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An Ecological Assessment of Merck Forest & Farmland Center Rupert, Vermont

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Executive Summary



Photo 1: farm fields at Merck Forest

Overview: Merck Forest & Farmland Center is a large, continuously forested tract in the Taconic Mountains of southern Vermont. Comprising approximately 3190 acres, this land exemplifies the iconic land use history of Vermont. Once the site of seven different homesteads, the last remaining actively farmed parcel is still in agricultural use. The rest of the property is now forested and has been under forest management practices since 1950.

Objective: The purpose of this report is to assess the land's current and potential ecological value and make recommendations for a conservation strategy. To achieve this

objective, I inventoried the landscape in an integrated approach that assesses abiotic factors, biotic factors, and land use history. I began by assessing the abiotic factors – hydrology, topography, geology, and soils – through available mapping. I then researched the human use history specific to Merck Forest, in conjunction with the human use history of Vermont, to understand the story this land tells. Over the course of eight weeks in the summer of 2014, I methodically walked every aspect of every hillside on the property, mapping the natural community types. Finally, I researched available data on wildlife use, bird diversity, and landscape-scale habitat features.

Natural Communities: A natural community is an interacting assemblage of organisms, their physical environment, and the natural processes that affect them (Thompson & Sorenson, 2005). Natural community mapping is used as a tool to evaluate the diversity of a particular place. The dominant natural community at Merck Forest is a mix of Mesic Red Oak-Northern Hardwood Forest and Red Spruce-Northern Hardwood Forest. Additional community types found at Merck are: Dry Oak Woodland, Dry Oak Forest, Dry Oak Hickory-Hophornbeam Forest, Mesic Maple-Ash-Hickory-Oak Forest, Boreal Talus Woodland, Montane Red Spruce-Yellow Birch Forest, Hemlock Forest, Rich Northern Hardwood Forest, and Northern Hardwood Forest. Only the Dry Oak Woodland is rare by state standards (S2), but each of these communities offers diversity to the local landscape of Merck Forest. There is a previously unknown population of the rare plant species, smooth yellow false foxglove (*Aureolaria flava*) with a state rank of S2.

Wildlife Habitat: Wildlife habitat is an important consideration when assessing the conservation value of a large tract of continuous forested land. Volunteers monitor bird populations at Merck Forest as part of Vermont Center for Ecostudies (VCE) Monitoring Program. Merck follows Audubon's Forestry for the Birds Program and using VCE data to look at the 12 key species populations, Merck Forest is doing quite well. White-tail deer wintering habitat is not identified according to the State survey, but site analysis identifies multiple areas on the property. The Jefferson Salamander is the only recorded rare (S2), threatened or endangered animal species at Merck Forest.

Habitat Connectivity & Forest Resilience: At a regional scale, Merck Forest is within a 41,000-acre habitat block (assigned by the State of Vermont) with high valued interior forest habitat. It

offers a corridor of connectivity for species with large home ranges to cross Route 315. According to The Nature Conservancy's modeling of terrestrial landscape resiliency, which measures local connectedness and landscape complexity, Merck Forest contains two areas of high resiliency.

Management Considerations: Regeneration in Northern Hardwood Forests is drastically changing, mostly due to American beech, a highly shade tolerant species. The onslaught of Beech Bark Disease causes a stress response of root sprouting in beech, which coupled with the effects of single-tree selection harvests leads to beech thickets that are shading out the regeneration of most other tree species. In a forest that is quickly losing diversity in regeneration, it is important to manage for increased diversity where possible. In order to balance economic goals with ecological goals, there should be areas reserved for no touch management within a matrix of actively managed conservation land. 'No touch' is defined as no harvesting for the purposes of this report. All recreation trail maintenance and silvicultural prescriptions to restore structural complexity ought to continue unimpeded. 'Light touch' is defined as limiting harvest to single tree selection methods, to preserve the closed canopy and continuity of the understory herbaceous plant life. The no touch areas will support the biological legacies that act as a seed source to the surrounding forest to promote diversity within the forest. It is best to reserve these communities from harvesting activities so that the natural processes of competition and regenerative capacity will select individuals with the most well-adapted seed source.

Conservation Recommendations: Merck Forest currently holds Compartment 6 in 'natural area' status, exempt from management to allow natural processes to occur. Studies have correlated increasing species richness (biodiversity) with increasing tolerance to environmental extremes, greater stability over time and greater potential to recover from disturbance (Tilman, 1997). By simply changing the conservation strategy from one of geography to one of biodiversity, the managed forest will gain the valuable timber that is currently withheld in the natural area, and the overall forest resilience will increase through increased biodiversity.

For these reasons I recommend the Board of Trustees move forward with a conservation easement on the whole property with Vermont Land Trust excluding the developed farm, office and cabin facilities. Additional restrictions on management should be incorporated to support a conservation strategy of biodiversity.

I further recommend the following management approaches: No touch treatment for the Dry Oak Woodland, Montane Yellow Birch-Red Spruce Forest, Boreal Talus Woodland, Hemlock Forest, Dry Oak-Hickory-Hophornbeam Forest, Mesic Maple-Ash-Hickory-Oak Forest, and the area of Rich Northern Hardwood Forest of Compartment 5, between Schenck Rd and Clarks Clearing Trail. I recommend a light touch treatment in the Rich Northern Hardwood Forest of Compartments 7 and 1.

Conclusion: Merck Forest is a large parcel of contiguous forest that has current ecological importance to the surrounding landscape, and may potentially play a much larger role in regional biodiversity as climate changes. An easement, and the enhanced protection of the significant natural communities identified, will protect this valuable landscape for generations of humans, animals, and plants, while supporting the organization's commitment to education and sustainable forest management.

Introduction

Merck Forest perfectly captures the essence of Vermont's identity. It tells the story of Vermont through tap scars on the maples, and rock walls of yesterday's fields now scattered through hardwood forests. At 3190 acres of contiguous forested landscape, with a variety of natural communities and great topographic variation, Merck Forest is a sight to behold and to preserve. The hilly terrain of the Taconic Mountains does not lend itself to ease of agriculture, but that didn't stop Vermont's early settlers. Hill farms flourished and brought Vermont through the economic boom of wool production. Today, the farm at Merck Forest is a relic of Vermont's pastoral heritage. Walking the nearly five square miles of forest surrounding the farm instills a sense of treasure-hunting.



Photo 2: old shoe uncovered by White Creek

But, as many who know this land intimately find out, my search revealed few individual species or natural communities of high-ranking rarity. What Merck Forest offers is stability in the face of a changing world. A tract of continuous forest, with only minor interruptions of development will allow species to move and respond to a new set of climatic conditions. The combination of topographic variation, diversity of natural communities, and habitat connectivity are significant in measuring Merck Forest's impact within the conserved lands matrix. In order to assess how this property weighs in the balance of

ecological priorities and human priorities, it is best to start with an understanding of what exists on the land.

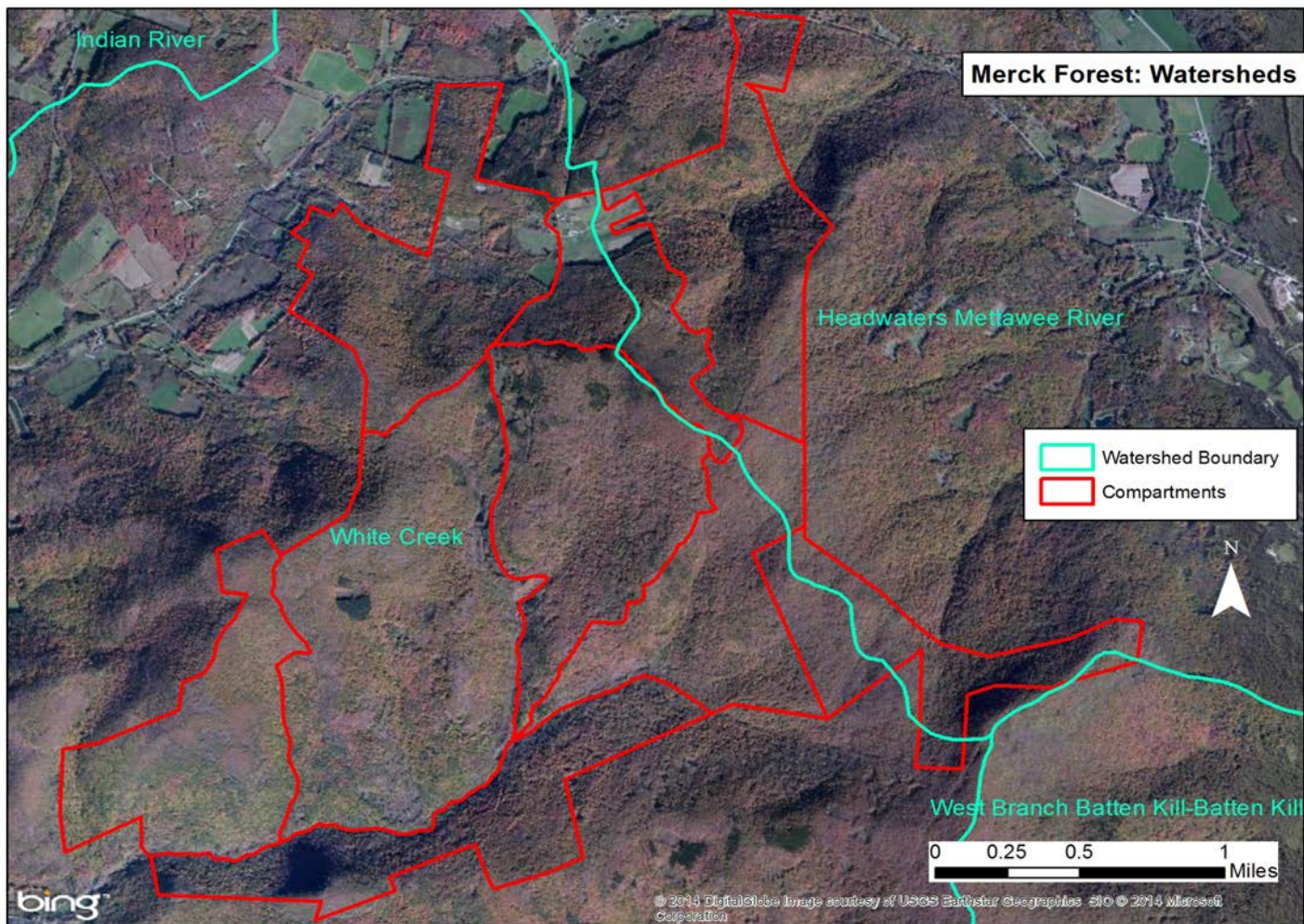
Objective

The purpose of this report is to provide a comprehensive assessment of the ecological value of Merck Forest. By systematically mapping the property and assigning natural community types to the land, we are able to understand how the property interacts with the surrounding landscape, and what value it might have within a broader, regional context. We consider its potential value to wildlife and plant life as Earth's climate deviates from the conditions to which the current inhabitants are adapted.

Property Description

Merck Forest and Farmland Center is a 3,190 acre (estimated) property in Rupert, Vermont. It sits in the eastern edge of the Taconic Mountains before they dip down to meet the Vermont Valley. Within this nearly five square mile parcel, elevation changes are steep and slopes are quite rocky near the ridgelines. Three mountains influence the topography of Merck Forest - Gallop Peak and Mount Antone reside within the property boundary, and Spruce Peak is just beyond the southeastern corner. Each over 2500 feet, they influence wind patterns enough to sustain a constant breeze.

The main drainage on the property is the North Branch of White Creek, traced by Old Town Road. White Creek eventually drains to the Hudson River (Map 1). On the other hand, the waters flowing off Gallop Peak and the north side of Spruce Peak drain into the headwaters of the Mettawee River, leading north to the St. Lawrence River.



Map 1: Merck Forest: Watershed Boundary

Though at one time nearly all the land was cleared, currently most of it is forested with less than 100 acres in active agricultural use. The forest is under active management, with a forest management plan in effect until 2021. Merck Forest and Farmland Center is a 501(c)(3) non-profit institution that encourages public access and outdoor recreation on the land. For the purposes of logging and providing access, the trail system is maintained when free of snow, with a corridor wide enough to support an All Terrain Vehicle. This trail system offers 36 miles of exploration opportunity, and connects a system of off-grid cabins for visitor use.

Ecological Assessment

Methodology

The methods I employed in this assessment were designed to provide a complete story of the ecological features of the land and what factors, both natural and human, might be influencing what we see on the property. I started with research of the underlying geology and soils. The chemistry of the rock type, exposure of bedrock, parent material type, soil moisture, soil nutrients, and pH can greatly affect what individual plants occur in a given place, and thus the community of plants as well. I also studied available aerial imagery to find similarities or differences in forest cover, or unusual features on the landscape.

Once I completed this background investigation, I began an onsite analysis to verify

some of the predictions about the vegetation. In the case of Merck Forest, I did not have high-resolution imagery at the beginning of the process so the property was walked systematically by elevation and aspect, rather than guided by aerial imagery. I transected every aspect of each hillside to determine a rough line of community boundaries. I recorded point data using a Garmin Oregon 450 GPS unit, and then uploaded the data to ArcGIS 10.2 to then consult aerial imagery and estimate the extent of the community types through areas not directly walked.

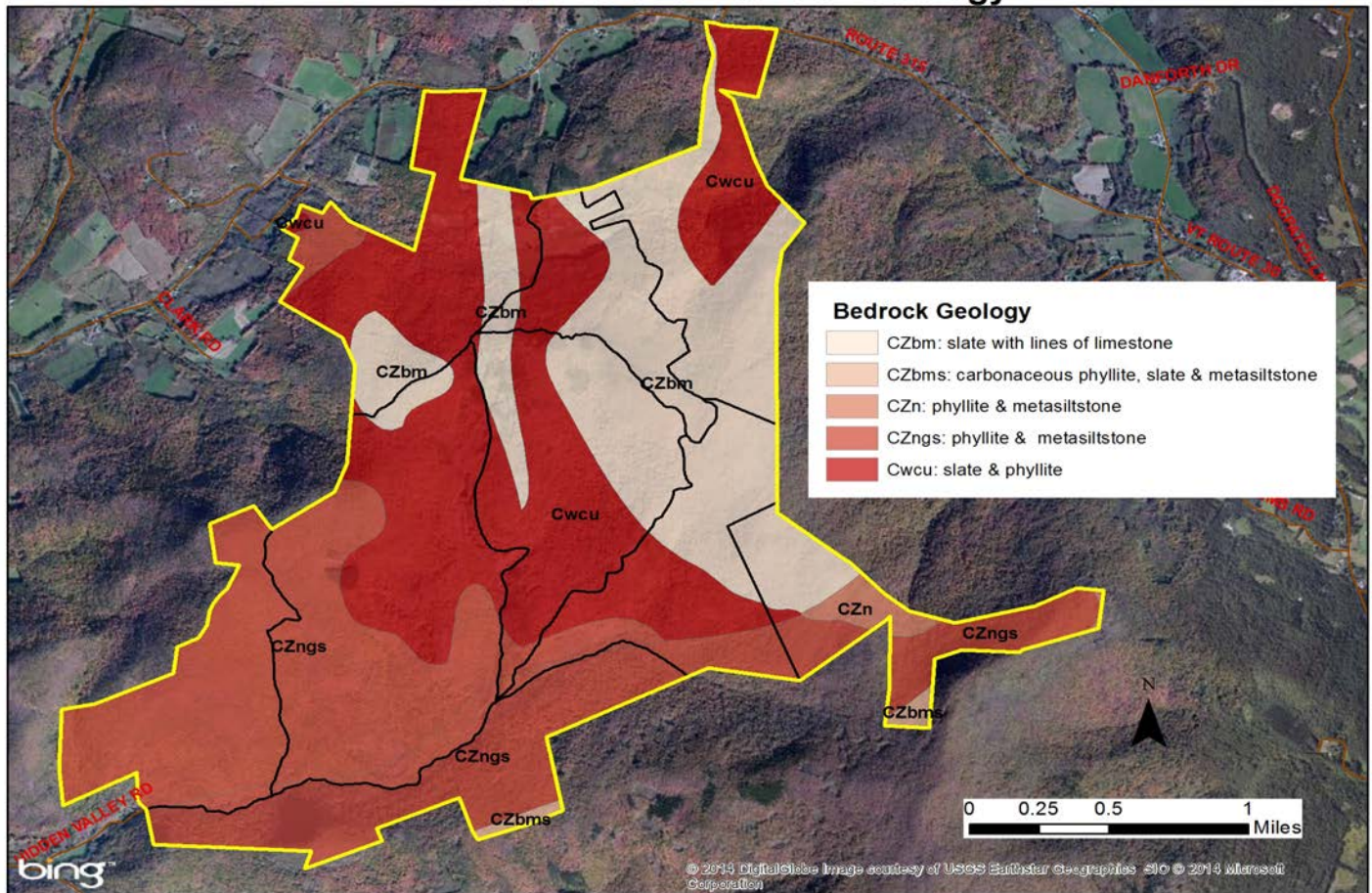
Background

Bedrock Geology

Though the most recent mapping of Vermont's bedrock geology suggests the presence

of calcium rich rocks, the on-site bedrock suggests otherwise. Geologist Tim Schroeder of Bennington College stated that he has only seen slate and phyllite bedrock exposures on Merck property. Back some 450 million years ago when the Taconic Orogeny affixed an island arc onto the Laurentian Continent, the mudstones laid down off the shore were heated and transformed into the slate rock we see today. There is Cheshire Quartzite present near the surface as either an inclusion in the slates and phyllites or possibly migrated on site as glacial till. Neither of these rocks have additional nutrients for plant life. The only way richness is exhibited on Merck land is through the process of colluviation, where downward momentum on slopes moves nutrients through the soil to collect in lower areas, typically flat or concave.

Merck Forest: Bedrock Geology



Map 2: Merck Forest: Bedrock Geology

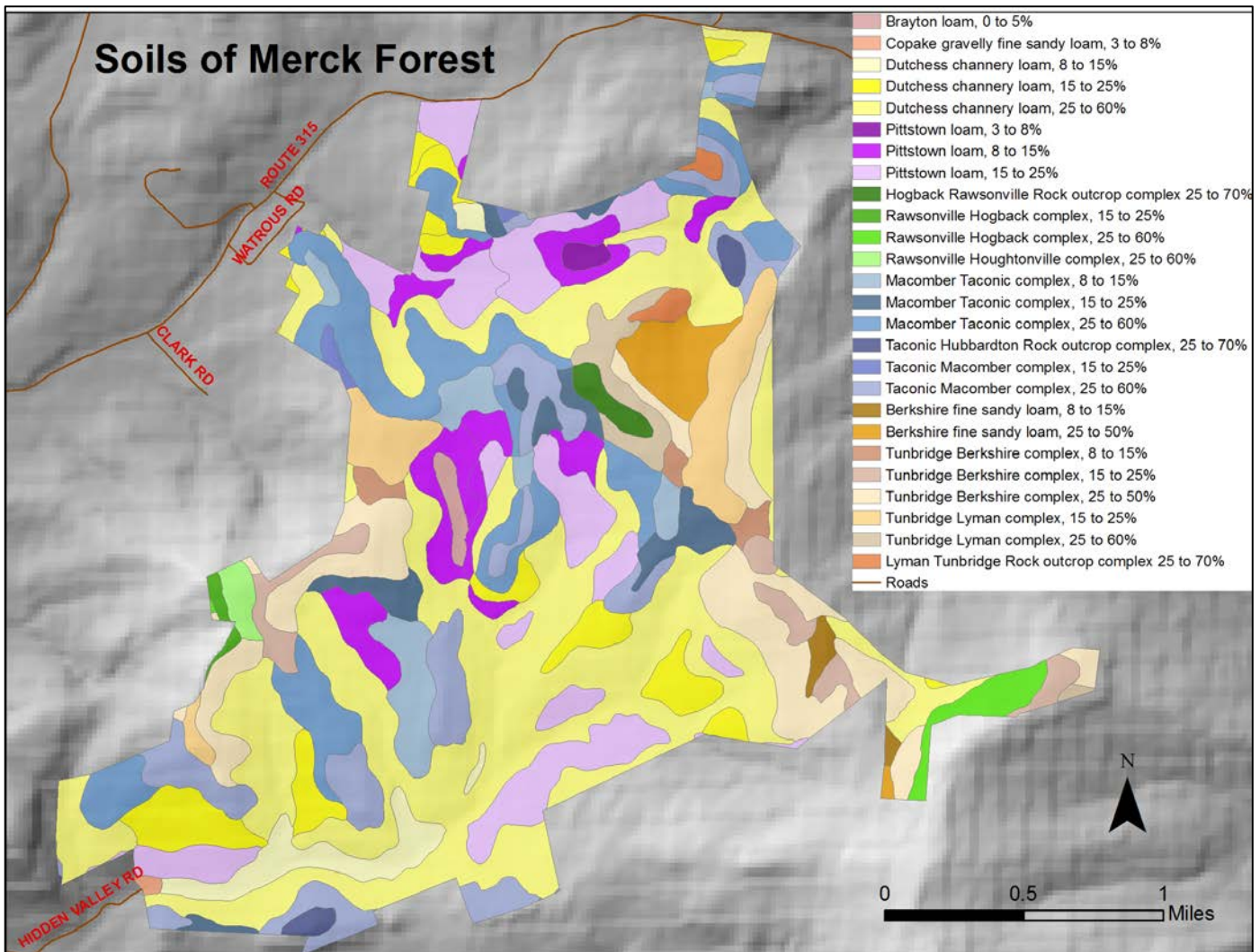
Surficial Geology

The surficial deposits in Merck Forest are almost entirely glacial till. The Laurentide ice sheet that covered all of New England wiped clean any previously accumulated organic material and deposited it to the south around New York. As the one-mile thick ice began to melt back to the north, the fine particulate matter, gravel, and boulders suspended in the lower parts of the ice were deposited onto the newly exposed rock. By about 13,000 years ago, the fine particulate matter mixed with larger pieces of gravel accumulated in a layer known as glacial till.

Soils

The soils on Merck property vary in formation but are nearly uniform in character at higher elevations, characterized as moderately to

moderately-well drained, very rocky soils (NRCS, 2014). Some of the formerly cleared lands were crop fields and thus had rocks removed. The formerly grazed lands retain their rocky character. The valleys and low-lying areas have the different characteristics of Dutchess Channery Loam. These are very deep, acidic, well-drained soils. The ridgelines are mostly the Taconic Macomber Complex or Macomber Taconic Complex, depending on which soil series dominates. These are moderately deep to shallow to bedrock soils, extremely to moderately acidic and well-drained. The area of the current farm and areas formerly cleared, also have Pittstown Loam. This soil class is suited to woodlands, but is frequently cleared for agricultural use. It is acidic and moderately well-drained, and it tends to retain moisture in the lower horizons.



Map 3: Merck Forest: Soils

Land Use

The consistent use of Merck's forested land over the last 300 years also influences the forest community of today. The plantations established in the 1950s influence the forest dynamics, introducing an even-aged monoculture and a non-native seed source. The former agricultural lands appear overworked, the soils lacking nutrients shown by sparse plant life beneath the canopy. Historical cutting of certain species for building and tool use over time possibly reduced some seed source and impacted the composition of the forest we see today. Since 1950, the property has been under silvicultural management, and a variety of methods have been employed over the years. Modern day single-tree selection methods favor the regeneration of shade tolerant trees like American



Photo 3: an old mill stone in the woods

beech and, combined with the stress of Beech Bark Disease, develop beech thickets. This might be the natural progression of the forest. But for a working forest, this bodes poorly for its future productivity, as well as its ecological diversity.

Birds disperse invasive species, such as Japanese honeysuckle, all over the forest, spreading them from ornamental plantings at homesteads. Garlic mustard and multiflora rose are interspersed on the landscape, most commonly on the edges of roads. Thankfully, Merck Forest does not have a rampant case of invasive species, but the presence of any invasive species is a sign of an altered landscape. Distinguishing the natural changes from the human induced changes can be difficult on land that has supported people for so long.

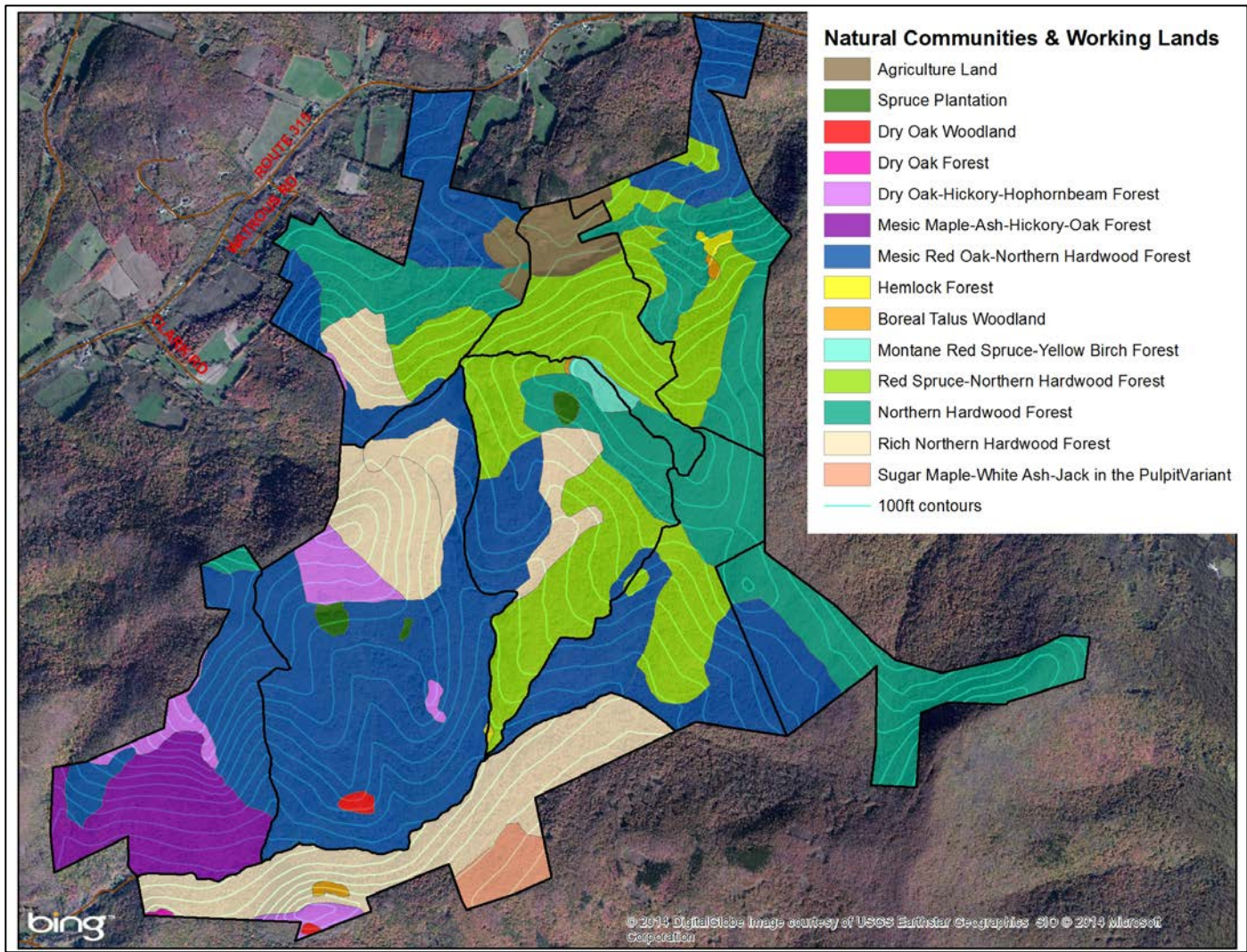
The Natural Community Concept

A natural community is an interacting assemblage of organisms, their physical environment, and the natural processes that affect them (Thompson & Sorenson, 2005). We can see these assemblages repeating over the landscape. Walk among the beech, maple and yellow birch of a Northern Hardwood Forest, and you'll probably feel like you've been there before. Find yourself at the edge of a Red Maple-Blackgum Swamp and the density of royal ferns will tell you that something is decidedly different. These communities repeat according to underlying rock chemistry, soil type and moisture, aspect, elevation and influences of human and animal use. Frequently, a large parcel like Merck Forest will have a 'matrix' community, a commonly occurring community covering much of the landscape. Within the matrix community are occurrences of other community types. We use this community concept to determine what exists on a parcel, as well as what might exist. Knowledge of existing communities allows inferences on other

potential plant associations and wildlife use. Knowing what exists lets us know the best way to manage the landscape to support biodiversity now and into the future. The communities are ranked according to the Vermont Natural Heritage Program approved standards. Each community is then evaluated as an individual occurrence to determine if the occurrence of the community type at Merck Forest is of state significance. The individual natural community occurrence is evaluated based on its size, condition, and landscape context, and is assigned a rank of A, B, or C, with A being of the highest quality.

The definitions of state rank are listed in Appendix 4.

Common names of plants and animals are used throughout this report; for the scientific name equivalent, please reference Appendix 2.



Map 4: Natural Communities at Merck Forest



Photo 4: Dry Oak Woodland

Natural Communities at Merck Forest

Dry Oak Woodland

There are two locations of Dry Oak Woodland at Merck Forest, totaling around seven acres. The first is at Lookout Overlook in Compartment 5 and the second is atop Haystack Mountain in Compartment 7. Stunted, gnarled oaks and a noticeably open canopy typify a Dry Oak Woodland. Shadbush and heath shrubs dominate the understory, with hairgrass and woodland sedge carpeting the floor. Cowwheat also grows at both occurrences. These locations are just within the parameters to be considered one occurrence and rank as state significant as a community of S2 rank, defined as 'rare in the state, occurring at a small number of sites or occupying a small total area in the state'. The occurrence rank is classified as B.

Dry Oak Forest

There is just one occurrence of this community on Merck property. It is just over one acre and it appears to be impacted from human use. It is atop Little Haystack Mountain in Compartment 7. This forest is the closed canopy version of a Dry Oak Woodland. The oaks are less stunted and less

exposed to the severities of natural processes and climate. Red oak and white oak make up the canopy, with heath in the understory and hairgrass and poverty grass typically on the forest floor. Dry Oak Forests have a state rank of S3, defined as 'high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered'. Since this occurrence has a road leading to it, its C class occurrence rank renders it not of state significance.

Dry Oak-Hickory-Hophornbeam Forest

Examples of this community type are scattered around the property, mostly associated with Mount Antone. They are in Compartments 7, 6, 5, and 1 adding up to around 81 acres. The best example of this community type is on the property boundary of Merck and Hatch land along the Masters Mountain Trail. A wide-open understory, and a dense canopy of red oak, white oak, hophornbeam and shagbark hickory, with



Photo 5: woodland sedge

occasional bitternut hickory, characterize this community. Shadbush and heath shrubs are at low density and the forest floor is carpeted with woodland sedge. Examples of this natural community on Mount Antone display a variation on this community that includes a canopy of sugar maple. Haystack Mountain illustrates this

community type with the addition of bitternut hickory. This community has a state rank of S3, defined as 'high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered'. The locations can be brought together as a single occurrence and qualify in the B class, making this state significant.

Mesic Maple-Ash-Hickory-Oak Forest

This community covers significant acreage at Merck Forest. It is entirely within Compartment 6 and equals around 165 acres. Shagbark hickory is plentiful and is mixed with red oak, white ash, and sugar maple. Bitternut hickory is also present, and both hickories appear to be regenerating. The understory is relatively open -- though that might be due to sugaring operation maintenance -- with some witch hazel and shadbush occurring. Maple leaf viburnum, striped maple, white snakeroot and marginal wood fern occur. This community is ranked as S3, defined as 'high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered'. The occurrence is classified as B, which qualifies it as state significant.



Photo 6: shagbark hickory

Hemlock Forest

Two examples of this community occur on Merck Property. They are not close enough to be considered a single occurrence. One is located in Compartment 4 and due to its size of less than one acre and a logging road/trail in close proximity, it is not state significant. The second occurrence is within Compartment 2 and is larger at over 4 acres and thus ranks as state significant. This community is characterized by a dense hemlock canopy with an open understory on the forest floor. Occasional herbs such as partridgeberry and evergreen wood fern can be found. Yellow birch and black birch are scattered in the canopy as well. This is an S4-ranked community, defined as widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small. This occurrence is classified as B, making it state significant.

Montane Yellow Birch-Red Spruce Forest

This natural community occurs on the top of Gallop Peak and is over 15 acres. Spanning the border of Compartments 3 and 4, it is bisected by Barton Trail. It is characterized by a canopy of yellow birch and red spruce with occasional paper birch and American mountain ash. The understory is composed of mountain maple and striped maple. The forest floor is covered in understory herbs common to this community with common wood sorrel, mountain wood fern, wild sarsaparilla, and evergreen wood fern present in abundance. This is an S3 state rank community, defined as 'high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered'. This occurrence, though small, has a B-rank and is therefore state significant.



Photo 7: yellow birch on talus

Boreal Talus Woodland

There are a few examples of this natural community on the property, totaling about 6 acres. They are quite uniform in having a relatively closed canopy of yellow birch, and as such they might actually be a variant of this community type, since a true example would have a good deal of red spruce in the canopy as well, and would have a more open canopy. Nevertheless, for means of measuring the significance of these occurrences, this community type is utilized. One location is on the slope of Haystack Mountain in Compartment 7, another at the base of the Hemlock Forest in Compartment 2, and a third, quite small, in Compartment 3 at the base of the Montane Yellow Birch-Red Spruce Forest. The talus is not well developed on these mountains given the habit of slate to break in a platy manner, rather than the typical blocky and boulder-like talus. Some mountain maple and striped maple grow in pockets with 90% of the rocks covered in moss and rock tripe. Appalachian polypody is frequently hanging on the rocks as well. This is an S3 state ranked community, defined as, 'high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered'. The location in Compartment 7 is distant enough to be considered an individual occurrence. That makes two occurrences, both with B class rank, and thus state significant.

Rich Northern Hardwood Forest

This community occurs interspersed across the property covering about 475 acres, mostly due to increased water movement in the soil where nutrients are picked up, moved along and deposited in lower lying areas, a process known as colluviation. Many of the rich spots (pH 6.5-7.5) around Merck are on steep hillsides where gravity is constantly moving water through and around stream beds. Larger areas occur in Compartments 7, 5, 4 and 1. Most of these locations are found in a mosaic pattern rather than uniform in richness, with rich indicators displayed in around 75% of the area. This community is typified by northern hardwoods, mostly white ash and sugar maple, with basswood and black birch common as well. In the areas of increased nutrients and higher pH, the herbaceous layer is composed of white baneberry, blue cohosh, red elderberry, white snakeroot, maple-leaf viburnum, wide-leaf and seersucker sedges, silvery glade fern and many more. The state rank is S4 and is defined as 'widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small'. The size of the hillsides displaying richness qualify this occurrence as class A of an S4 community, and is therefore state significant.



Photo 8: wild ginger

Northern Hardwood Forest

At over 650 acres, this is one of the most expansive community types at Merck. It is interspersed with Red Spruce-Northern Hardwood Forest and Mesic Red Oak-Northern Hardwood Forest across Merck's landscape. With seed sources of red oak and red spruce on the hilltops and ridgelines, these species are at an advantage for seed dispersal by wind and gravity. It is possible that the continued presence of these species at higher elevation is the reason for their presence at lower elevation. Alternatively, it is possible that their presence is due to the former extent of the now higher elevation communities. At points I felt that the matrix community of this landscape is Northern Hardwood Forest, with the spruce and oaks simply legacies of their past expanse. But, in some areas the spruce and oaks are regenerating, though not as prolifically as beech. This community is characterized by American beech, yellow birch, white ash, and sugar maple in the canopy, a shrub layer of striped maple, and hobblebush, with jack in the pulpit, wild sarsaparilla, evergreen wood fern and Christmas fern dominating the floor. There is a variant of this community located in Compartment 7 - the Sugar Maple-White Ash-Jack in the Pulpit Forest. This variant shows enrichment, but not to the degree of Rich Northern Hardwood. The Northern Hardwood Forest community is ranked S5, defined as, 'common and widespread in the state, with high quality examples easily found'. It must be in A class to be considered state significant, and with the many years of management on Merck Forest, this occurrence is B class.

Mesic Red Oak-Northern Hardwood Forest

This community is the matrix community at Merck Forest covering much of the central and western side of the property totaling to around 1150 acres. Though the forest might be in transition to a matrix of Northern Hardwood Forest given the scarcity of oak regeneration, the current oak presence is great enough to call this part of the

matrix. Red oak, sugar maple, white ash and American beech dominate the landscape. The shrub layer is mostly striped maple and beech thickets, though this dominance might be caused by single-tree selection performed in the forest rather than the natural process of succession. Indian cucumber root, Christmas fern, evergreen wood fern, hay scented fern, starflower, wild sarsaparilla, and wild oats are common ground cover. The state rank of this community is S4, defined as, 'widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small'. Due to the size, it is classed as B, and is state significant.

Red Spruce-Northern Hardwood Forest

This community is more widespread on the east side of the property totaling to over 560 acres. It is characterized by red spruce and yellow birch mixed with American beech and sugar maple. Paper birch and quaking aspen are common in areas that are still maturing post-logging. Hobblebush and striped maple are abundant, with some mountain maple and occasional young American mountain ash. The herbs reveal the boreal affinity in this community, with common wood sorrel, starflower, and bluebead lily present on the forest floor. Christmas fern and evergreen wood fern are present as well. This community is ranked as S5, defined as 'common and widespread in the state, with high quality examples easily found'. Due to the size of the occurrence on Merck, it qualifies as A class and is state significant.

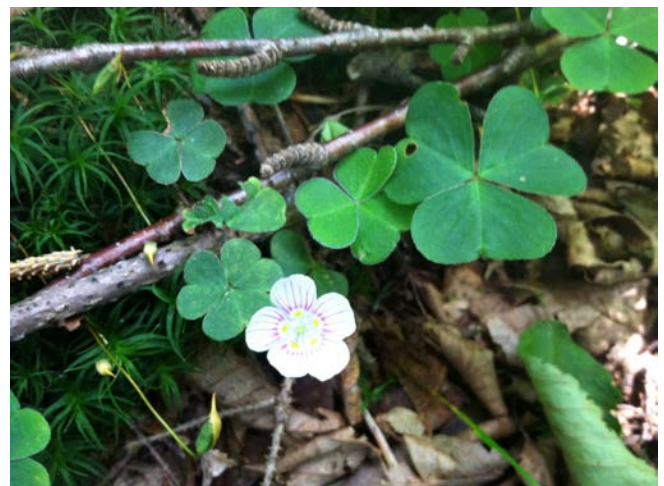


Photo 9: common wood sorrel

Natural Community Ranking

Merck does offer the landscape of Vermont significant and diverse habitat as noted in the community occurrence ranks. Though only the Dry Oak Woodland ranks as rare in the state, additional areas on the property are such good examples of their respective community type that they deserve special attention. Additionally, though they might not be rare on a state scale, some community types offer Merck Forest diversity within the property boundaries that will support future diversity within the forest. Wildlife habitat and landscape connectivity are considerations for protection beyond what the state rank might suggest.

Rare, Threatened or Endangered Species of Note

There is also a recent find of a rare plant at Merck Forest, not yet on record with the State of Vermont. The smooth false foxglove is in a well-traveled area on Masters Mountain Trail, in an outlying area of a switchback. This plant is ranked S2 in Vermont, defined as 'rare in the state'.



Photo 10: smooth false foxglove

Wildlife Considerations

Bird Monitoring

Merck Forest is fortunate enough to be enrolled in the Vermont Center for Ecostudies (VCE) Bird Monitoring Program. Since 1992, plots established on Mount Antone's eastern slopes have been revisited each summer to observe migrating and nesting birds. Unfortunately there was a 10-year break from 2003 to 2013 where no data were recorded, but data collection was renewed recently so we can start to see trends. The data collected can be found in Appendix 1 of this report, with an additional discussion on key species as identified by Audubon's Foresters for the Birds Program.

Statewide Bird Trends

VCE compiled a report from their monitoring plot data collected 1989-2006 (Faccio, 2007). These data revealed population trends, some of which were statistically significant. Forty species were considered in the analysis, and overall 26 species displayed an increasing population trend, while 22 species declined. Four species showed statistically significant declines - Hermit Thrush, Blue-headed Vireo, White-throated Sparrow, and the Wood Thrush. A stronger trend was noted in the short-distance migrants (Hermit Thrush, Blue-headed Vireo, and White-throated Sparrow are categorized as such) of a 3% decline per year. The species showing statistically significant increases in population were Baltimore Oriole, Common Yellowthroat, White-breasted Nuthatch, and Tufted Titmouse. Of the significant declining populations, Merck Forest monitoring has witnessed a similar decline in Hermit Thrush numbers, but the Wood Thrush population appears to be steady. Blue-headed Vireo is a somewhat recent bird on record for Merck, appearing only the last two years. The White-throated Sparrow is not monitored at Merck's plots. Of the species with an increasing trend, Common Yellowthroat was not recorded, Baltimore Oriole has only been sighted once, Tufted Titmouse

has only been sighted twice, and the White-breasted Nuthatch is sighted often but not regularly (roughly every other year).

From the VCE monitoring data we can see some basic trends of bird populations at Merck Forest. American Redstart, Eastern Wood Pewee, Ovenbird, Red-eyed Vireo, Wood Thrush, Veery, Rose-breasted Grosbeak, Scarlet Tanager, and American Robin have been present every year. All of these species are common to abundant breeders across New England, except the Eastern Wood Pewee, which ranges from uncommon to common. All these species have a preference for deciduous forests, whether on the edge, early successional, or mature - all of which Merck Forest offers in abundance.

Forestry for the Birds

Audubon's Foresters for the Birds Program provides guidance to land managers for forest management techniques that will promote habitat for 12 priority forest birds. Merck Forest follows these guidelines when creating its management plans. By analyzing the data from VCE's bird monitoring program at Merck Forest, we can see how the management guidelines have impacted the presence of these key species. The details of this analysis are listed by species in Appendix 1. Habitat management considerations are sourced from Audubon's Birds with Silviculture in Mind and New England Wildlife (DeGraaf & Yamasaki, 2001).

Deer Wintering Habitat

Vermont Fish and Wildlife Department (VFWD) conducted deer wintering surveys throughout the 1970s and 1980s. The areas identified on Map 5 are the result of this work. Interestingly, there appears to be a trend toward sites being identified near developed areas. One might assume that this is due to the information provided by people, who might not traverse the remote hillsides, but tend to frequent nearby areas. Additional mapping analysis was conducted in 2009/2010, and resulted in additional sites identified as potential deer wintering habitat. However, these sites were not

field-checked by state VFWD officials and therefore are not included on this map. The state also set a minimum mapping unit of 20 acres for consideration in order to condense and prioritize their study areas. This does not mean that the deer require a 20-acre plot (VCGI, 2014).

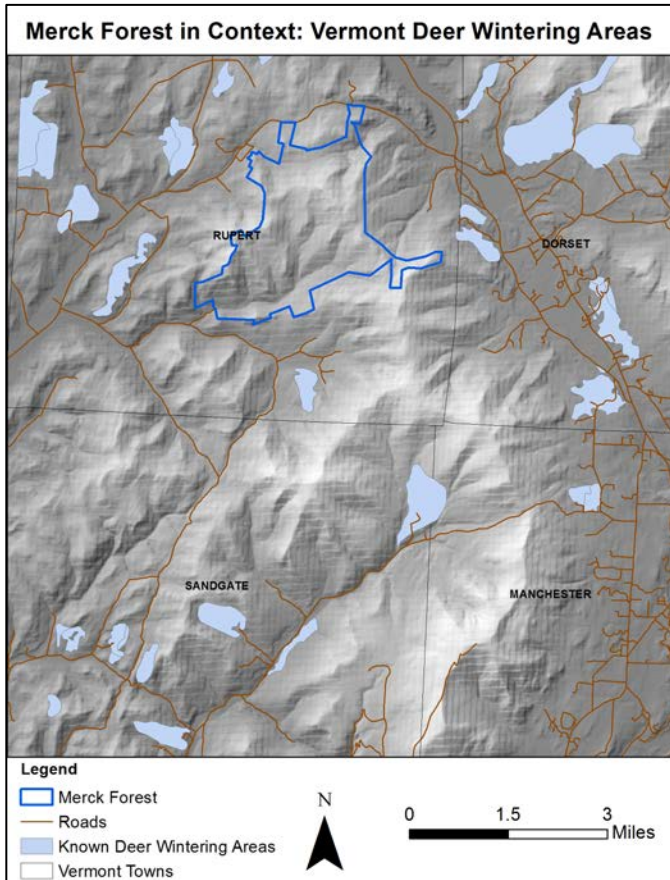
white-tail deer. The Hemlock Forests and spruce plantations around Merck Forest offer considerable availability of protected areas for deer. For example, the spruce plantation just south of Ned's place offers dense conifer forest, adjacent to a clearcut now sprouting with hardwood saplings.

Rare, Threatened or Endangered Species of Note

There is just one known occurrence of a rare animal on Merck Forest land. The Jefferson salamander was found and photographed in the pig barn. Odd though this location might be, the stream running from the pigpen to Page Pond is suitable habitat. On an informal survey one day, more than 20 salamanders (though no Jefferson salamanders) were observed in less than 30 feet of stream. Possible additional protection measures might be necessary to conserve this habitat since the farm animals are rotated through this grazing field.



Photo 11: Northern Dusky Salamander



Map 5: Deer Wintering Areas in Vermont (VFWD)

On-site analysis revealed possible quality deer wintering habitat on the Merck property. Hemlock and other dense conifer stands are used by deer in winters with heavy snow when the snowpack beneath conifers is less than in the surrounding forest. Availability of browse nearby is also necessary to sustain the deer population through a winter. Hobblebush, striped maple, and sugar maple seedlings are the preferred foods of

Climate Change Considerations

As climate change becomes a reality, we witness new weather patterns, elevational and latitudinal migration of tree species, and an accelerated rate of extinction. Researchers suggest a variety of potential scenarios of how our current ecosystems will respond to these changes, but frequently their models don't agree. Without knowing the type or degree of change, we cannot know what species will prevail and focus protection efforts on those species. Therefore, some conservation organizations are beginning to build strategies to support landscapes that will show resilience in the face of climate change. According to the International Union of Forest Research Organizations (IUFRO) Report on Forests and Society, "The resilience of the ecosystem is crucial, not necessarily to keep the ecosystem in the same state after a disturbance, but to help it evolve towards a state that is acceptable for the manager or the society" (Locatelli et al., 2010).

One strategy is to focus on broad concepts such as landscape connectivity so that species have the space and habitat availability to respond as quickly as possible to changes in local conditions. Prioritizing areas of landscape complexity and less common geologic features is another approach. Conserving a diversity of forest types for their habitat value and their possible greater resilience is a suggested facilitation strategy (Noss, 2001). Looking at Merck Forest through each lens of resilience, we can see that it plays an integral role in the resilience of the regional landscape, has a variety of natural communities that will increase the diversity of the local landscape and contains areas of topographic complexity. I discuss Merck Forest through each lens in greater detail in this section.

Another point to consider in creating resilient forests is the genetic variability and the potential of increased adaptability of particular individuals. Logging in Vermont is not always ecologically focused but rather economically focused. High-grading (harvesting the most mature and high-quality trees) a forest returns the highest

profits, but frequently also removes the best, most successful (i.e. most well-adapted) individuals, thus removing their genes from the future forest (Bill Keeton, University of Vermont, personal communication, 2014). Merck Forest contains individual trees existing and succeeding (in this case illustrated by regeneration) under difficult conditions. The Dry Oak Woodlands are located on shallow to bedrock, well-drained soils prone to drought conditions. While these trees are not economically valuable, the individual oaks in this community might be a source for seeds that will succeed under new weather extremes predicted in climate change models.

Resilience Analysis

The Nature Conservancy (TNC) has spent the last decade interpreting climatic change and creating predictive models to determine just how change will impact our current species assemblages. This resilience analysis develops an approach to conserve biological diversity while allowing species and communities to rearrange in response to a continually changing climate. TNC identified three elements necessary to protect biodiversity - variety of geology types, complex landforms, and connectivity of natural systems. Based on these elements, it performed a regional analysis to map 'hot spots' of resilience.

Merck Forest falls within seven different 1000-acre resiliency hexagons according to TNC's dataset. These hexagons group information on landscape complexity, local connectedness, and resilience category - how the local connectedness and landscape complexity relate to the larger ecoregion. Averaging the data from these seven hexagons, Merck Forest is 'average', though slightly (less than one standard deviation) towards 'above average'. Looking at the property at a fine-scale resolution (90m hexagons) the area of 'above average' falls in the rectangular piece of Compartment 9, added to Merck Forest in the 1990's. One other area of high resiliency is identified just off the farm, down Stone Lot Rd.

Interestingly, this site is close to the area that saw severe wind damage in 2000.

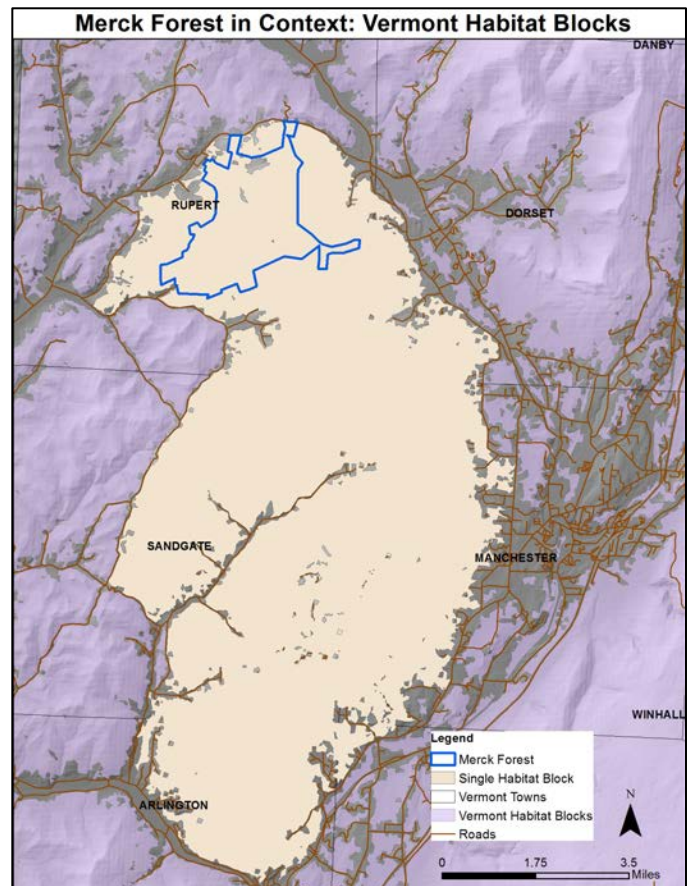
While this hexagon analysis works well at a broad scale, the framework of prioritization based on topographic complexity and connectivity can also be used on a more local scale. Anyone who has hiked the trails at Merck Forest has experienced the steepness of terrain. The elevation gradient is a good measure of resilience because as conditions warm, it is likely that species will migrate to higher elevations to stay within their optimal temperature zone. A variety of soil conditions are valuable as well since weather is predicted to be more extreme with flooding and drought conditions fluctuating. Merck Forest provides an assortment of soil conditions in close proximity to each other. Well-drained soils characterize the ridgelines, and partially saturated loam soil covers the lower elevations. Within the property, connectivity is not an issue, since the roads are driven so infrequently. The measure of landscape connectivity is discussed below as part of Vermont's habitat block analysis.

Landscape Connectivity

A recent report by the Vermont Fish and Wildlife Department took an in-depth look at the matrix of forested and open lands across Vermont from the perspective of species that must move to adjust to changing climatic conditions. With development pressures and ex-urban sprawl exacerbating the stress of climate change, conservation organizations are attempting to develop land use plans that promote connectivity of conserved lands, rather than piecing together what's left after development has occurred. Habitat connectivity is recognized as a primary strategy for conserving biodiversity as climate change occurs (Sorenson & Osborne, 2014). Many current models suggest that climate change will happen at a rapid enough pace to prove genetic adaptation strategies irrelevant, and therefore the chance of species' successful resiliency will come with a shift in geographic range. Facilitation measures that increase connectivity will ease species migration (Locatelli, 2010). Additionally, with changing climate

comes a possible increase of extreme weather events, which would further the potential of species population isolation. Spatially-separate species populations (known as metapopulations) will move through landscapes with the least amount of habitat fragmentation (i.e. highest habitat connectivity) (Opdam, 2004). According to the State's plan, a habitat block core area is defined as greater than 250 acres without any class 4 or larger roads. Blocks are ranked according to their biological and conservation value and for the potential threat to them by fragmentation (Sorenson & Osborne, 2014).

A Vermont Agency of Natural Resources habitat block analysis done in 2006 and updated in 2011 previous to the VFWD 2014 report identifies Merck Forest within a block size about 41,700 acres, categorized as an 'anchor block'. The total weighted block score of this area is at level 9 of 10 in a statewide ranking. The perceived threat of 5 weighted factors measuring likelihood of fragmentation/development ranks this block as 7 out of 10.



Map 6: Habitat Block Analysis

It should be noted that due to the reputation Merck Forest holds, the property is assumed to be under permanent conservation status according to publicly available data of Vermont's conserved lands (VCGI, 2014). Therefore, if Merck Forest is not protected through a conservation easement, the ranking of this block will drop.

Taking a closer look at the area surrounding Merck property (Map 6), the habitat block map indicates less of a break between blocks along route 315, right where Merck property meets the road. During the most recent analysis of habitat blocks by VFWD, the boundary of Merck along route 315 is identified as wildlife road crossings (ANR Biofinder, 2014). Availability of quick access to a forested block directly across a road will encourage movement of wildlife between these blocks, assuming they make it across. The 2011 analysis ranks the Merck Forest block as a 10 out of 10 classification for importance and potential for wildlife movement between blocks. Additionally, the ranking of 9 out of 10 for ratio of interior habitat to edge habitat illustrates the quality of habitat Merck Forest has to offer the regional landscape under perpetual conservation status.

Biodiversity, Management and Resilience at Merck Forest

In addition to what Merck Forest can offer the regional landscape in the face of changing climate, particular areas within Merck Forest offer the local landscape increased biodiversity. Much of the forest is within the matrix communities of Red Spruce-Northern Hardwood Forest and Mesic Red Oak-Northern Hardwood Forest. Northern Hardwood and areas of enrichment within the Northern Hardwoods are also quite common on the property. But natural communities occurring on hilltops and ridgelines, as well as south-facing outcrops, add significant diversity to the matrix forest. Seed source is an important element when considering manipulating a forest through management practices. The natural communities that provide diversity contain individuals that are more successful than others through the process of

competition. To allow the red oak and red spruce seed sources to continue competition and regeneration unimpeded would benefit the more actively managed areas on the property by supplying more well-adapted seeds to the surrounding forest. The situational advantage of many of these communities being on outcrops and ridgelines may also offer increased rates of dispersion for species that use wind and gravity seed dispersal methods.

It is important to consider the impacts of active forest management on the resilience of a forest. Research supports the idea that old growth forests may possess inertia to carry them through the effects of climate change. Since old growth has more time to adapt to the current climate regime, it can respond to change and remain stable as opposed to more recently forested areas, growing in response to previous conditions (early successional forests) and still 'catching up' to the current conditions (Franklin et al., 1991). Through the process of succession the local climate changes -- from an open canopy to closed, drier to moist -- and species give way to more well-adapted species. But things are always changing, and in an old-growth forest we see patchiness on the landscape. A wind event might form pockets of early successional growth surrounded by late successional growth, which increase the overall forest diversity. Structural complexity of an old growth forest - such as coarse woody debris, tip-ups, and snags - alter microsite moisture conditions that may buoy populations of plant and animal life through times of drought. While management techniques cannot make a forest age faster, it can mimic some of these structural characteristics and support forest resiliency. However, forest management practices can either exacerbate or alleviate the stress of a changing climate (Franklin et al., 1991). To balance active management supporting economic goals with capacity building to withstand climate change, there should be areas reserved from tree harvesting within a matrix of actively managed conserved land. These areas will support the biological legacies (previous generation trees) acting as seed sources of diversity for the matrix forest. Studies have correlated increasing

species richness (biodiversity) with increasing tolerance to environmental extremes, greater stability over time and greater potential to recover (Tilman, 1997).

Studies of the mesophication (increase of soil moisture) of eastern forests call into question management practices that utilize fire to regenerate oak. By looking at the historical records of fire occurrence and drought and comparing it to current conditions, some researchers theorize that fire is not the driving force behind the shift of oak to more mesic species like maples and beech (McEwan & Pederson, 2011). With further documentation and research we may soon understand if oaks are relinquishing their dominance in the canopy due to a change in soil moisture instead of fire. Prescribed fire is mimicking a disturbance regime that, while natural, puts additional stress on the forest. In times of changing climate, it is thought that disturbances might have a greater impact on the ability of an ecosystem to adapt and change responsively, than the actual climatic changes that will occur (Noss, 2001). It would be best to allow a community like the Mesic Red Oak-Northern Hardwood Forest, that does not sustain a fire regime anymore, to regenerate naturally and support the overall health of the forest and habitat availability it may offer.

Regeneration in Northern Hardwood Forests is changing drastically, mostly due to American beech. As a shade tolerant species, it can recruit and monopolize understory resources in small canopy gaps (Wagner, 2010). Beech Bark Disease (BBD) affects the composition, structure and function of forests containing American beech (Giencke et al., 2014). The extensive mortality of overstory beech from BBD results in prolific root sprouting, which lead to the creation of understory thickets of beech saplings (Cale et al., 2013). Cale's group researched the effects of beech thickets on biodiversity and concluded that floral species diversity was significantly lower in beech thickets than areas free of beech. The beech shade-out regeneration of other canopy dominant species such as sugar maple and yellow birch. Due to BBD and single-tree selection silvicultural

methods, beech thickets are abundant. However, the future of beech is unknown. How long will beech thickets continue? Since the root sprouts arise near the source of infection, a secondary front of BBD induced mortality is thought to be likely (Giencke et al., 2014). Merck Forest hosts natural communities that do not support American beech, typically due to their soil moisture and soil type which may be beneficial given the low survival of American beech against BBD and its impacts on regeneration of other species.

In a forest that is quickly losing diversity in regeneration, it is important to manage for increased species diversity and individual success where possible. Allowing natural ecological processes to govern areas of localized diversity within the property will promote the genetic strength of these species by not harvesting the best individuals and allowing them to seed. Management techniques could be employed that would remove less successful individuals and allow the superior quality trees to remain and seed the surrounding forest. Additionally, management techniques could create old growth characteristics by creating structurally complex features (e.g. dropping trees and leaving them). By having more complex structural characteristics, and greater overall age of the stand, the forest will be more resilient to change. And, if through BBD or silvicultural methods, American beech loses dominance in the midstory of the matrix forest, the regeneration capacity of the forest will be maintained and species diversity will increase.



Photo 12: oak regeneration

Conservation Recommendations

A conservation easement on the land of Merck Forest will protect nearly 8% of a habitat block as designated by the State of Vermont. The complex landform and habitat connectivity rank high and suggest a more resilient place to withstand the effects of climate change. An easement should be pursued to protect the entire property with the exclusion of the farm and office areas, possibly the remote cabins as well to support expansion of the non-profit. Additional management restrictions can be applied to preserve the ecological diversity of plant life and available habitat, and build a more resilient landscape for future changes in climate.

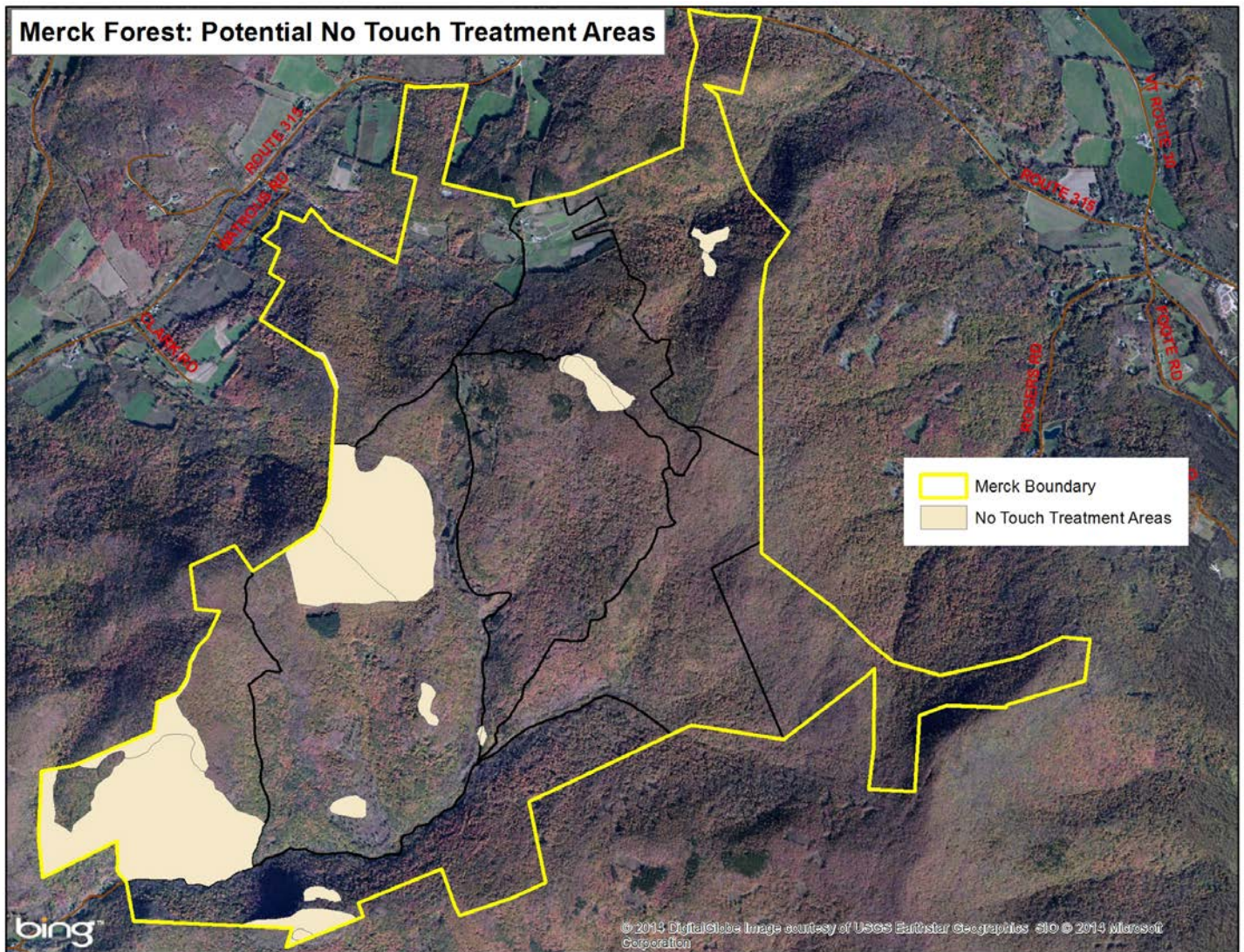
Merck Forest currently holds Compartment 6 in 'natural area' status, exempt from management to allow natural processes to govern the forest. It is mentioned in the Board's ruling that the natural area extends into Compartment 5, but the accompanying map is not with the ruling, and therefore is not clearly delineated. This natural area exemption occurred under a Board of Trustees decision. The acreage of this area is roughly 10% of the property (321+acres). By simply reconfiguring the land withheld from management in order to prioritize biodiversity on the landscape rather than a particular geographical area, this forest will have more opportunity to adapt to climatic change in the upcoming decades. By setting aside the 'seed source for diversity' community types, the total acreage is 380, under 12% of the property. The dry oak communities and red spruce/boreal communities located on outcrops sometimes grow under difficult conditions

which makes them a low grade timber. Their situational placement above the matrix forests might be the reason red oak and red spruce exist in the matrix forests. However, the oaks and spruce in the matrix forests, growing in mesic conditions are not qualified as non-productive timber. By scattering no-touch* management or natural area designation throughout the property, it frees up the productive timber, matrix community areas in Compartment 6 for silvicultural use, and protects the more ecologically diverse, non-productive areas.

Common reserve design favors the creation of large blocks of protected lands or connected blocks. Frequently, these areas exist within a matrix of a developed landscape, and so additional space is needed to buffer wildlife from human activities. With Merck Forest, there would be actively managed, conserved lands buffering the protected, no-touch* communities. I do not foresee these communities becoming isolated and fragmented due to management activities. This strategy allows the economic needs of the organization to be met, while enhancing the ecological diversity for increased resilience.

**** For the purposes of this report 'no touch' management is defined as no tree harvesting. All recreation trail maintenance and silvicultural prescriptions to restore structural complexity ought to continue unimpeded. 'Light touch' is defined as limiting harvest to wintertime, single-tree selection methods, to preserve the closed canopy and continuity of the understory herbaceous plant life.***

With these thoughts in mind, I recommend the following restrictions on management:



Map 7: Potential No Touch Treatment Area

- No touch treatment for the Dry Oak Woodlands:** This community is generally self-maintaining due to drought conditions and therefore doesn't require silvicultural support. Also, the gnarled and stunted tree growth makes it a non-productive zone for forestry. As mentioned previously, this community is one of the dry oak communities that regenerates as a seed source for the oaks in the matrix community at lower elevation.

- No touch treatment for the Montane Yellow Birch-Red Spruce Forest:** Surrounded by Northern Hardwood Forest, if this community experiences single tree selection, or light touch treatments it will likely promote the establishment of beech thickets and thus decrease regeneration of

other species. Given the steep terrain and shallow soils, this area is not likely to regenerate quickly, making it a low-productivity area. It is therefore more valuable for ecological processes to dominate instead of silvicultural processes. Like the dry oak communities, it is likely the foothold for red spruce on the property and is seeding red spruce in the matrix community at lower elevation.

- No touch treatment for the Boreal Talus Woodland:** Unstable terrain restricts growth on these talus slopes. Not many tree species are able to grow on the talus, and therefore these slow growing woodlands are generally less productive than other areas. Since they are dominated by yellow birch, a canopy component of the Northern Hardwood Forest, they act as a seed source for

yellow birch much like the dry oak woodlands for oak.

- **No touch treatment for the Hemlock**

Forest: Thought to be possibly the oldest trees on Merck property (Kerry Woods, Bennington College, personal communication 2014), this forest exhibits the stability that comes with age and might be best able to adapt to changes in climate. The invasion front of Hemlock Woolly Adelgid is currently present at Vermont's southern border. However, with so few hemlocks on Merck land available to support pest movement through the forest, this pocket of Hemlock Forest might stand a chance of survival and aid future needs of regeneration.

- **No touch treatment for the Dry Oak-**

Hickory-Hophornbeam Forest: This community is typically surrounded by Mesic Red Oak-Northern Hardwood Forest, which experiences the beech thicket effects of BBD and harvesting. Opening the canopy for silvicultural use will likely introduce beech thickets to this community as well. As a means of encouraging regeneration of diverse species, particularly species that are a valuable wildlife food source like oak and hickory, this community should be preserved in 'no touch' designation.

- **No touch in the Rich Northern Hardwood Forest of Compartment 5, between Schenck Rd and Clarks Clearing Trail:**

This area exhibits an impressive display of rich plant life. Common on calcareous bedrock forests, this community type is infrequent on the acidic rocks of the Taconic Mountains. Other occurrences are Mount Equinox and Mother Myrick Mountain. Mount Antone might be the next 'stepping stone' of rich habitat for species that require these conditions. Though more areas exist on Merck property, this area is by far the best example of rich plant life, containing some

less common species like Rattlesnake Fern. Management activity would possibly damage the abundance and diversity of herbaceous plant life, and for this reason, no touch is recommended.

- **No touch treatment for the Mesic Maple-Ash-Hickory-Oak Forest:**

Currently containing a sugaring operation, this area is part of the current natural area on Merck property. It offers additional species diversity and an important wildlife food source with a regenerating population of shagbark hickory trees, an infrequent occurrence elsewhere at Merck Forest. This community borders the Northern Hardwood Forest, abundant with beech thickets. If single-tree selection methods were employed in the Mesic Maple-Ash-Hickory-Oak Forest, it is likely the beech would opportunistically spread and shade out other species regenerating here.

- **Light treatment in the Rich Northern Hardwood Forest of Compartment 7 and 1:**

Rich Northern Hardwood Forest is uncommon in the Taconic Mountains due to the more acidic soils. However, these areas have seen more recent logging and the herbaceous layer is not as well developed as in Compartment 5.

- **No restrictions in Northern Hardwood Forest:**

This is a common, productive forest around Merck Forest and Vermont.

- **No restrictions in Mesic Red Oak-Northern Hardwood Forest:**

This is a common, productive forest around Merck Forest and Vermont.

- **No restrictions in Red Spruce-Northern Hardwood Forest:**

This is a common, productive forest around Merck Forest and Vermont.

Conclusions

Merck Forest is an important component of its regional landscape with great conservation value. It is approximately 8% of a habitat block, and contains a critical piece of forested road crossing that allows wildlife to move between habitat blocks. The land is characterized by topographic variation and a diversity of natural communities, which offers a range of habitat to species shifting in response to climate change. For these reasons, I recommend that the Board of Trustees move forward with a conservation easement in partnership with the Vermont Land Trust. For the property itself, and its current inhabitants, the best possible approach for sustaining biodiversity will be to sustain the variety

of habitats available – i.e. the variety of physical settings and the variety of natural community types present. By incorporating additional no-touch treatment management restrictions previously outlined, the natural processes of competition and regenerative capacity will build a more robust seed source and be able to support forest resilience under a new climatic regime. Following sustainable forest management methods to increase structural complexity across all treated areas will increase habitat availability and support forest resilience within productive zones as well. Merck Forest is a landscape with a long history of supporting people on the land. This land will continue to support the organization and its mission, while supporting the ecological needs of all wildlife and plant life existing within its boundaries.

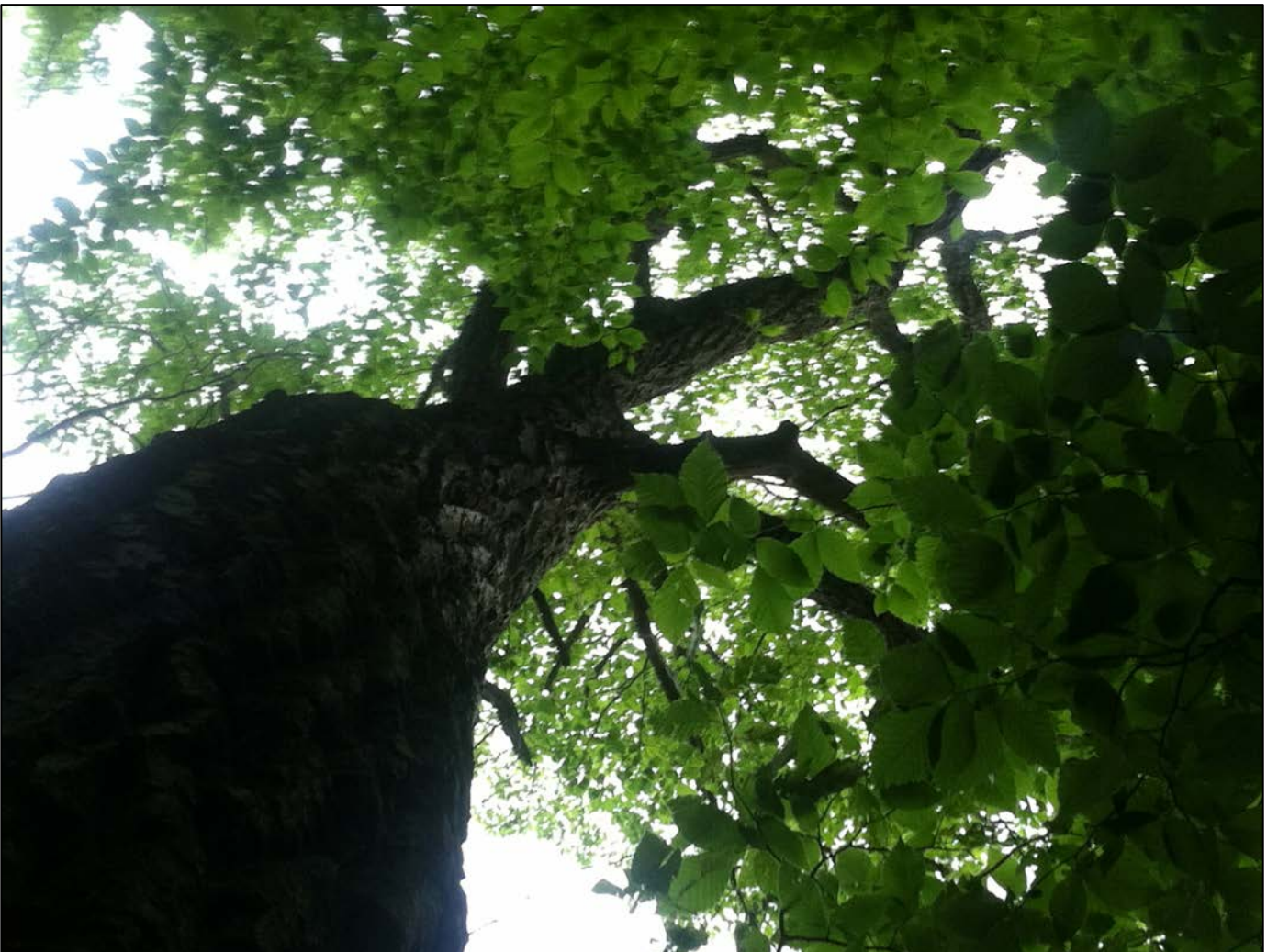


Photo 13: A forest legacy, a chestnut oak

Works Cited

- Anderson, M.G., Clark, M., & Sheldon, A.O., 2012, Estimating Resilience, *Resilient sites for terrestrial conservation in the Northeast and Mid-Atlantic Region*. The Nature Conservancy, p15-35.
<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/TerrestrialResilience020112.pdf> (14 December 2014)
- ANR Biofinder:Habitat Blocks, *ANR Biofinder*, <http://biofinder.vt.gov/MappingPage.html?Viewer=BioFinder> (1 January 2015)
- Audubon Vermont, 2011, *Birds with Silviculture in Mind*, Audubon Vermont & Vermont Forest, Parks & Recreation.
<http://vt.audubon.org/sites/default/files/documents/bird-guide.pdf> (1 January 2015)
- Cale, J., McNulty, S., Teale, S., & Castello, J., 2013, The impact of beech thickets on biodiversity. *Biological Invasions*, p.699-706.
- DeGraaf, R., & Yamasaki, M., 2001, *New England wildlife: habitat, natural history, and distribution*, University Press of New England, Hanover, NH, 271p.
- Faccio, S., 2007, Sorting Through the Morning Chorus. *VINS Field Notes*, p.10-11.
- Franklin, J. F., F. J. Swanson, M. E. Harmon, D. A. Perry, T. A. Spies, V., H. Dale, A. McKee, W. K. Ferrell, J. E. Means, S. V. Gregory, J. D. Lattin, T. D. Schowalter, & D. Larsen., 1991, Effects of global climatic change on forests in northwestern North America, *Northwest Environmental Journal* , vol.7, p. 233–254.
- Giencke, L., Dovc'iak, M., Mountrakis, G., Cale, J., & Mitchell, M., 2014, Beech bark disease: Spatial patterns of thicket formation and disease spread in an aftermath forest in the northeastern United States, *Canadian Journal of Forestry Research*, vol.44, p.1042-1050.
- Lambert, J., Faccio, S., 2005, Canada Warbler population status, habitat use, and stewardship guidelines for northeastern forests. *Vermont Institute of Natural Science Technical Report*, vol. 05-4, 20p.
- Locatelli, B., Brockhaus, M., Buck, A., Thompson, I., Bahamondez, C., Murdock, T., & Webbe, J., 2010, Forests and adaptation to climate change: challenges and opportunities, *Forests and society - responding to global drivers of change IUFRO Report*, vol.25, p.21-42.
- McEwan, R., Dyer, J., & Pederson, N., 2011, Multiple interacting ecosystem drivers: toward an encompassing hypothesis of oak forest dynamics across eastern North America, *Ecography*, p.244-256.
- Noss, R., 2001, Beyond Kyoto: forest management in a time of rapid climate change, *Conservation Biology*, p.578-590.
- Opdam, P., 2004, Climate change meets habitat fragmentation: linking landscape and biogeographical scale levels in research and conservation, *Biological Conservation*, p.285-297.
- Sorenson, E., & Osborne, J., 2014, Vermont habitat blocks and habitat connectivity: an analysis using geographic information systems, *Vermont Fish & Wildlife, Vermont Land Trust*. 48p.
http://www.vtfishandwildlife.com/library/Reports_and_Documents/Fish_and_Wildlife/Vermont_Habitat_Blocks_and_Habitat_Connectivity.pdf (14 December 2014)
- Thompson, E., & Sorenson, E., 2005, *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont*, University Press of New England, Hanover, NH. 456 p.
- Tilman, D., 1997, Biodiversity: population versus ecosystem stability, *Ecology*, vol.77(2), p.350-350.
- VCGI:Private conservation lands in the northern forest lands area, *Vermont Center for Geographic Information*, <http://vcgi.vermont.gov> (13 December 2014)
- Wagner, S., Collet, C., Madsen, P., Nakashizuka, T., Nyland, R., & Sagheb-Talebi, K., 2010, Beech regeneration research: from ecological to silvicultural aspects, *Forest Ecology & Management*, p.2172-2182.
- Web Soil Survey, NRCS, <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> (1 November 2014)

Appendix 1: Natural Community Narrative by Compartment

Compartment 1

This is the Northwest corner of the property covering land that was formerly tilled for agriculture. The farm fields next to and below the Sap House are within this compartment, as well as a clear cut that was done in 2001 and is now in early stages of succession. It has also experienced successive treatments through the 1990's covering much of the compartment. The south end of the compartment follows McCormick Trail, which traces a northern ridgeline off Mount Antone, and where the trail drops down into a drainage, the plant life diversifies into a Rich Northern Hardwood Forest. This richness continues down through the drainage until the landscape levels out. Dense blue cohosh and red elderberry mix with maidenhair fern, ostrich fern, spikenard and silvery glade fern under a canopy of sugar maple, white ash, beech, and red oak. There is also a rather dense pocket of wild millet, a woodland grass recovering from rarity. Following the ridgeline to the west along the property boundary, the forest opens into a Dry Oak-Hickory-Hophornbeam Forest, without hickory present. This association of plants is seen on many of the ridges coming off Mount Antone. The steepness of the ridge, combined with the southwestern aspect warms the area and dries out the soils making oaks the dominant species with hophornbeam just under the canopy and woodland

sedge mixing with lowbush blueberry and maple-leaf viburnum on the forest floor.

Following McCormick Trail brings you through a sharp change in community. As you bend around the hillside, changing aspect to the northwest, red spruce enters the canopy with the northern hardwoods, identifying this as a Red Spruce-Northern Hardwood Forest. Jack in the pulpit, touch me not, selfheal, Christmas fern, true solomon seal and foamflower are scattered on the floor with striped maple, pin cherry, and young red spruce midstory. This land appears tired. The plant life is not diverse and vibrant, but in a state of recovery from nutrient depletion after agriculture and then logging. Areas of the forest floor are completely bare unless near a stream bed.

The lower elevation area is a continuation of the tired former agriculture land displayed by a barren understory, without the influences of oak from the mountain ridge above. This is a Northern Hardwood Forest of white ash, sugar maple, American beech and yellow birch.

The area north of the current agriculture fields have seen logging somewhat recently, however the canopy is closed and mature oaks, maple and ash are joined by paper birch, and aspen. This is the Mesic Red Oak-Northern Hardwood Forest that covers much of this property.

Recommendations:

Light touch treatment on the Rich Northern Hardwood Forest

Compartment 2

This is the northeast corner of Merck Forest. It contains an interesting study in natural processes since a wind event came through in 2000 that leveled a swath of trees from Marquand Rd east through the widest part of compartment 2. Much of this area is now impassable with the blowdowns grown over by striped maple, pin cherry, and birch saplings. The ridgeline coming off the intersection of Hatch Trail and Gallop Rd was added to Merck along with Compartment 9. This was a great asset since it now buffers the area just north which offers some additional uniqueness to Merck Forest. The main drainage coming off Gallop Peak to the north follows a deep crevice in the bedrock and flows on a bed of slate for much of its path. Interestingly, this is one of few drainages on Merck property that does not offer any nutrient enrichment noticeable in the plant life. However, after the creek crosses a waterfall, the steep slope rising out of the drainage is a fine example of a Boreal Talus Woodland - variant of Yellow Birch Talus Forest. The trees are nearly all yellow birch with striped maple and mountain maple as shrubs. Evergreen wood fern and moss cover the rocks.

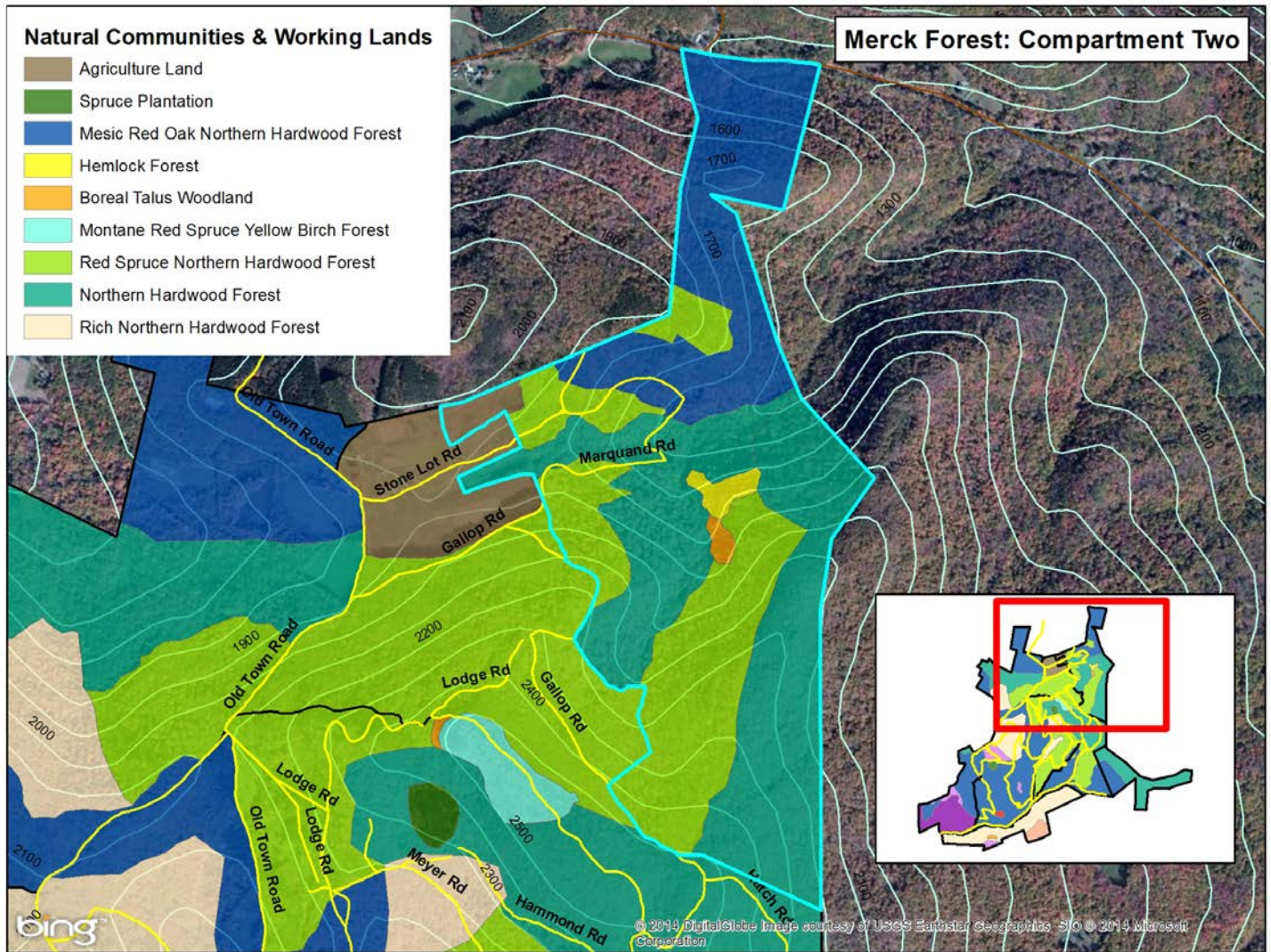
Just above the talus slope, and just south of the creek's intersection with the creek paralleling Stone Lot Rd. is a fine example of a Hemlock Forest. Kerry Woods with Bennington College

cored some of these trees and estimates them as an early-established second growth forest. The land was cleared as nearly all Vermont was, but soon after these Hemlocks re-established and continued to close the canopy to what we see today. Old Growth Hemlock Forests have an established herbaceous layer but this forest is bare. Hemlocks are highly valued as wildlife habitat for many species - white tail deer especially use their dense covering as shelter during heavy snow winters. There is another example, though much smaller, on Merck property of a Hemlock Forest, just across the North Branch of White Creek from the intersection of Wade Lot Rd and Old Town Rd.

The other areas of Compartment 2 describe Northern Hardwoods. The opposite side of the same drainage as the Hemlock Forest is entirely east facing, and is Northern Hardwood Forest. The southeastern aspect hillside up from Stone Lot Rd offers a mosaic of Mesic Red Oak-Northern Hardwood, when the aspect is southern, and Red Spruce-Northern Hardwood when it shifts to the east. The spruce dominate the canopy on the peak of the hill, just off Merck property, potentially a Lowland Spruce Fir Forest.

Recommendations:

Hemlock Forest no touch treatment including the Boreal Talus Woodland below.



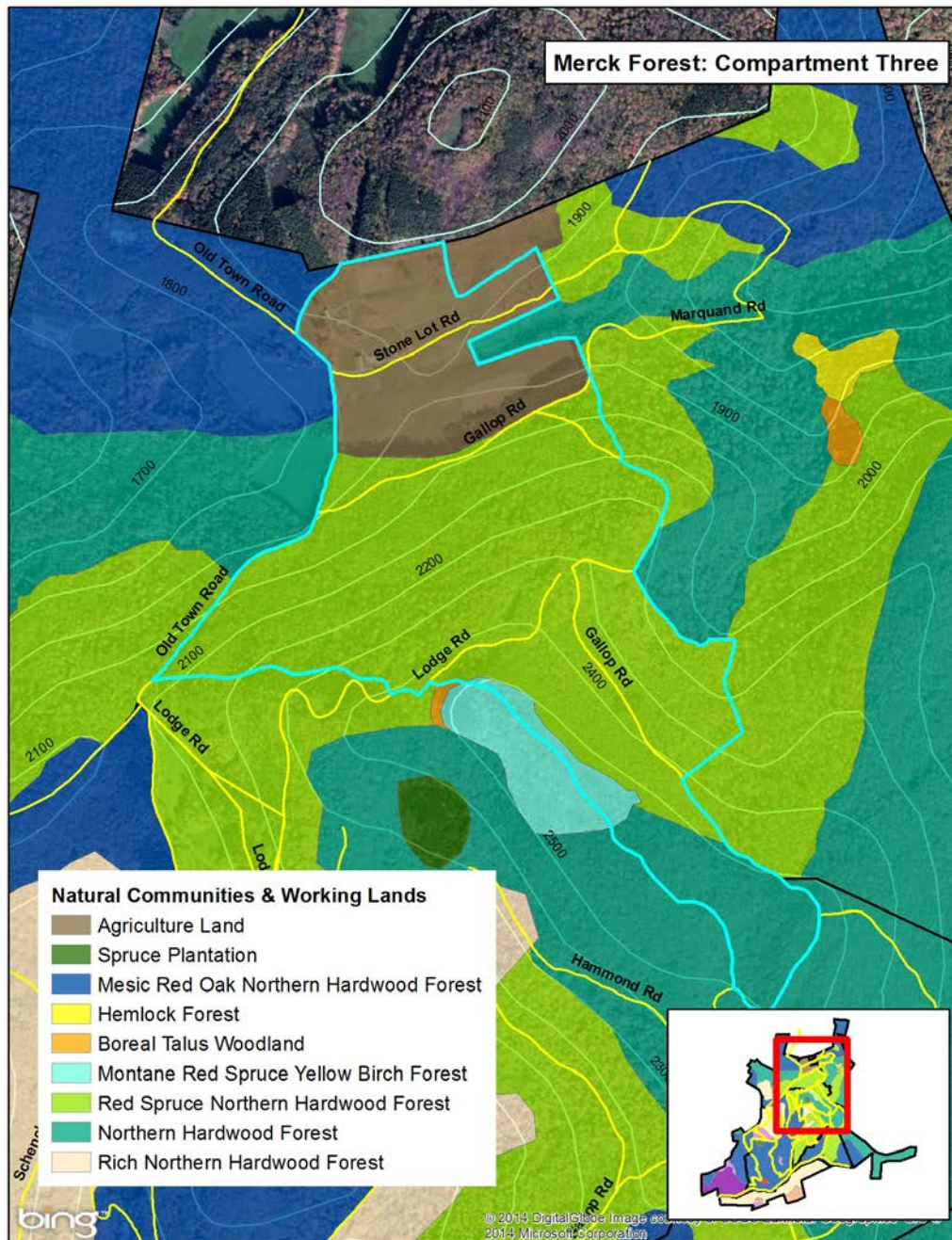
Compartment 3

The area of compartment 3 is the smallest compartment on the property. The details are described more fully under 'Compartment 4', since much of this compartment is influenced by Gallop Peak. The northern aspect of the sugarbush between Viewpoint Spur Trail and the Barn Cabins is just downhill from Gallop Peak. The presence of Red Spruce below and above the sugarbush implies a Red Spruce-Northern Hardwood Forest possibly with added enrichment from colluvium.

The herbaceous layer includes common wood sorrel, Virginia creeper, evergreen wood fern, narrow beech fern, jack in the pulpit, hay scented fern, silvery glade fern, white snakeroot, foamflower, striped maple, touch me not, and wood nettle. Red elderberry and striped maple are midstory.

Recommendations:

Gallop Peak, the Montane Yellow Birch-Red Spruce Forest, with a Boreal Talus Woodland below it, should be no touch treatment.



Compartment 4

Compartment 4 covers Barton Trail westward to Old Town Rd, bound in the north by Lodge Rd/Viewpoint Spur Trail. Like much of the rest of the property it is mainly comprised of Northern Hardwood Forest with Rich or Red Spruce variants intertwined. Rich Northern Hardwood Forest is introduced in pockets, following drainage areas, where colluvium processes add nutrients to the soil. The hillside between Meyer Rd and Kouwenhoven Rd displays these rich drainages. Herbaceous plants include rattlesnake fern, broad beech fern, maidenhair fern, marginal wood fern, Christmas fern, white baneberry, sensitive fern, interrupted fern white snakeroot, touch me not, jack in the pulpit, red trillium, and blue cohosh.

Roughly from Kouwenhoven Rd west to Old Town Rd, south of The Lodge, and north of The Glen, the dryness and warmth of southwestern exposure brings the Oaks back to dominance and this is more Mesic Red Oak-Northern Hardwood Forest.

Gallop Peak accessed via the Barton Trail displays another influential community for the property - Montane Yellow Birch-Red Spruce Forest. Red spruce is locally abundant in areas around Merck, but on Gallop Peak it is dominant. Yellow birch, American mountain ash, mountain maple and striped maple complete most of the canopy. The understory is comprised of mountain wood fern, evergreen wood fern, common wood sorrel, fringed bindweed, and Canada mayflower.

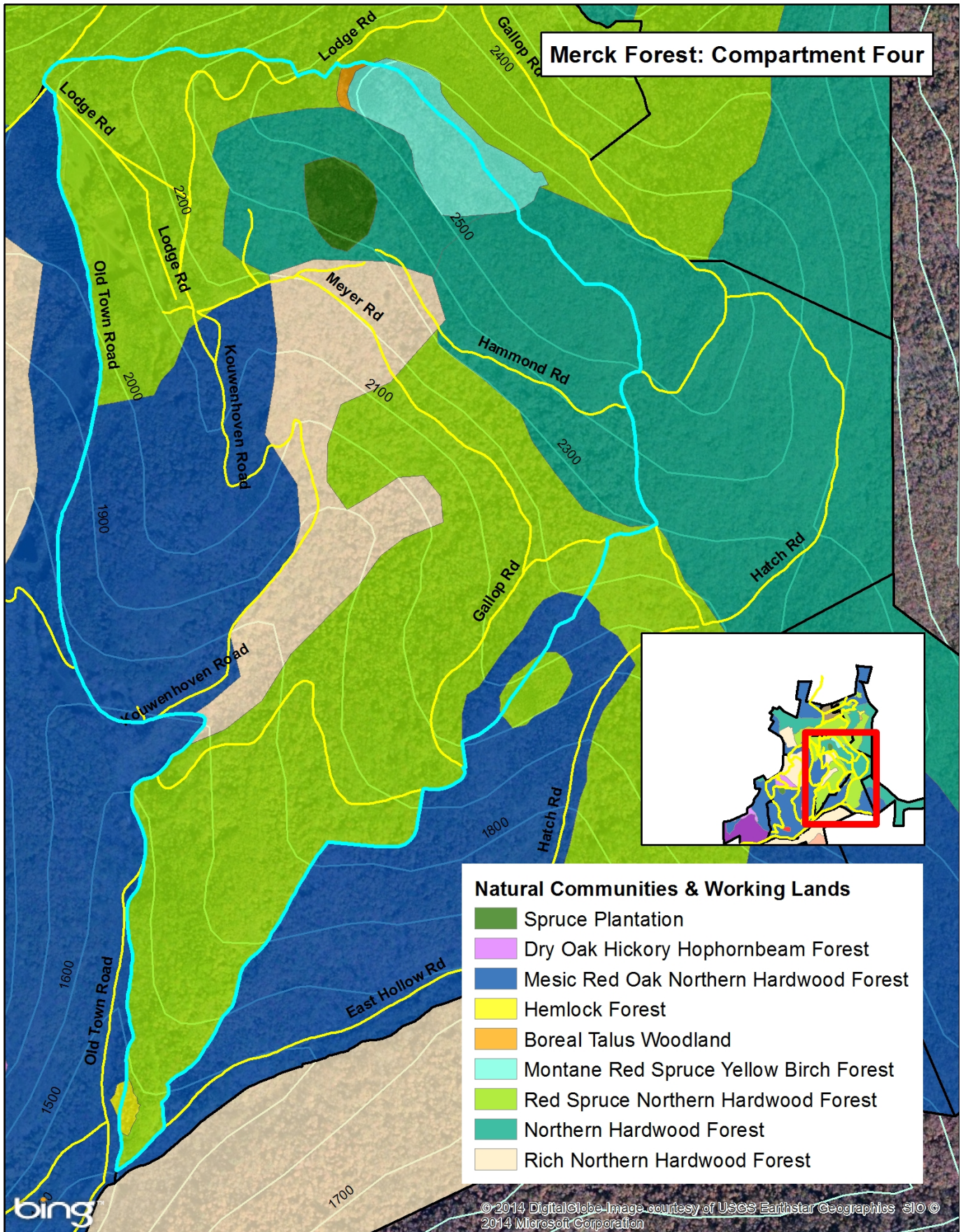
Appalachian polypody covers the rock outcrops on the northern face of the peak. At the base of the outcrops is a talus slope, with a small example of the yellow birch talus forest variant of a Boreal Talus Woodland.

Gallop Peak acts as a seed source for most of the surrounding forest, leaving its legacy as a Red Spruce-Northern Hardwood Forest to the north and west aspects. This forest type is quite common around Vermont as Northern Hardwoods give way to the Boreal Spruces with a gain in elevation. Foresters and forest ecologists question whether Red Spruce was much more a canopy dominant in pre-settlement years. The forest by Viewpoint Cabin reveals a more boreal tendency with lowbush blueberry and American mountain ash. A shadbush and some Red Oak saplings nearby illustrate just how this forest is a meeting place of community types.

Recommendations:

Gallop Peak, the Montane Yellow Birch-Red Spruce Forest, with a Boreal Talus Woodland below it, should be in no touch treatment.

Rich Northern Hardwood Forest drainage between Meyer Rd and Kouwenhoven displays some uncommon plants (rattlesnake fern & broad beech fern) which might warrant adding a larger stream buffer for a no-cut zone. This might impact the use of Kouwenhoven as a skidder trail as some individuals were directly next to the road.



Compartment 5

This area extends from where Antone Rd intersects Old Town Rd, just before the split with Lodge Rd, down to the southern end where it meets Old Town Rd once again.

Two particular areas require special attention within this compartment. First is the eastern aspect hillside coming off the Antone ridgeline that encompasses Lourie Trail, Clarks Clearing Rd, Silviculture Rd and Schenck Rd. This hillside offers the greatest diversity of herbaceous plant life on the property. This Rich Northern Hardwood Forest has a mature canopy of sugar maple, white ash, basswood, black cherry, beech, yellow birch and occasional red oak. The mid story is comprised of beech, striped maple, hophornbeam, and sugar maple. Red elderberry is prolific. A walk along Lourie Trail reveals wild ginger, white baneberry, sweet cicely, maidenhair fern, Canada violet, a pod of rattlesnake fern (rather uncommon), blue cohosh, waterleaf, jack in the pulpit, seersucker sedge, and spikenard. This diversity and lushness carries from Antone Rd down to Schenck Rd, bounded to the west by the ridgeline paralleling Wade Lot Rd, and to the east by the Birch Pond drainage that intersects the Silviculture Trail.

The second area in compartment 5 demanding special mention is Lookout Overlook. This occurrence is one of only two examples of a Dry Oak Woodland on Merck's land. Just uphill from the clearcut and burn area off Lookout Rd, this example of a Dry Oak Woodland sees many visitors. Dry Oak Woodlands are known for attracting diverse bird species. This ranks as the

most rare community, by Vermont standards, found on Merck property. The gnarled, stunted oaks offer no value to a timber sale and therefore ought to be easily left untouched. This community is thought to be positively impacted by lightning struck fires, however, much of its existence is due simply to the drought conditions of shallow soil that kill off all trees but the toughest of oaks. More consideration should be given to sustaining large fires in such close proximity to this community since it is already under a good deal of naturally created stress. Additionally, just beyond the Dry Oak Woodland, is the rather uncommon occurrence of climbing fumitory, a plant endangered in Maine and Rhode Island and of special concern in Massachusetts.

The ridgeline and steep southern aspect off Nenorod is also worth mention. This Dry Oak-Hickory-Hophornbeam Forest offers a few more shagbark hickory as a wildlife food source beyond Compartment 6.

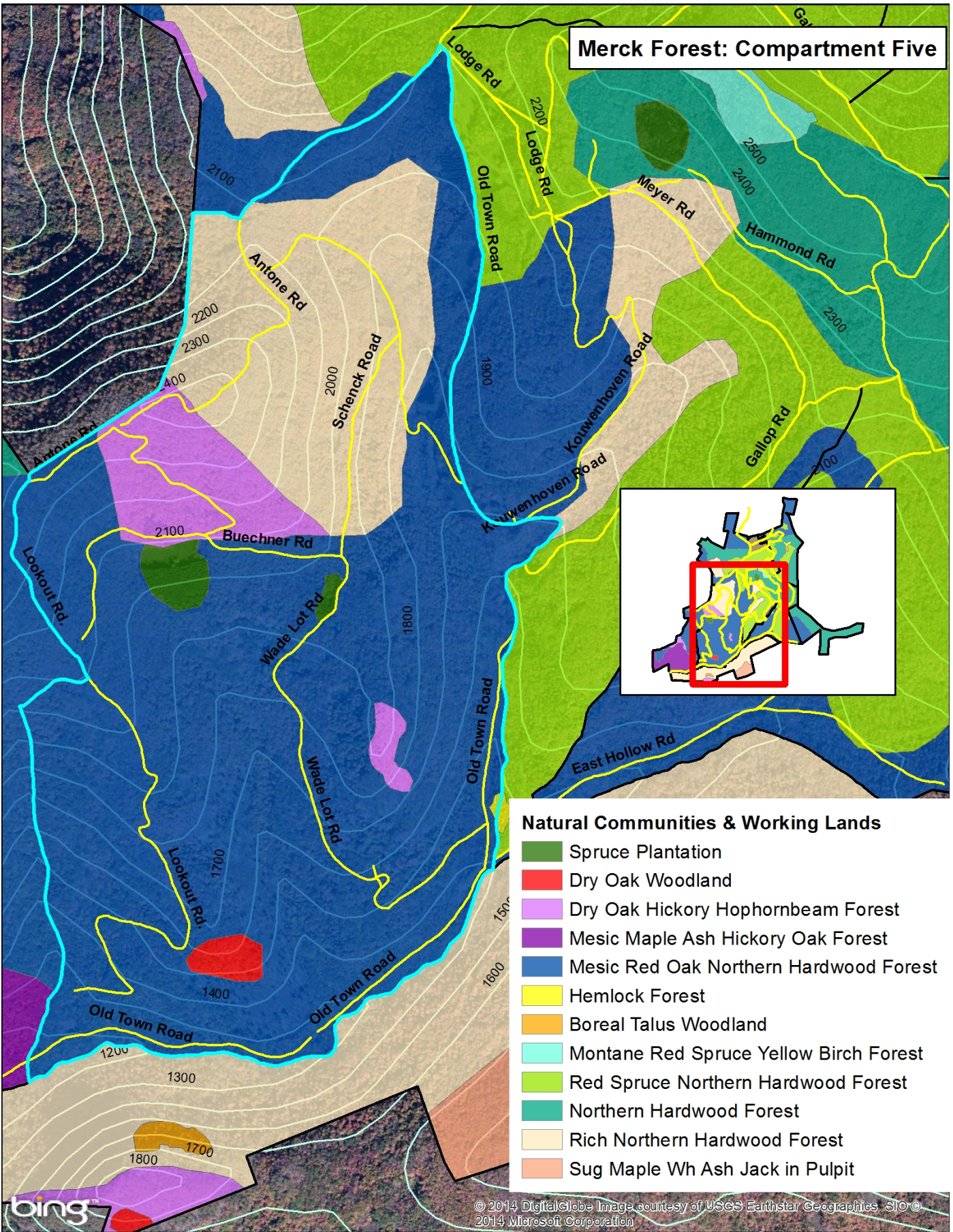
Recommendations:

Lookout Overlook designated no touch treatment.

Further consideration is needed to know how critical Rich Northern Hardwood Forests are to the region, but such a sizeable piece might necessitate increased restrictions on management efforts. The occurrence in Compartment 5 is the most pristine on Merck Property and should be no touch treatment for that reason alone.

The Dry Oak-Hickory-Hophornbeam Forest off Nenorod should be no touch management to encourage release of oak and hickory saplings instead of allowing beech thickets to invade.

Merck Forest: Compartment Five



Natural Communities & Working Lands

- Spruce Plantation
- Dry Oak Woodland
- Dry Oak Hickory Hophornbeam Forest
- Mesic Maple Ash Hickory Oak Forest
- Mesic Red Oak Northern Hardwood Forest
- Hemlock Forest
- Boreal Talus Woodland
- Montane Red Spruce Yellow Birch Forest
- Red Spruce Northern Hardwood Forest
- Northern Hardwood Forest
- Rich Northern Hardwood Forest
- Sug Maple Wh Ash Jack in Pulpit

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Compartment 6

Compartment 6 is designated a 'Natural Area' by the Board of Trustees for Merck Forest. This designation is noted in the LaReau Management Plan (1989) under advisement from Vermont Natural Resource Council, to reserve an area of a large parcel to remain untouched. Currently, there is a leased sugarbush operation within this Natural Area that contradicts the stated limitations. It is thought that this area was potentially logged last in the 1950's or 60's. This compartment rivals compartment 7 for diversity of tree species. The mesic condition of the soils coming off Mount Antone, combined with a southern aspect creates a hillside of Mesic Maple-Ash-Hickory-Oak Forest. This hillside boasts the most shagbark hickory on the property. Shagbark hickory is a great asset to have for possible Indiana bat habitat and wildlife food source reasons. Bitternut hickory is also present in this area. This community extends from Old Town Road up the south-facing slope that contains Masters Mountain Trail. The western edge of this community is another abrupt ridgeline and along it, conditions dry out making it more suited for a Dry Oak-Hickory-Hophornbeam Forest. The best example of this forest type is in this location, split partially between Merck and Hatch property. What makes it a 'classic' example is the presence and abundance of shagbark hickory and white oak. All other examples of this community type at Merck only contain red oak. The woodland sedge carpets the understory with lowbush blueberry interspersed. This spot also has exposed bedrock, indicating how shallow the soil is, which limits the invasion of the American beech. A mature chestnut oak located on the western property boundary, down this same ridgeline, is indicative of the past composition of this forest.

The top of this ridge leading to Mount Antone (which the Masters Mountain Trail follows) has the dry conditions that support the Dry Oak-Hickory-Hophornbeam Forest, without the presence of hickory. It splits and follows along the southern ridgelines where presumably the more droughty soil continues. Likely caused by beech bark disease, a dense beech thicket edges the Masters Mountain Trail leading to Mount Antone and along the spur trail leading to the peak. Additionally, black cherry and white ash are common. The composition of this forest is characterized as a Mesic Red Oak-Northern Hardwood Forest. This community continues downhill to the east across the drainage to Lookout Rd.

Along Old Town Rd, colluvium once again brings in rich indicators along the North Branch of White Creek. Basswoods are frequent in the canopy, along with black birch with maidenhair fern and white baneberry occasionally sighted.

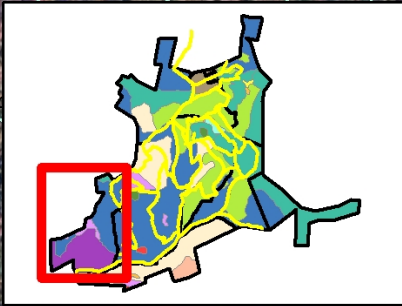
Recommendations:

Re-assess outline of Natural Area. Possible exclusion of eastern aspect hillside of Mount Antone, the Mesic Red Oak-Northern Hardwood Forest may be warranted. Additionally, exclusion of the western aspect between drainage and Lookout Rd might be considered.

Assess possible impact of leased sugarbush on wildlife. This area should be managed for wildlife above timber. The Mesic Maple-Ash-Hickory-Oak and Dry Oak-Hickory-Hophornbeam Forests should be no touch treatment to preserve the biodiversity they contain.

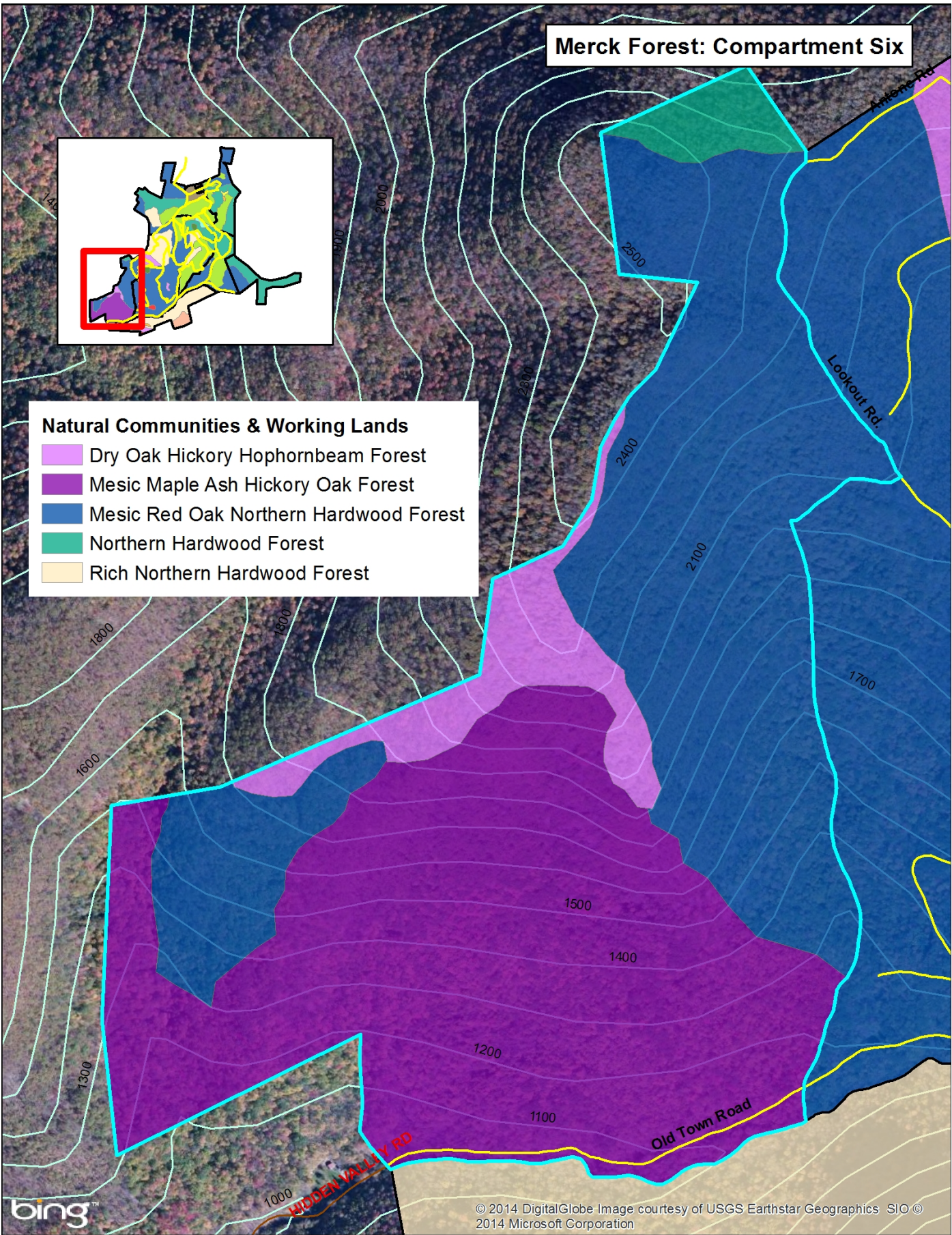
Mount Antone overlook is current maintained with a vista cut for recreational value. Allow this to continue, as it is not a rare community.

Merck Forest: Compartment Six



Natural Communities & Working Lands

- Dry Oak Hickory Hophornbeam Forest
- Mesic Maple Ash Hickory Oak Forest
- Mesic Red Oak Northern Hardwood Forest
- Northern Hardwood Forest
- Rich Northern Hardwood Forest



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Compartment 7

This compartment is entirely south of Old Town Rd and East Hollow Rd, being the north facing slope uphill of White Creek's North Branch. The southern property boundary follows the ridgeline of this slope crossing Little Haystack, Haystack and along Burnt Hill. The peak of Little Haystack is just inside the property line, but has an access road coming up to a clearing with a fire pit at the top from the non-Merck side. It was unclear whether this was on the property or not, and how maintained it is as an open space. The canopy is closed in, just off the clearing, with red oaks and shagbark hickory and a light midstory of shadbush, hophornbeam, red maple and striped maple. The floor cover is lowbush blueberry and hairgrass with woodland sedge. The open area is covered in short grass but again, seems maintained. Interestingly, there are well established seedlings of oak scattered across the understory as well. This is a Dry Oak Forest.

Coming off the peak, the saddle between the Haystack Mountains, is a Rich Northern Hardwood Forest with mature red oak in canopy. Hophornbeam are present as well, but mix with black birch and basswood and illustrate a transition between the Dry Oak Forest and the Rich Northern Hardwood. Musclewood, mature, undiseased beech, sugar maple, white ash, yellow birch and paper birch comprise this well-diversified forest. The steep downslope movement off Little Haystack and Haystack Mountains provides richness to support herbaceous plants with higher nutrient requirements as well. Pockets among the pit and mound topography offer colluvium as well as short plateaus on the hillside. In these areas maple-leaf viburnum, wild ginger, maidenhair fern, wide-leaved sedge, hepatica, and blue cohosh - all rich site indicators- can be found. The drier areas support Christmas fern, partridgeberry, and starflower, common in Northern Hardwood Forest. This north-facing hillside is a mosaic of Northern Hardwood and Rich Northern Hardwood Forests.

Haystack Peak is a unique ridge top community at Merck Forest. The north face up to

the ridge is impressively steep and offers an example to the northeast side of the yellow birch talus forest seen elsewhere at Merck, which is best categorized as Boreal Talus Woodland. Mountain maple and striped maple are the midstory, with a few red spruce. By far the canopy dominant is yellow birch, a species able to make use of other trees' failed attempts at rooting into the rocks - they are known for establishing on 'nurse logs', and send their roots down to wrap around a stump or large boulder. This talus is at the base of slate outcrops. To the northwest face of the peak, red spruce mix in with red maple, aspen and midstory beech, denoting where the boreal plants meet the northern hardwoods. American mountain ash seedlings are also present. Caught at the right time of year, the mountain cliffs display mountain azalea in full, fragrant bloom. This was not exhibited anywhere else on the property. The herb layer is sparse, mostly ferns - appalachian polypody and evergreen wood fern. This is a Northern Hardwood Forest and some influences from the Boreal Talus Woodland with the azalea as an unexpected element.

The true ridgetop of Haystack Mountain exhibits a Dry Oak-Hickory-Hophornbeam Forest, with red oaks and bitternut hickory along with white ash, red maple, and some black cherry. Midstory is hophornbeam, witch hazel and shadbush. The herbaceous plants include Canada mayflower, hairgrass, lowbush blueberry, and woodland sedge. The southeastern face of Haystack displays a Dry Oak Woodland - one of two on Merck property. Stunted oaks with an open canopy let light filter to the shadbush midstory and groundcover of lowbush blueberry and hairgrass. Interestingly, there is no woodland sedge beneath the true Woodland area, most likely due to the exposed bedrock.

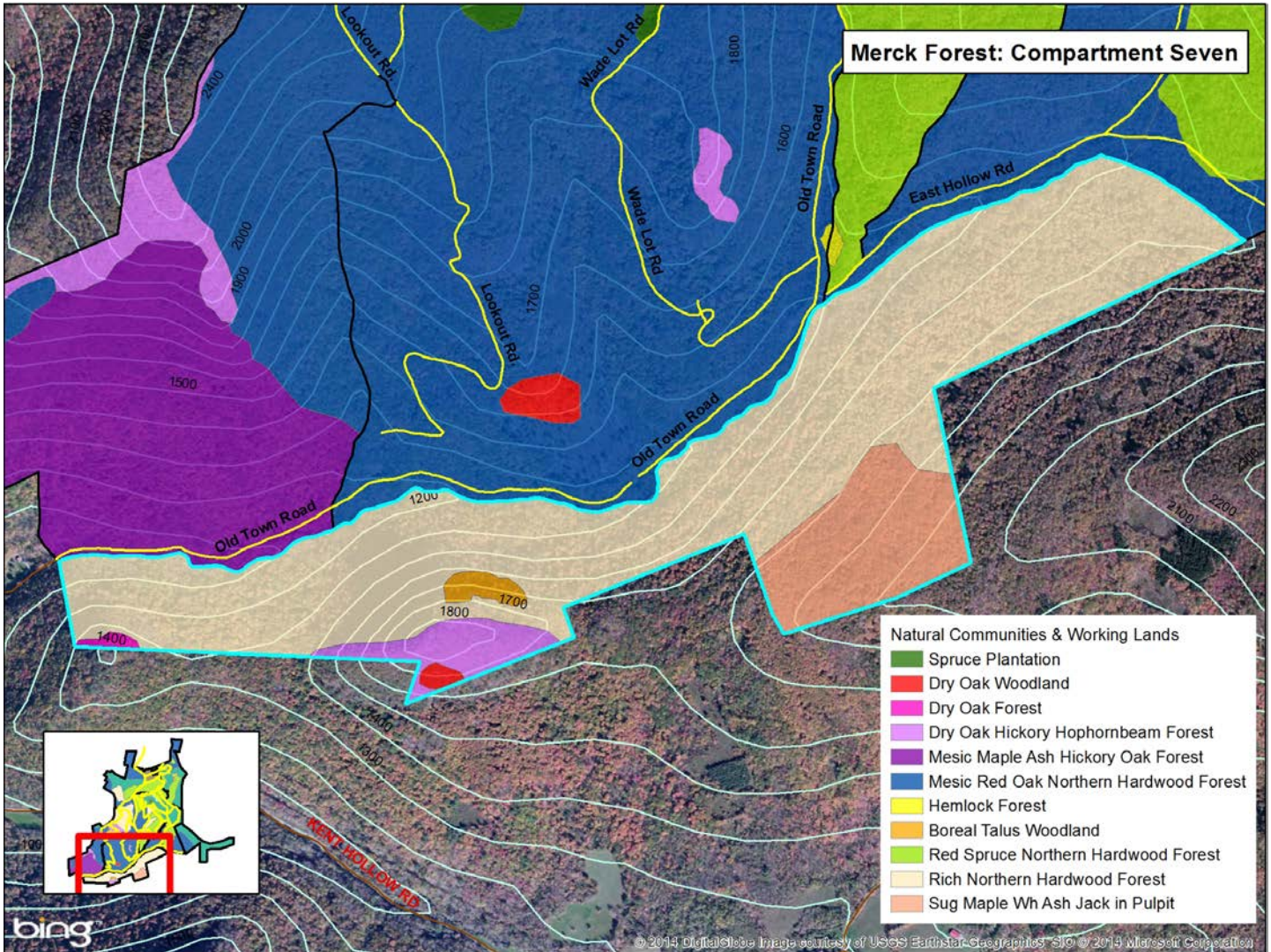
Burnt Hill is the next peak along the ridgeline east of the Haystacks. Merck property does not include this peak, but wraps around the northern aspect hillside. Area 7B is the portion that follows up the ridge for a bit, and the relatively shallow incline makes it somewhat richer than other parts of this ridge. In the past, this area has been designated as Rich Northern Hardwood, but I would

characterize it more as the White Ash Sugar Maple Jack in the Pulpit variant of Northern Hardwood Forest. Possibly the cutting done in the 1980's and again in 2003 removed the rich indicator tree species (basswood and black birch), but with the herbaceous layer so sparse, it is difficult to call the community Rich Northern Hardwood. Heading into 7A, with a great number of seeps coming off Burnt Hill, spots of colluvium are frequent with blue cohosh and pale touch me not. There are a good deal of skidder tracks through this area with dense

hay scented fern and raspberry. It was last entered in 1991. The Burnt Hill portion of compartment 7 is a mosaic of Northern Hardwood Forest and Rich Northern Hardwood in wetter areas estimated at about 75% of the hillside down to North Branch White Creek.

Recommendations:

Haystack Mountain peak: Dry Oak Woodland, Dry Oak-Hickory-Hophornbeam Forest, and Boreal Talus Woodland should be in no touch treatment.



Compartment 8

This compartment encompasses Hatch Trail down to East Hollow Rd and to the east along the southern property boundary. Its northern boundary is the intersection of Gallop Rd and Hatch Trail. This northern section between Gallop and Hatch was logged in 2003, and is classically Northern Hardwood Forest with a heavy beech thicket from the recent release after single-tree selection and the stress of Beech Bark Disease. Hobblebush, jack in the pulpit, foamflower comprise much of the herbaceous layer. The canopy is beech, sugar maple, white ash, yellow birch.

Within this compartment is the Ridge Cabin area. From Gallop Rd, Ridge Rd follows the nose of a south-southwest facing ridge. The level ridgeline mimics the surrounding Northern Hardwood Forest, but off the southeast facing ridge, the canopy has mature red oak with red oak seedlings and saplings coming along. The forest floor on the ridge top retains the woodland sedge with bracken fern, Canada mayflower, and wild sarsaparilla mixed in. This ridgeline is much like others on the property - exhibiting some characteristics of a Dry Oak-Hickory-Hophornbeam Forest as well as a Northern Hardwood Forest community. The herbaceous layer seems more like a Northern Hardwood Forest and thus it is a Mesic Red Oak-Northern Hardwood Forest.

The eastern facing slope off the ridge has a dense stand of red spruce. Interspersed are paper birch and yellow birch –no other species able to root on this steep, rocky slope. No herbaceous layer is present. Compared to the surrounding area these spruce are quite isolated. There is no record of this being a plantation, so I assume the steepness of the land gave these spruce a pocket of protection from past logging. Or perhaps this was a pre-Merck Foundation plantation. Nevertheless this pod of red spruce influence the forest farther down the hillside, and have an interesting influence on the surrounding Mesic Red Oak-Northern Hardwood Forest. A sight frequent

across Merck landscape is a red oak-hardwood community type with red spruce growing in pockets midstory.

The Mesic Red Oak-Northern Hardwood Forest continues downhill from Ridge Cabin along the southeastern exposure to Hatch Trail, and farther down in elevation to East Hollow Rd. Cutting was done last winter (2013/14) within this area of compartment 8. A few seeps offer diversification of plant life, with rich site indicators of blue cohosh, wood nettle and seersucker sedge found in wetter, level spots. But, mostly this formerly cleared land is a hillside of red oak, beech, black cherry, white ash, sugar maple, and yellow birch with mature aspen and paper birch. Red spruce, striped maple and beech comprise most of the midstory. Christmas fern, and evergreen wood fern sparsely cover the floor.

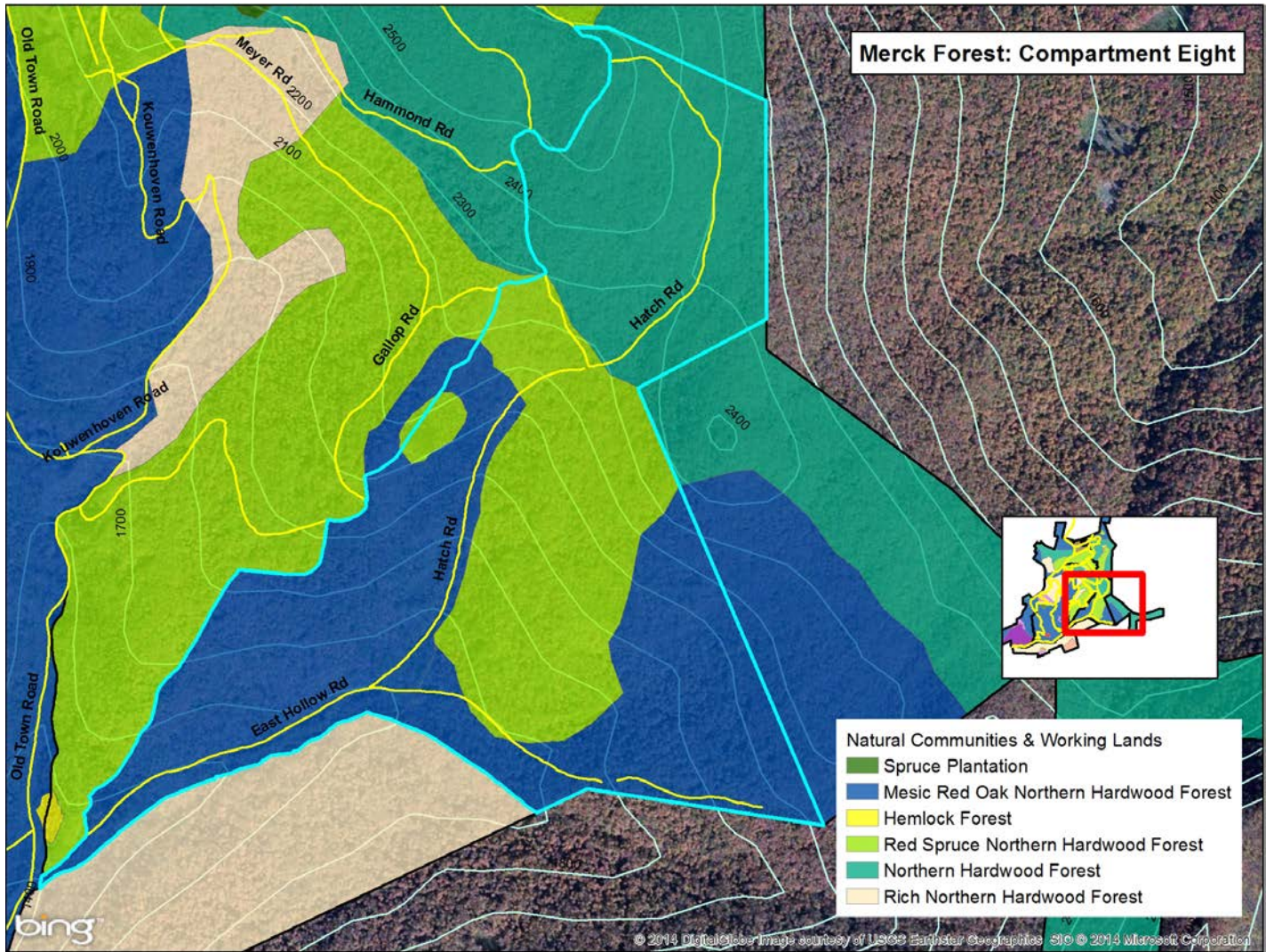
To the east of Hatch Trail, the red spruce are present again, and this area appears to be caught between a Red Spruce-Northern Hardwood Forest and a Mesic Red Oak-Northern Hardwood Forest. Beech is once again significantly dense in the midstory, probably due to single-tree and small group cutting done in 1996, and Beech Bark Disease. This area is classified as Red Spruce-Northern Hardwood Forest.

There is a small example of Hemlock Forest just across from the Wade Lot Rd and Old Town Rd intersection that is partially in Compartment 4 but mostly in Compartment 8. It covers what might be a glacial esker, well drained and quite steep. A logging road cuts through one section but the hemlock on the steep slope has been left uncut for sometime.

Recommendations:

Hemlock Forest should be a no touch treatment.

Consideration might warrant restricted management activities around Ridge, since red oak seem to be naturally regenerating, an infrequent sight on this property.



Compartment 9

This compartment is the eastern-most section of the property. It is inaccessible from the trail system of Merck Forest and therefore does not receive any visitors. However, there is a well-used ATV road (9D), established before Merck acquired this land in mid 1990s. The section (9E) along Spruce Peak was logged in 1999, contributing to the heavy midstory of beech thickets. Much of this compartment is north or northeast facing in aspect. Without the added warmth from a southern aspect, the community is simply a Northern Hardwood Forest. Mature sugar maple, yellow birch and beech comprise the north facing slopes with little herbaceous layer but a good deal of beech midstory. The midstory also includes some black cherry growth, common with such well drained soils on steep hillsides. Some areas are steep talus slopes coming off Spruce Peak and offer little stability. Yellow birch talus forest seen elsewhere on the property as a potential variant of Boreal Talus Woodland could be denoted here. However, the occurrence is so small that the influences of the Northern Hardwood Forest are dictating the floral characteristics rather than the more boreal influences of the classic community type.

The Northern Hardwood Forest continues westward through 9D where the topography levels and the drainage area offers refuge to some

herbaceous plants - sensitive fern, ostrich fern, spotted touch me not and hay scented fern.

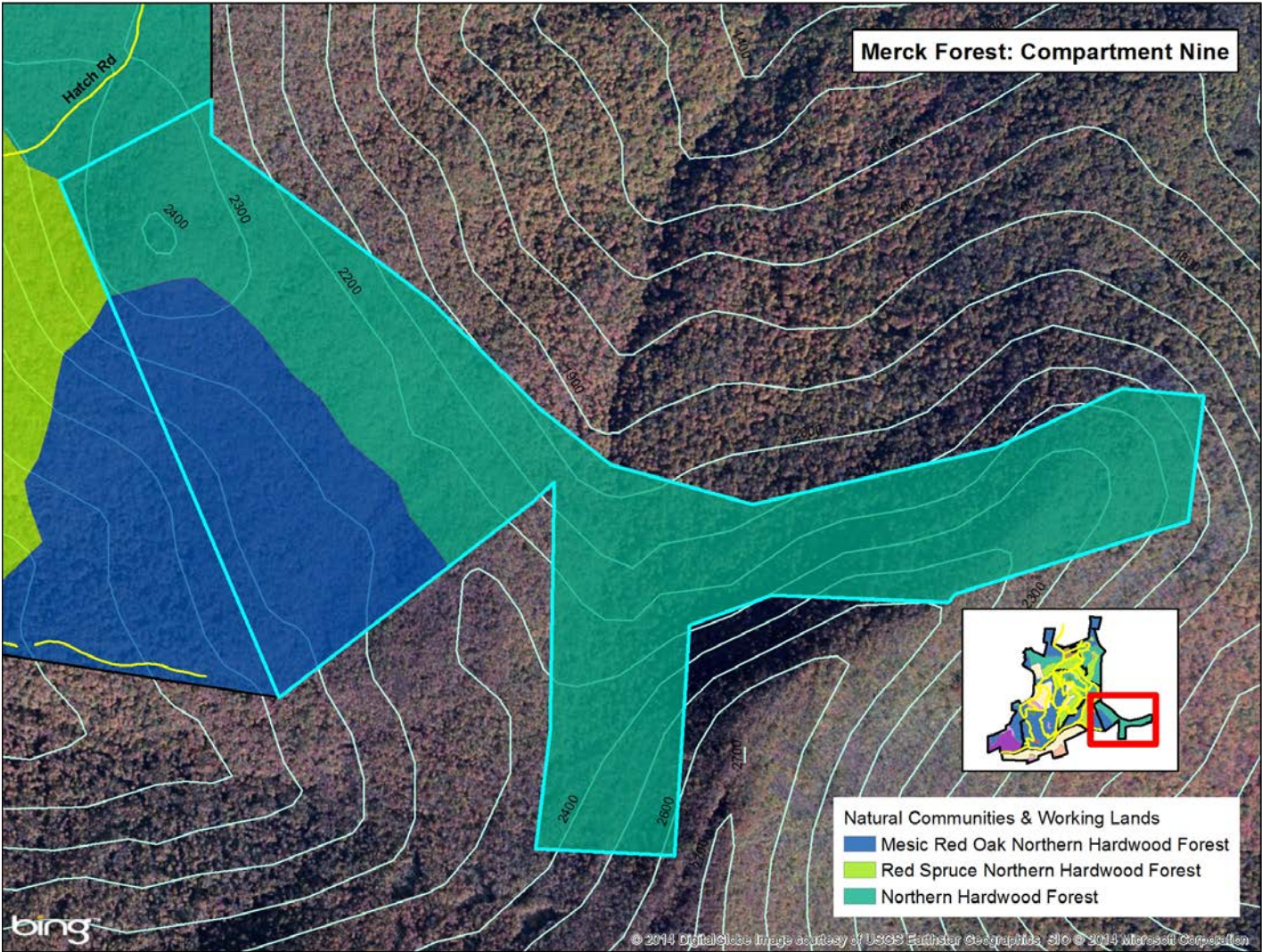
An interesting remnant of a dry oak community type exists on the southwest aspect within 9B. Red oaks tower in the canopy with a heavy component of black cherry. Mature hophornbeam are also present. Woodland sedge is interspersed on the forest floor. This oasis from the dense beech thickets is a relief, but with a canopy closed in and beech nearby, this is now a Mesic Red Oak-Northern Hardwood Forest possibly transitioning to Northern Hardwood Forest. The oak do not appear to be regenerating.

There are a few spots of colluvium richness in 9B beneath rock outcrops. Blue cohosh, alternate leaved dogwood and bladder sedge indicate spots of higher nutrient content at the base of steep slopes. Mostly the canopy is white ash, sugar maple, yellow birch, beech, and striped maple. The herbaceous layer also suggests Northern Hardwood Forest with spots of richness. Most of the forest floor is covered with Canada mayflower, wild sarsaparilla, evergreen wood fern, fringed bindweed and jack in the pulpit.

Recommendations:

No restrictions.

There is an existing conservation easement with New England Forestry Foundation on Compartment 9 which requires pre-approval to any activity.



Appendix 2: Bird Monitoring Data

These data were collected from Vermont Center for Ecostudies (VCE) forest monitoring program at Merck Forest. Each plot was visited at least twice a year for eight consecutive years before the collection became irregular. Basic trends in presence/absence of species can be noted, but the data are too incomplete to make greater inferences. The species are listed by the VCE four-letter identifier, and the numbers represent individuals observed. Each key species from Audubon's Forestry for the Birds Program is discussed in greater detail using the VCE monitoring data.

VCE Monitoring Plot Data: Merck Forest																			
Count of Spp																			
Row Labels	AMRE	AMRO	BAOR	BHVI	BTBW	BTNW	CAWA	EAWP	HETH	OVEN	RBGR	REVI	SCTA	TUTI	VEER	WBNU	WOTH	YBSA	
6/10/92	6	1							6	2	5	4	3	1		3	1	4	2
6/24/92	3	1							4	1	9	2	4	1		5	2	7	2
6/8/93	6	4			1		2		4	2	9	4	6	6		5		1	2
6/22/93	6	4							3	2	6	3	5	1		1		5	1
6/9/94	7	4			1				5	3	4	2	12	7		2	3	4	2
7/6/94	8	5			2	1			8	2	5	1	12	7		5	1	8	1
6/15/95	5	5			1				9	2	3	2	9	7		2	1	3	2
7/3/95	4	8			1	1			6	7	4	2	9	5		2	3	4	4
6/17/96	6	8			1				7	2	2	4	11	2		3	1	5	3
7/7/96	1	2			1				5		1	4	10	3		4	1	3	4
6/10/97	1								2	2	3	2	2			1	1		
6/16/97	6	1			1				4	3	1	1	6	2		2	2	4	
6/3/98	1										1	1	1					2	
6/6/98	3	1			2				3	2	3	2	5	3		1	1	1	1
6/20/98	2	1			3	1			6		3	2	4			3		1	1
6/3/99	4								4	1	3	1	2	4				4	1
6/19/99	4	3			2				3	4	4	1	6	1		4		2	1
6/4/00	4					1			5	2	1	6	8	3		3	3	1	1
6/17/00	2								5	2	2	2	7	3		1		3	2
6/5/03	3	1				1			7		3	2	9	3		1		4	10
6/19/03	8	4							1			6	7	2		1		3	3
6/16/13	13	4	1	1					3		10	1	10	1		9	2	3	4
6/22/13	12	1							4		14	1	8	5		9	2	7	10
6/7/14	9	3		3	1				5	1	10	3	6	5	1	7		6	2
6/15/14	11	6		1					5	2	12	2	4	6	1	10	3	6	2
Grand Total	135	67	1	5	17	5	2	114	42	118	61	166	78	2	84	27	91	61	

Table 1: Birds at Merck Forest data from VCE plots 1992 – 2014 (observations performed twice each year)

Black Throated Blue Warbler (BTBW): Detected consistently in early 1990's, with a possible nesting pair in 1998, this species was not listed in early 2000's but 3 individuals were sighted again in 2014. It is sensitive to the availability of large (250+ acres), continuous hardwood forest tracts with dense understory. Possible targeted surveying might be useful in Compartment 4/8 at the top of Hatch Trail where forest conditions meet these criteria exceptionally well. This species is one of the most abundant across Vermont according to VCE's cumulative report in 2006.

Black Throated Green Warbler (BTNW): Sighted sporadically in the 1990's and 2000's and again an individual was detected in 2014. Since these birds

prefer softwood stands in large tracts, it is understandable they would be less frequent. It will be interesting to watch the frequency of this species at Merck Forest in the upcoming decades if the midstory red spruce become more common in the canopy. Currently Gallop Peak offers the best habitat for this species on the property with its tendency towards a boreal community type (Red Spruce Yellow Birch Montane Forest). Hemlock Forests are infrequent at Merck Forest, which would be the preferred, non-boreal community. This species is one of the five most abundant at VCE's monitoring sites around Vermont.

Blue Headed Vireo (BHVI): This species prefers complex forests characteristic of mid-late

successional stages. There is no record of this species at Merck Forest until 2013 and then present at all monitoring since. This is a good sign that Merck's management strategy is improving structural complexity in the forest, which has been closely linked to increasing biodiversity. This bird has been tracked in declining populations from VCE's cumulative bird trends report 1989-2006. Recent detections indicating greater habitat availability is encouraging.

Canada Warbler (CAWA): Sighted once in 1993, this species has not been observed at Merck Forest since. That might simply be due to its preference of habitat in swampy, riparian areas and upland forests with coarse woody debris (CWD). There are no swamps present on Merck land. Given the management history of Merck Forest, not much CWD is present on the forest floor. This species is in decline throughout the Northeast at rates of 4-7% per year, possibly due to a lack of preferred habitat. The removal of shrubs and saplings by thinning or deer browse reduces the suitability of habitat. (Lambert & Faccio, 2005)

Chestnut-sided Warbler (CSWA): Chestnut-sided Warbler was not a species monitored at VCE's monitoring plots in Merck Forest so it is difficult to make any comment on the population changes. However, 2014 records of 5 individuals sighted at Merck Forest in the eBird database, indicates they are present now and should to be monitored in the future. The patch cut along Clarks Clearing in Compartment 5 offers ideal habitat for this species. They prefer young hardwood stands 5-15 years old with dense shrubs and saplings and low (30%) canopy.

Eastern Wood Pewee (EAWP): A common songbird throughout the historical record, and common at Merck Forest. This species prefers deciduous woodlands with relatively open understories. The frequent sighting of woodland sedge under a towering canopy of sugar maples or red oak at Merck is ideal for these birds. They have been detected every year, with minor variations in the numbers observed.

Scarlet Tanager (SCTA): Another species quite regular in Merck Forest's bird records, this species prefers interior forests with a significant oak component. Given the apparent lack of oak

regeneration at Merck Forest, it will be interesting to monitor how this species' abundance is influenced by a changing community assemblage over the upcoming decades.

Veery (VEER): This species prefers moist woodlands with thick understory of trees and shrubs. Frequently present in regenerating clearcuts. It is a common breeding songbird throughout New England. It is thought to have reached peak populations after the white pines were cleared from Vermont's landscape and a young hardwood forest emerged. However, the data from VCE monitoring plots suggest its presence is increasing at Merck Forest. Throughout the 1990's and into the early 2000's less than 5 individuals were detected. In the last 2 years, each survey has recorded closer to 10 individuals. Using a disturbance-like silviculture treatment might continue to enhance this population given its preference for clearcuts on the landscape.

White-throated Sparrow (WTSP): This species prefers softwood and mixed forests with gaps but greater than 50% canopy and a dense midstory. Historically, it preferred higher elevations with stunted tree growth, but has been found at lower elevations since the 1950's. Unfortunately, the data collected by VCE omitted this species from collection. But, eBird's database shows 12 individuals observed in one sitting at Merck Forest last year. Assuming this was a positive identification, the White-throated Sparrow population is not of concern.

Wood Thrush (WOTH): Wood Thrush nest in both interior and edge areas of mature deciduous or mixed forests. Like the Veery, this songbird has a consistent record of observations at Merck Forest. It prefers a more mature forest than the Veery and Hermit Thrush. The consistent detection of Wood Thrush and Veery suggest a healthy mix of early and mid-successional forest stages available at Merck Forest. This bird has a declining presence across the state at VCE monitoring plots according to their 1989-2006 trends report.

American Woodcock: A meadow and edge species primarily, this bird is not monitored as part of VCE's forest monitoring program. However, there is an observation listed at Merck Forest in ebird for American Woodcock. Given that this species prefers old fields, the forest edge around the farm provides ample habitat for this bird.

Yellow-bellied Sapsucker (YBSA): A migratory woodpecker, these birds are a common sight in orchards in the spring and fall. Their signs are frequent in the forests, with small, evenly spaced holes lining the bark of apple and birch especially.

They nest in snags or dead standing trees by excavating out a cavity. The presence of these birds implies good structural complexity in the forest, with available snags for nesting. Surveys in 2013 recorded 10 individuals at Merck Forest. On a separate observation 2 family groups were identified. There was a nesting pair on the edge of the parking lot that I know from personal observation. The population at Merck Forest is healthy and possibly increasing, looking at the number of observations from VCE's monitoring data.

Appendix 3: Plants and Animals Referenced in this Report: Common and Scientific Names

PLANTS: (source: USDA/NRCS PLANTS Database)

American beech (*Fagus grandifolia*, Ehrh.)
American mountain ash (*Sorbus americana*, Marshall)
Appalachian polypody (*Polypodium appalachianum*,
Haufler & Windham)
Basswood (*Tilia americana*, L.)
Bitternut hickory (*Carya cordiformis*, Wangenh.) (K.Koch)
Black/sweet birch (*Betula lenta*, L.)
Blackgum (*Nyssa sylvatica*, Marshall)
Bladder sedge (*Carex intumescens* Rudge)
Blue cohosh (*Caulophyllum thalictroides*, (L.) Michx.)
Bluebead (*Clintonia borealis*, (Aiton) Raf.)
Chestnut oak (*Quercus Montana*, Willd.)
Christmas fern (*Polystichum acrostichoides*, (Michx.) Schott)
Common wood sorrel (*Oxalis acetosella*, Raf.)
Cow wheat (*Melampyrum lineare*, Desr.)
Eastern hemlock (*Tsuga Canadensis*, (L.) Carriere)
Evergreen wood fern (*Dryopteris intermedia*, (Muhl. ex
Willd.) A. Gray)
Fringed black bindweed (*Polygonum cilinode* Michx.)
Garlic mustard (*Alliaria petiolata*, (M. Bieb.) Cavara &
Grande)
Hairgrass (*Deschampsia flexuosa*, (L.) Trin.)
Hay scented fern (*Dennstaedtia punctilobula*, (Michx.) T.
Moore)
Heath family (*Ericaceae*)
Hobblebush (*Viburnum lantinoide*s, Michx.)
Hophornbeam (*Ostrya virginiana*, Mill. (K. Koch))
Indian cucumber root (*Medeola virginiana*, L.)
Jack in the pulpit (*Arisaema triphyllum*, (L.) Schott)
Japanese honeysuckle (*Lonicera japonica*, Thunb.)
Lowbush blueberry (*Vaccinium angustifolium*, Aiton)
Maple-leaf viburnum (*Viburnum acerifolium*, L.)
Marginal wood fern (*Dryopteris marginalis*, (L.) A. Gray)
Mountain maple (*Acer spicatum*, Lam.)
Mountain wood fern (*Dryopteris campyloptera*, Clarkson)
Multiflora rose (*Rosa multiflora*, Thunb.)
Paper birch (*Betula papyrifera*, Marshall)
Partridgeberry (*Mitchella repens*, L.)
Poverty grass (*Danthonia spicata*, (L.) P. Beauv. ex Roem. &
Schult.)
Quaking aspen (*Populus tremuloides*, Michx.)
Red elderberry (*Sambucus racemosa*, L.)
Red maple (*Acer rubrum*, L.)
Red Oak (*Quercus rubra*, L.)

Red Spruce (*Picea rubens*, Sarg.)
Rock tripe/navel lichen (*Umbilicaria spp.*, Hoffm.)
Royal fern (*Osmunda regalis*, L.)
Seersucker/plantainleaf sedge (*Carex plantaginea*, Lam.)
Shadbush (*Amelanchier spp.*, Medik.)
Shagbark hickory (*Carya ovata*, (Mill.) K. Koch)
Silvery glade fern (*Deparia acrostichoides*, (Sw.) M. Kato)
Smooth yellow false foxglove (*Aureolaria flava*, (L.) Farw.)
Spikenard (*Aralia racemosa*, L.)
Starflower (*Trientalis borealis*, Raf.)
Striped maple (*Acer pensylvanicum*, L.)
Sugar maple (*Acer saccharum*, Marshall)
Touch me not (*Impatiens spp.*, Nutt.)
White ash (*Fraxinus americana*, L.)
White baneberry (*Actaea pachypoda*, Elliot)
White oak (*Quercus alba*, L.)
White snakeroot (*Ageratina altissima*, (L.) R.M. King & H.
Rob.)
Wide-leaf or plantainleaf sedge (*Carex plantaginea* Lam.)
Wild oats (*Uvularia sessilifolia*, L.)
Wild sarsaparilla (*Aralia nudicaulis*, L.)
Witch hazel (*Hamamelis virginiana*, L.)
Woodland sedge (*Carex pennsylvanica*, Lam.)
Yellow birch (*Betula alleghenensis*, Britton)

ANIMALS: (source: ITIS Report)

American Redstart (*Setophaga ruticilla*, L.)
American Robin (*Turdus migratorius*, L.)
Baltimore Oriole (*Icterus galbula*, L.)
Black Throated Blue Warbler (*Setophaga caerulescens*, JF
Gmelin)
Black Throated Green Warbler (*Setophaga virens*,) JF
Gmelin)
Blue-headed Vireo (*Vireo solitaries*, A. Wilson)
Canada Warbler (*Cardellina Canadensis*, L.)
Chestnut-sided Warbler (*Setophaga pensylvanica*, L.)
Common Yellowthroat (*Geothlypis trichas*, L.)
Eastern Wood Pewee (*Contopus virens*, L.)
Hermit Thrush (*Catharus guttatus*, Pallas)
Jefferson salamander (*Ambystoma jeffersonianum*, Green)
Northern Dusky Salamander (*Desmognathus fuscus*, Raf.)
Ovenbird (*Seiurus aurocapilla*, L.)
Red-eyed Vireo (*Vireo olivaceus*, L.)
Rose-breasted Grosbeak (*Pheucticus ludovicianus*, L.)
Scarlet Tanager (*Piranga olivacea*, Gmelin)

Tufted Titmouse (*Baeolophus bicolor*, L.)
Veery (*Catharus fuscescens*, Stephens)
White-breasted Nuthatch (*Sitta carolinensis*, Latham)
White-tailed deer (*Odocoileus virginianus*, Zimm.)

White-throated Sparrow (*Zonotrichia albicollis*, Gmelin)
Wood Thrush (*Hylocichla mustelina*, Gmelin)
Yellow-bellied Sapsucker (*Sphyrapicus varius*, L.)

Appendix 4: Vermont State Natural Community Ranking

Source: Vermont Fish and Game Dept.

State Rank: these ranks indicate the relative rarity of natural community types and are assigned by the Vermont Nongame and Natural Heritage Program

S1	very rare in the state, generally with fewer than five high quality occurrences
S2	rare in the state, occurring at a small number of sites or occupying a small total area in the state
S3	high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered
S4	widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small
S5	common and widespread in the state, with high quality examples easily found