Meanwhile, the expanding valley began to sink relative to the surrounding uplands, with the east side sinking faster than the west as the Eastern border fault plunged deep under the bedrock toward the west. Thus, the layer cake of basalts and arkose sandstones tilted upward at their western flank and downward to the east, a topography still very much in evidence today. Shortly thereafter, the central Connecticut lowlands would become a "failed" rift valley, as the main tension of the separating continents shifted eastward, opening up what is now known as the Atlantic Ocean. No longer subjected to intense pulling, the land ceased faulting, but erosion continued apace. Bands of reworked sediments in the wake of the Hampden Basalt flow comprise the youngest layer of sandstone and siltstone, the Portland Formation, some 2000 m thick in places. Today, with subsequent erosion of the younger sedimentary rocks, the Metacomet Range consists of tilted hills mostly capped by resistant older basalts, interspersed with sedimentary layers.

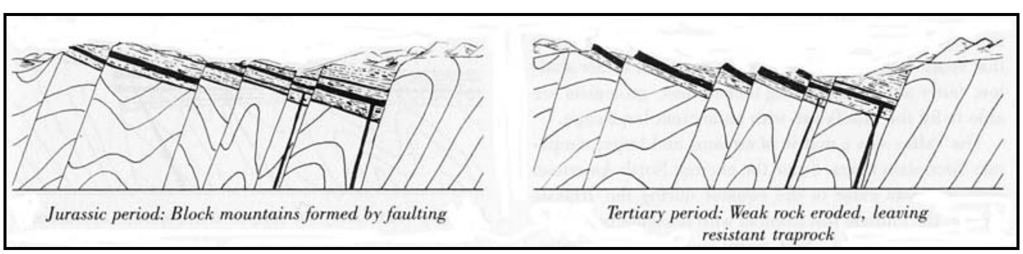

Figure 5. Stratigraphy, faulting, and subsidence of the range. Source: Lee (1985)

The Metacomet Range is one of the best places in the world (outside current centers of activity, such as Hawai'i and Iceland), and the only area on the eastern seaboard with a developed trail system, to view a broad array of well-preserved volcanic and sedimentary features such as columnar basalt. Basaltic lava developed polygonal shrinkage cracks as it cooled, much like those that criss-cross drying mudflats. In places, these cracks filled with precipitated quartz and calcite, further enriching the chemistry of the bedrock (and the soils weathered from it). These deep fissures broke the rock into pentagonal and hexagonal columns, some of them more than 1 meter in diameter. Eons of glacial plucking and freeze-thaw action continue to accentuate these vertical columns and to expose new ones. The term "trap rock," used to describe this columnar basalt, derives from the Swedish word, "trappa," meaning "step." Towers of columnar basalt create the precipitous, west-facing cliffs so characteristic of the Metacomet Range. Upon exposure to air, the iron-rich minerals of basalt turn a brownish rusty color.

Figure 6. Columnar basalt at summit of traprock ridge, Meriden, Connecticut.

Other volcanic features of interest include pillow lava (magma that instantly cooled into rounded shapes as it bubbled into a water body) and lava tubes (formed as surface lava cooled while underground lava continued to flow), both of which are especially well exposed where the Trail passes through Talcott Mountain State Park in Simsbury, Connecticut.

Figure 7. Trees root in crevices of columnar basal, Giuffrida Park.

Fractured basalt blocks collect in enormous fans of talus at the base of the steep exposures. These jumbles of sharp boulders lie at the angle of repose and thus are highly unstable. As such, they tend to be colonized only slowly by plants, and their upper reaches can remain open expanses for decades. However, these talus slopes create their own microclimate that tends to foster unique vegetation at their bases. Large boulders absorb the heat of the sun while shading all surfaces below them and keeping them cool; ice from winter may persist long into the spring beneath talus. Cool air, which is denser than warm air, sinks into the interstices of the talus slope in downdrafts and is constantly replaced by warm air from above. This process draws in warmer air toward the steep cliffs, some of which rises in updrafts as it contacts the boundary layer around the solar-heated rock columns. Raptors (and occasional hang-gliding enthusiasts) can be seen soaring on these thermals. This natural "air-conditioning" circulation creates variable climates from the base to the summit of these mountains.

Figure 8. Talus slopes plunge into lakes at the Hanging Hills, Hubbard Park.

The sedimentary layers of the Metacomet Range hold their own fascination, principally in the form of fossils. Arkose sandstone that was deposited in quiet waters shows a rippled texture in places. Dinosaur footprints abound in certain strata, frequently revealed by quarrying (trail users can view an example of these on display near Mirror Lake in Hubbard Park, Meriden, Connecticut). Fossils of bony fish remain on Totoket and Pistapaug Mountains in Durham, Connecticut, reminders of when fish abounded in stagnant tropical lakes of the late Jurassic period.

While many miles of the Metacomet-Mattabesett Trail scramble over the striking cliff-and-valley topography of trap rock in Connecticut, it is important to note that southern portions (principally the Mattabesett sector) traverse bedrock of very different types. Here, to the east of Metacomet Range, remnants of the ancient proto-Atlantic Ocean that existed during the Devonian Period (400 million years ago) — *before* the American and African plates had even joined — are visible. Squeezed at the impact zone during the collision of continents, these rocks were heavily metamorphosed under heat and pressure. Their complex, crumpled crystal structure renders them resistant to erosion; thus, they form more rolling topography of ledges and low hills. Together, these resistant gneisses and schists comprise the Iapetus terrane of Connecticut (see Figure 2). Broomstick Ledges, Mica Ledges, and Mt. Pisgah in Durham, Connecticut exemplify the bedrock types of this terrane. These contrasts in bedrock geology contribute to the diversity of landscapes and vegetation types that users of the Metacomet-Mattabesett Trail encounter.

Figure 9. Micaceous and pegmatite bedrock at Mica Ledges, Durham, Connecticut.

Glacial Geomorphology

Although the next 200 million years following formation of the Metacomet Range were not without incident (notably the formation of the Connecticut River valley by uplift), geologists tend to think of Pleistocene glaciation as the next Big Event affecting this region of New England. Making multiple advances between 2.3 million and 16,000 years ago, ice sheets more than a mile deep covered Connecticut. Dragging enormous quantities of sediment and rock over the summits of the Metacomet Range and other local highlands, ice sheets rounded and scarified the bedrock surface; these scratches are still visible on Metacomet summits today. Glacial erratics, large boulders transported and strewn about by glaciers, are frequent features along the Trail. Glacial till, the predominant soil type of the region, is a mixture of materials of varying size and composition – from sand grains to boulders – brought and deposited by the expanding and contracting rivers of ice. The emblematic stone walls of region (celebrated by Thorson [2002] as “the signature of the interior New England landscape”) were painstakingly created by farmers sorting bothersome rocks from their till. The Metacomet-Mattabesett Trail also visits many kettle ponds, formed by abandoned ice blocks trapped under mounds of till, which melted in place to form flooded depressions.

As the ice sheet receded north, glacial meltwater poured into valleys, creating extensive lakes where moraines (collections of dumped outwash) dammed the outlets for water. One such debris dam, which formed a glacial lake covering the area around present-day Avon and Simsbury, Connecticut, caused the Farmington River to divert its formerly southward course eastward through a gap in the Holyoke Basalt in Tarriffville, Connecticut. Water found the only outlet available through this gap, and over the past 16,000 has eroded the deep, vertically-sided Tarriffville Gorge. The Metacomet Trail and its side trails yields a spectacular view of the gorge from the rim; alternatively, hikers can descend to river level, where the Farmington still courses with gusto through the narrows (Class II and III rapids attract whitewater specialists). The gorge walls show all three layers of basalt flow in vertical exposure: a unique glimpse across almost 100 million years of geological history (Wetherell 1992). Elsewhere, the Metacomet-Mattabesett Trail offers views across miles of glacial lake valleys, where agriculture still takes advantage of the rich alluvial clays and loams left behind.

Figure 10. View of farm field on rolling coastal outwash, Guilford, Connecticut.

Soils

Soil types along the Metacomet-Mattabesett Trail vary largely in respect to the country rock from which they are derived (Reynolds 1979). The summits of the traprock ridges and talus slopes are characterized by very shallow, nearly xeric soils that are highly weathered by wind; these thin soils hold little water and have little organic matter. Crevices among the traprock fissures and talus can harbor pockets of slightly deeper and moister soil; frequent ant colonies further enrich the meager soil. These soils are mapped generally as Hollis-rock outcrop and Holyoke-rock outcrop complexes (Reynolds 1979). The more moderate, east-facing slopes immediately below the open summits support deeper soils formed from the weathering of basalt or arkose sandstone. Both soil types are abundant in Calcium and Magnesium relative to most other Connecticut soils — two limiting nutrients that are essential for plant growth and support an unusual array of calcium-loving plants in the region. However, studies from the Metacomets in Massachusetts reveal that these parent materials give rise to soils that differ subtly in composition, with implications for the vegetation that colonizes them. Arkose-derived soils, for example, are more acidic, and somewhat lower in organic content, Calcium, Magnesium, Manganese and Zinc than basalt-derived soils (Searcy et al. 2003). A higher number of species of trees, shrubs, and herbaceous plants is associated with basalt than with arkose (Searcy et al. 2003), and a significant number of species predictably occur on basalt. Thus, contrasting assemblages of plants that specialize on these subtly different soil types are juxtaposed along the Trail. Deeper, mesic soils that accumulate at the toe of talus slopes are the richest of all in mineral nutrients and organic matter. These soils are generally classified as Wethersfield loam and Ludlow silt loam (Reynolds 1979).

Soils derived from the gneisses and schists of the Iapetus terrane are generally more acidic and lower in mineral nutrients than soils of Metacomet origin, and support very different suites of plant species (e.g., fewer calciphiles). These rocky tills and their associated natural communities share more affinity with soils to the east and north in Massachusetts.

At lower, valley elevations along the Metacomet-Mattabesett Trail, soils are dominated by glacial till, alluvial silts and clays (in former glacial lakes), deltaic outwash (gravels and sands forming fans at the border of former glacial lakes), and poorly drained wetland mucks. Peatlands and highly acidic, gleyed soils, more common in colder areas to the north near Mount Monadnock, are rare in this sector of the Trail except in cool, saturated pockets. Were the trail to extend to the coast in Guilford, Connecticut, it would traverse glacial outwash in the form of sandy beaches and rocky subterminal and lateral moraines.

Figure 11. General soil types associated with the Metacomet-Mattabesett Trail in Connecticut (Trail overlay in black). Source: University of Connecticut datalayers.

Hydrology

Fissuring and faulting of the basaltic bedrock, and interbedding with sedimentary layers, creates complex drainage patterns along the Metacomet Range. Precipitation evaporates quickly from the exposed summits. Off the summit, water drains rapidly through talus and glacial till, finding routes through bedrock crevices until it encounters impermeable strata. Water tends to collect at the surface along these bedrock shelves, forming vernal pools (seasonally flooded depressions), seeps, and more extensive wetlands. Large wetland complexes are a common feature along the western flank of the Metacomet mountains (see Figure 1). Ponds and lakes also tend to form along major fault lines: Lake Quonnipaug and Myer Huber Pond, both visible from the Trail at Bluff Head in Guilford, Connecticut, overlie eastern border faults of the Central valley.

Figure 12. Vernal pool along Mattabesett Trail. Wood frog egg masses are visible in foreground.

Figure 13. Myer Huber Pond, visible from Bluff Head, Guilford, Connecticut.

Groundwater percolates downhill, west to east through basalt strata; thus, the valleys associated with the Metacomet Range often constitute important recharge areas for drinking water. Valleys formerly covered by glacial lakes are particularly valuable recharge areas, as deep coverage of clay and gravel protects aquifers to a certain degree from direct surface contamination. Clusters of aquifer protection areas and corresponding wellhead fields occur all along the flanks of the Metacomet Range. No fewer than 8 drinking water reservoirs occur in association with the range (Lareau 1997 and inspection of topographic maps). Relatively undisturbed, forested slopes also help to maintain good water quality in the Central lowlands of Connecticut.

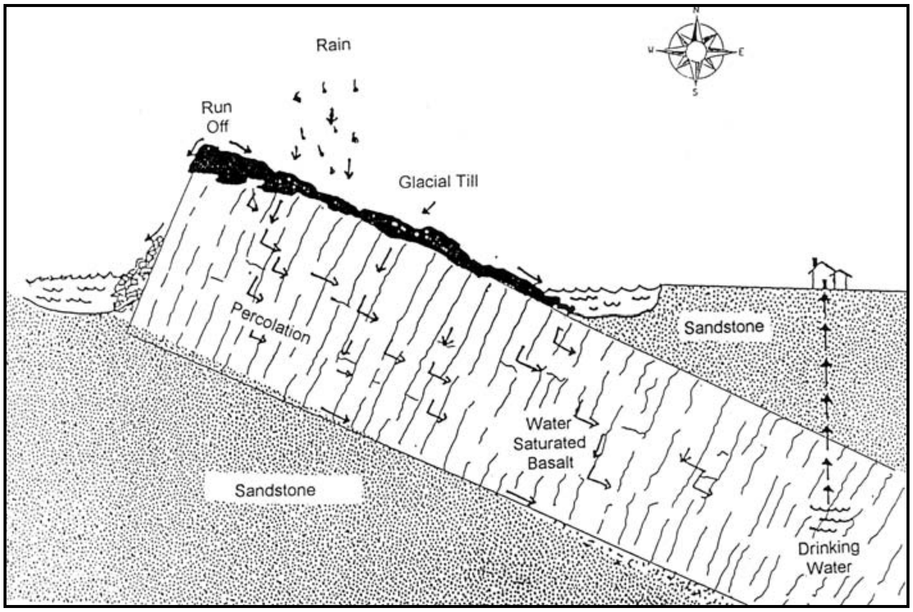

Figure 14. Diagram illustrating aquifer recharge. Source: Shaw (1989).

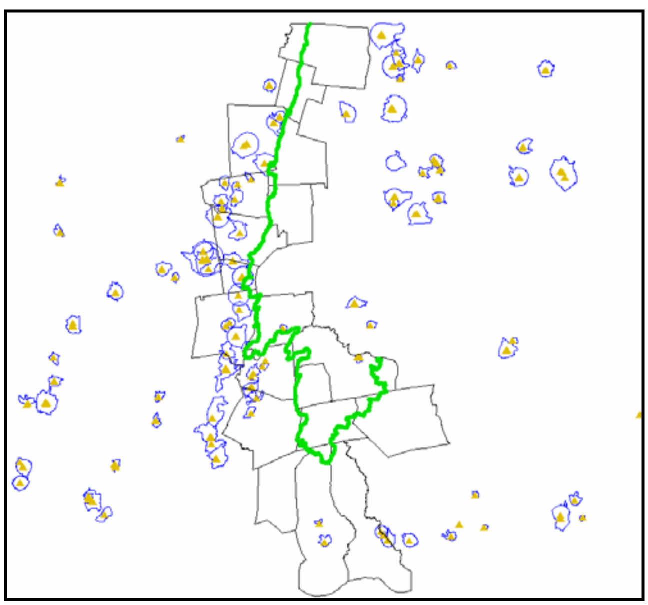
Figure 15. Well heads (yellow) and aquifer protection areas (blue areas delineated) in proximity to the Metacomet-Mattabesett Trail (Trail overlay in green). Town boundaries are also shown. Source: University of Connecticut datalayers.

Climate and Air Quality

Connecticut enjoys an equable climate, with an even distribution of precipitation among the four seasons, and precipitation falling, on average, one out of every three days (Connecticut State Climate Center 2004a). Connecticut lies in the prevailing westerlies of the middle latitudes of North America, which bring frequent fronts and storm centers over the state throughout the year. Central Connecticut is primarily influenced by continental air masses originating in subarctic North America (bearing cold, dry air) and the Gulf of Mexico (bearing warm, moist air). The state also occasionally experiences severe winter storms ("nor'easters") originating from the Atlantic. Thunderstorms occur on 20-30 days per year, with severe activity such as downbursts and hail occurring infrequently. Extreme weather events such as tornadoes and hurricanes are very rare (occurring on decadal time scales). Connecticut typically attains 55-60% of available sunshine (Connecticut State Climate Center 2004a). Snow can fall from October to April, but is usually concentrated between December and February. The statewide mean annual temperature is 48.47^{o}F, and has been increasing 0.14^{o}F per decade (National Oceanic and Atmospheric Administration 2004).

Local climate varies between the northern and southern portions of the Metacomet-Mattabesett Trail, with contrasts in precipitation and temperature being most significant during the winter months. For example, Windsor Locks (near the northern end of the Metacomet Trail in Connecticut) has a mean December temperature of 30.9^{o}F, 1,051 heating degree days, and total snowfall of 8.5 inches. Middletown, Connecticut, in the heart of the Mattabesett Trail area, records mean December temperatures of 32.9^{o}F, 989 heating degree days, and 6.1 inches of snowfall (Connecticut State Climate Center 2004b, 2004c). Average annual precipitation also varies considerably from north to south along the trail, with less than 44 inches falling in the northern tier around the Metacomet Range, 48-53 inches recorded for middle New Haven County, and drier conditions (46-48 inches) at the coastline.

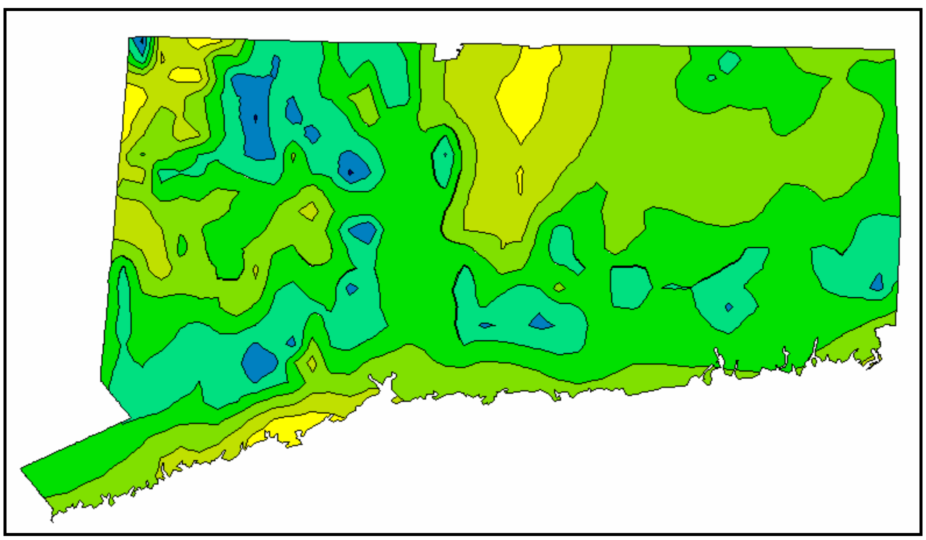

Figure 16. Map of Connecticut showing precipitation isoclines. Darker areas correspond to higher mean annual precipitation amounts. Source: Connecticut State Climate Center datalayers.

As noted above, users of the Metacomet-Mattabesett Trail also experience a variety of microclimates as they proceed from the Central lowlands to mountain summits. Due to the high heat capacity of dark basalt and the updrafts of warm air conducted to the top of west-facing ridges, the summits tend to warm up earlier in the spring and to remain warm longer into the autumn. The central Metacomet ridgetops (e.g., Beseck, Higby, and Totoket Mountains) fall within the sector of the 50-51^{o}F mean annual temperature isopleths; this sector exhibits the earliest average date (April 2) of extended daily temperatures exceeding 43^{o}F (Brumbach 1965). Mean annual temperature on the summit of Higby Mountain at about 900 feet elevation, for example, is 55.2^{o}F compared to 50.7^{o}F at 370 feet at the Middletown climate monitoring station (Ruf 1985a, b; Connecticut State Climate Center 2004c). Thus, a hiker climbing in spring and summer experiences warmer temperatures at higher elevations. Forest cover on the lower elevations fosters cooler conditions on the trail, and the bases of talus slopes exhibit the coolest temperatures overall.

Air quality in the Central valley is good to moderate (Environmental Protection Agency 2004). The number of days for which overall air quality is unhealthy or harmful for sensitive groups is generally 15 and under in Hartford and New Haven Counties (Table 1). Principle pollutants of concern are ozone and particulates, largely originating from car exhaust and industry. The Central valley can be subject to short-lived inversions during the year, during which air masses and pollutants can stagnate in the area. These brief episodes can result in reduced long-distance visibility. Middletown's Northeast Utilities power station is considered one of Connecticut's "Filthy Five" plants; until recently, its emissions were permitted to exceed the 1972 Clean Air Act. However, these exemptions are slated to be discontinued, so its emissions should decrease in coming years (Lobel et al. 2002). Pollution is more severe in the southern sectors of the state, influenced by large urban centers to the southwest.

Table 1. Mean Air Quality Conditions (Year 2003 Data summarized from EPA 2004)
Note: these data are obtained from urban monitoring stations.

Air Quality Indicator	**EPA Standard**	**Hartford County**	**New Haven County**
Number of days air is rated unhealthy for sensitive groups	-	7	15
Number of days air is rated as broadly unhealthy	-	0	5
Carbon monoxide (8-hour average)	9 ppm	10.1 ppm	2.7 ppm
Nitrogen dioxide (annual mean)	0.053 ppm	0.017 ppm	0.025 ppm
Ozone (8-hour average)	0.08 ppm	0.097 ppm	0.134 ppm
Sulfur dioxide (annual mean)	0.03 ppm	0.004 ppm	0.005 ppm
Particulates < 2.5 µm (annual mean)	15.0 µg/m^3	13.0 µg/m^3	17.9 µg/m^3
Particulates < 10 µm (annual mean)	50 µg/m^3	38 µg/m^3	41 µg/m^3

Biological Richness of the Metacomet-Mattabesett Trail

Because the Metacomet-Mattabesett Trail visits such varied and unusual terrain, straddling a diversity of bedrock types and landforms, it is home to a concentration of plant and animal species, several of which are state-listed or globally rare. In fact, the Trail and its environs constitute a "hotspot" in the state and the northeast for rare and declining species. Overall, the Trail visits 3 of Connecticut's 13 most imperiled ecosystems, namely traprock summits, coastal beaches, and large riparian systems (Metzler and Wagner 1998). Rare species and exemplary uncommon natural community types occur all along the Metacomet-Mattabesett Trail. Intensive surveys for biological diversity have identified many clusters of rare species occurrences in this area (e.g., Dowhan and Craig 1976, Moorhead 2003).

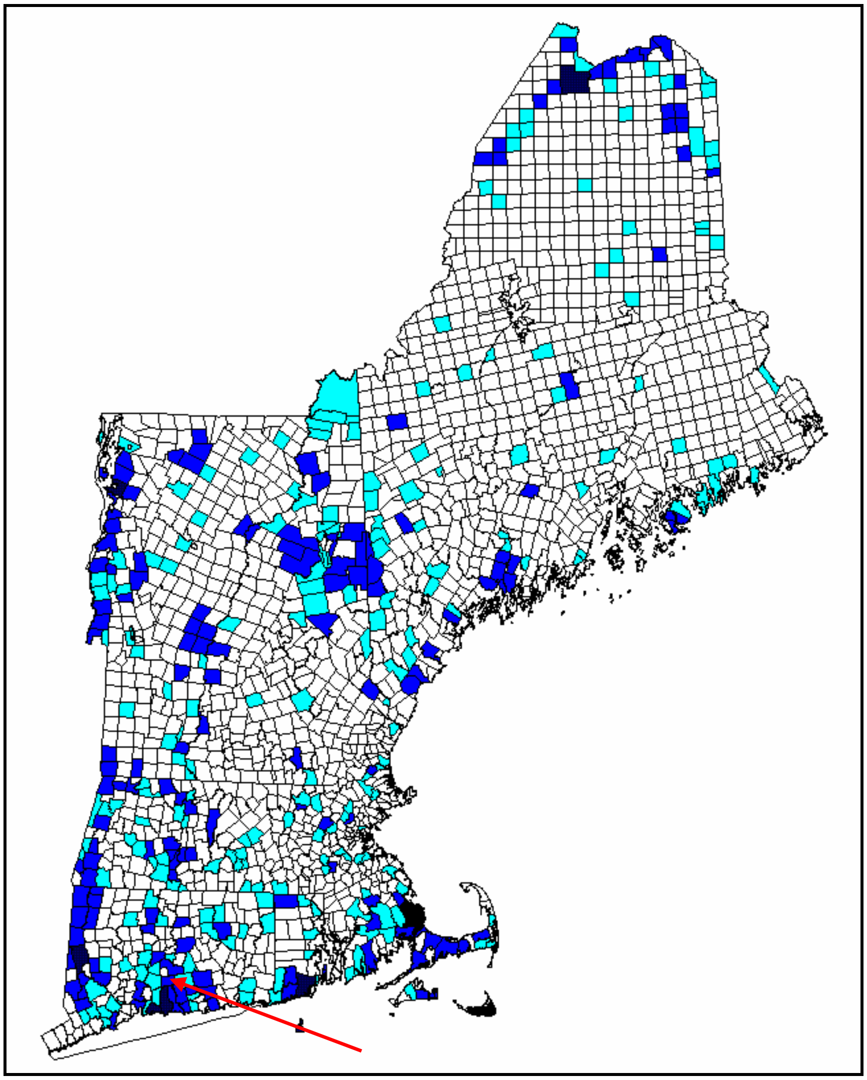

Figure 17. Clusters of rare plant occurrences in New England. Town boundaries for New England states are shown. Shading of towns corresponds to the number of extant rare plant occurrences recorded for each town; darker shading corresponds to higher numbers of occurrences. Red arrow points to general area of Metacomet-Mattabesett Trail in Connecticut. Source: Farnsworth (2003).

From data provided by the Connecticut Natural Diversity Database, 132 records of rare species or natural community types exist within a 1,000-foot buffer of the Metacomet-Mattabesett Trail. The majority of occurrences (76 or 58%) are extant. Of these, 15 (11%) have received an element occurrence rank of “A,” “AB,” or “B” from the state Natural Heritage Program, indicating they show good to excellent viability on account of population size or intact habitat context. Another 40 are ranked “E” (extant only with no further information) or are relatively new discoveries that have not been evaluated for viability as yet. Twenty-one populations (16%) are regarded as more precarious (ranked “BC” to “D”). Fifty-six occurrences are ranked as state-historical (SH) and are known only from observations predating 1975. Several of these historical records may still be in existence in the area, but have not necessarily been searched for systematically.

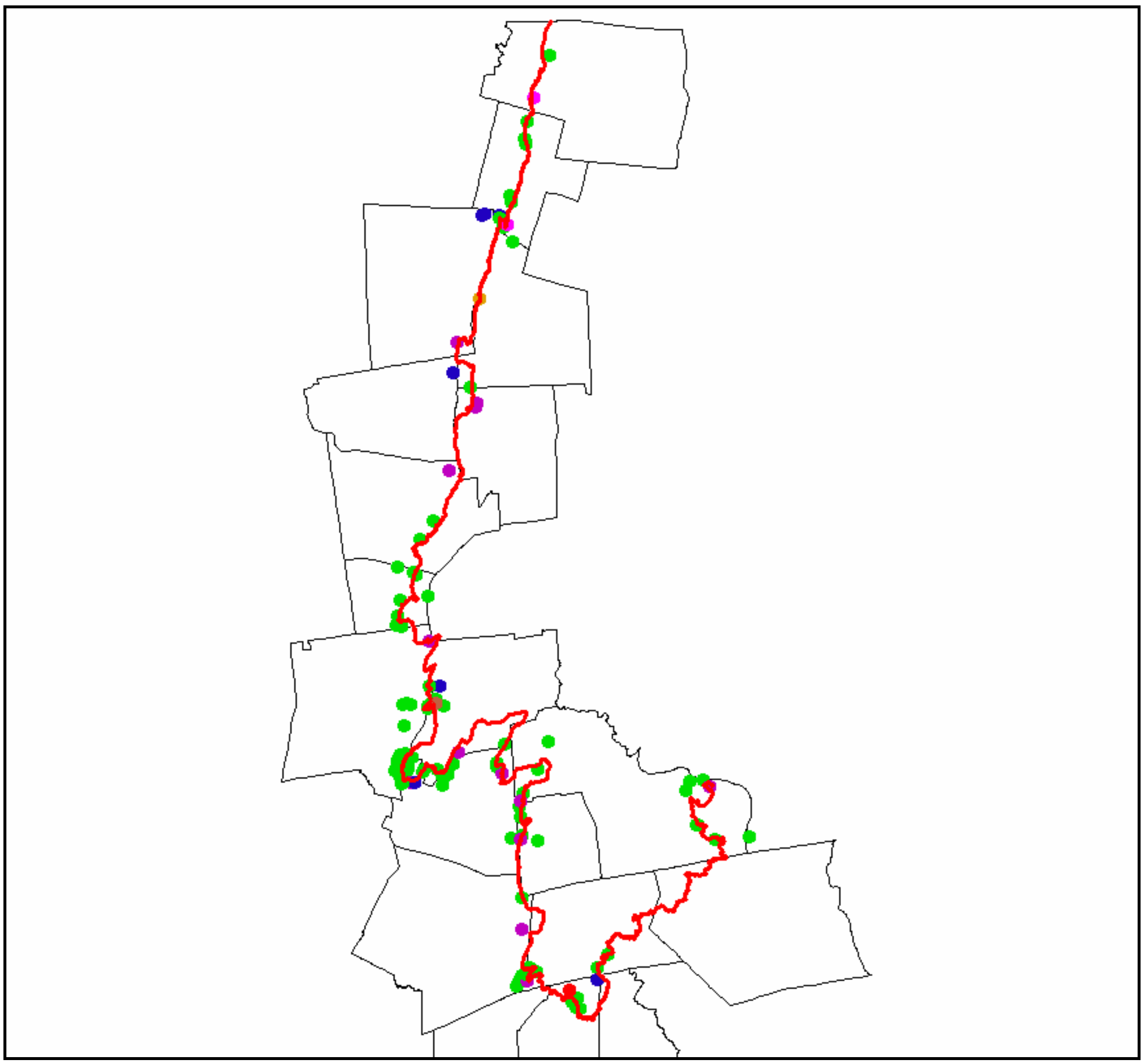

Figure 18. Occurrences of state-listed plants and animals along the existing Trail route (Trail overlay in red). Town boundaries are also shown. Dots correspond to localities of known extant occurrences, to 1-minute precision. Green=plants, blue=birds, red=area of unique natural significance; pink=amphibians and reptiles; brown=fish. Source: Connecticut Natural Diversity Data Base.

Extant occurrences include 1 species of turtle, 2 snake species, 3 salamander species, 1 mussel, 1 species of bat, 1 butterfly, 1 rare fish, 4 species of birds, 30 plant species, and 3 rare community types, two of which are considered globally imperiled or vulnerable (G2 or G3) by NatureServe. These are given below, along with their element occurrence ranks and global conservation ranks (NatureServe Explorer 2004). In addition, 6 rare insect species, 1 turtle, 1 bat, and 11 plants have been identified (either through historical records or through recent biological inventory) from similar habitats within 10 miles of the trail. These have a reasonable likelihood of inhabiting the areas along the trail; likewise, the trail can offer alternative or buffer habitat for these species. Three of these species (2 plants and a bat species) are ranked as globally imperiled (G2) by NatureServe.

A 2001 Biodiversity Day survey in Guilford identified an additional 46 rare species in proximity to proposed trail extension routes. These included a number of coastal species that do not venture inland. Three insect species, 19 bird species, 1 bat, and 13 plant species were unique to this sector and are listed as state-rare.

Table 2. Rare species and natural features of the Metacomet-Mattabesett Trail
Data provided by the Connecticut Natural Diversity Database, Fitzgerald (2001), and Menunkatuck Audubon Society (2001)

Species or Technical Name	Common Name	State EO Rank	Global Rank	Year Last Observed
NATURAL FEATURES				
Area of unique natural significance	Fossil fish bed	A	Not ranked	1982
Subacidic cold talus forest/ woodland		B	Not ranked	1989
Subacidic rocky summit/outcrop		B	G2	1984
Subacidic rocky summit/outcrop		B	G2	1982
Subacidic cold talus forest/ woodland		BC	Not ranked	1987
Subacidic rocky summit/outcrop		BC	G2	1991
Poor fen		C	G3	1981
Subacidic rocky summit/outcrop		No data	G2	No data
Subacidic rocky summit/outcrop		C	G2	1987
Subacidic rocky summit/outcrop		E	G2	1984
ANIMALS				
Agkistrodon contortix	Copperhead	Not ranked	G5	No data
Ambystoma jeffersonianum	Jefferson Salamander	A	G4	2000
Ambystoma jeffersonianum	Jefferson Salamander	E	G4	1999
Ambystoma jeffersonianum	Jefferson Salamander	E	G4	1986
Ambystoma jeffersonianum	Jefferson Salamander	E	G4	1998
Ambystoma laterale	Blue-spotted Salamander	E	G5	1982
Ambystoma laterale	Blue-spotted Salamander	E	G5	1980
Anthocharis midea	Falcate orange-tip butterfly	E	G5	2004
Crotalus horridus	Timber Rattlesnake	H	G4	1943
Eremophila alpestris	Horned Lark	H	G5	1976
Falco peregrinus	Peregrine Falcon	H	G4	1935
Falco peregrinus	Peregrine Falcon	H	G4	1934

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Species or Technical Name	Common Name	State EO Rank	Global Rank	Year Last Observed
Falco peregrinus	Peregrine Falcon	H	G4	1940
Hemidactylium scutatum	Four-toed salamander	Not ranked	G5	No data
Lampetra appendix	American brook lamprey	E	G4	1997
Lasiurus cinereus	Hoary Bat	E	G5	1999
Ligumia lacustris	Eastern pondmussel	E	G4G5	No data
Passerculus sandwichensis	Savannah Sparrow	E	G5	1975
Pooecetes gramineus	Vesper Sparrow	E	G5	1997
Pooecetes gramineus	Vesper Sparrow	H	G5	1975
Terrapene carolina	Eastern Box Turtle	E	G5	1998
Terrapene carolina	Eastern Box Turtle	E	G5	1998
Terrapene carolina	Eastern Box Turtle	E	G5	2000
Terrapene carolina	Eastern Box Turtle	Not ranked	G5	1999
Terrapene carolina	Eastern Box Turtle	Not ranked	G5	1999
Thamnophis sauritus	Eastern Ribbon Snake	Not ranked	G5	1987
PLANTS				
Agrimonia parviflora	Small-flowered Agrimony	H	G5	1919
Agrimonia parviflora	Small-flowered Agrimony	Not ranked	G5	2000
Alopecurus aequalis	Orange Foxtail	H	G5	1907
Aplectrum hyemale	Puttyroot	H	G5	1897
Arenaria glabra	Smooth Mountain Sandwort	A	G4	1997
Arenaria glabra	Smooth Mountain Sandwort	B	G4	2002
Arenaria glabra	Smooth Mountain Sandwort	F	G4	1989
Arenaria glabra	Smooth Mountain Sandwort	H	G4	1914
Arenaria macrophylla	Large-leaved Sandwort	CD	G4	2003
Arenaria macrophylla	Large-leaved Sandwort	F	G4	1995
Asclepias purpurascens	Purple Milkweed	H	G5?	1916
Asclepias purpurascens	Purple Milkweed	H	G5?	1900
Asclepias purpurascens	Purple Milkweed	H	G5?	1900
Asclepias purpurascens	Purple Milkweed	H	G5?	1902
Asplenium ruta-muraria	Wallrue Spleenwort	H	G5	1947
Asplenium ruta-muraria	Wallrue Spleenwort	H	G5	1901
Aster x herveyi	Hervey's Aster	H		1905
Carex hirsutella	Sedge	B	G5	2000
Carex hirsutella	Sedge	E	G5	1998
Carex hirsutella	Sedge	E	G5	2000
Carex hitchcockiana	Hitchcock's Sedge	E	G5	1999
Carex hitchcockiana	Hitchcock's Sedge	E	G5	1998
Carex hitchcockiana	Hitchcock's Sedge	E	G5	1988
Carex lupuliformis	False Hop Sedge	BC	G4	2002
Carex lupuliformis	False Hop Sedge	C	G4	2000
Carex lupuliformis	False Hop Sedge	E	G4	2000
Carex oligocarpa	Eastern Few-fruit Sedge	CD	G4	1997
Carex oligocarpa	Eastern Few-fruit Sedge	E	G4	1997
Carex squarrosa	Sedge	E	G4G5	1994
Carex squarrosa	Sedge	H	G4G5	1917
Carex squarrosa	Sedge	Not ranked	G4G5	2001
Carex typhina	Sedge	AB	G5	2000

Table 2. Rare species and natural features of the Metacomet-Mattabesett Trail
Data provided by the Connecticut Natural Diversity Database, Fitzgerald (2001), and Menunkatuck Audubon Society (2001)

Species or Technical Name	Common Name	State EO Rank	Global Rank	Year Last Observed
Carex typhina	Sedge	H	G5	1913
Carex willdenowii	Willdenow's Sedge	E	G5	2000
Carex willdenowii	Willdenow's Sedge	H	G5	1907
Chamaelirium luteum	Devil's bit lily	D	G5	2000
Coeloglossum viride var. *virescens*	Long-bracted Green Orchid	H	G5T5	1895
Corydalis flavula	Yellow Corydalis	A	G5	2002
Corydalis flavula	Yellow Corydalis	A	G5	2002
Corydalis flavula	Yellow Corydalis	A	G5	2002
Cuphea viscosissima	Blue Waxweed	H	G5?	1913
Cypripedium parviflorum	Yellow Lady's-slipper	E	G5	2002
Deschampsia caespitosa	Tufted Hairgrass	H	G5	1929
Desmodium glabellum	Dillen Tick-trefoil	C	G5	2002
Dicentra canadensis	Squirrel-corn	B	G5	2003
Dicentra canadensis	Squirrel-corn	H	G5	1943
Dicentra canadensis	Squirrel-corn	H	G5	1935
Diplazium pycnocarpon	Narrow-leaved Glade Fern	H	G5	1873
Diplazium pycnocarpon	Narrow-leaved Glade Fern	H	G5	1914
Dryopteris goldiana	Goldie's Fern	C	G4	1999
Dryopteris goldiana	Goldie's Fern	H	G4	1898
Dryopteris goldiana	Goldie's Fern	H	G4	1910
Dryopteris goldiana	Goldie's Fern	H	G4	1914
Elymus trachycaulus ssp. *subsecundus*	Slender Wheatgrass	C	G5T5	2002
Elymus trachycaulus ssp. *subsecundus*	Slender Wheatgrass	C	G5T5	2002
Equisetum pratense	Meadow Horsetail	H	G5	1900
Goodyera repens var. *ophioides*	Dwarf Rattlesnake Plantain	H	G5	1904
Goodyera repens var. *ophioides*	Dwarf Rattlesnake Plantain	H	G5	1894
Hydrastis canadensis	Golden-seal	BC	G4	2001
Hydrastis canadensis	Golden-seal	H	G4	1899
Linnaea borealis var. *americana*	Twinflower	E	G5T5	2002
Linum intercursum	Sandplain Flax	H	G4	1900
Liparis liliifolia	Lily-leaved Twayblade	D	G5	2001
Lygodium palmatum	Climbing Fern	H	G4	1917
Malaxis unifolia	Green Adder's-mouth	H	G5	1902
Megalodonta beckii	Water-marigold	H	G4G5	1910
Megalodonta beckii	Water-marigold	H	G4G5	1905
Moneses uniflora	One-flower Wintergreen	H	G5	1949
Opuntia humifusa	Eastern Prickly-pear	D	G5	2002
Orontium aquaticum	Golden Club	H	G5	1902
Panax quinquefolius	American Ginseng	H	G4	1898
Panax quinquefolius	American Ginseng	H	G4	1898
Panax quinquefolius	American Ginseng	H	G4	1893
Paronychia fastigiata	Hairy Forked Chickweed	H	G5	1916
Platanthera dilatata	Tall White Bog Orchid	H	G5	1900
Platanthera hookeri	Hooker Orchid	H	G5	1902
Platanthera hookeri	Hooker Orchid	H	G5	1896

Table 2. Rare species and natural features of the Metacomet-Mattabesett Trail
Data provided by the Connecticut Natural Diversity Database, Fitzgerald (2001), and Menunkatuck Audubon Society (2001)

Species or Technical Name	Common Name	State EO Rank	Global Rank	Year Last Observed
Podostemum ceratophyllum	Threadfoot	E	G5	2002
Polygala nuttallii	Nuttall's Milkwort	B	G5	1997
Polymnia canadensis	Small-flowered Leafcup	A	G5	2002
Populus heterophylla	Swamp Cottonwood	H	G5	No data
Populus heterophylla	Swamp Cottonwood	H	G5	1924
Potentilla arguta	Tall Cinquefoil	BC	G5	2001
Potentilla arguta	Tall Cinquefoil	C	G5	2002
Potentilla arguta	Tall Cinquefoil	E	G5	2001
Potentilla arguta	Tall Cinquefoil	E	G5	1992
Potentilla arguta	Tall Cinquefoil	H	G5	1941
Potentilla arguta	Tall Cinquefoil	H	G5	1897
Pycnanthemum clinopodioides	Basil Mountain-mint	H	G2	1902
Ribes rotundifolium	Wild Currant	E	G5	2003
Sagittaria cuneata	Waputo	H	G5	1933
Salix pedicellaris	Bog Willow	H	G5	1900
Sporobolus compositus var. *compositus*	Dropseed	E	G5T5	2000
Sporobolus heterolepis	Northern Dropseed	C	G5	1994
Stellaria borealis	Northern Stitchwort	CD	G5	2001
Stellaria borealis	Northern Stitchwort	H	G5	1932
Trisetum spicatum var. *molle*	Spiked False Oats	CD	G5	2002
OTHER SPECIES FOUND NEARBY IN SIMILAR HABITAT				
ANIMALS				
Asterocampa celtis	Hackberry butterfly	No data	G5	No data
Oligia chlorostigma	Noctuid moth	No data	G5	No data
Cicindela duodecimguttata	Twelve-spot tiger beetle	No data	G5	No data
Cicindela rufiventris	Red-bellied tiger beetle	No data	G5	No data
Rhodoecia aurantiago	Aureolaria seed borer	No data	G4	No data
Eumeces fasciatus	Five-lined skink (lizard)	No data	G5	No data
Clemmys insculpta	Wood turtle	No data	G4	No data
Myotis sodalis	Indiana bat	No data	G2	No data
PLANTS				
Aristolochia serpentaria	Virginia snakeroot	No data	G5	No data
Cheilanthes lanosa	Hairy lip-fern	No data	G5	No data
Draba reptans	Whitlow-grass	No data	G5	No data
Houstonia longifolia	Longleaf bluet	No data	G4G5	No data
Lespedeza repens	Creeping bush-clover	No data	G5	No data
Oxalis violacea	Violet wood sorrel	No data	G5	No data
Pedicularis lanceolata	Swamp lousewort	No data	G5	No data
Plantago virginica	Hoary Plaintain	No data	G5	No data
Pycnanthemum clinopodioides	Basil mountain mint	No data	G2	No data
Pyncnanthemum torrei	Torrey’s mountain mint	No data	G2	No data
Senecio pauperculus	Ragwort	No data	G5	No data

Table 2. Rare species and natural features of the Metacomet-Mattabesett Trail
Data provided by the Connecticut Natural Diversity Database, Fitzgerald (2001), and Menunkatuck Audubon Society (2001)

Species or Technical Name	Common Name	State EO Rank	Global Rank	Year Last Observed
ADDITIONAL SPECIES RECORDED FOR GUILFORD (POTENTIAL TRAIL EXTENSION AREAS)				
ANIMALS				
Cicindela tranquebarica	Dark-bellied tiger beetle	No data	G5	2001
Hesperus baltimorensis	Rove beetle	No data	No rank	2001
Abagrotis nefascia benjamini	Coastal heathland cutworm	No data	G4T3	2001
Ardea alba	Great egret	No data	G5	2001
Egretta thula	Snowy egret	No data	G5	2001
Egretta caerulea	Little blue heron	No data	G5	2001
Ixobrychus exilis	Least bittern	No data	G5	2001
Plegadis falcinellus	Glossy ibis	No data	G5	2001
Circus cyaneus	Northern harrier	No data		2001
Accipiter striatus	Sharp-shinned hawk	No data		2001
Accipiter cooperii	Cooper's hawk	No data		2001
Buteo lineatus	Red-shouldered hawk	No data		2001
Falco sparverius	American kestrel	No data		2001
Rallus elegans	King rail	No data	G4	2001
Haematopus palliatus	American oystercatcher	No data		2001
Catoptrohporus semipalmatus	Willet	No data		2001
Sterna hirundo	Common tern	No data		2001
Chordeiles minor	Nighthawk	No data	G5	2001
Progne subis	Purple martin	No data		2001
Ammodramus caudacutus	Saltmarsh sharp-tailed sparrow	No data	G4	2001
Ammodramus maritimus	Seaside sparrow	No data	G4	2001
Sturnelia magna	Eastern meadowlark	No data		2001
Lasiurus borealis	Eastern red bat	No data	G5	2001
PLANTS				
Acalypha virginica	Three-seeded mercury	No data	G5	2001
Agastache nepetoides	Yellow giant hyssop	No data	G5	2001
Atriplex glabriuscula	Orach	No data	G4	2001
Cirsium horridulum	Yellow thistle	No data	G5	2001
Hottonia inflata	Featherfoil	No data	G4	2001
Liatris scariosa var. novae-angliae	Northern blazing star	D	G5?TNR	2001
Lycopus amplectens	Clasping water-horehound	No data	G5	2001
Polygonum glaucum	Seabeach knotweed	No data	G3	2001
Prunus maritima	Beach plum	No data	G4	2001
Rubus cuneifolius	Sand blackberry	No data	G5	2001
Scirpus cylindricus		No data		2001
Solidago rigida	Stiff goldenrod	No data	G5	2001
Viola canadensis	Canada violet	No data	G5	2001
Zizia aptera	Heart-leaved golden alexanders	C/D	G5	2001

Two major attributes explain the biological richness and significance of the environments along the trail: 1) high diversity of landforms; 2) high connectivity among parcels that are protected for conservation purposes or that suffer minimal lasting damage from human disturbance.

Diversity of landforms

The Metacomet-Mattabesett Trail traverses an elevational gradient with numerous climbs and descents from sea level to over 800 feet. It crosses traprock ranges, valleys, open waters, streams, and wetlands, and a proposed extension of the trail would bring hikers to coastal marshes, tidal rivers, and beaches. Together, these features create habitat for a wide array of species.

The unique bedrock and topography of traprock ridges fosters contrasting microenvironments: 1) a warm summit condition which, together with meager soil development, creates a xeric habitat with affinities to more southerly ecoregions; and 2) cold conditions at the base of talus slopes which, together with deeper soils influenced by seeps, creates a cool, mesic habitat with affinities to more boreal ecoregions. Due to this local climatic variability, and because this region of Connecticut lies at the juncture of three ecoregions (Griffith et al. 2004), many of the plant species found along the Metacomet Range reach the northern or southern boundaries of their range in this part of Connecticut. *Viola canadensis, Linnaea borealis* var*. americana, Dryopteris goldiana,* and *Dicentra canadensis* are examples of plant species that occur at the southern end of their New England ranges along the trail. *Corydalis flavula, Sporobolus compositus* var. *compositus*, and *Opuntia humifusum* are examples of plant species that hail from warmer regions. Insect species also reach their range limits here; for example, the Falcate orange-tip butterfly (*Anthocharis midea*) extends northward to New England only along the southern Metacomet Range, seeking specialized host plants in the mustard family. It is a common and spectacular sight in early spring along the ridgetop.

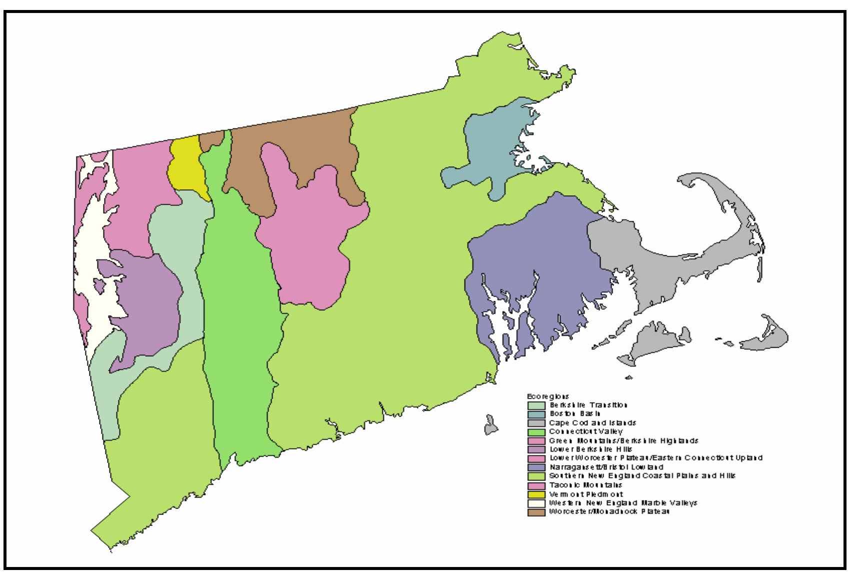

Figure 19. Ecoregions of Southern New England. The Trail passes through the Lower Worcester Plateau/Eastern Connecticut Upland, Connecticut Valley, and Southern New England Coastal Plains and Hills. Source: Griffith et al. (2004).

Figure 20. Dryopteris goldiana, a rare fern of cool talus and seeps.

Figure 21. Corydalis flavula, a rare herb of warm summits.

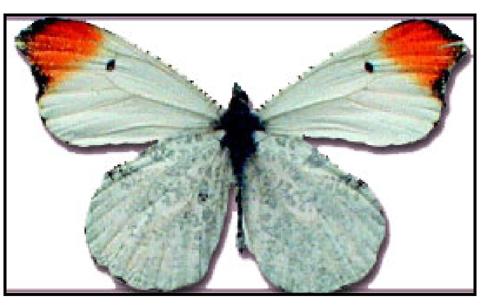

Figure 23. Falcate orange-tip butterfly. Source: Robert J. Nuell, Jr.

The calcium- and magnesium-rich soils associated with both these habitats fosters the development of diverse plant communities (Lapin 1992). Calcareous bedrock occupies only a small proportion of the New England landscape (southern Connecticut, Berkshire and Champlain Valleys, isolated pockets in northern Maine); thus, the calciphilic vegetation types that are concentrated along the Metacomet Range are rare in the region and two (poor fens – peatlands dominated by ericaceous shrubs, and circumneutral rocky summit outcrop – the glades and balds of traprock summits) are considered globally rare. Hence, many of their characteristic plant species are also listed as Threatened or Endangered in Connecticut (and other New England states).

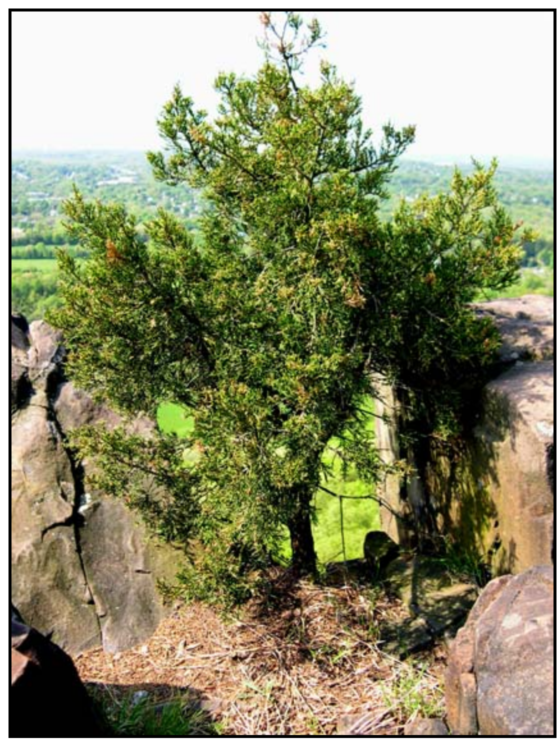

Figure 22. Red cedar (*Juniperus virginiana*) is a characteristic member of the summit bald community.

Figure 24. Typical summit glade, dominated by hickory (*Carya* spp.), white ash (*Fraxinus americana*), and oak (*Quercus* spp.), with a park-like understory of sedges (principally *Carex pensylvanica*), grasses, and sparse herbaceous dicots.

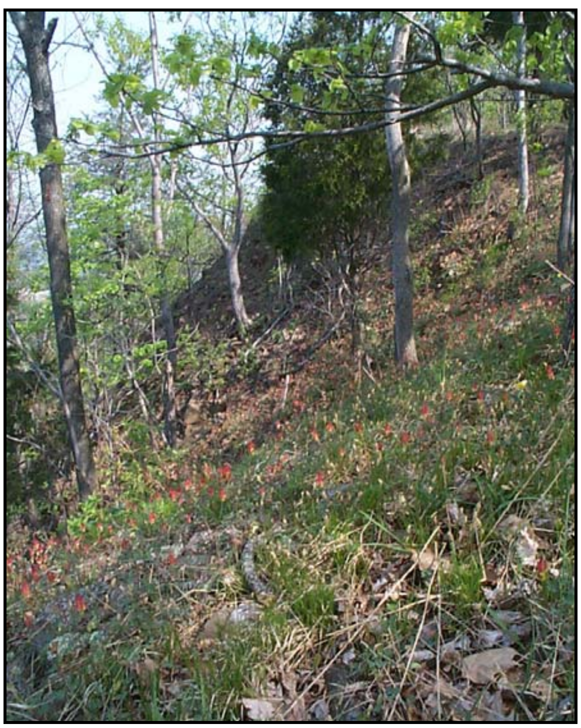

Figure 25. Upper talus slope of Mount Higby, with a profusion of columbine (*Aquilegia canadensis*) in bloom.

Figure 26. Base of talus slope at Totoket Mountain, with northern-affinity herbaceous species (*Aralia nudicaulis*, Wild sarsaparilla).

Areas underlain by more acidic bedrock support hemlock (*Tsuga canadensis*), pine (*Pinus strobus*), and oak (*Quercus* spp.) forests with a well-developed shrub layer of mountain laurel (*Kalmia latifolia*) and witch hazel (*Hamamelis virginiana*), and a sparser herbaceous understory of blueberry (*Vaccinium* spp.), wintergreen (*Gaultheria procumbens*), trailing arbutus (*Epigaea repens*), and other species. Coastal oak forests and brackish and salt marshes (dominated by *Spartina* spp. [grasses] and *Scirpus* spp. [bulrushes] predominate in the southern portions of the proposed Guilford extension.

Figure 27. Oak, beech (*Fagus grandifolia*), and red maple (*Acer rubrum*) forest with blueberries (*Vaccinium* spp.) on acidic soils, Reservoir Loop of Mattabesett Trail.

Figure 28. Shrub layer of very old Mountain laurel (*Kalmia latifolia*) at Reservoir Loop Trail.

Figure 29. Brackish marsh (Spartina patens) and tidal river on projected southern extension of Trail, Guilford, Connecticut.

Figure 30. Turkey vulture over Totoket Mountain.

A number of migratory raptor species also cruise the thermals that rise along the steep, westward-facing cliffs of the Range, and the Range functions as a major flyway during the spring and autumn (Zalles et al. 2000). The nearby Connecticut River functions as an important stopover site for Nearctic-Neotropical migrants (U. S. Fish and Wildlife Service 1996). Once home to the Peregrine falcon, the cliffs still offer ample nesting habitat (in fact, falcons have returned to parts of the Range in northern Massachusetts).

Talus slopes, wet areas, and warm ridgetops are home to unusual snake species that are found in very few other sites in the northeast, including the Northern Copperhead whose numbers have declined precipitously throughout the region. Talus affords protected sites for denning and for sunning (Peterson and Fritsch 1986).

A variety of water features along the trail, including streams, ponds, vernal pools, and seeps, supports several rare salamander and turtle species. Jefferson's and Spotted salamanders, for example, use vernal pools as their obligate breeding ground. Clear streams with good water quality support rare populations of the native Brook Trout and the American brook lamprey. Coastal mudflats and marshes attract numerous birds, including several (e.g., *Egretta thula* and *Ammodramus caudacutus*) that are less common farther north. The East and West River Marsh areas of Guilford, Connecticut, through which the new trail would access the coast, have been identified as a Globally Important Birding Area by the Audubon Society — a critical staging and breeding site for coastal birds. An estimated half of the world population of Saltmarsh sharp-tailed sparrows (a state-listed species, see Table 2), breeds in southern New England, with a sizable proportion of birds using these marshes, according to Partners in Flight.

Figure 31. A young hiker discovers a painted turtle near the Trail. Source: Ann Colson.

Figure 32. First Lake, Guilford, Connecticut. Iron Brook, above this lake along proposed trail route, contains one of a very few healthy native Brook trout populations in central Connecticut.

Figure 34. Nest holes abound on the Trail.

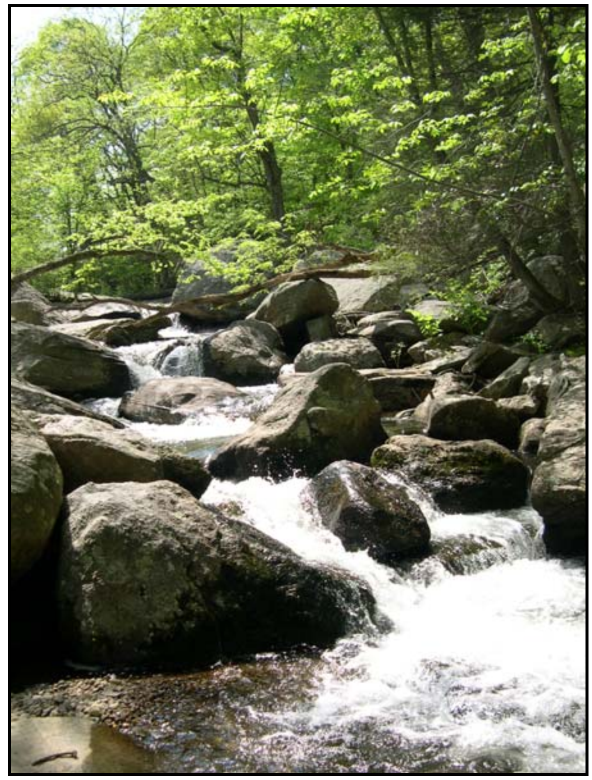

Figure 33. Seven Falls, Middletown.

Connectivity of intact habitats

A high diversity of plant and animal species inhabit the Metacomet-Mattabesett Trail corridor because it represents a continuous, relatively undisturbed (undeveloped) swath of land over 100 miles long, comprising at least 20,000 acres. Despite a history of land use that includes mining, grazing, and logging (see below) and its proximity to urban areas, the forests and wetlands associated with the trail have not been subjected to major degradation and, in fact, have largely recovered to healthy levels. Large, contiguous tracts of deciduous and coniferous forest cover in the Connecticut River watershed as a whole provide critical habitat for interior forest nesting birds (Anderson and Merrill 1998). Twelve species of neotropical migrants using this watershed (including 5 warbler species, 2 vireo species, Louisiana waterthrush, Grasshopper sparrow, Yellow-breasted chat, Orchard oriole, and Blue-gray gnatchatcher) are largely restricted to the Lower New England Ecoregion (Anderson and Merrill 1998). Large mammals including bear, bobcat, mustelid species (minks, fishers), and bats also use these large forested corridors. The Hoary bat (*Lasiurus cinereus*), recorded from near the Trail (Table 2) requires habitat buffered from urban influences and with little evidence of anthropogenic disturbance (Tuttle 1995). Large predatory snakes need sizable home ranges on the order of hectares, and may move up to half a kilometer away from nest sites (McCartney et al. 1988). Thus, the Metacomet Range is one of only a handful of sustainable refugia for these species (Klemens 1993).

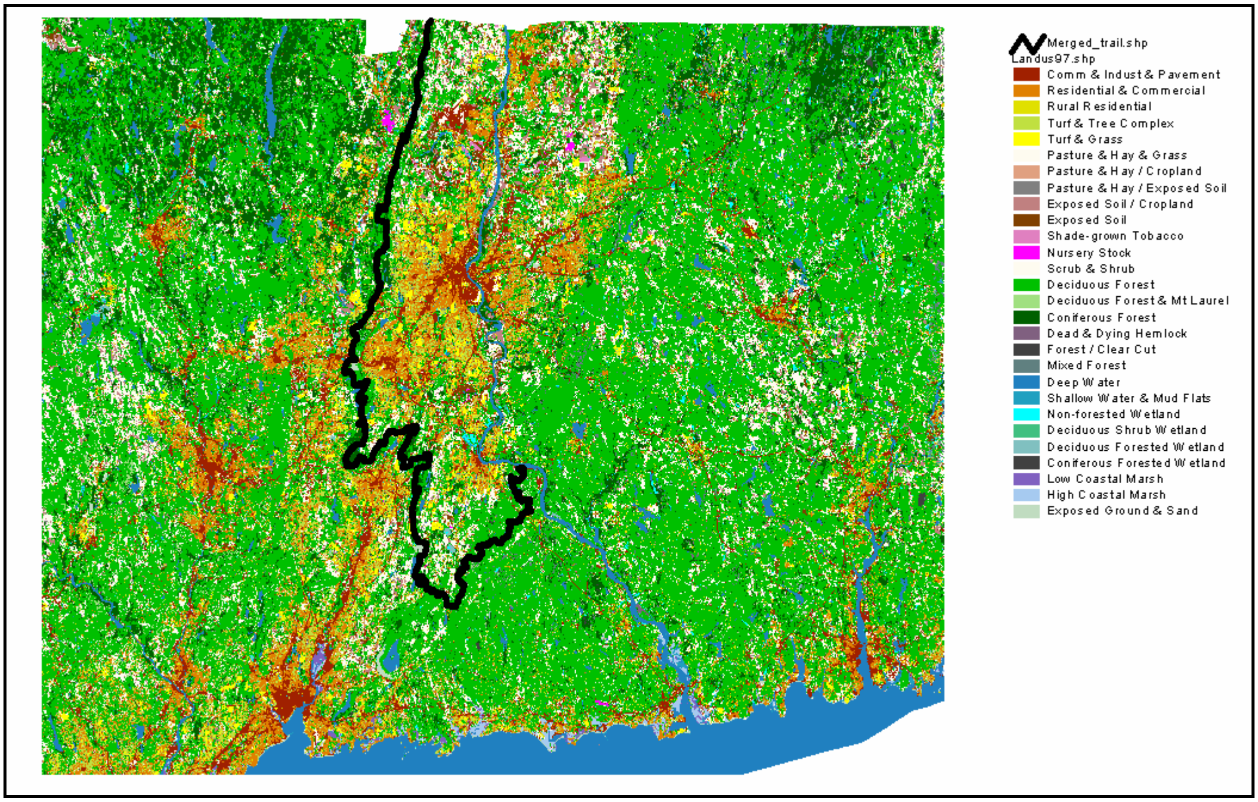

Figure 35. Land cover types along the Trail (overlay in black).
Source: University of Connecticut datalayers.

A considerable proportion of the Trail and environs (over 25% of total trail length; unpublished data) falls on land protected in fee or through easement by conservation entities including the Connecticut Department of Environmental Protection, The Nature Conservancy, and a host of local land trusts including the Berlin Land Trust, Cheshire Land Trust, Farmington Land Trust, Guilford Land Conservation Trust, Haddam Land Trust, Madison Land Conservation Trust, Middlesex Land Trust, Simsbury Land Conservation Trust, Sufflield Land Conservancy, and the Wallingford Land Trust (Fitzgerald 2001). State Parks and Forests traversed by the Metacomet-Mattabesett Trail include: Black Pond Wildlife Management Area (Middlefield), Cockaponset State Forest (Durham and Haddam), Lamentation Mountain State Park (Berlin), Millers Pond State Park (Durham and Haddam), Penwood State Park (Bloomfield and Simsbury), Talcott Mountain State Park (Avon, Bloomfield, and Simsbury), and Trimountain State Park (Durham and Wallingford) (Leary 2004). Additional municipal and private parks such as Hubbard Park (Meriden) and the Hill-Stead Museum (Farmington), extend the level of protection and increase accessibility to portions of the Trail. Lands held by regional water utilities comprise another significant sector of land (approximately 14% of total trail length) that is kept relatively intact (aside from selective forestry) to protect drinking water supplies.

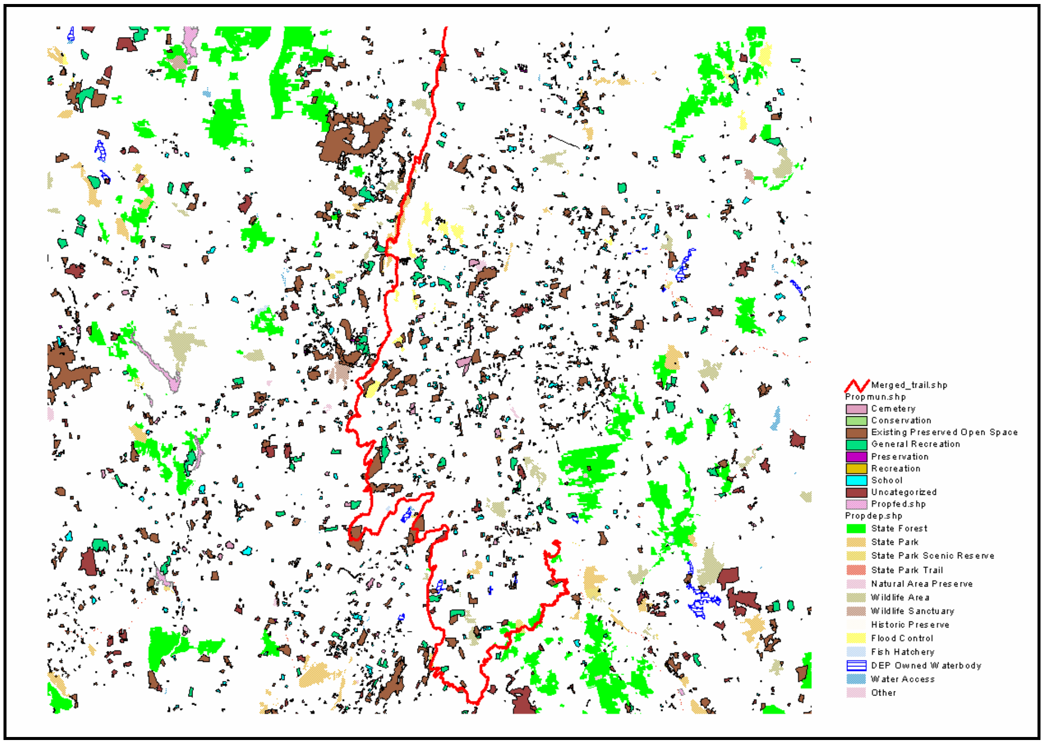

Figure 36. State parks and forests found along Metacomet-Mattabesett Trail. Towns with Trail are outlined in orange. Adapted from Leary (2004).

Land Use along the Trail: Past and Present Influences on Natural Resources

Connecticut has been occupied by humans for at least 10,000 years (Keegan and Keegan 1999), and human activity has had critical influences on the landscapes of the Metacomet-Mattabesett Trail. Native American activity was intense throughout central Connecticut, with the Niantic tribes focused on the mouth of the Connecticut River and the Mohegan-Pequot tribes inhabiting areas to the east (Sultzmann 1997). Quinnipiac Indians were known to create settlements in the Branford and Guilford areas (Camacho et al. 2002). Numerous Archaic and Woodland sites dated from 9,000 BP on are documented from the region, particularly where stream tributaries meet the main stem of large rivers like the Connecticut. Low, flat river terraces were preferentially occupied during Spring to Fall, when foragers exploited rich shellfish beds and anadromous fish (Juli 1994). Basalt was used for flint and arrowheads.

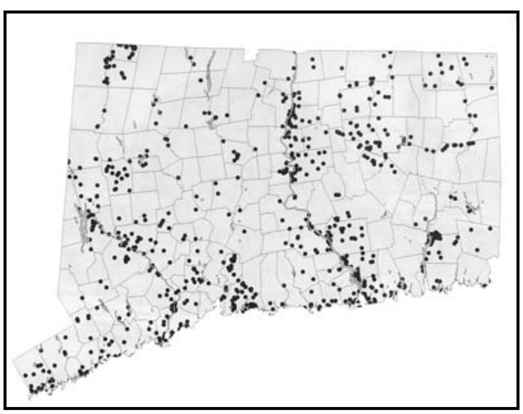

Figure 37. Native American sites from the Woodland Period. Source: Keegan and Keegan (1999).

The name of the Metacomet-Mattabesett Trail commemorates two important tribes that once occupied the region. Chief Metacomet (aka “King Philip”), son of the Wampanoag ally of the Pilgrims, Massasoit, is the trail’s most notorious namesake, leading some of the most damaging attacks against white settlers throughout Massachusetts and Connecticut in the 1670’s (Clapp and Kohl 1978). The promontories of the Metacomet Range served as strategic lookout points for mounting raids on the nascent towns of Connecticut. Legends, many apocryphal, ascribe natural landmarks such as “King Phillip’s Cave” (a lava tunnel visible from the Trail at Talcott Mountain) to famous battles between Native Americans and colonists.

Native Americans likely exerted profound local influences on the structure of natural communities in the region, but their precise impacts are still being reconstructed (Cronon 1983, Hall et al. 2002). Deer-hunting, fishing, and plant-gathering would have been the predominant activities during the Woodland Period. Intentional burns may have been used in limited ways to concentrate wildlife, or to promote growth of blueberries or nut-bearing trees, but evidence for major fires with large-scale impacts on forests is not conclusive (Parshall and Foster 2002). Pollen evidence (Hall et al. 2002) suggests that forests during Native American occupation were dominated by chestnut (*Castanea dentata*), oak (*Quercus* spp.), beech (*Fagus grandifolia*), hickory (*Carya* spp.), and pine (*Pinus* spp.), with chestnuts and hickories providing a major food source. Sedentary agriculture did not commence until after 1,000 years BP, with some tribes in central Connecticut planting corn, sunflowers, and squash (Keegan and Keegan 1999). Cultivation would have required only limited land clearing using axes and hoes (Keegan and Keegan 1999).

Europeans entered Connecticut in the 1630s, and large-scale land clearing, homesteading, tilling, and grazing of the Connecticut River and Farmington River valleys began in the 1650’s (Feder 1999). Intentional fires and logging became widespread throughout the next century, transforming a largely forested landscape to a pastoral one. This activity shifted forest composition to young, disturbance-tolerant stands dominated by birch (*Betula* spp.), maple (*Acer* spp.), pine (*Pinus* spp.), cherry (*Prunus* spp.), and poplar (*Populus* spp.). Many house foundations of the 1700’s were built of trap rock collected from the bases of talus slopes along the Metacomet Range (Lee 1985). Industrialization during the early 1800’s led to the construction of innumerable dams on large and small rivers, providing hydro-energy for mills, and altering the courses and flow dynamics of many waterways. Logging to provide wood fuel for local foundries and other industries may have denuded some portions of the Metacomet ridge from valley to summit. A large traprock quarry opened on East Rock (New Haven, Connecticut) in 1810, and large-scale extraction of traprock to provide crushed paving stone and brownstone for a large number of buildings in the Northeast and beyond began in the 1850’s (Lee 1985).

The legacy of early colonial settlement and industrialization is preserved in numerous historical sites along the Trail – from simple foundation holes to restored landmarks that appear on the National Historic Register. One alternative route proposed for the Trail extension through Guilford would include the nationallyrecognized, historic Clapboard Hill District. An archaeological preserve surrounds "Hospital Rock" in Plainville, a monument to the quarantine at the site of colonial-era Farmington and Hartford residents afflicted by smallpox. The Mattabesett Trail was twice traveled by George Washington, once on his way to assume command of the new American revolutionary army, and again in 1789 when he was elected President (Leary 2004). Local politicians have also made their marks on the Trail throughout the years, creating, for example, the Selectman's Stones monument at Mica Ledges in Durham, Connecticut.

Figure 38. Selectman's Stones. Newly elected selectmen for the four towns that bordered at this site were required to "peregrinate" town boundaries. They hauled engraved stones to this site as proof of fulfilling their official obligations. Note engraved dates from the 1800's.

In the 1830's to 1950's, increasing urbanization, population pressure, and large-scale exploitation of the New England landscape stirred a new aesthetic appreciation among the populace for the remaining natural areas of the region. Henry David Thoreau, Ralph Waldo Emerson, and painters of the emerging Hudson River School (Thomas Cole, Thomas Charles Farrar, William Henry Bartlett, and others) extolled the virtues of nature in writings and artwork. The painters in particular flocked to the Metacomet Range to capture its grandeur and views (Doezema 2002). Interestingly, the paintings of this time reveal the mountains as some of the only forested land in a sea of agriculture and rural settlement, indicating that some of the mountains may have provided a critical refuge for plant and animal species for hundreds of years.

Figure 39. Classic painting by Thomas Cole, *View from Mt. Holyoke, Northampton, Massachusetts, After a Thunderstorm (The Oxbow)*, 1836.

Buildings dating from this period began to spring up along the summits of the Metacomet Range from Massachusetts to Connecticut. The historic Heublein Tower atop Talcott Mountain, for example, was the fourth in a series of towers built at the site from 1810 to 1914 (Leary 2004). Eminent visitors to these landmarks made the range famous; Mark Twain quoted his friend, the Reverend Joseph Twichell issuing the cry, "Just look at this magnificent autumn landscape! Look at it! Look at it! Feast your eyes on it!" (Twain 1876). While the ridge was never densely populated, it was (and continues to be) a popular day-trip destination for tourists, students, and artists. This popularity created the impetus for the establishment of a protected system of hiking trails, among the first of its kind in the United States.

Figure 40. Castle Craig, a fanciful tower constructed in 1900 of basalt, provides a dramatic lookout over the Hanging Hills of Meriden from an elevation of 976 feet.

Local hiking trails attracted visitors from medium-sized, decentralized urban areas (Hartford, Meriden, New Haven, etc.) throughout the state. In the late 1800's, philanthropic industrialists donated large areas of land for parks and recreational areas (Waterman and Waterman 1989). By 1895, the Connecticut Forestry Association (later called the Connecticut Forest and Park Association) formed with a mission to preserve woodlands, and the state of Connecticut formed a park commission in 1913. Many of the protected areas cobbled together during this time were very small, but emphasized the same kind of views that had thrilled Twain and many others. Frederick W. Kilbourne, a Meriden resident, pioneered the idea of a "Trap Rock Trail" to span the distance from Long Island Sound to the Massachusetts border in 1918, and Edgar Laing Heermance took the project forward. By 1929, the Connecticut Forest and Park Association devised its first Trails Committee, and the concept of the Blue Trail system was inaugurated (Woodside 2004). The cumulative effect of this land protection and outreach was the creation of a "continuous hiking trail of almost 50 miles right up against the most densely populated heart of Connecticut, threading between and around the cities of Meriden, Berlin, Wallingford, Durham, and Middletown" (Waterman and Waterman 1989: 438), a corridor of green in an urbanized context unlike any other trail before it. Socially, this trail system permitted a burgeoning number of recreation-seekers to gain a new appreciation for Connecticut's natural ecosystems, and engaged a new class of volunteers in construction and maintenance. An utterly new literary genre – the trail guide – was invented to educate trail users about their environs (e.g., Longwell and Dana 1932), and the Trail received a great deal of attention in the popular press of the time (e.g. Anonymous 1932, 1933). Ecologically, the formation of the Metacomet-Mattabesett Trail led to the long-term conservation of dozens of contiguous miles of relatively intact habitat.

Today, the Metacomet-Mattabesett Trail passes through areas that are largely forested (see Figure 35). A qualitative analysis of digital ortho-photo quads (Farnsworth, unpublished data) indicates that over 70% of the trail passes through deciduous or hardwood-hemlock stands 20-100 years in age, interspersed with wetlands, fields, and residential areas. Areas surrounding the Trail are primarily rural, suburban, and exurban. Recreation heads the list of major activities within the trail corridor, but at least seven quarries still operate along the Metacomet ridge (The Mineral Database 2004). Selective forestry, usually by Municipal landowners (e.g., Water Commissions) or state agencies, continues on small scales (typically cuts of 20 acres at a time or less).

Threats to the natural resource values of the Trail

The natural resources found along the Metacomet-Mattabesett Trail are principally intact, but face several threats from both human activity and natural agents of disturbance. These factors are discussed in priority order in terms of the amount of area they impact, their influence on the quality of the trail experience, and the immediacy of threat. Several large-scale forces, such as hurricanes and global change, are mentioned as potential threats and are treated only in more general terms.

Development

Development of land adjacent to the Metacomet-Mattabesett Trail poses the most serious threat to the quality and continued existence of the Trail and to the integrity of the region's natural resources. The population of central Connecticut in the 19 towns encompassing the Trail was 454,890 according to the 2000 census, and rates of population increase averaged 7.6% between 1990 and 2000 across these towns (Connecticut Office of Policy and Management 2003). Suffield, Durham, and Farmington showed the highest rates of growth (from 15-18%). Building permits (an index of housing starts) have increased more rapidly than population, rising 26.0% from 2003-2004 (Connecticut Department of Labor 2004). The Metacomet Range is an attractive place to site residences because of its views and its convenient proximity to highways and cities. Several developments now cluster densely along the bases of traprock ridges (displacing formerly rich talus habitat and increasing the risk of human-snake contact, among other problems). Road-building and widening along the base of the Metacomet Range to accommodate increased vehicular traffic (e.g., along Route 66 in Middletown) has also contributed to habitat destruction.

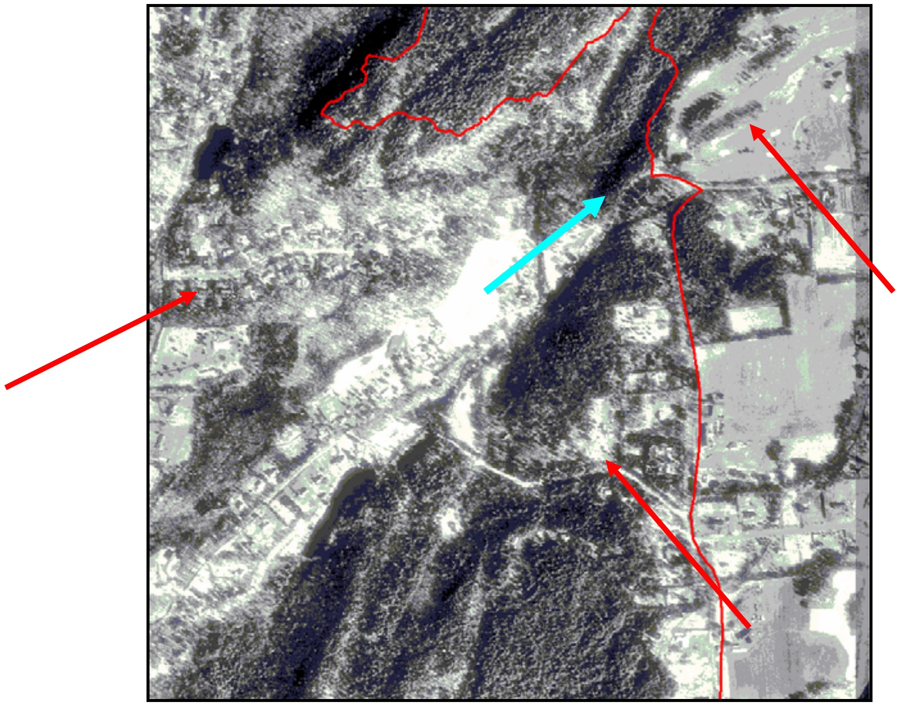

Figure 41. Aerial photograph with arrows highlighting development, taking place over several years (left to right: housing; road building across ridge; golf course), that has encroached on the Metacomet Trail (in red) in Berlin/Southington. Note narrowing of forested habitat toward the northeast (blue arrow).

Homebuilding has been less frequent to date at higher elevations along the range, principally because of the formidable engineering challenges of constructing roads and houses on steep, shallow-to-bedrock slopes and in permitting on-site septic on soils of the Hollis and Holyoke Rock Outcrop Complexes. Enabling legislation (Public Act 95-239) allows towns to zone their ridgetops for viewshed protection by limiting or prohibiting building, and at least five trailside towns to date (e.g., Southington, Farmington, Middlefield, Durham, and Meriden) have created overlay ordinances designed to protect the viewshed of traprock ridges. Likewise, the towns of Meriden, Middletown, and Berlin formulated the Tri-Town Land Use Plan (1994) to address the need to maintain and protect open space on the traprock ridges (particularly Lamentation Mountain and Chauncey Peak). In 1998, 17 traprock ridge towns in Connecticut signed the Metacomet Ridge Conservation Compact to confirm their joint commitment to protect the range. However, pressure to build on the range has increased in recent years and some local property owners have objected to legislation limiting building rights on private land. Protests by individual landowners have led to temporary trail closures. A 1997 attempt to regulate clear-cutting, quarrying, and development on the ridge in Middletown failed (Lareau 1997).

Disturbance on these shallow-to-bedrock ridges would irreversibly alter habitat for both plants and animals inhabiting the range. Vegetation regrowth is severely limited by soil availability at the summit and would be slow in the wake of clearing. Large-scale removal of forest and expansion of paved surfaces would impair the recharge capacity of the range, with implications for water quality of associated aquifers. Disruption of habitats would place rare plant and animal species in danger of local extirpation. Such development would permit intensified, unregulated access by people, pets, and all-terrain vehicles to the Trail, increasing the risk of harming plant and animal species, the probability of invasive species introductions, and overall damage to the Trail itself.

There have also been several proposals to construct cell phone and radio communications towers along the Metacomet summits and elsewhere along the Trail (e.g., along Talcott Mountain). Road construction to service towers, and herbicide use to maintain clear areas around the tower would have negative impacts on local plants and animals, as discussed above. Likewise, towers may pose a collision risk to migratory birds, especially the raptors that seasonally frequent the range in large numbers (Kerlinger 1989).

Quarrying

Quarrying for traprock has taken place since the early 1800's in Connecticut, and the level of quarrying intensity (in terms of economic output) has remained relatively stable since the 1970's (Fitzgerald 2001). Although the Connecticut Department of Labor (2004) projects a 4.3% decrease in mining-related employment statewide in the coming year, the demand for quarried traprock may be increasing as much as 11% per year (Lareau 1997). Contemporary quarries on the range are typically large operations impacting on average several tens to over one-hundred acres. Quarrying entails clear-cutting of forest, removal of substantial amounts of bedrock (estimates range from 7.5 to 20 million tons of traprock annually), permanent changes in topography, alteration of hydrology, additional land for disposal of waste materials, dust generation, and noise. One such quarry operates directly adjacent to the Metacomet-Mattabesett Trail at Chauncey Peak in Meriden, Connecticut. The Trail has been moved to accommodate mining and will soon have to be relocated further (personal observation). In proximity to the mine, the hiking experience is much diminished and damage to the plant and animal communities (through dust accumulation, noise disturbance, and outright destruction) is obvious. However, evidence of disturbance becomes much less visible beyond 30 feet away from the quarry edge. Negotiation of conservation easements and restoration strategies with the largest quarry owners will be essential to sustaining the continued existence of the Trail and to minimize further harm to natural systems and aquifers.

Figure 42. Quarry near Chauncey Peak within close view of the Trail.

Trampling, rogue trails, and Off-Road Vehicle use

The Metacomet-Mattabesett Trail is well-marked and regularly reblazed by volunteers. While the vast majority of users respect designated trail boundaries, some evidence of unauthorized uses was found during reconnaissance in Spring, 2004. Particularly popular areas for walkers, e.g., Ragged Mountain, showed significant trail widening at lower elevations, because hikers and trailbike riders use a variety of alternative paths. This proliferation of paths can disorient hikers (Higbee 2003). A few sites with attractive rock-climbing areas also have rogue trails that lead to staging sites. Such trails can harm rare plant populations. At Mount Higby, for example, an offshoot trail leading to a talus overlook crosses through a population of the State-listed plant, yellow corydalis (*Corydalis flavula*). Certain plant species, such as the rare *Potentilla arguta*, tend to cluster closely along trail margins (possibly because of increased light availability at trailside) and would be eliminated by trampling or trail widening (William Moorhead, Consulting Botanist, personal communication). Less than 5% of the trail length surveyed during this reconnaissance was affected by this activity.

Figure 43. Trail widening due to foot and bike traffic at Ragged Mountain.

Off-road vehicle tracks were seen on a larger sector of the trail (approximately 20% of the trail mileage surveyed by the author during 2004 showed some impact; note that this is a qualitative visual estimate). In fact, ORVs, motorcycles, and other vehicles have been noted as issues along the Trail since the 1940's (according to minutes from past Blue Trail Committee meetings). ORVs tend to create deep ruts and gullies in deeper, moist or wet soils at lower elevations, and to remove or compact shallow, dry soils at higher elevations. Tracks traversing steep slopes can hasten soil erosion and alter water drainage patterns along the Trail, and exacerbate damage resulting from high rainfall events. ORV riders can inadvertently trample rare plants and animals as well. Noise and air pollution from 2-stroke engines can further disturb both hikers and resident organisms.

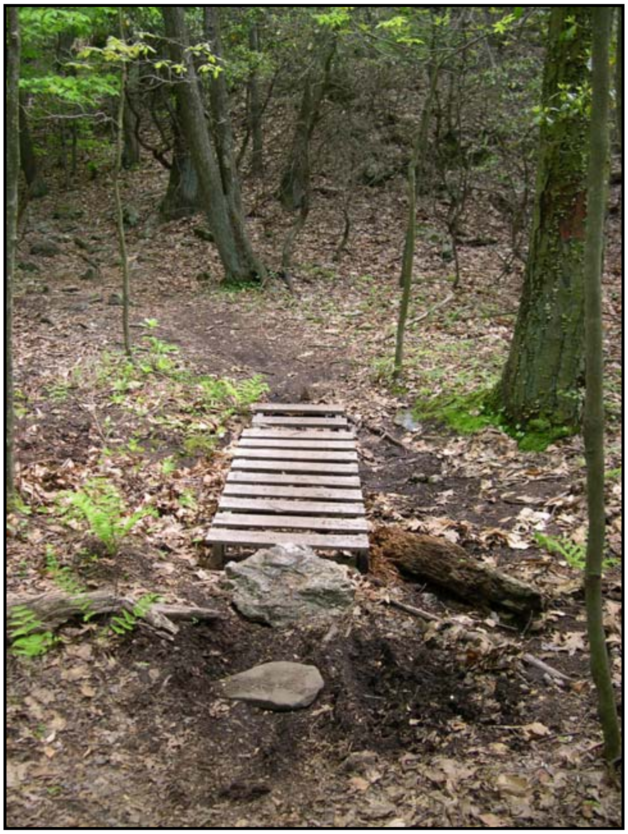

Figure 44. ORV tracks skirt a footbridge, creating ruts in a streambed at Reservoir Loop.

Normal trail maintenance activities could exert their own impacts on vegetation, drainage patterns, and animal burrows, if not undertaken carefully to avoid erosion or widening. Digital elevation models (unpublished data) indicate that as much as 25% of the Trail occurs on steep slopes in excess of 20% grades; such paths require special attention to placement and maintenance. However, training materials and workshops given to Blue Trail volunteer managers by the Connecticut Forest and Park Association stress the importance of minimizing collateral damage to adjacent areas while clearing debris, blazing new trails, and constructing water bars and steps, with an emphasis on using hand tools.

Invasive species

Two classes of invasive species pose significant potential threats to the integrity of natural communities, the viability of rare plant and animal species, and the experience of hikers along the Metacomet-Mattabesett Trail: invasive insects and invasive plants. Principal among these agents are the hemlock woolly adelgid and exotic shrubs.

The hemlock woolly adelgid (*Adelges tsugae*), introduced from Japan in the 1920's, is now ubiquitous throughout central Connecticut on hemlock (*Tsuga canadensis*). Feeding by these phloem-sucking relatives of aphids can lead to whole-tree mortality within 3-10 years of colonization. Sites of infestation are patchily distributed along the Trail, but tend to wreak the most damage in hemlock stands on drier soils in warmer aspects (trees are more stressed on droughty soils and the adelgid benefits from warmer temperatures; Bonneau et al. 1999, Orwig et al. 2002). Hemlock infestations are more frequent and severe in the southern latitudes of Connecticut, as the invasion front is still moving northward (Orwig et al. 2002). The dark shade under a dense canopy of healthy hemlock tends to discourage formation of a dense herbaceous or shrub layer in the understory. By contrast, defoliation results in stands of dead and dying trees, a considerable amount of downed wood, and canopy openings; soils in damaged stands are more acidic, lower in moisture, and higher in coarse woody debris than soils in undamaged stands (Kizlinski et al. 2002). Salvage logging of dying hemlock has been conducted at some sites near the Trail to reduce fire hazards and promote safety of forest visitors (e.g., Penwood State Forest, Cockaponset State Forest); these harvesting practices create large gaps that are conducive to regeneration of fast-growing deciduous trees and herbaceous plants, particularly black birch (*Betula lenta*) and hay-scented fern (*Dennstaedtia punctilobula*) (Kizlinski et al. 2002). Together, adelgid infestation and salvage logging can permanently alter the forest profile and associated ecosystem dynamics. Because a large proportion of the Metacomet-Mattabesett Trail traverses ridgetops that are not dominated by hemlock, most (perhaps 70%) of the Trail is not directly affected by this defoliation. However, dying trees are visible at many viewpoints along the Trail. It is also important to note that a host of other invasive insects and pathogens have killed – or are projected to kill or weaken – a significant number of trees of many species: Gypsy moth, beech bark disease, chestnut blight, Dutch elm disease, butternut canker, dogwood anthracnose, sudden oak death, and Asian longhorn beetle (Orwig 2002).

Figure 45. Dead hemlocks at Hubbard Park, Meriden, Connecticut.

Much of the Metacomet-Mattabesett Trail is relatively free of invasive plant species, as they have yet to gain a foothold in intact forest interiors. The areas where invasive plants most frequently occur are trail access points near roads or infested fields (perhaps 10% of total trail length). These areas receive the largest number of human visitors, and have the highest proportion of "edge" habitats that attract birds and other animal vectors that spread invasive plant seeds. High-light conditions at these habitat edges tend to favor growth of invasives and other sun-demanding native species. Areas where these species appear to penetrate forest interiors tend to coincide with previously grazed or farmed plots or with house foundation sites (personal observation). Exceptions to this trend occur at Beseck Mountain along the Mattabesett Trail, where invasive shrubs have spread to the summit. Hikers, bikers, and pets can potentially transport invasive propagules all along the Trail.

The most common invasive species (in terms of ground cover) noted along the Trail during 2004 and in previous surveys (Farnsworth 2001) included the following shrub species: Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), honeysuckles (*Lonicera* spp.), glossy buckthorn (*Frangula alnus*), and winged euonymous (*Euonymous alatus*), and autumn olive (*Elaeagnus umbellata*). Japanese knotweed (*Fallopia japonica*) is common along well-visited waterways near the Trail.

Figure 46. Japanese knotweed along stream shore at Seven Falls.

Figure 47. Japanese barberry at Ragged Mountain.

While there is widespread consensus in the scientific and conservation community that invasive plant species are becoming more prevalent in Connecticut, few systematic studies to date have characterized the long-term impacts of particular invasives on rare species or community structure, or have documented the actual longevity of particular infestations. Thus, while it is obvious that species composition in certain habitats traversed by the Trail (especially ecological borders between forest and anthropogenically altered landscapes) will change with the presence of invasives, the lasting effects of these invasions are not as yet known (Farnsworth, in press). In the immediate term, these invasives tend to homogenize the landscape, reducing the diversity of natural community types visible along the Trail. Thorny shrubs can also pose a hindrance to hiking.

While not considered "invasive" in the strict sense, native white-tailed deer (*Odocoileus virginianus*) are burgeoning in the state and are changing the face of Connecticut forests through heavy grazing pressure. Deer often utilize human trails, and can be seen along the Metacomet-Mattabesett Trail at all times of year. Dense populations of deer can hamper forest regeneration through overconsumption of tree seedlings; shift forest understory structure to low-diversity stands of resistant herbaceous species (such as hay-scented fern, *Dennstaedtia punctilobula*), and reduce reproduction and growth of rare plant species (McShea et al. 1997).

Campsites and fire rings

Despite prohibitions against camping in undesignated sites, areas along the Metacomet-Mattabesett Trail attract campers and partiers. Unauthorized uses are more frequent in sectors of the Trail in proximity to densely populated areas (e.g., the cities of Meriden and Berlin) where visitation pressure is higher. The main problems resulting from this activity are an increased risk of fire, and pollution from dumping. Fire rings and small garbage heaps were found at a few sites on Lamentation Mountain in particular during 2004 reconnaissance. Dumping has local effects that are primarily aesthetic in nature. However, fires could spread rapidly in the more xeric areas of the Metacomet summits. Fuel loads are low on rocky balds, but increase markedly at short distances from the ridgetops. Fires would be difficult to fight in areas of the Trail that are less accessible to emergency vehicles. During a recent fire on the Mt. Holyoke Range (along the Metacomet Trail in Massachusetts), detection and control was hampered for several days due to difficulty of access; eventually, water drops had to be made from aircraft to contain the fire. There is little conclusive evidence that lightning-strike fires have been frequent on the Metacomet Range, or that fire is a natural ecological driver in maintaining the oak-hickory glades or other community types that predominate on the range (Fitzgerald 2001). Therefore, the impacts of fire on natural community structure are largely unpredictable without further systematic study. Studies of post-fire recovery on the Mt. Holyoke Range reveal a shift toward more diverse and dense herbaceous vegetation (some exotic) in burned zones, along with gradual stump-sprout regeneration by trees (Hampshire College, unpublished data).

Figure 48. Fire ring with associated litter at Lamentation Mountain.

Global change

The term “global change” encompasses a range of human-induced alterations of ecological processes that occur at very large scales; the manifestations of global change that impinge most directly on the Trail in Connecticut are climatic warming and nitrogen pollution. Climatic warming — due at least in part to rising levels of atmospheric greenhouse gases — is demonstrably occurring (IPCC 2001); Connecticut mean annual temperatures have risen 1.4^{o}F in summer and 2.4^{o}F in winter between 1885 and 1999 (New England Regional Assessment Group [NERAG] 2001; also see data in “Climate and Air Quality” above). The cascade of impacts of such warming is highly complex and still difficult to predict. Among the factors that could impact the Trail and its users are: 1) an increased incidence of Lyme disease; 2) more days that are classified with unhealthful ozone levels; and 3) more days with extreme heat levels (NERAG 2001). Some general circulation models predict a higher frequency of extreme storm events, including ice storms and hurricanes (which would result in significant tree and Trail damage); however, this prediction is variable among models and is difficult to refine at a regional level.

Another facet of global change of concern is increased nitrogen pollution. Total reactive Nitrogen levels in the atmosphere have increased considerably in the Northeast in the past 50 years, from approximately 30 terragrams/year to 160 terragrams/year (Hubbard Brook Research Foundation 2003). Nitrogen is released into the atmosphere and waterways through food production and consumption (fertilizer inputs, fixation by crops, production by livestock, sewage outputs) and by emissions from motor vehicles and power plants. Nitrogen emissions contribute to the formation of ground-level ozone that impacts human health and may reduce primary productivity in Northeastern forests by an estimated 14% (Hubbard Brook Research Foundation 2003). Reactive Nitrogen also contributes to acid precipitation, increased nitrate contents of runoff, and acidification of water bodies. Nitrgoenous pollution of lakes, rivers, and estuaries can cause algal blooms and fish die-off. Elevated soil Nitrogen has also been implicated in fostering invasions by certain plant species that are efficient at taking up and using nutrients for growth (e.g., Bertness et al. 2002). Increased tree mortality, water pollution, and prevalence of invasive species reduce biodiversity and may significantly alter ecosystem processes in the forests and wetlands associated with the Trail.

Together, the threats of development, bedrock extraction, improper trail use, and global change will have to be addressed through a combination of local and national legislation, public education, and negotiation with private and industrial landowners. Fortunately, a variety of regional interests, town planning agencies, conservation organizations, Connecticut Forest and Park Association and others — many with long standing and broad influence in the state — can work together to devise judicious strategies for Trail protection.

Conclusions

The Metacomet-Mattabesett Trail roams a variety of diverse habitats that are unique in Connecticut, and in North America. It is a critical corridor of semi-protected land that many organisms – including humans – find to be essential refuge. National Scenic Trail designation will help to ensure that these significant hotspots are conserved and will promote the aesthetic and educational potential of the Trail for its many users.

Figure 49. View of Merimere Reservoir from South Mountain, Meriden, Connecticut.

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