Conservation Management Plan
for the Smokey House Center Forests

Dorset Mountain as seen from the agricultural fields at Smokey House Center, on Danby Mountain Road

Danby, Vermont

2021 – 2031 Planning Period

Prepared by:
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Licensed Forester

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Executive Summary

This resource is a conservation plan for the Smokey House Center (SHC) to be submitted to Vermont's Current Use program and change SHC's current use category from "productive timberland" to "conservation." This plan was put together by Seth Inman (Master of Environmental Management) and Blanca Begert (Master of Environmental Science), two February 2021 graduates from the Yale School of the Environment, in collaboration with Vermont licensed forester Steve Handfield. It was created as a postgraduate fellowship, devised and funded by the Smokey House Center, and coordinated in partnership between the Forest School at Yale and Smokey House. Consulting forester Steve Handfield, Board President and Connecticut forester Curtis Rand, SHC Executive Director Jesse Pyles, and Yale faculty member Joseph Orefice provided guidance and oversight on the plan.

SHC is a 4,888-acre property in the town of Danby, in Rutland County, VT, in the watershed of the Otter Creek headwaters. With this current application, SHC seeks to enroll 4,264.79 acres of forested and nonproductive land in Current Use under the "conservation" category. Smokey House forests are an important part of the Eastern Wildway wildlife corridor, connecting forests in Maine and Quebec with those further south in the Appalachians. Since 1958, when the land was purchased by Stephen and Audrey Currier, it has been stewarded by the Taconic Foundation, and then by the autonomous Smokey House Center since the 1990s, with the goal of conserving the land and the rural character of the region. Historically the goals of SHC were to protect the land from subdivision and development, to promote and support rural livelihoods such as farming and timber production at a sustainable scale, and to provide a place for young people to learn and grow outdoors. The property is approximately 938 acres of farmland and 3,950 acres of forestland, and 4,695 acres of both farmland and forestland are under conservation easements with the New England Forestry Foundation (NEFF Easement). Several areas of the property, including historic gravel pits and areas around some of the farmsteads, totaling 92.74 acres, are excluded from the restrictions of the easement. SHC also has ongoing youth education programs and is used by the wider Danby community for recreation, and particularly for hunting.

Timber management has always been a significant part of SHC's forest management history, and the forest has been carefully managed to provide periodic income and support for the regional timber economy. However in recent years, while timber harvest is ongoing, SHC has scaled back its harvesting activities. SHC enrolled in Vermont's Use Value Appraisal program in the "productive timberland" category in 2012. They now seek to transition to the "conservation" category, as, since its origins, conservation has been a significant driving principle behind all activities that occur on the property. In the conservation plan, management goals will focus on wildlife and forest resilience, while continuing to support timber economy as a part of a conservation approach that promotes early successional habitat and resilient, diverse, climate-adaptive forests.

The property's altitude ranges from 1,214 to 3,769 feet above sea level; 1,226 acres are over the 2,500-foot mark (in yellow below—contour lines are 100 feet). Any logging activity over 2,500 feet of elevation in Vermont requires an Act 250 permit.

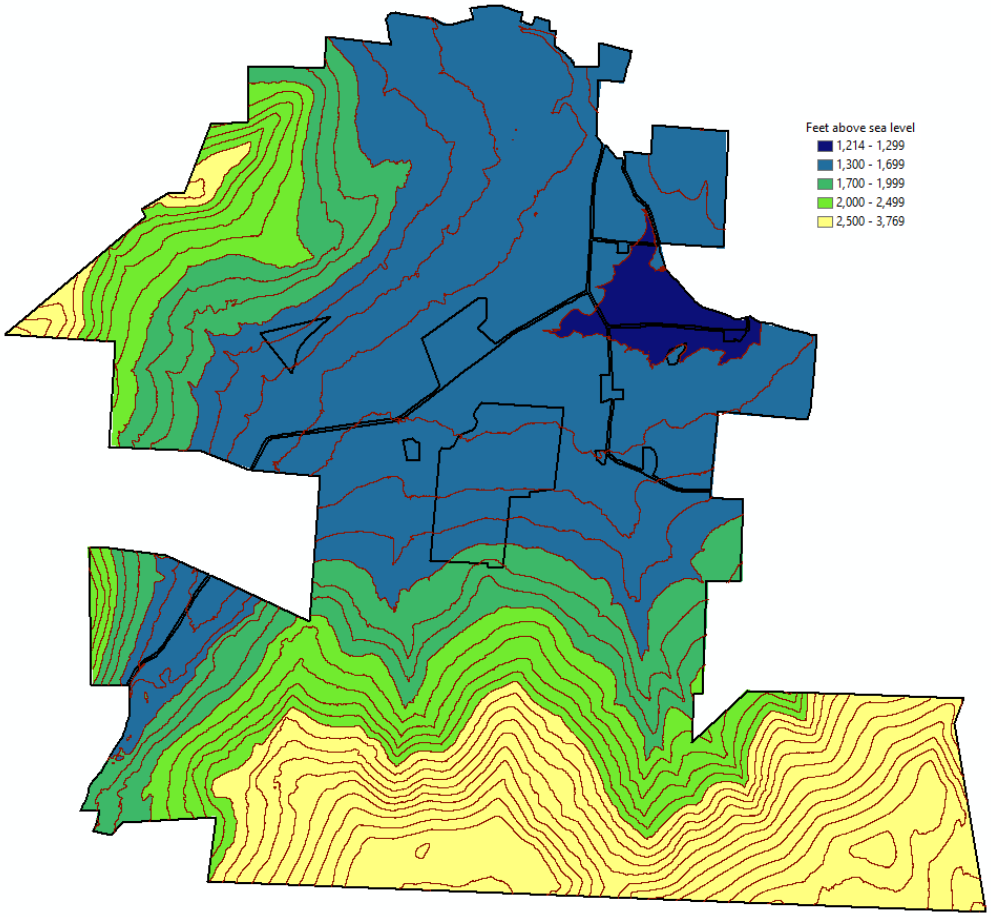


Figure 1. Topography of SHC landscape

From rich lower forests to high montane conditions, SHC hosts a diversity of forest types and wildlife habitats: roughly 583 acres of diverse northern hardwood forests, containing, among other species, American beech, sugar maple, white ash, and black cherry trees; an additional 883 acres of enriched northern hardwood forests with exceptionally productive soils; 460 acres of softwood and mixed forests, containing hemlock and white pine at lower elevations; 1,534 acres of northern hardwoods mixed with red spruce and yellow birch at higher elevations; and finally, higher up the mountain, 417 acres of balsam fir and red spruce forests that are of particularly significant ecological value. The property also contains active and former sugarbush (183 acres), alder swamps (83 acres), and several seeps, ponds (the largest being a 2-acre body of water), vernal pools, and waterways, supporting amphibian and other animal life. About 1,018 acres of SHC land are over one mile away from a local road, and there are approximately 119 acres of open, idle land that is not used for agriculture and in some cases is being slowly and passively colonized by native plants. That the property contains the forested headwaters of Mill Brook, a tributary of Otter Creek, makes water protection an important management value for SHC, with implications for the wider region.

Over the years, SHC has sought to increase stand biodiversity, protect soils and water, provide public access, and respect and promote the natural succession of native species and the habitat they provide, in addition to supporting a rural way of life. For the next ten years, management will continue this trajectory, focusing on tree species diversity and structural diversity, and diverse wildlife habitat for generalist and niche species. This plan will describe the natural resources of the property, as well as detailing some of the

management history. While maintaining former stand delineations for ease of reference, this plan re-categorizes the property by natural communities, which can be considered as units for management. While the plan does not prescribe any specific management activities, it does make recommendations for management activities that could occur in the future, that would benefit healthy, resilient forests, and diverse wildlife habitat, should SHC choose to pursue them. These include, for example, recommendations to control invasive plants, primarily Japanese barberry, common buckthorn, and multiflora rose, or to regenerate American beech in certain areas of the property.

Ultimately, the aim is to shift the written goals for the property to better align with the conservation ethos that Smokey House Center already has. The next 10 years will hopefully move SHC further into the space it has already carved out, as an example of conservation forestry practices for landowners and nonprofits in the region, as well as a research, outdoor learning, and skills development space for students and young professionals.

Plan Overview

Grand List Landowner Name: Smokey House Center

Applicant organization: Smokey House Center

Phone: (802) 293-2300

Email: jesse@smokeyhouse.org

Contact person: Jesse Pyles, Executive Director

Location and Address: 426 Danby Mountain Rd, Danby, VT 05739 (Rutland County)

Acreage: Total land area is 4887.70 acres; total area to be enrolled in current use is 4,264.79 acres.

SPAN: 171-054-10957

Parcel ID: 984

Orthophoto(s): 451089, 451091, 451093, 453089, 453091, 453093, 453095, 455089, 455091, 455093, 455095, 456089, 456091, 456093, 456095, 458089 (2016).

Resource Inventory Assessment and Process:

The fellows conducted desk research through aerial imagery, online soil survey, online hydrology maps, topography maps, Vermont Natural Resources Atlas, Vermont BioFinder and other geospatial resources to understand the biophysical properties of the site within the context of its surrounding region. The fellows also corresponded with local experts to better ascertain some of SHC's unique resources and prepare for two 3-day field visits to the property, which took place in April and May of 2021. During field visits, fellows walked through nearly every stand on the property making qualitative observations on the current state of the forest, with the help of executive director Jesse Pyles and consulting forester Steve Handfield. Geospatial as well as ground-truthed qualitative observations were used to categorize the landscape into units for management, based on natural communities, unique site features such as waterways and topography, and land use history. Further desk research was conducted to come up with possible future management recommendations suited to the management units.

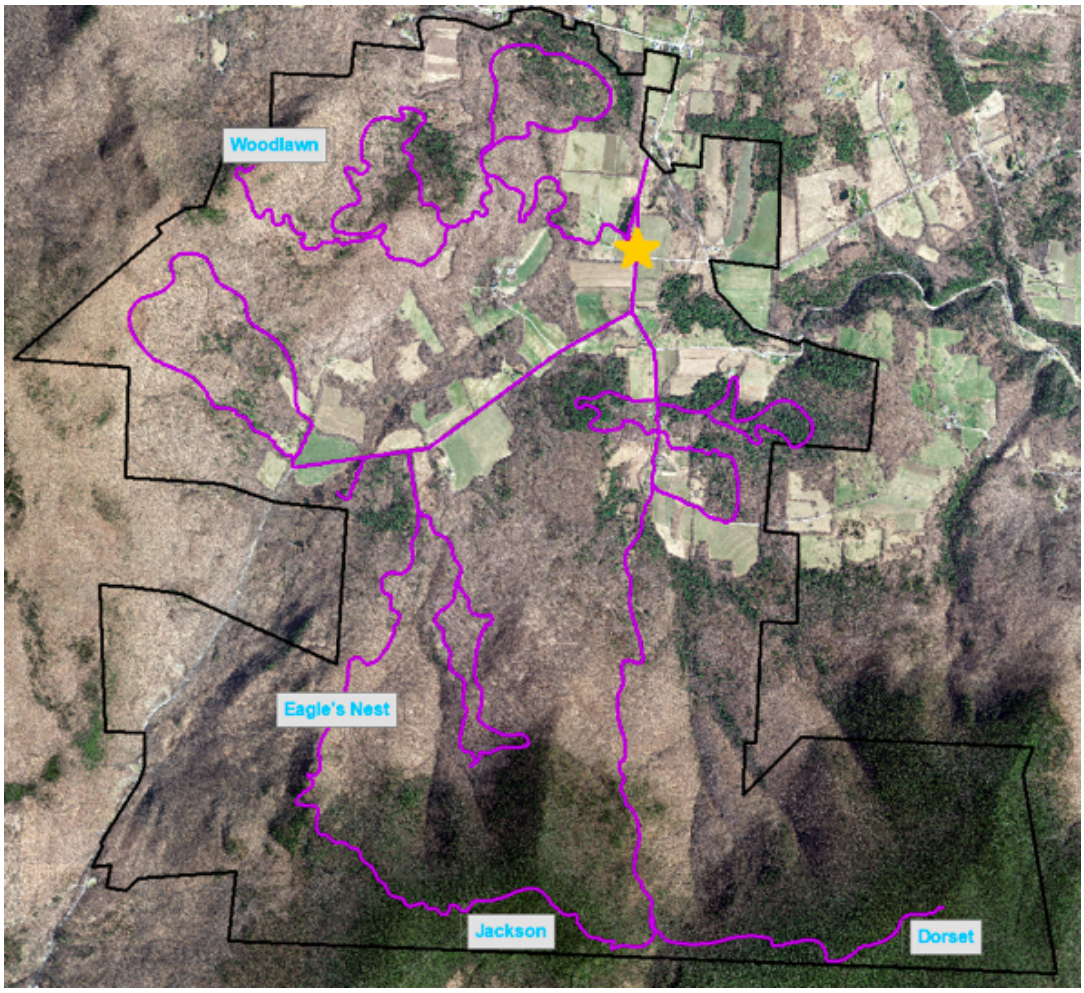


Figure 2. Routes walked throughout the forest in April and May of 2021 to inform site descriptions.

This conservation management plan supersedes the forest management plan completed by Curtis Rand and Steve Handfield in October 2012, but also draws on information from that plan. The new plan will be valid from 2021–2031. This plan is a guide to the current condition of the forest and makes recommendations for management activities in the upcoming planning period, although none are scheduled.

Document Objective

In 2012 SHC was enrolled in Vermont's Use Value Appraisal program as "productive forestland." This designation requires that timber management be one of the goals for the property. Timber management has occurred on the property but it is not the main priority of the center. Instead, the focus of the stewardship has been, and will continue to be, ecosystem conservation and education. With a history of being a conservation-focused non-profit, SHC is switching from the "productive forestland category" to the "conservation" category. This allows SHC to forgo timber management if desired, to still engage in sustainable timber management if desired, and to receive the tax benefits of the program. SHC is a 501(c)3 that has been approved as a qualified organization through Form PVR-321, with its parcels certified for enrollment through Form PVR-322.

Management Goals

SHC seeks to continue promoting ecological diversity, wildlife habitat, resilient forests, soil productivity, rural livelihoods such as farming and forestry, aesthetics, appropriate recreation, and educational

opportunities. Smokey House board and staff, as well as the authors of this plan, recognize the interconnectedness of conservation values related to wildlife, forest health and vigor, water quality and climate change adaptation. Improving the structural diversity of the forests and releasing healthy trees through silviculture techniques emerged as a significant strategy for meeting many of the wildlife and forest resiliency goals, however it should also be noted that passive management is an acceptable and appropriate approach for many areas of the forest. Core to the goals for SHC are maintaining forest connectivity both on the property and in the broader landscape through river systems, riparian forest corridors, and large interconnected habitat blocks of interior forest as a focus. Monitoring for invasive species and forest pests will allow SHC to respond quickly to these threats and take actions to support native plant species.

In terms of public outreach, SHC currently prioritizes youth education in conservation and farming. While this will continue to be a core goal, another goal is to expand public engagement to include fellow conservation organizations and land managers. In the making of this plan, many conservation professionals commented on the significance of the Smokey House Forests' scale for conservation and for research. With the right programming, management practices, and interpretation, SHC could become a resource for those in the region seeking to learn about and conserve forest lands.

Recommendations Overview

While this plan does not prescribe any specific management actions, throughout the plan we discuss strategies that SHC could consider to increase the value of its forests for wildlife, improve structural and species diversity, and help make the forests more resilient to future stress. These are summarized in a table at the end of the plan.

Protect and promote wildlife habitat:

- Create and maintain buffers around streams, rivers, vernal pools and seeps
- When harvesting, maintain *at least* 6 snags or tree cavities per acre, and consult with a forester on leaving slash and brush piles of tree crowns, branches, and limbs where appropriate for wildlife habitat
- Create 5 to 20 acre patches of young, early successional forest habitat where appropriate (maintaining about 5 percent of the forest in young forest <15 years of age)
- Designate areas to become old growth forests (can be passively managed or actively managed to develop the characteristics and functions of old forests)

Promote forest health, vigor, and resilience

- Control invasive species
- Monitor for hemlock wooly adelgid, emerald ash borer, and other pests
- Manage the forest as a complex distribution of even-, uneven-, and all- aged stands. Work with a forester to create forest edges, diversity of forest successional stages, and diversity of tree species, light tolerances, and tree age distributions across the property. Potential methods, depending on local site conditions, include variable density thinnings, irregular shelterwoods, crown thinnings, and more.

Conserve Plant Species of Concern

- Regenerate beech and promote beechnut mast, favor mature healthy beech where they exist

- Restore and promote butternut

Protect Soils and Unique High-Elevation Areas

- Limit harvest above 2,500 feet in Montane Spruce-Fir forests
- Install camera traps in Montane Spruce-Fir areas to monitor for wildlife and better understand the ecological value of these areas

Describing the Property

Landscape Setting / Biophysical Region:

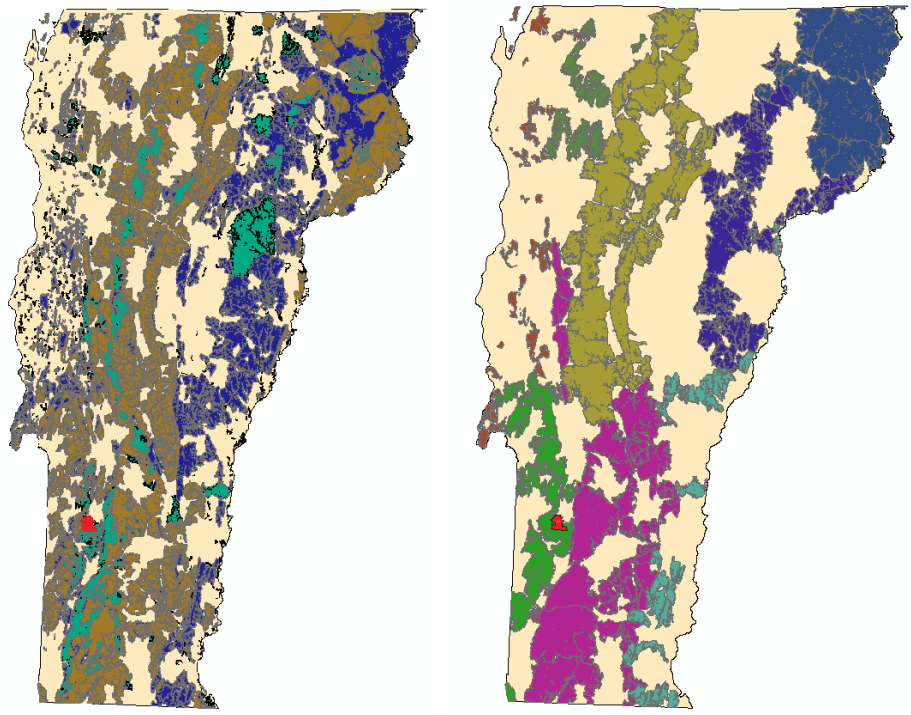


Figure 3. Maps showing the various high priority landscapes of which SHC (in a red polygon on each map) is an important part.

SHC is located in a unique position relative to the surrounding landscape within Vermont. It is roughly in the middle of the **Taconic Mountain** range, but also practically adjacent to the southern **Green Mountains**. As part of the eastern Taconic Mountains, it contains rich limestone and marble slopes. It shares some of the Green Mountain range's ecological features, like high elevation spruce-fir forest, while being on the other side of US Route 7, which is an important consideration for wildlife connectivity.

As defined by Vermont's Conservation Design (VCD) project for Ecologically Functional Landscapes, SHC is mostly within a "rare" physical landscape diversity block (shown in teal on the left-hand map in Figure 3), with some bands of calcareous bedrock (dark blue) which are in the priority "responsibility" category given their regional importance in the state. SHC's forestland is also part of two VCD Highest Priority connectivity "interior forest" blocks, shown above in the right-hand map in Figure 3 (green being the Taconic Mountains region, and purple being the southern Green Mountains), and the high-elevation spruce-fir forests in particular are among the highest priority natural community and habitat features (not

shown in maps in Figure 3).[1] Along the southern property boundary, which generally follows the Rutland-Bennington county divide, SHC neighbors a section of Green Mountain National Forest delineated as "remote backcountry forest" as part of the Dorset-Peru Integrated Resource Project.

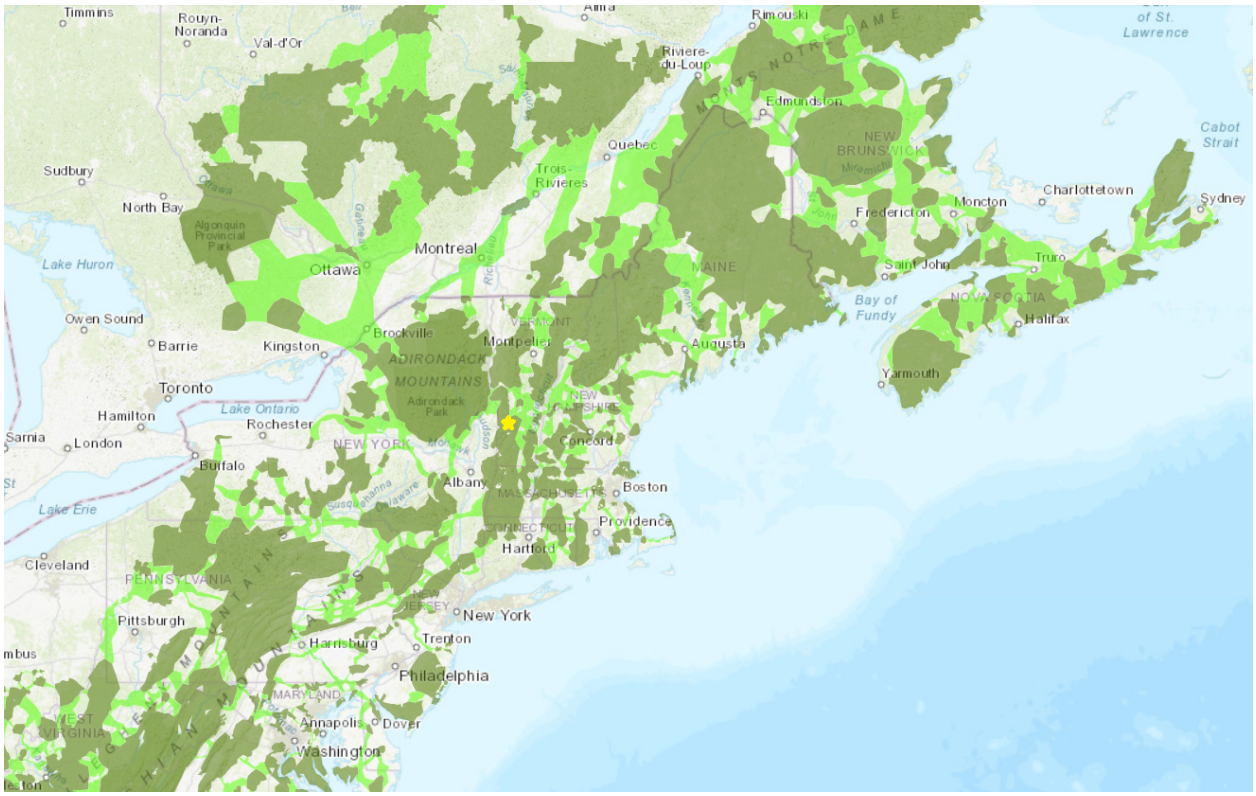


Figure 4. The Eastern Wildway connectivity matrix.

At a broader scale, SHC lies within an important section of the **Eastern Wildway**, a connectivity matrix identified by the Wildlands Network. This segment of the Taconic and Green Mountains is one of the few "potential core habitat areas" (in dark green on Figure 4) that runs north-south between the Adirondacks and Acadian forests of the far northeast to connect (via potential habitat corridors in light green on Figure 4) with blocks of forest in Connecticut, New York, and New Jersey onwards to the Appalachians.

Another consideration of SHC's regional importance is the fact that only 3% of Vermont's forests are over 2,500 feet in elevation. These islands of high-elevation forest are naturally vulnerable ecosystems (due to frost and wind), and further stressed by decades of atmospheric deposition from acid rain (now less of an ongoing issue, but impacts are still being felt). SHC's peaks will likely serve as refugia for plants and wildlife in the years to come, as climate change shifts species' ranges upslope.

Human and Management History

[1] Vermont Conservation Design: Maintaining and Enhancing an Ecologically Functional Landscape. Summary Report for Landscapes, Natural Communities, Habitats, and Species. Vermont Fish and Wildlife Department, Vermont Department of Forests, Parks, and Recreation, and Vermont Land Trust.

Native Land and Indigenous Forest Management

SHC forests sit at a point where Mohican, Abenaki, and Wabanaki (Dawnland Confederacy) territories overlap, however, as shown in Figure 5, there are many other tribes who have shared and continue to share the greater landscape.

Before colonization, for thousands of years, these groups sustained themselves from the land, living in settlements as well as moving seasonally through the region. Archaeological evidence points to heavy use of some of the more fertile valleys near lakes and waterways by Native peoples since they first arrived in the area, but their impact on the landscape would have been minimal compared with that of European colonizers who arrived in the 18th century (Thompson and Sorenson 2000). Through the process of colonization, Native peoples were violently dispossessed of their lands. Settlers stole land from Native nations through genocide and war, by talking advantage of cultural differences in relationships to land, and by instituting policies like federal guardianships and land allotments. During the 20th century, the state of Vermont targeted Native people through a forced sterilization program (VPR, 2016).

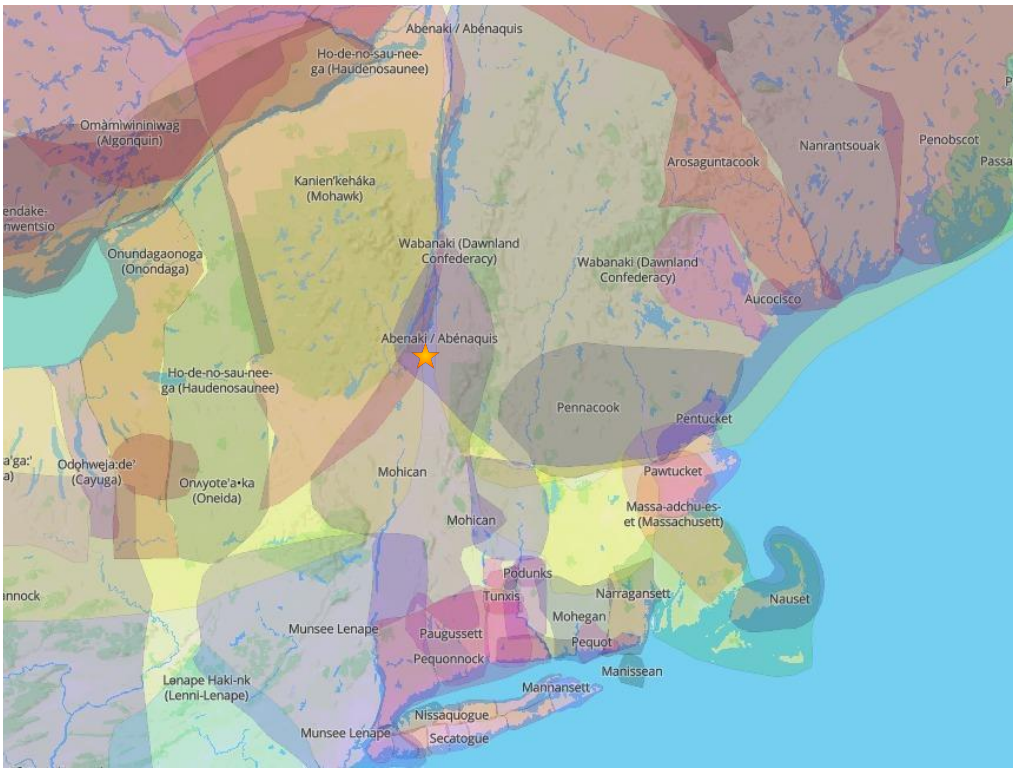


Figure 5. A map of Native territories in New England, from Native-Land.ca. Native Land draws on maps from a variety of sources, prioritizing Native nations' current delineations of their unceded territories. Star marks Danby, VT. Source: Native-Land.ca, run by Native Land Digital.

Today, Native peoples maintain a presence in Vermont, as they have throughout time, and settler colonialism continues to impact their lives. Four Abenaki tribes were legally recognized by the state in 2011 and 2012 (Elnu Tribe, Koasek Tribe, Missisquoi Tribe and Nulhegan Tribe). Displaced Native peoples also describe maintaining strong connections to their original homelands in New England, even when they live in other parts of the country and in Canada. To build relationships and enter into any process of land return, the Smokey House Center would need to seek the guidance and leadership of the tribes. As one suggestion of a pre-established resource, the Abenaki Cultural Use Land Access Project is a collaboration

between Vermont Family Forests (VFF) and Middlebury College students that is exploring a process for granting Abenaki tribal citizens permission to access private forestland in Vermont for cultural use, such as hunting and harvesting plants. SHC can learn more about the process of establishing a cultural use agreement on VFF's website.[2]

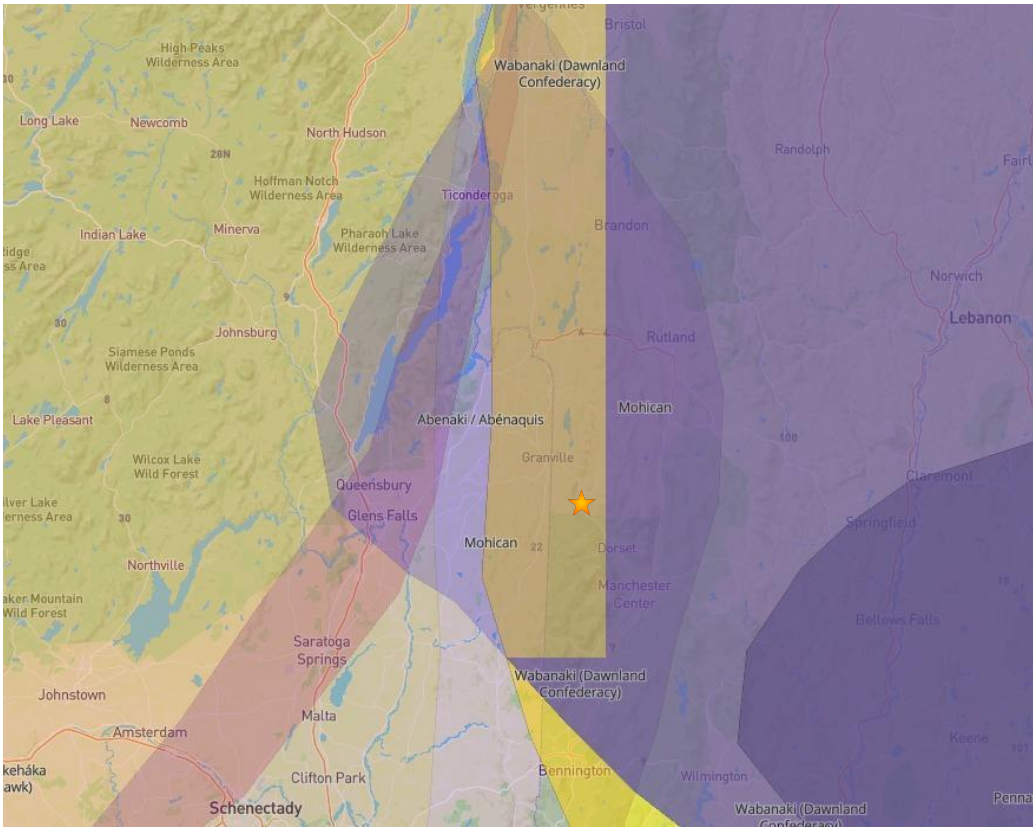


Figure 6. A close-up map of the Native land claims to Danby and the surrounding area. Star marks Danby, VT. Source: Native-Land.ca, run by Native Land Digital.

Colonization, Agriculture and Land Abandonment

European settlers dramatically changed land use when they arrived, with drastically different patterns of cultivation, habitation and resource extraction. In 1750, when only a few European trappers had entered what is now known as Vermont, the state was probably 95% forested. In the late 1700s European colonizers started arriving in more significant numbers and clearing the forests for timber and agriculture. By 1850 nearly three quarters of the state was cleared and soil erosion had become a problem (Thompson and Sorenson, 2000). Sheep grazed across the landscape and Vermont had become one of the world's largest exporters of wool. Eventually dairy farming would replace sheep.

When the Currier family began to acquire parcels in the late 1950s which would eventually become consolidated into SHC, this area of Danby—like much of Vermont—had already seen dramatic cycles of land-use change caused by forest clearing in prior centuries for cropland, livestock pasture, and timber extraction. Land was often "abandoned" in the mid-1800s as sheep farming became less profitable due to expanding sheep production in other parts of the world. Colonists also moved west to seek more fertile

[2] https://familyforests.org/mutually-beneficial-relationship-in-action-vffs-abenaki-cultural-use-land-access-project/

soils, or followed the industrial opportunities of urban areas. By the 1950s, dairy farming was already losing profitability for small farmers due to aggregation and vertical integration by larger companies, among other factors. By 1980, only 21 percent of the land that had once been cleared remained open (Thompson and Sorenson, 2000).

Much of the land no longer used for livestock and agriculture became forest again through a process dubbed **"old field pine succession,"** illustrated in Figure 7 below. White pines are some of the early colonizing species, but there are others, such as bigtooth and quaking aspen, white birch, and black cherry and pin cherry, which benefit from high sunlight conditions; sugar maple and red oak can also establish themselves here but are slower-growing. At each stage of succession, the plant community alters the soil and microclimate thus facilitating the establishment of the next group of plant species. In the SHC Northern Hardwood Forests, white ash and sometimes oak will come in with the **early successiona**l species, and eventually American beech and sugar maple will grow to become the dominant canopy species, until there is a new disturbance, like a fire, or another forest clearing. At SHC, most of the hardwood forests have already been through these stages over decades, and are in some form of mature second growth where white pine has dropped out of the canopy long ago, both through natural succession and through human selection of sugar maple as the preferred dominant canopy tree.

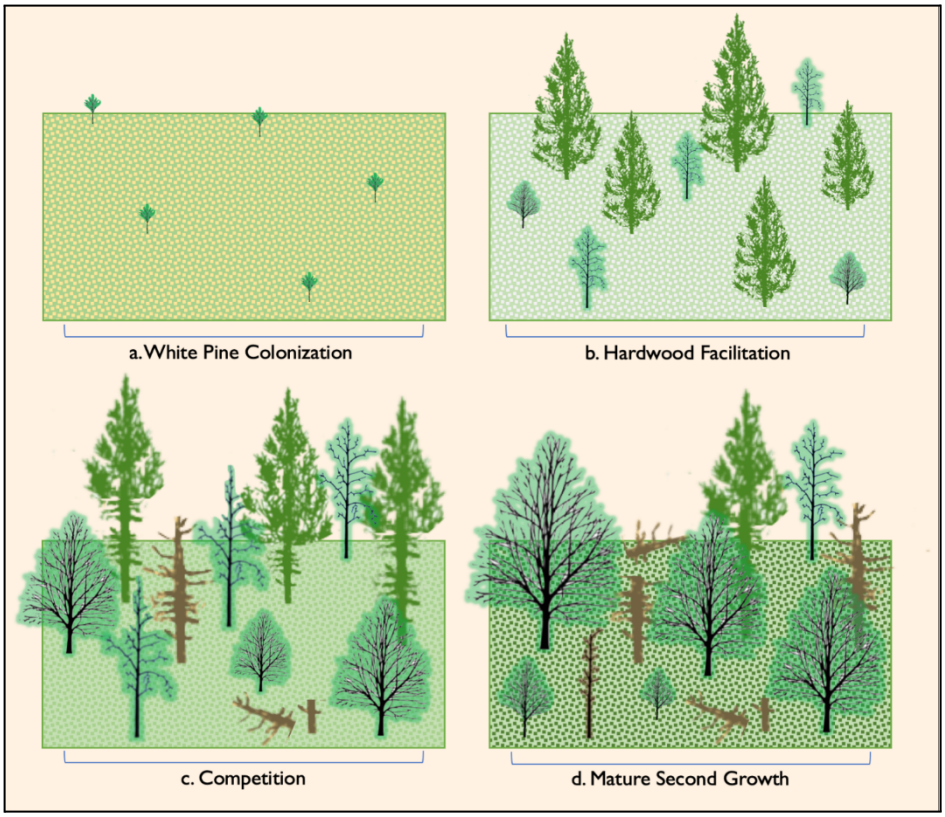


Figure 7. A diagram depicting secondary succession. A disturbance to a forest could be a fire or, more commonly in the case of Vermont, forest clearing for agriculture and livestock. Plant species begin to grow in and in each stage, the plant community creates the conditions for new successional species to grow. Box b would include early successional species like white pine, aspen, and cherry, box d would include more shade tolerant, late successional hardwoods like American beech and sugar maple. *Source: Seth Inman, drawing from* The Practice of Silviculture *by Ashton and Kelty.*

Aerial Imagery: Land Use History and Succession

The old stone walls that cross much of SHC's property are evidence of the old fields and pasture delineations that have since become forest; aerial imagery also helps tell the story of agricultural abandonment in a more modern era. Georeferenced 1942 aerial imagery, while not taken at the right time of year to differentiate between coniferous and deciduous vegetation, is a helpful reference for historical extents of forest cover across the parts of Danby that would later become SHC land. In the two decades until the next available aerial imagery (1962), there is evidence that agricultural areas were abandoned, and recolonized by native vegetation. Stands in the center and northeast of SHC show some of the recolonization of old fields by white pine, which can be seen spreading between 1942 and 1962, and which still have pine canopies today. There are also some areas, like a patch just north of the Currier tract, which was colonized in the last two decades by pioneer hardwoods instead of white pine. More recent aerial images can be viewed in Appendix A.

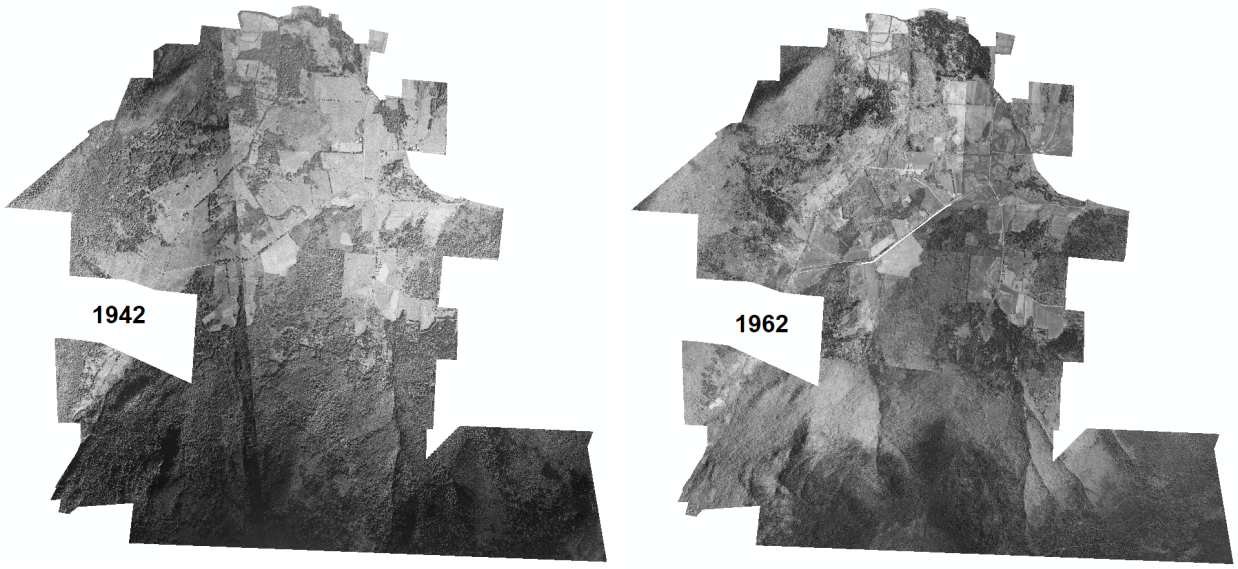


Figure 8. Aerial photograph mosaics of 1942 and 1962 imagery. Stitching and projection methods are imperfect and result in some mistakes.

Logging History

When the Curriers started accumulating land in the 1950s, they bought up over 35 individual farms that all had their own histories of sheep farming and timber harvest, which in many cases included high grading, a practice of cutting all of the most valuable, large diameter timber from a stand. High grading creates problems for future forest regeneration by removing seed tree sources. It also limits structural and species diversity, impacting flora and fauna, as trees of the largest size classes are often critical habitat for animals, help other trees establish, and can take decades to replace.

Since the time of the Curriers, stewardship goals for the property have included the prevention of subdivision and development, and providing support to rural economies, including through timber production. A 1994 draft document making the case for a Smokey House Forest Reserve states that, as with forests across the nation, "heavy cutting and high grading in Vermont forests has often resulted in lower quality stands. Smokey House is fortunate because, despite the high quotas of our current use plan, we stopped cutting when we saw the negative outcomes." In general, forest management at Smokey House has been interested in exploring the question of sustainable use, and incorporating non-commodity forest values into management. Still, up through the 1970s and 1980s, some heavy selection cutting and high

grading was done on the property, with old growth forests being cut in some of the stands, and trees being harvested at high elevation and on steep slopes. Beginning around the 1990s and 2000s, Smokey House forest management cleaned up some high graded areas across the property, through practices such as removing the overstory of a two-age stand and allowing it to grow in as a more diverse, uneven age stand, and moving from a sequential unit based cutting approach to an approach that maintained more consistent diversity of stand ages and structures throughout the property.

Board Survey Results:

To inform this conservation plan, a survey on conservation values was sent to the Smokey House board (see Appendix E for survey questions), followed by a group discussion of the survey topics. In the survey, board members prioritized values like wildlife habitat protection and connectivity, protecting ecologically sensitive areas that are unique or rare, youth outreach and education, water quality and watershed protection, carbon storage, aesthetics, forest research, and recreation. Overall, most board members viewed the conservation goals of the Smokey House Center as multi-pronged and mutually reinforcing, with no one goal clearly superseding all the rest. They also viewed forest conservation as compatible with Smokey House's long tradition of maintaining working forests, so long as timber harvests were planned not just to earn money, but to continue to support conservation, social, educational, as well as organizational goals.

We also had a discussion on the meaning of the term "re-wilding" and where it fits into Smokey House's forest management objectives. Most understood "re-wilding" to mean a hands-off approach to forest management. While board members thought that some areas of the forest, such as high mountain tops, might be suitable for this approach, most also felt that ongoing active management would still be appropriate in many areas of the forest as long as it was geared towards reaching conservation objectives of resilient, healthy, vigorous forests. State forester Keith Thompson pointed out that while people often associate the growth of old forests with a completely passive management approach, it is often the case that old forest function can be achieved in a faster, more meaningful time frame through active management that makes sure to set the forest on a path to diverse, uneven-aged stands.

Lastly, we discussed the relationship of forests and forest conservation with the educational mission of Smokey House. As a large block of undeveloped land, SHC holds significant educational potential. While in-person youth education is core to the mission of Smokey House, many pointed to the potential to explore other types of outreach and education, with land managers, conservation professionals, researchers, and other landowners, through initiatives that might go beyond on-site, in-person instruction.

Recreation and Access:

There are several marked trails on SHC property, in varying stages of maintenance. One is near the beaver pond and in places has succumbed to changes in the hydrology; another loops around the Currier tract (triangular exclusion in the 2016 orthoimagery above); a lookout point trail at Eagle's Nest in the southeast of the property takes advantage of the rocky outcrops above the gravel pits; and a trail leads along the ridge of Dorset to the peak. Many of these trails are connected to old roads (including logging or skid roads), making accessibility fairly open for pedestrians as well as snowmobilers in the winter (who have permission to lightly maintain a club trail) and unwanted all-terrain four-wheelers in the summer (who are not encouraged to use SHC land for recreation given noise and erosion concerns). Hikers also access Dorset Peak from the south, coming from Bennington County and entering SHC land near the summit. This land neighboring SHC to the south is part of Green Mountain National Forest, which approved

official trail improvements to the non-forest service trails to Dorset Peak in 2013. While it is unknown if these Dorset Peru Integrated Resource Project actions were taken, it seems that foot traffic to the peak is existent, but not high intensity. There did appear to be some rutting damage to part of the trail within the spruce-fir forest, caused by unauthorized ATV use in wet conditions. Responsible hunting and some trapping is allowed on SHC property, including in a few condoned tree stands and to manage beaver populations when necessary.

Site Description: Geology and Soils

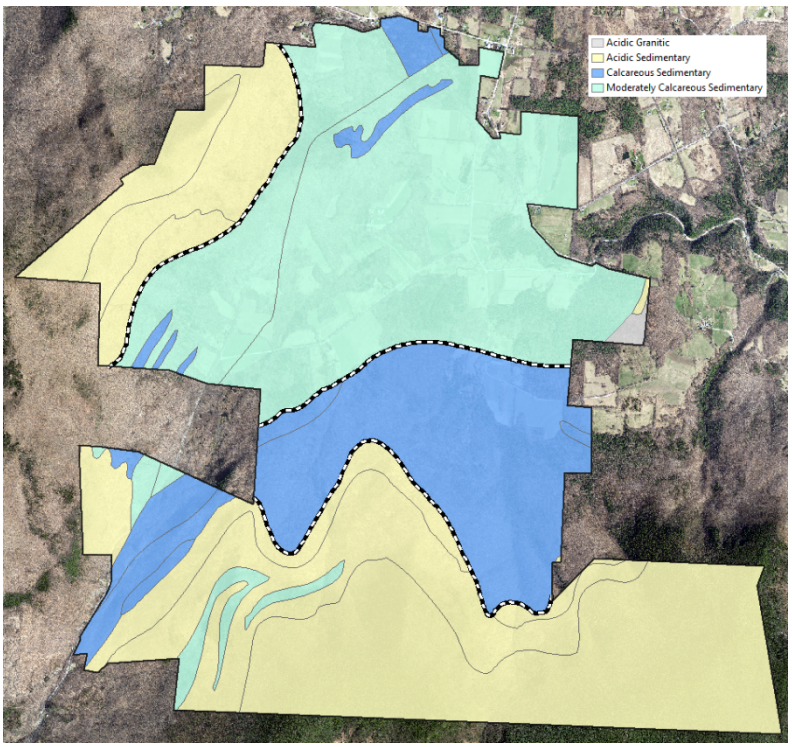


Figure . Adaptation of the 2011 Bedrock Geologic Map of Vermont, by Ratcliffe et al. for USGS.

Bedrock: SHC lies atop three main bedrock zones, defined by the Netop Formation of Dorset Mountain in the south, the Bascom and Walloomsac Formations in the middle and north, and the West Castleton Formation with Mettawee slate facies in the northwest on Woodlawn. The majority of the property's bedrock is **dolomitic limestone and quartzite**, with basal limestone and phyllite that includes shale and slate. Three fault lines run across the land; two of these are responsible for the Cambrian and Neoproterozoic mountains on either end of SHC, and the other bisects the property neatly in half, separating the Upper Ordovician formations in the north like Walloomsac and Ira (formerly identified as Hortonville in the 1960s maps) from the Middle and Lower Ordovician Bascom Formation in the south.[3] Bedrock geology is important as the bones of a landscape's topography, as well as the parent material for some soils. While glacial movement in New England deposited substrates that also influence soil formation, underlying bedrock weathers over a long timescale, yielding some of the soil conditions presently found in the SHC forests. At SHC, some of these soils are special in that they are rich in **calcium**, which arises from bedrock based in limestone, marble, and dolostone, among others. In certain forms, calcium is a mineral that enhances forest productivity by improving soil structure and enhancing plant health.

SHC's geology is also valuable for species that will likely undergo range shifts in the coming decades, as plants and animals follow the ecological niches they are most physiologically suited to. With the changing climate, flora and fauna globally are expected to move poleward, upslope to higher elevations, downslope to moister riparian areas, and locally toward microclimates (Anderson et al. 2016). By conserving a breadth of abiotic conditions, species have a higher probability of persisting in the face of a changing climate (Anderson & Ferree 2010). According to Anderson and Ferree, four geophysical factors drive species

[3] As a reminder of geological eras, their relative age from oldest to youngest is Neoproterozoic, Cambrian, and Lower, Middle and Upper Ordovician.

diversity in the northeastern region of the United States and in maritime Canada: 1) the number of geological classes, 2) latitude, 3) elevation range, and 4) amount of calcareous bedrock. Conservation of a broad array of abiotic conditions will provide the diversity of environments needed to support current and future biodiversity, even if the species composition and climates in those regions change (Ackerly et al. 2010, Beier & Brost 2010).

As seen in Figure 10, SHC contains three main types of bedrock (Acidic Sedimentary, Calcareous Sedimentary, and Moderately Calcareous Sedimentary, each with their own metamorphic equivalents) as well as a tiny area of a fourth type (Acidic Granitic). SHC also enjoys a relatively broad elevation range (about 2,550 feet), and enough calcareous bedrock to make an impact on forest richness in certain spots. Using Anderson and Ferree's 2010 theory of "conserving the stage," SHC has the right conditions to protect future biodiversity under climate change.

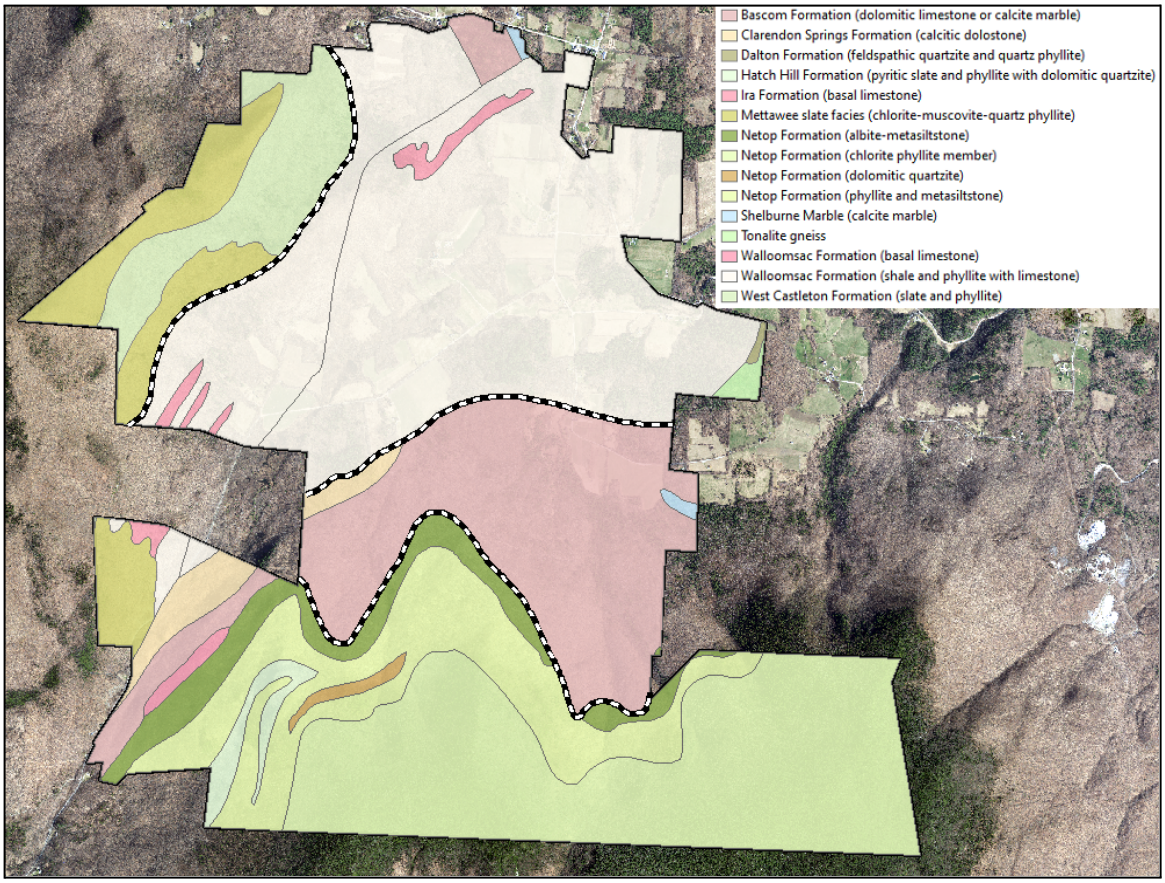


Figure 10. Bedrock Classification, summarizing formations in Figure 9 into categories drawn from Anderson and Ferree (2010).

Surficial Geology: SHC's surficial geology is a bit more homogenous, being mostly comprised of glacial till deposited on the northern and southern ends of the property, running down into the lowest/flattest elevations and center of the property where outwash and fluvial gravel are concentrated (these also generally coincide with prime agricultural soils, a fact reflected in past and current land use at SHC).

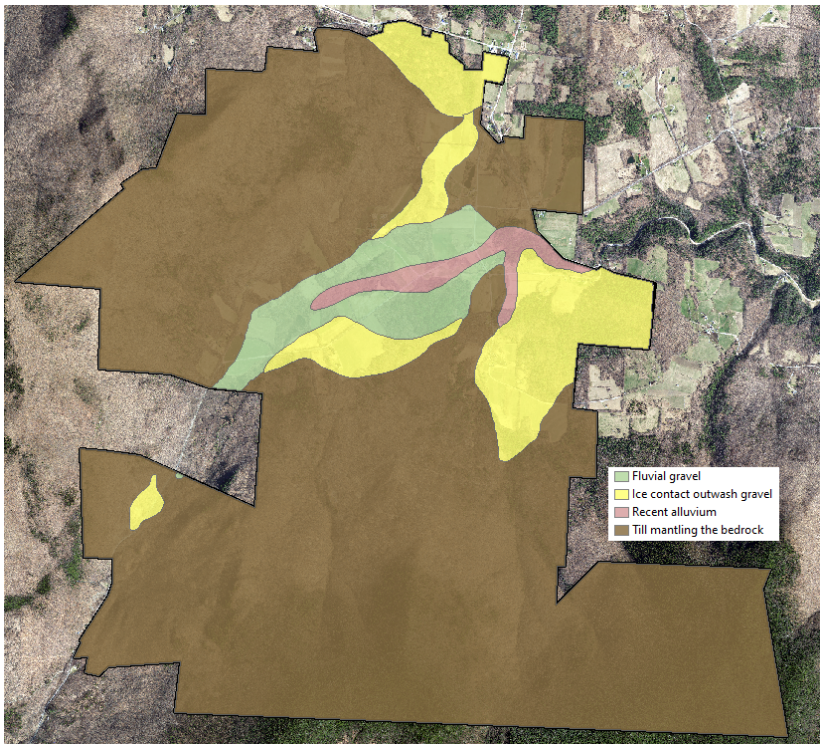


Figure 11. Surficial geography categorizations.

Soils: With around thirty different soil types at SHC, plus different gradations of slope and rockiness within those, trying to understand that level of heterogeneity across five thousand acres can be tricky (see Appendix B for map with all the different soil complexes on the property).

Lumping these soil complexes can risk overly oversimplifying the landscape, given that most of the land is glacial till. The specificity of NRCS soil parent material descriptions helps move toward a system of breaking the property into zones, while highlighting some of the sites that stand out relative to the rest of the property. For example, in Figure 12 below, we can note the broad swaths of spodic glacial till associated with the mountain slopes of the north and south, which are generally more acidic, and often associated with conifers, given that they are not the most fertile (although they are responsive to management). In the middle of the property, high base saturation glacial till results from calcareous bedrock, and cation exchange from calcium enrichment increases vegetation productivity. This central region of ordinary to rich glacial till (i.e. Glacial Till and Glacial Till with high base saturation) is interlaced with bands and pockets of gravelly outwash, organic deposits, and alluvial soils that are highly productive, but in some spots limited by poor drainage and excessively wet conditions. The two lone soil units with dense till parent material are in the central-east of the property, where fine sandy loam rests atop humps of hardpan densely packed by glacial movement.

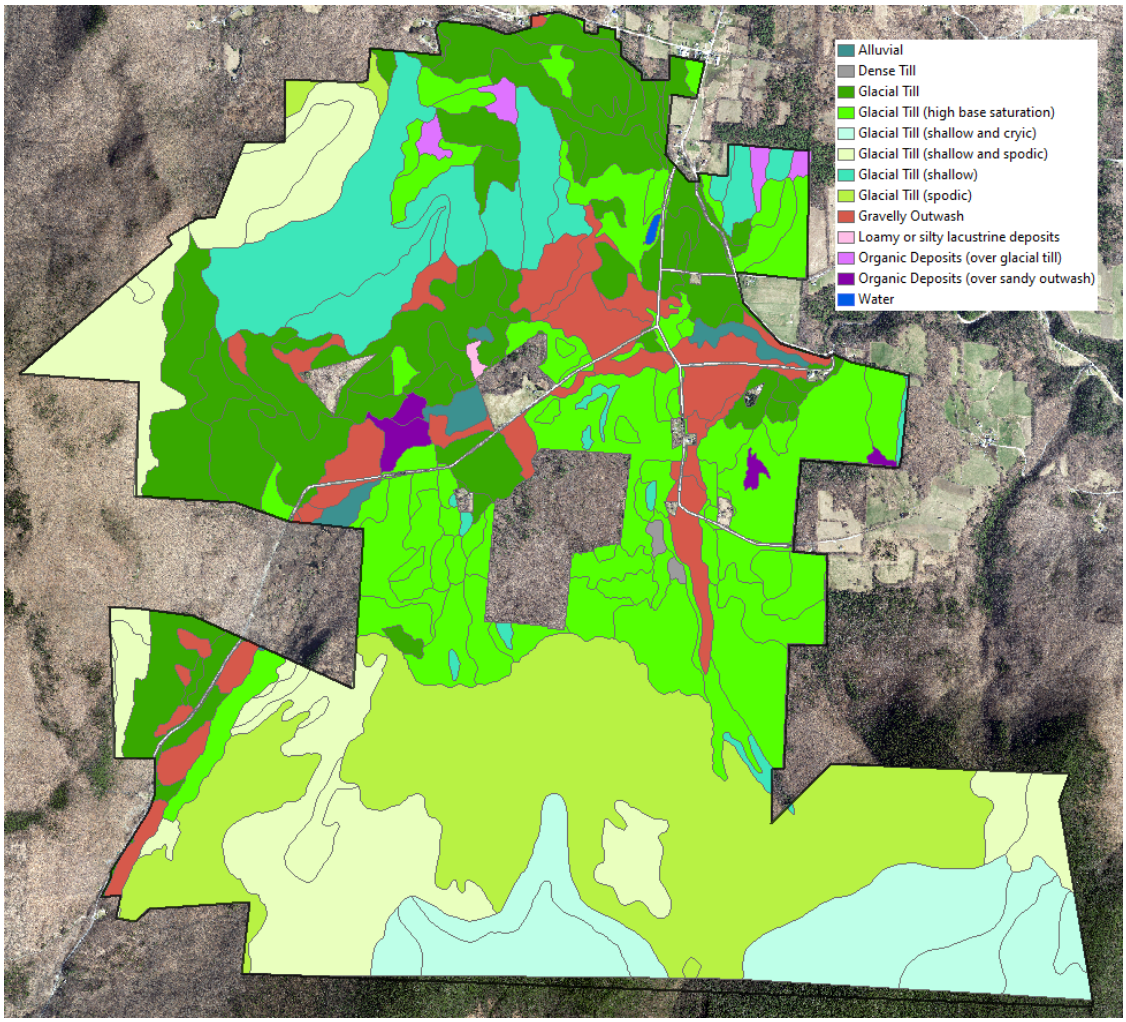


Figure 12. Soils categorized by parent material.

Soils by Forest Value: In the late 1990s and early 2000s, the NRCS developed a methodology for calculating forest value according to soil series, which could serve as a sort of proxy for timber harvestability. In Vermont, sugar maple site index was used as a site indicator for northern hardwoods (see Appendix C for map of SHC soils categorized by sugar maple site index values), and a soil potential index was created using factors such as drainage, erodibility, rockiness, and slope to estimate costs associated with commercial harvesting on a particular soil map unit. Figure 13 below shows the result of this work. It is important to remember that this is a 2003 product that makes certain assumptions that do not always apply to SHC, like having even-aged stands or needing to install skid roads everywhere. (This map also does not reflect current land-use considerations, like the fact that many high-value areas are presently under agriculture). Nonetheless, this map may be useful for approximating areas of high soil productivity for planning harvests.

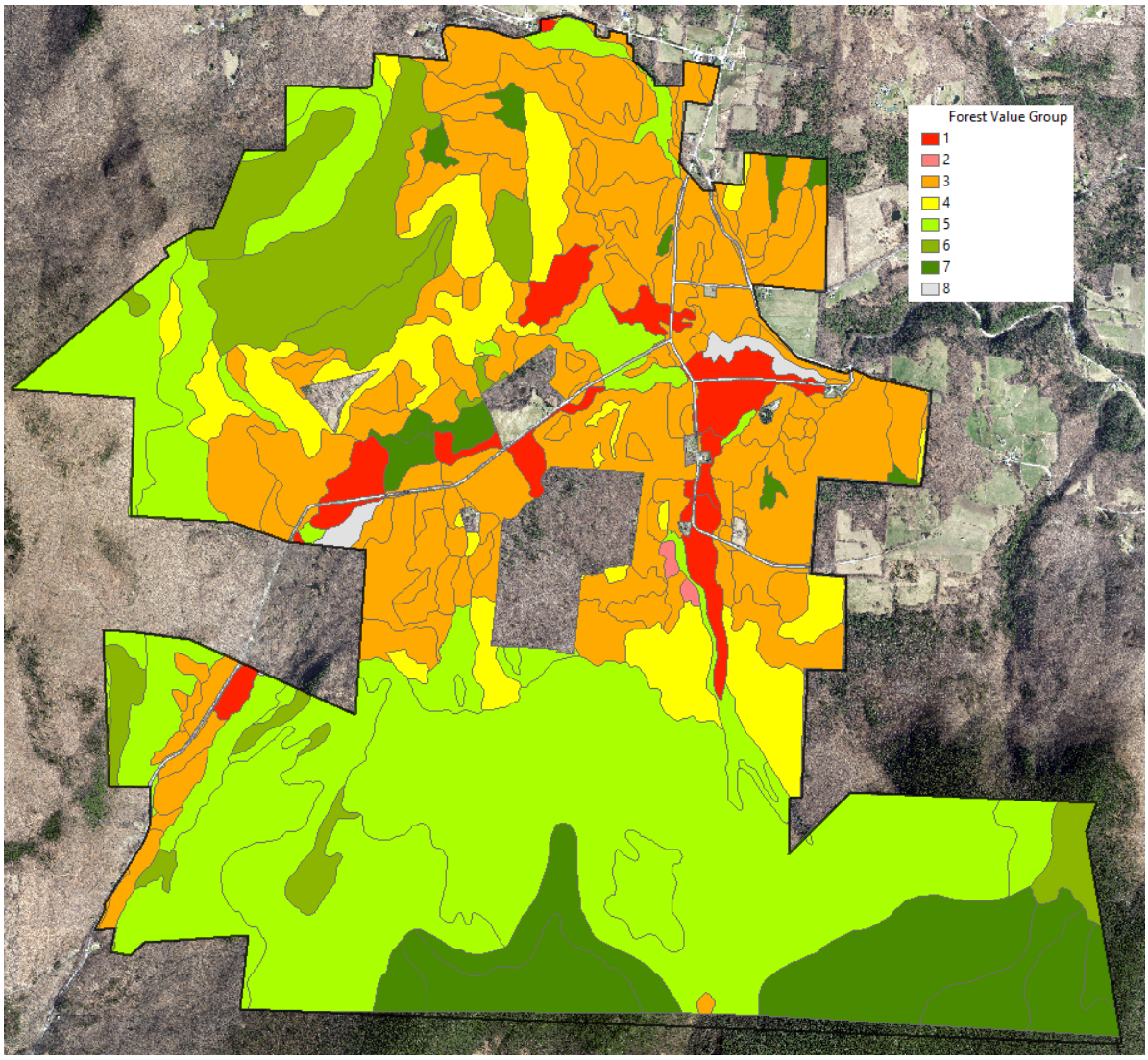


Figure 13. Soils categorized by forest value group, with 1 being the highest value for commercial timber harvest and 8 being the lowest, equivalent to no value

Site Description: Topography, Aspect, and Hydrology

SHC has a relatively diverse topography, resulting in an equally diverse arrangement of aspects (positions facing a particular direction). The bulk of the property faces north or northwest. The map in Figure 14 below shows different slope aspects and offers a perspective on potential growing conditions and microclimates across the landscape. South-facing aspects in North America receive more sunlight during the day, which generally enhances productivity, but soil can also dry out faster, especially on convex slopes. There are few purely southern aspects on SHC property, but plenty of southeastern aspects in the north-central region. It is therefore not surprising that most of SHC's red oaks are found along this band of southeast-facing slopes (see Appendix D). Much of the bottom slopes of southeastern aspect hillsides are taken up by agricultural land. North-facing aspects tend to be cooler than south-facing ones.

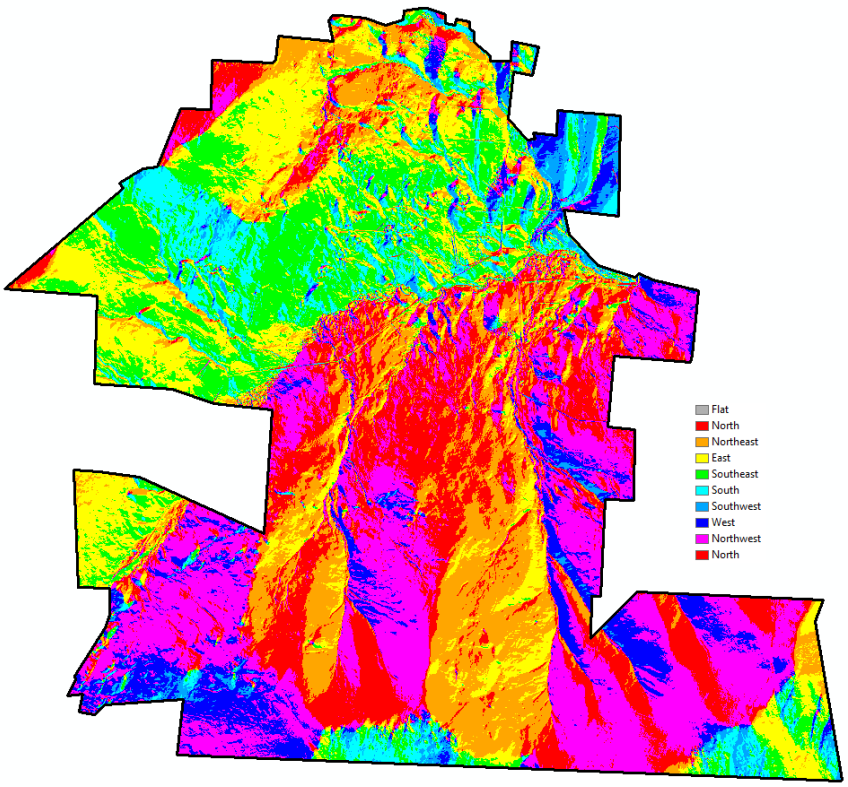


Figure 14. Aspects across SHC.

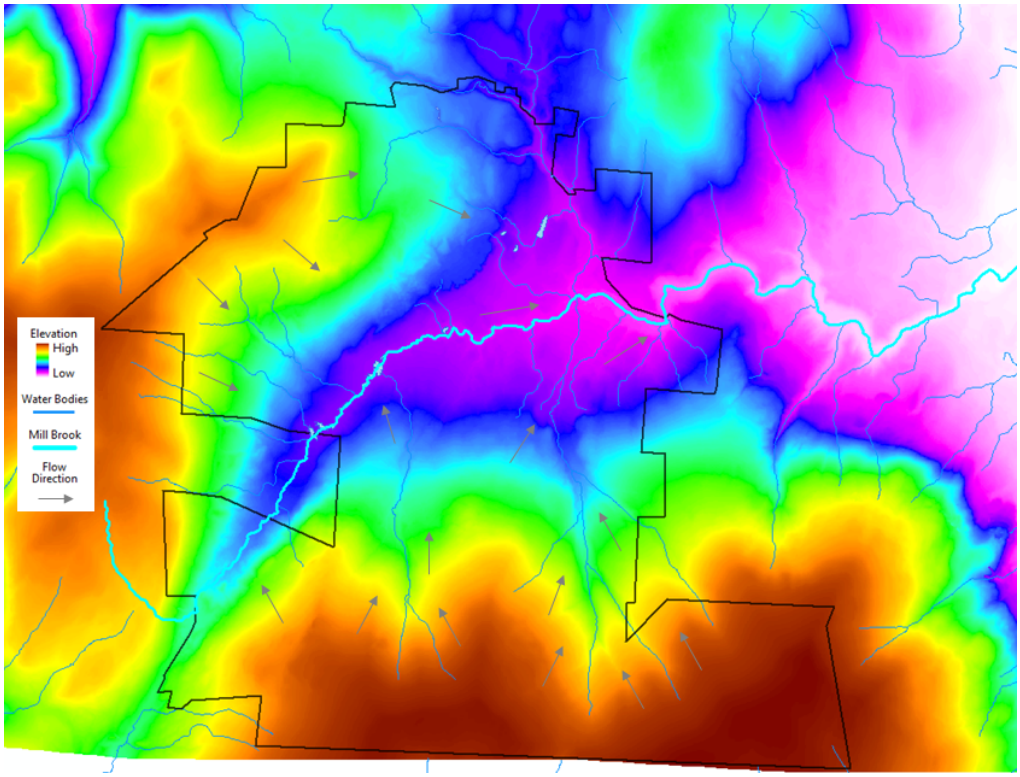
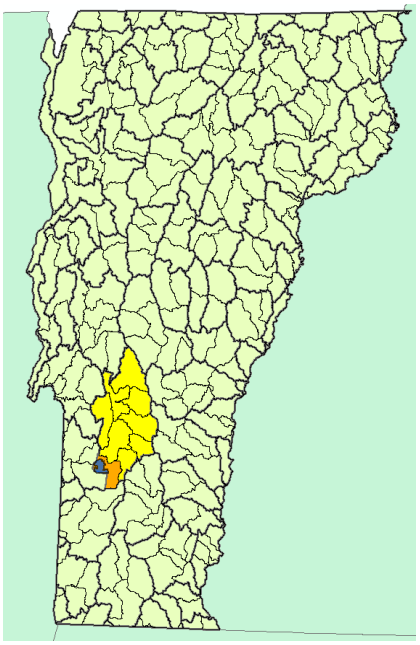


Figure 15. Hydrology at SHC, flowing out Mill Brook toward Otter Creek.



At the local scale, SHC forms part of the direct headwaters of Mill Brook, which flows west to east through the property, roughly bisecting it. In terms of official federal hydrologic units (the areas of the landscape that drains to a section of the local stream network), SHC is part of the Headwaters of Otter Creek (in orange and then in yellow in Figure 16, with SHC shown in blue).[4] Both the watershed and subwatershed are known as the Headwaters of Otter Creek, emphasizing the importance of SHC's mountains, and Mill Brook, in accumulating water that flows east and then north, eventually into Lake Champlain. SHC must steward these headwaters by continuing to buffer streams from erosion potential when harvesting nearby, and ensuring that agricultural activities use different inputs responsibly.

Fish and Wildlife Habitat and Rare, Threatened, or Endangered Species

The following section describes important forest and hydrological features that support wildlife in Vermont and on the Smokey House property, with some preliminary recommendations for how to improve and create habitat for a diversity of species. Further recommendations are detailed in the "SHC Forest Management Strategies and Recommendations" section of the plan.

General Forest Habitat Considerations: Soft mast, browse, vertical structure, coarse and fine woody material, snags, tree cavities, and early successional habitat are all important forest features that support animals. When promoting bird habitat, one of the main elements to consider is "**soft mast**", fleshy berries like partridgeberry, and other edible, dry fruits like samaras, the winged fruits of ash and maple, and other achenes. In addition to native trees and shrubs, many invasive species like autumn olive, multiflora rose, and Japanese barberry, while potentially harmful to forest health, do provide this type of soft mast. Mammals like chipmunks, deer, squirrels and bears also eat soft mast, though they prefer "**hard mast**", like oak acorns and beechnuts. Grosbeaks, turkeys and ruffled grouse also eat hard mast. Later in the plan, we discuss strategies to promote beechnut regeneration. Animals like deer, porcupine, and the rare New England Cottontail rabbit also feed on leafy and woody vegetation, or **browse**, of different heights, so it is important to promote a diversity of species to meet their diverse needs.

In general, a more diverse and **complex forest structure** will support a greater variety of species, by creating more fine-scale habitats within the forest. Structural complexity can refer to variation of size, age class, successional stage, and spacing of trees. As an example of how vertical complexity is beneficial to wildlife, we can look at how different bird species nest at different heights. Wood thrushes nest between 5 and 15 feet above the ground, other birds nest in short shrubs, and some nest right on the ground. For ground birds, having **coarse woody material** and **brush piles** on the forest floor is essential. Downed woody material also creates critical habitat for reptiles and amphibians, which take cover and feed on mushrooms and insects under fallen branches and bark. Mammals use branches and logs, as well as **tree cavities** in trunks and under roots and dense thickets of shrubs to make dens and hide from predators. And birds like the pileated woodpecker often require "**snags**", or standing dead trees, to nest in.

[4] As an interesting aside, the yellow watershed boundary for the Headwaters of Otter Creek in Figure 16 is the largest 10-digit hydrologic unit within Vermont. Otter Creek is the longest river contained solely within the state.

Wild turkeys, American woodcock, ruffed grouse, as well as many other species, rely on **early successional habitat**, which grows as an **even-aged forest** on recently cleared stands. When enough trees are removed across a large area, the result over the next several years is a swath of thick herbaceous ground cover, tree seedlings, and saplings growing without being overshadowed by a full forest canopy. This early successional habitat often has a much higher volume of foraging material available from the ground, and a diversity of food sources like raspberries and blueberries.

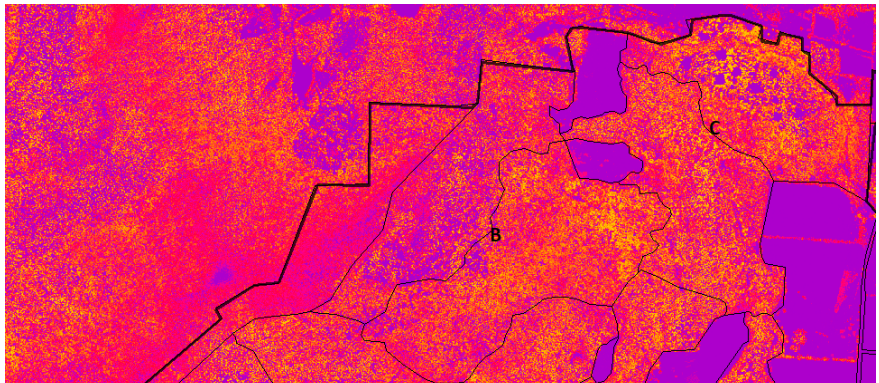
As the forest ages, individual trees or small gaps of trees die and are replaced by new trees, resulting in an **uneven-aged** forest. **Old forests,** over 100 years old, with high levels of downed woody material, cavity trees, and other features are particularly rare in Vermont. Old and young forests are both important to wildlife and can be produced through silvicultural techniques that mimic natural disturbances. Designating areas as preserves of old growth trees will add diversity to the forest while also providing key habitat to many animal species, encouraging a form of rewilding at SHC.

When juxtaposed against reserves of older trees, the area of forest that has undergone a harvest creates an edge of different habitat types. The edges between these forest communities provide especially high-quality habitat for wildlife, especially the American woodcock. Regeneration treatments that establish new cohorts of trees realize the dual benefits of diversifying age classes and creating**edge habitat**.

Active forest management can play a role in promoting all of these structural and other wildlife habitat elements, including mast, browse, structural diversity, coarse woody material, snags and cavity trees, early successional habitat, old forests, and edge habitats. Silviculture can regenerate the forest in a way that would mimic the structures created by natural disturbance (for example, in southern Vermont, about 5% of the forest would be young (<20 years), and later successional forests would contain a greater diversity of age classes). In the "SHC Forest Management Strategies and Recommendations" section of the plan we summarize possible actions that can be taken to create these features. At the end of this section we also include further resources for managing forests for wildlife.

Structural Diversity across the SHC Property: SHC enjoys great diversity and forest heterogeneity between stands, which is key to forest resilience. However even within certain forest blocks there can be a greater variety of forest ages and habitat types that promote resilience to future disturbance.

In Figure 17 below, a canopy level heatmap shows the range of tree density and height that helps visualize past harvests across the landscape, which can help us think about diversity. At **Point A**, a large patch cut in 2010–11 created a relatively large area with purely early successional habitat, encouraging an abundance of pioneer plant species like paper birch, quaking aspen, and pin cherry that in turn will host different fauna. **Point B** also shows a blotchiness in canopy height that results from smaller patch-cuts with thinnings in 1989; the nearby concentration of bright yellow to the east is primarily eastern white pine and red spruce, contrasting with the surrounding hardwoods. At the far north of the property, the distinct pattern of



patches at **Point C** portrays the mixed matrix within old field white pine and newer northern hardwoods that have come up under the coniferous canopy.

Figure 17. Relative canopy height across the northwest quadrant of SHC, showing various harvests and land uses.

The closed canopy that some of the forest currently exhibits can be beneficial to several animal species (Appendix G4), but it rarely allows for strong shrub or ground story vegetation layers to form; too little light is available below the canopy and subcanopy. As ground vegetation approaches a level of coverage around 50% percent and higher, a suite of species will be able to use this newly available habitat as forage and/or shelter (Appendix G5).

Riparian Habitat: There are many species that rely on **riparian habitat,** such as **wetlands, streams** and **rivers**, in Vermont. In general, riparian ecosystems are high in biological diversity, and benefits are highest when continuous vegetated habitat remains alongside waterways for extensive distances. Maintaining riparian wildlife connectivity may be the single most important goal for land use planning from an ecological standpoint (VT Fish and Wildlife). Mink, beaver, wood turtle, yellow warblers, common yellowthroats, wood ducks, and great blue herons are just a few examples of the wide variety of wildlife that rely on riparian corridors, rivers and wetlands on the Smokey House Property. Little is known about the fish and aquatic invertebrate species present in SHC rivers and streams; this is an area that merits further study, whether through collaboration with visiting students or local environmental NGOs, or with assistance from the government. The USFWS Lake Champlain Fish and Wildlife Conservation Office has a riparian restoration program through partnerships with landowners.[5]

Figure 18b. Source: VT NRCS Specification Guide Sheet for Riparian Forest Buffer

Buffers are a critical management tool for protecting wildlife that rely on riparian areas. The Vermont Wildlife Habitat Landowner Guide, put out by the Vermont Fish and Wildlife Department explains that most streams require a minimum 50 ft buffer to protect aquatic function, however to protect wildlife functions along a stream corridor, it is often necessary to protect a 660 foot buffer. If possible, the ideal buffer strip should

Figure a. A vernal pool where frogs had laid eggs in the Northern Hardwood forests.

Table 1. Riparian Forest Buffer Widths for Fish and Wildlife

SPECIES	DESIRED WIDTH (in feet)
Wildlife dependent on wetlands or watercourses	**30-600'**
Bald eagle, nesting heron, cavity nesting ducks	600
Pileated woodpecker	450
Beaver, dabbling ducks, mink	300
Bobcat, red fox, fisher, otter, muskrat	330
Amphibians and reptiles	100-330
Belted kingfisher	100-200
Songbirds	**40-660**
Scarlet tanager, American redstart, rufous-sided towhee	660
Brown thrasher, hairy woodpecker, red-eyed vireo	130
Blue jay, black capped chickadee, downy woodpecker	50
Cardinal	40
Cold water fisheries	**100-300**

Source - Connecticut River Joint Commission (CRJC) Buffers for Habitat - in the series *Riparian Buffers for the Connecticut River Watershed*

[5] https://www.fws.gov/lcfwro/habitat/riparian_restoration.html

extend at least 100 to 300 feet from the water. Similarly with wetlands, while Vermont Wetland Rules typically require 50 foot buffers, many species benefit from larger buffers, such as American bitterns which require a 300 foot buffer. Heron rookeries, often found in wetlands, require a primary buffer of 300 feet that excludes all timber harvesting, and a secondary buffer of 300–650 feet that excludes gravel extraction and road or building construction. A tertiary buffer zone of 650 to 1300 feet excluding construction and timber harvest during nesting period may also be beneficial (VT Wildlife Habitat Landowner Guide, VT Fish and Wildlife).

Vernal Pools and Seeps: The SHC property contains several vernal pools, which are temporary woodland pools, and seeps, small wetlands found within forested habitats. Seeps are important sources of cold water and shoots for wildlife, and vernal pools are especially important to breeding salamanders and frogs because the fish that normally eat eggs are absent from these water bodies. Vermont Fish and Wildlife recommends a 100-foot buffer and an additional 600-foot buffer for protecting wildlife that relies on vernal pools. State herpetologist Luke Goff mentioned that while the current draft state for vernal pools specifies 650-foot buffers, some herpetologists recommend 750-foot buffers for protecting amphibians that rely on vernal pools and streams.

As with all the 600–700-foot buffers, if timber production is a goal in the area, it can still occur in the buffer, but trees must be very carefully harvested to minimize soil disturbance, and harvests must be timed appropriately to minimize impacts to the hydrology. With harvest in the 600-foot vernal pool buffer zone, a 70% canopy crown closure must be maintained to provide the right shade conditions for amphibians.

Rare and Vulnerable Wildlife / Special Wildlife Considerations

This subsection describes some of the wildlife that has been seen on the property or that is known to be in the area, and details some of these species' requirements that SHC can be mindful of as it makes management decisions in the future. There are many other species beyond those described here that use the forests.

Reptiles and Amphibians: A conversation with state herpetologist Luke Groff indicated that box turtles, spotted turtles, blue spotted salamander, Jefferson salamander, and red eft all may be present in the SHC forests, along with many other species. Wood frogs and spring peepers can be heard calling at night. Wood turtles, a species of concern, have been found at the town intersection in Danby, coming in from Otter Creek. This should be taken into consideration for managing SHC waterways and headwaters, which have an impact on downstream wildlife. There is also snake habitat on the property; open fields and shrubby areas are smooth green snake habitat and a garter snake was observed on one of the field visits.

Generally speaking, mixed forests are best for reptile amphibian species as compared to coniferous forests, and amphibians also do well at forest edges, and make use of **old stone walls** and **rock piles**. Luke Groff does not currently monitor vernal pools on SHC property for amphibians but he mentioned

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he would be interested in possibly adding them to his monitoring routine. Warrens Disease is also affecting salamanders, may be affecting newts, and would be something to monitor for on the property.

Bats: Northern long-eared bats, tri-colored bats, and Eastern small-footed bats, among others, all can be found in the area. Dorset, nearby, has several noted bat habitats such as the Dorset Cave and Mount Aeolis. Most bats spend the winter in caves and roost during the summer in structures like roost trees (snags and/or trees with loose bark and cavities), bat boxes, or rock ledges. They also benefit from forest connectivity and diversity of forest habitat.

Pollinators: Bees are the primary pollinator at SHC, and they benefit from much of the same habitat diversity as other wildlife. There are about 40 genera of native bees in New England, which require a variety of native flowers, whether from trees and shrubs like maple, willow, and serviceberry; spring wildflowers on the forest floor; or early successional plants like goldenrod and *Rubus* in fields and recently harvested open areas. For nesting, uncompacted soils are ideal, as is dead woody material. Butterflies and moths are generally associated with a host plant on which the larva feed. Pollinating insects have varied foraging ranges, with some species able to travel over a mile and others only flying a few hundred yards to find nectar and pollen.

Large Mammals: Black bears roam over large areas and use many different natural communities. They feed on hard mast from oak and beech trees in the fall and eat green vegetation growing in seeps and swamps in the spring (VT Fish and Wildlife, Natural Community Inventory), as well as *Rubus* soft mast in the summer. Bands of beech on the southern portion of the SHC property, at mid elevation, provide important bear habitat, where trees have been marked by years of claw-scraping. Bear scat was observed while walking the property in May 2021, as were moose and deer droppings. Moose are very infrequently sighted at SHC, but signs of their presence were noted on Jackson Peak around 3,300 feet above sea level, where they browse on mountain ash and balsam fir saplings. White-tailed deer are more ubiquitous at SHC, and the Hemlock-Northern Hardwoods in the K stands are classified as winter cover for them.

Beaver: At Smokey House, beavers have created dams by the alder swamp and wetland in the west of the property along Mill Brook. This has at times led to flooding on Danby Mountain Road, and dams have had to be removed. However, beavers are a keystone species that play an important role in creating wetland habitat for other wildlife that rely on wetlands, such as raccoons, moose, a variety of duck species, and great blue herons. Management should take care to continue to support beavers, even as it seeks to mitigate flooding. In addition to regulated trapping during trapping season, there are a variety of water control structures, like baffles, that can allow water to pass through dams. It is also possible to build exclusions in front of culverts to prevent beavers from building in the most inopportune locations. See Vermont Fish and Wildlife Department "Managing Human-Beaver Conflicts".

Birds: While walking on SHC property in April and May 2021, the 52 bird species observed were: American Crow, American Goldfinch, American Kestrel, American Robin, Baltimore Oriole, Blackburnian Warbler, Black-and-white Warbler, Black-capped Chickadee, Black-throated Blue Warbler, Black-throated Green Warbler, Blue Jay, Brown Creeper, Chestnut-sided Warbler, Chipping Sparrow, Common Grackle, Common Raven, Common Yellowthroat, Dark-eyed Junco, Eastern Kingbird, Eastern Phoebe, European Starling, Field Sparrow, Gray Catbird, Hairy Woodpecker, Hermit Thrush, House Wren, Indigo Bunting, Killdeer, Least Flycatcher, Mallard, Mourning Dove, Northern Cardinal, Ovenbird, Pileated Woodpecker, Red-eyed Vireo, Red-tailed Hawk, Red-winged Blackbird, Rose-breasted Grosbeak*, Ruby-crowned Kinglet, Ruby-throated Hummingbird, Ruffed Grouse, Savannah Sparrow, Song Sparrow, Tree Swallow,

Turkey Vulture, Veery*, White-breasted Nuthatch, Winter Wren, Wood Thrush*, Yellow Warbler, Yellow-bellied Sapsucker, and Yellow-rumped Warbler. Additional species logged by the Vermont Center for Ecostudies Mountainwatch on Dorset Peak in June 2019 and 2020 are American Redstart, Blue-headed Vireo, Golden-crowned Kinglet, Nashville Warbler, Purple Finch, Red-breasted Nuthatch, and Swainson's Thrush. The Bicknell's Thrush*, a threatened species with a small and declining population, was observed in the summer of 2020 by several birdwatchers on Dorset Peak.

* These species are in the US Fish and Wildlife Service's Birds of Conservation Concern 2021 report.

While many birds make use of **early successional habitat** for forage, Steve Hagenbuch, Senior Conservation Biologist with Audubon Vermont, noted that this type of forest is usually sufficiently represented in the region, when one accounts for human and natural disturbance. His organization's priority is managing forests for the suite of birds that nest in mature, closed-canopy forests, such as wood thrush, black-throated green warblers, and scarlet tanager. With large blocks of interior forest, SHC already supports a good number of mature forest-nesting species. It could take steps to support them further by increasing mature forest structural and species complexity. Ecological silviculture encourages **all-aged stands**, where many age classes exist, but they are not necessarily balanced in distribution throughout the stands as is usually the case in **uneven-aged stands** managed for timber. The goal is to create even uneven-aged forests with even more spatially diverse structure, through methods like **variable density thinning**, **group selection**, and **irregular shelterwood treatments.** All of these strategies and more are detailed in Audubon Vermont's *Silviculture with Birds in Mind* guide and in the *Silvicultural Guide for Northern Hardwoods in the Northeast*, and generally promote the removal of low-vigor and poor quality trees while maintaining variable degrees of canopy cover, and the regeneration and release of diverse native trees that provide good bird habitat. It should be noted that many of these strategies are also highly compatible with carbon sequestration and the general promotion of healthy and vigorous forests. The guide also includes other considerations for birds, like retaining softwood inclusions in hardwood stands, retaining and regenerating yellow birch (preferred by several songbird species for foraging), and girdling trees to create snags.

Further Reading:

A Landowner's Guide: Wildlife Habitat Management for Lands in Vermont. Vermont Fish and Wildlife Department.

Vernal Pool Habitat in Conservation Planning Vermont. Vermont NRCS Biology Technical Note 1.

Specification Guide Sheet for Riparian Forest Buffer (391). Vermont NRCS.

New England Pollinator Handbook: Pollinator Biology and Habitat. Maine, New Hampshire, Vermont, Connecticut, Massachusetts, and Rhode Island State NRCS, the Xerces Society for Invertebrate Conservation's Pollinator Conservation Program, and the University of Maine Cooperative Extension.

Forest Bird Habitat Assessment: A Guide to Integrating Bird Habitat Data into a Vermont Forest Inventory. USFS and Audubon Society.

Silviculture with Birds in Mind: Options for Integrating Timber and Songbird Habitat Management in Northern Hardwood Stands in Vermont. USFS and Audubon Society.

Technical Guide to Forest Wildlife Habitat Management in New England. Richard DeGraaf, Mariko Yamasaki, William Leak,

Anna Lester. University of Vermont Press.

A Guide to Creating Vernal Ponds: All the Information You Need to Build and Maintain an Ephemeral Wetland. USFS, Ducks Unlimited, and the Izaak Walton League of America.

Forestry Habitat Management Guidelines for Vernal Pool Wildlife. Metropolitan Conservation Alliance.

Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast. Massachusetts Division of Fisheries and Wildlife.

Forest Management and Bats. Bat Conservation International.

Mark S. Ashton and Matthew J. Kelty. Chapter 24: Silviculture for Wildlife Habitat. *The Practice of Silviculture: Applied Forest Ecology.* Tenth Edition. 2018 John Wiley & Sons Ltd.

Silvicultural Guide for Northern Hardwoods in the Northeast. USFS.

Invasive Species and Forest Pests:

Invasive Plant Species

It is nearly impossible for a property the size of SHC to be completely free of invasive plants, given that the landscape has a history of farming at a time when exotic species were introduced without knowledge of potential negative impacts. Although much of SHC has some presence of invasives, density overall is generally low and manageable, and many stands have no sign of incursion.

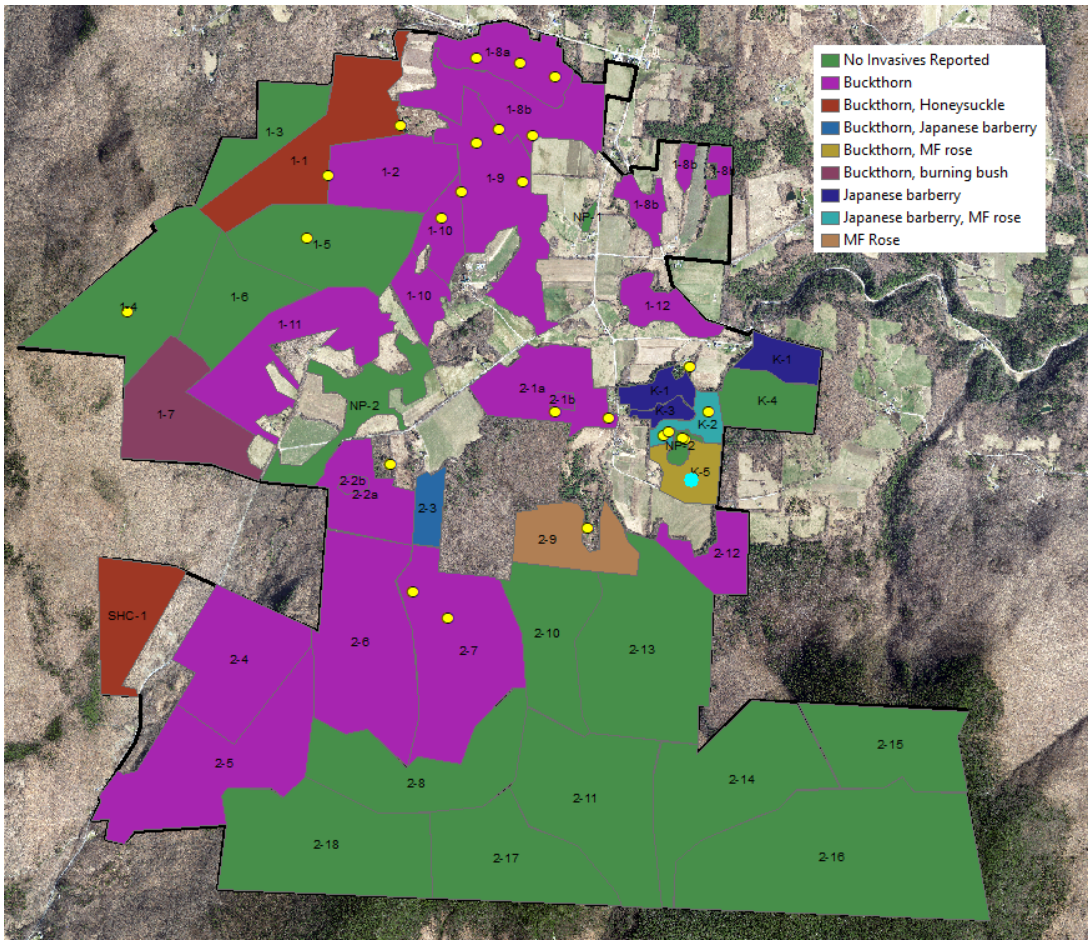


Figure 20. Stands from the 2012 management plan coded by invasive presence documented at the time, with yellow points showing 2021 observation points of invasives, and a light blue point showing the only high-density incursion of a problematic species in a forest stand.

The most widespread invasive species on the property is, unsurprisingly, one that was brought by European colonists as an ornamental shrub: **common buckthorn** (*Rhamnus cathartica*). With prolific seeds that are well-dispersed by the natural laxative found in its berries, buckthorn spreads both with the help of wildlife and through root shooting, making eradication near-impossible. In the open area just north of the 2-2 stands, there is an area that appears to be a former orchard of buckthorn, which may be a strong source of seeds for surrounding forest edges. Depending on the cultural value of this spot to SHC, it may be prudent to eradicate this relic buckthorn stronghold and use the area for experimental programming in forest restoration.

Most stands at SHC have at least some buckthorn present; those that do not tend to have another invasive species reported, primarily **Japanese barberry** (*Berberis thunbergii*) and **multiflora rose** (*Rosa multiflora*). The southern mountain stands are the exception, likely due to their isolation from old agricultural land, lack of heavy harvesting in the last century, and higher elevation (Japanese barberry and multiflora rose have still been noted at relatively high elevations in the north, but this may be related to favorable aspects to the sun). In general, harvests should be planned away from areas where invasive plants have been sighted, as canopy openings can provide opportunities for these species to take advantage of the new light, and spread faster than native competitors. For the three main invasive plants found at SHC, **mechanical and chemical control methods** are available, but also labor intensive, and requiring multiple years of attack to make any significant change.

We recommend that at the very least, the presence of invasive species be taken into account while implementing harvest treatments. Targeted control efforts of barberry and rose could be piloted in the northwestern stands (1-4, 1-5). The 2012 management plan found no evidence for these species in these stands, so their presence may indicate more recent invasion, and the possibility of further expansion into sensitive areas might be greater. Japanese barberry in particular has been linked to greater tick abundance with Lyme disease, but SHC is fortunate in not seeming to have extremely dense thickets of the invasive, apart from a spot just north of Keeler Rd in Stand K-5 (shown in light blue instead of yellow in Figure 20). This stand would benefit from a concerted effort to reduce the plant's dominance in the understory. Stand K-5 is also the only area to have been deemed high density of buckthorn and multiflora rose in the 2012 management plan. This stand is therefore a good candidate for strong management of invasives by SHC, although the presence of swampy habitat in the pocket of Stand NP-2 may limit the judicious use of chemical controls.

Common buckthorn and Japanese barberry are on Vermont's Class B Noxious Weed list, while multiflora rose is on the watch list. **Burning bush** (*Euonymus alatus*) and **honeysuckle** (*Lonicera sp.*) have also been observed at SHC in the past, and the property should be monitored for expansion of burning bush from the stand where it was originally noted (1-7). The same goes for **autumn olive** (*Elaeagnus umbellata*) which was possibly sighted in the patch cuts of Stand 1-8a, and **Japanese knotweed** (*Fallopia japonica*), which can be found in Stand 1-9 at the edge of the agricultural field and the sugarbush.

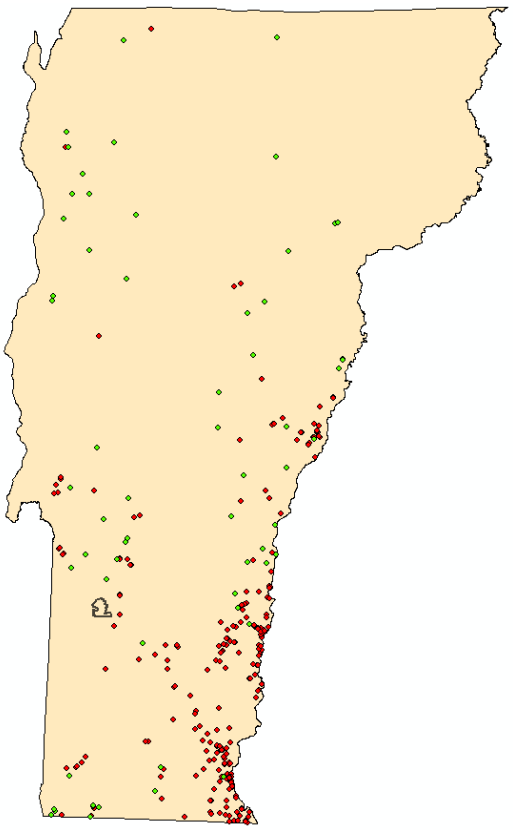
In the following table, we synthesize the most effective control methods recommended by VTinvasives.org, a collaborative effort by the University of Vermont Extension, the Vermont Department of Forests, Parks and Recreation, the Vermont Department of Environmental Conservation and the Vermont Chapter of the Nature Conservancy. In the case of plant removal by pulling or digging, the best time to do so is when soil moisture is high. Always ensure that the whole root of the plant is removed, and dispose of the plants in a way that they will not re-root (hang over branches, burn, etc.). Visit VTinvasives.org for more information about each plant and their control methods, and use glyphosate with caution, as it can severely impact neighboring native plants.

Species	**Mechanical Control**	**Chemical Control**	**Cautions**
Autumn olive	Pulling and digging	Cut-stump spray of 20–50% glyphosate	Resprouts vigorously after mowing or cutting
Burning bush	Hand pull or cut stump and cover tightly	Cut-stump drip of 18–21% glyphosate	Check stumps for new growth and cut back
Common buckthorn	Hand pull or cut stump and cover tightly	Cut-stump drip of 18–21% glyphosate	Check stumps for new growth and cut back
Honeysuckle	Hand pull or cut stump and cover tightly	Cut-stump drip of 18–21% glyphosate	Check stumps for new growth and cut back
Japanese barberry	Hand pull or cut stump and cover tightly	Cut-stump drip of 18–21% glyphosate	Use foliar spray of 2% glyphosate for dense pops.
Japanese knotweed	Cut stalks once a month during growing season for 5 years until vigor is lost, or	Cut stalks in late June, and after August 1 cut again and drip or inject	Fragments can resprout, especially in wetlands or moist soil areas

	smother.	18–25% glyphosate	
Multiflora rose	Hand pull or cut 3–6 times per growing season for 2–4 years	Cut-stump drip of 18–21% glyphosate	Thorns can be a hazard during mechanical control

Invasive Diseases and Insects that Impact Trees

Another common invasive species, but one that is quite different from the plants above, is beech scale (*Cryptococcus fagisuga*), an insect from Europe that is the main cause of **Beech Bark Disease** (**BBD**). While the disease is actually a "disease complex" that involves both the beech scale and a fungal "Nectria" infection by *Neonectria faginata* and/or *Neonectria ditissima*, this infection would not be possible without the invasive insect attacking the beech bark first and creating an opening. BBD moves through northern hardwoods of New England in three phases, where initially there is a wave of scale insects attacking the region, feeding on bark (advancing front). During the next nineteen years, beech trees may be colonized by the Nectria fungus, killing patches of bark and sometimes causing tree mortality and snap (killing front). Left behind is a forest that often has much lower beech composition than it used to, either with resistant trees still thriving in areas, or with stressed but surviving beech sprouting clonally in an attempt to stay alive, despite being equally susceptible to BBD (aftermath forest).



delgid (red dots)
ermont.

BBD has been widespread in Vermont since the 1960s, and SHC has not been immune; in fact, any northern hardwood stand in the state can be considered an aftermath forest. The Vermont Agency of Natural Resources produced management guidelines in 2011 for optimizing mast yields in beech mast producing areas (see Further Reading), which can help SHC approach the stewardship of remaining beech trees, whether they are resistant, partially resistant, or susceptible to BBD. We also explore some of these options in the Management Strategies section.

It is telling that some of the more homogenous stands on the property, as described in the 2012 management plan, are among those with evidence of prior tree pests that target individual species. For example, stands dominated by white pine frequently show signs of either **white pine weevil** (native to North America) damage, or the **white pine blister rust** (*Cronartium ribicola*, native to Asia). The old sugarbush has suffered from **sugar maple borers** (likely native to North America) in the past. Where possible, it is best to encourage a mix of tree species that buffer those vulnerable to forest pests, or in the case of sugar maple borer, increasing the growth of young sugar maples is helpful.[6]

The eastern side of SHC, where hemlock dominates or comprises a large portion of a given stand, may be particularly vulnerable to an impending invasive threat. These hemlock areas are labeled by the state as

[6] Another native species that may become more of an issue with climate change is the spruce budworm.

deer wintering grounds; the dense canopies of this conifer species provide shelter for many animals under their cooler, darker shadow, and offer unique habitat. **Hemlock woolly adelgid** (*Adelges tsugae*), an invasive species that is expanding its range in New England and New York, is becoming widespread across Vermont as well, with several sightings within ten miles from SHC just within the last couple years (and months). Figure 21 displays red points where hemlock woolly adelgid has been reported to the state. SHC should be monitored closely for signs of infestation, and groves of hemlock should be encouraged.

Another threat that will soon make its way to SHC is the **emerald ash borer** (**EAB**, *Agrilus planipennis*). This beetle, native to Asia, was accidentally introduced to North America and has been reported throughout Vermont (shown in green on the map in Figure 21). EAB is causing widespread mortality in white, green, and black ash, and will have severe impacts on New England's forest composition and potential harvest revenues. At SHC, white ash has a strong presence in much of the (Rich) Northern Hardwoods canopy, where it is not as omnipresent as sugar maple, but often co-dominant—and in certain places, the dominant species. We recommend following the guidance in 2020 literature produced by the Forest Stewards Guild, co-written by Dr. Tony D'Amato at the University of Vermont (Ten Recommendations for Managing Ash in the Face of Emerald Ash Borer and Climate Change). One key takeaway is that individual ash trees are either male or female, and males are generally much more numerous, so female trees should probably be prioritized. Rather than attempting to salvage the monetary value of white ash, Dr. Joe Orefice at the Yale Forest School recommends regenerating the species so that there is a seedling bank ready to rise when parent trees start dying in the peak of EAB outbreak. We frequently observed white ash seedlings in the ground layer of the (Rich) Northern Hardwoods zones, which is a good sign for the future since we also noted many white ash already under stress (but for unclear reasons).

There is a minor threat to balsam fir that should be noted for future monitoring: the **Balsam woolly adelgid** (*Adelges piceae*). This European invasive has already been managed in Vermont for decades, but has the potential to become more problematic with climate change, resurging after mild winters.

Finally, an invasive pathogen that is already established from the lake states to Maine, but with unknown impacts at SHC, is the **Butternut canker** *Ophiognomonia clavigignenti-juglandacearum* (**Oc-j**), previously classified in the genus *Sirococcus*. This fungus attacks butternuts, a member of the walnut family, and creates a canker that can rot the branches, roots, and stem of the tree, sometimes girdling and killing it. Infected trees stop producing nuts, but some butternuts are resistant, (free of cankers and with more than 50% live crowns) and others may be disease-tolerant (less than 20% of stem/root circumference affected by cankers and more than 70% live crown). We recommend monitoring butternuts at SHC and not harvesting any trees, and address the species further in the management recommendations section later on.

Further Reading:

Ten Recommendations for Managing Ash in the Face of Emerald Ash Borer and Climate Change. Forest Stewards Guild.

Leaflet on Balsam Woolly Adelgid. Vermont Department of Forests, Parks, and Recreation.

Management Guidelines for Optimizing Mast Yields in Beech Mast Production Areas. Vermont Agency of Natural Resources.

A Blueprint for Restoring Butternut Across Eastern North America. Journal of Forestry.

Delineating Natural Communities as Management Units

In the 2012 management plan created for SHC, the property was divided into the traditional forest management unit: stands. We have chosen a different approach for this conservation plan, but include the original stand delineations here for reference, color-coded according to the forest type that was deemed dominant in 2012. We approach the natural communities as units for management that are broader zones than the scale of a stand, but do not intend to erase the history of stand delineations that have existed since the 1980s. It is still useful to be able to reference individual stands when addressing more specific locations and previous harvest regimes; it is likely that prescriptions will still take place at the stand level.

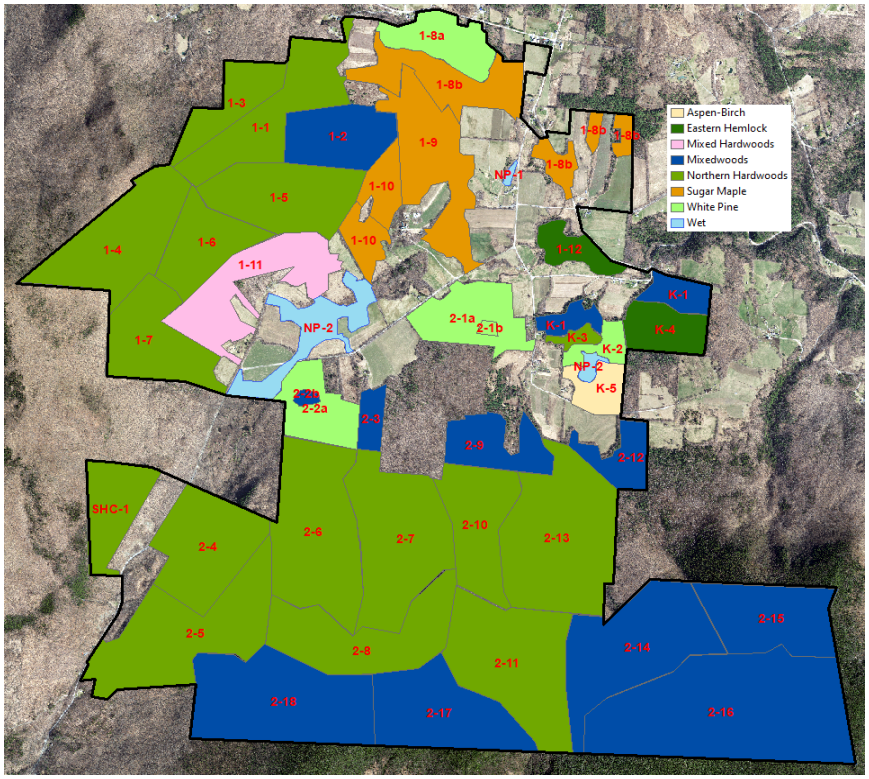


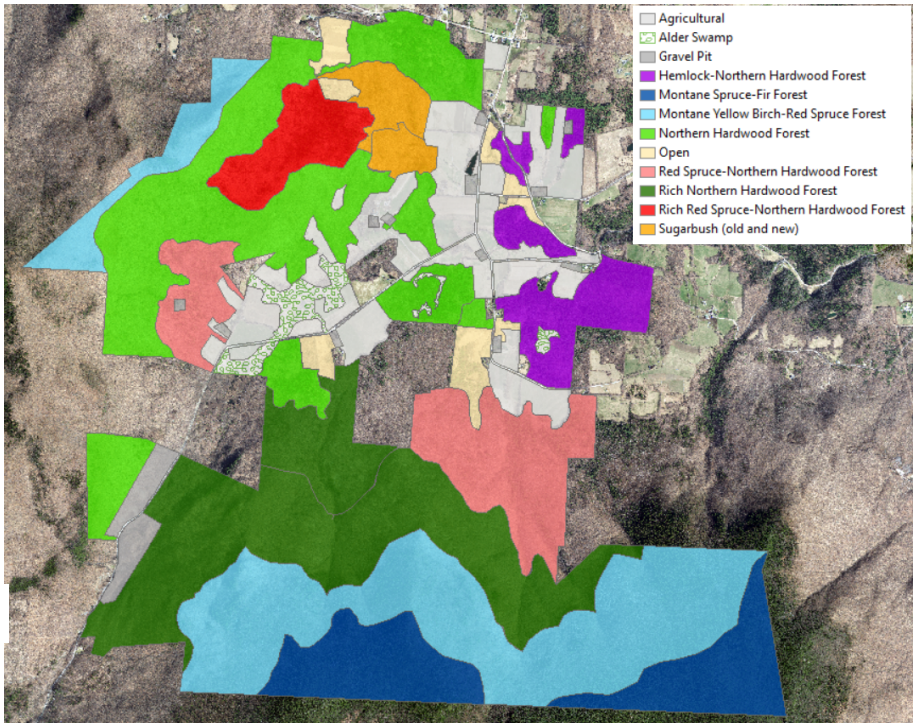
Figure . Stands of the Smokey House forests with key indicating dominant tree community from 2012 survey.

As mentioned in the land use history section of the plan, although since the 1950s Smokey House may have been spared some of the intensity of logging that occurred elsewhere in the region, it still went through a period of high grading and management as an even-aged forest. For example, Stands 2-4 and 2-5 had major cutting back in the 1970s which removed a lot of old growth, while Stands 2-6 and 2-7 were also high graded and being managed as a two-aged stand. In more recent years the overstory was removed and now the area is mostly a 40-year stand. A patch cut and thinnings in 2000 in Stands 1-1 to 1-4 helped clean up a high graded area. In the area around Stand 2-14 and 2-15 there may have been a fire many decades ago, which might explain why much of the hardwood that has grown back is birch.

A common category used to classify the landscape of Vermont is that of the**natural community**. Natural communities are assemblages of plants and animals that repeat across the landscape wherever similar environmental conditions occur (Natural Community Inventory, VT Fish and Wildlife). The natural

communities of Vermont have been described in the book *Wetland, Woodland, Wildland* by Elizabeth Thompson and Eric R. Sorenson. After reviewing the natural communities that likely aligned with the Smokey House Center forests, we used NRCS soil surveys and underlying bedrock geology, hydrology and topography maps, present and historical aerial images, and field observations of plant communities present in the forest to map out the natural communities on the property in Figure 23.

Not all of the boundaries of the natural communities represented on the map are exact. There are zones of transition where natural communities blend into each other. Relatedly, some communities could be classified as two things (ie: an old sugarbush could also be a northern hardwood forest). We tried to classify communities to the most specific degree possible using pre-existing categories. It should also be noted that species of natural communities may shift over time through stages of succession or in response to the changing climate, but it is believed that the locations of high quality natural communities represent physical landscape settings that will continue to support important natural communities into the future (Common Natural Communities Component Abstract, ANR).



Northern Hardwood Forests (~883 acres)

Figure . Northern Hardwood Forest

Unlike certain other natural communities that require just the right groundwater, topography, and bedrock to exist, Northern Hardwood Forests are generalist natural communities, and can exist in a variety of conditions (Natural Community Inventory, VT Fish and Wildlife). These are the most common natural communities in Vermont, and our natural communities map breaks the Northern Hardwood Forests down into several variations including Hemlock-Northern Hardwood Forest, Red Spruce-Northern Hardwood Forest, Rich Northern Hardwood Forest and Rich Red Spruce-Northern Hardwood Forest. The Sugarbush could also be considered a variation of the Northern

Hardwood Forest, though it has been managed for almost exclusively maple sugar trees and would need thinning, small group selection, or patch cut treatments in order to regenerate a more diverse forest.

Figure 25. Both these photos depict a section of northern hardwoods on the western end of Stand 1-8b where sugar maple, black cherry, yellow birch, and white ash could benefit from single tree selection or thinning.

Generally speaking, Northern Hardwood Forests are dominated by sugar maple, American beech, yellow birch and hemlock, though hemlock was less prevalent throughout the SHC forests, except in the K stands. White ash, black cherry, red maple, white pine, red oak, red spruce, and paper birch are also present, though less abundant than sugar maple, in these forest types. Ash, an indicator of enriched forests, was especially common in the SHC forest canopies, and butternut was also present, another sign of richness. While understory beech was common, we saw very few areas where mature beech took a prominent place in the canopy, likely due to beech bark disease. Most Northern Hardwood Forest soils are formed in till soils and are loamy, cool and moist. Common understory species include striped maple and hobblebush, as well as American hophornbeam and musclewood. As described in the land use history section earlier in the plan, many of the SHC Northern Hardwood Forests likely began as post-agriculture white pine stands, and the conifers were eventually replaced by hardwoods. Other early successional species found in SHC Northern Hardwood Forests are black cherry, bigtooth aspen, quaking aspen, white birch, red spruce, and a small amount of pin cherry, which all point to the history of logging or other disturbance on the property. We noted a high prevalence of mature black cherry across these natural communities.

Figure 26. In Stand 1-5, thin sugar maple poles released by previous harvests now crowd the understory, not yet shading out ground cover.

The forests in the northwestern part of the property are a good example of Northern Hardwoods. Walking towards Woodlawn Mountain we encountered a predominant canopy of sugar maple, yellow birch, and large white ash, in addition to white birch, black cherry, quaking aspen, and white pine, and some less frequent American beech, red oak, red maple, and hophornbeam. The understory contained a significant amount of striped maple, especially in areas that had been more recently harvested, and as elevation rose, small red spruce groves were present. In Stand 1-4, where the forest verged into **Montane Yellow Birch-Red Spruce Forest,** a large patch cut was created at an elevation of around 2,100 feet. Here we found successful regeneration of red maple, striped maple, American beech, black cherry, pin cherry, and yellow birch. These types of shrubby, open, early successional forests are ideal habitat for ruffed grouse, which were heard drumming and were also flushed in the area.

In the northeastern part of the property there are patches of Northern Hardwoods that are currently is in old field pine succession, which amount to around 230 acres. After the abandonment of an old pasture, white pine is often one of the first species to grow back

as it is one of the few species that is able to colonize compacted, disturbed soil in full sun. White pine seeds are wind dispersed and remain in the buried seed bank until satisfactory conditions for propagation occur. Despite the predominant legacy of pine trees that remain in the stands, these forest areas will still transition to Northern Hardwoods over time.

In 2014, pine was sold in half acre groups in the northeast of the property. Part of the goal was to regenerate pine in the clearings, and regeneration has been slow, although some yellow birch, white pine, cherry, and spruce are growing up. Around the groups, the forest was also thinned to promote regeneration. Large pine trees remain predominant in the stand, some over 80 years old. In the thinned areas, some sugar maple, yellow birch, and beech seedlings are present. Eventually, it is likely that hardwoods would become dominant in this stand, and there is no requirement to artificially maintain pine here.

*Figure SEQ Figure * ARABIC 32. One of the half acre group selection cuts in stand 1-8a, an old field pine area on the property. White pine seed trees surround the cut.*

Rich Northern Hardwood Forests (~882 acres)

Most herbaceous plants of Northern Hardwood Forests are long lived perennials—early blooming wildflowers such as violets, trillium, and Canada mayflower. Where soils are thicker and richer, and especially where calcium has been drawn from the soil parent materials, the diversity and quantity of species increases dramatically, including bloodroot, blue cohosh, elderberry, Dutchman's breeches, trout lily, maidenhair fern, wood nettle, and ramps. (Nature of Vermont, Charles Johnson). Rich Northern Hardwood Forests are more productive and usually have higher tree species diversity than regular Northern Hardwood Forests, often with a higher prevalence of sugar maple and white ash.

Figure 27. Clockwise from top left: Dutchman's breeches, white trillium and budding bluebead lily, trout lilies, and blue cohosh.

Some rich forest indicators were found in the forests to the north of Danby Mountain Road, an area that has historically been productive for timber and agriculture. However, a wide band of forest on the north facing slopes to the south of the property was found to be particularly enriched. In these forests, a mix of sugar maple, white ash, and yellow birch dominate the canopies, with black cherry, paper birch, and basswood also present. We also saw Amelanchier, butternut, and an American elm on the gentler slopes approaching the mountains to the south. Young sugar maples and American beech are prevalent in the understory. From the lack of structural diversity in parts of this forest, and approaching the**Montane Yellow Birch-Red Spruce Forest,** it seems that parts of this area may have been high graded for sugar maple and yellow birch, or managed as even-aged stands historically. Deer browse could also be an issue in this area. In the southwestern part of the area marked Rich Northern Hardwood Forest on the map in Figure 23, the Weatherby harvest created some patch cuts with successful regeneration, including red maple, pin cherry, black cherry, aspen, paper birch, and yellow birch. A lot of what had been cut in this area had been birch, which had grown in after a high grade. Around this area, there are 30-40 year old stands which might be potential sites for future timber harvests.

As the elevation rises, around 2,000 feet high, the natural community begins to change to **Montane Yellow Birch-Red Spruce Forest**, which on the north-facing slopes in the south of SHC still had rich understory indicators. Around the transition zone, the notable presence of mature beech and understory beech (Stand 2-7) should be an area of consideration for beech regeneration, which we will discuss further below.

Hemlock-Northern Hardwood Forest (~230 acres)

Hemlock is a shade tolerant, long-lived, late successional species that often persists under the shade of a hardwood canopy for decades, eventually becoming dominant. While it once comprised about 10% of Vermont's forests, it is more uncommon now. Hemlock forests are stands of 75-100% hemlock, below 1,800 feet in elevation. The SHC hemlock forests would more likely be classified as Hemlock-Northern Hardwood forests, because they include significant amounts of hardwoods and other softwoods, and hemlock make up much less than 75% of the canopy in some of these areas. In SHC Hemlock-Northern Hardwood Forests to the east, we found American beech, white pine, red spruce, paper birch, red oak, sugar maple, red maple, and black cherry also growing in the forest. These areas had a broad range of soil hydrology (drainage), from well to excessively drained to poorly drained. Soils were predominantly loamy and often sandy or stony, given the glacial outwash deposition in this eastern area of SHC. As with other conifers, needles can acidify the soils causing mineral leaching.

Figure . Hemlock-Northern Hardwood Forest

Figure 29. A scene at the recent K-1 harvest.

Toward the east of the property, we visited the site of the harvest in a Hemlock-Northern hardwood Forest in Stands K-1 to K-4. In addition to hemlock we observed ash, pine, aspen, basswood, red spruce, and some hophornbeam. There were very few sugar maple and red maple on this site. This area was harvested recently, with the last cut being two years ago, removing mostly ash, as well as some hemlock, pine, and aspen. Older stumps of a former harvest, some 30 years prior, also dot the landscape. Large diameter specimens of all species remain, including some hemlock which appeared to be 60–70 years old, and red spruce of over 20 inches in diameter at breast height. From counting the rings on the stump of a harvested hemlock, Steve Handfield estimated that it could have been around 100 years old, and another was closer to 200 years old, both dating back to around the era of land abandonment. A goal of the harvest was to retain forest vigor by regenerating hemlock, spruce, and fir, and other softwoods, and it seemed to be successful, with understory revitalization including all those species, in addition to white pine and yellow birch, some of which had been left in the canopy during the harvest.

Red Spruce-Northern Hardwood Forest (~417 acres + ~157 acres of richer forest)

This is a variable community where softwood and hardwoods occur in mixed stands and persist that way over time. They can result from locally shallow soils or areas where moisture is close to the surface, and soils are well drained or moderately well drained (Thompson and Sorenson, 2000). These can often be found on gentle slopes, which is the case at SHC. Apart from the higher presence of red spruce in the canopy, the community is very similar to the Northern Hardwood Forest, with a mix of yellow birch, beech, and sugar maple, with white ash on richer sites, and red maple in the younger stands, especially in the west of SHC. Through much of this forest type at SHC, dominant red spruce were intermittent, but more numerous as sub- to mid-canopy trees underneath sugar or red maple. Although not as shade tolerant as hemlock or beech, red spruce easily persists in the shade of other trees, and makes a valuable contribution to these northern hardwood stands through thermal cover, forage diversity, and nesting sites.

Since red spruce was often selectively removed in New England forests (and aerial imagery seems to confirm this for the early- to mid-20th century on the land that eventually became SHC), we recommend retaining this species and possibly even encouraging its dominance in stands where it is well-established under other species. Herbaceous plants in Red Spruce-Northern Hardwoods can be similar to those in northern hardwood forests, depending on the richness of the site, and canopy shade levels.

Figure 30. Red spruce growing under Northern Hardwoods in stand 1-7 in the northwestern part of the property.

Sugarbush (~183 acres)

The northern part of the property contains an old sugarbush (SB1 in the north, about 74 acres) where many of the trees have been cut and sold over the years, as well as an actively managed sugarbush (SB2 in the south, about 41 acres). Judging by the estimated age and homogeneity of the trees in the southern part of the area, the stand could have been high graded for other timber species and sugar maple back in the 40s and 50s, when there was a good maple market, and it has continue to be logged over the years. Moving north, along the ridge in the eastern part of the Sugarbush unit, the forest starts to gain some diversity, including white

birch, ash, and black cherry. Grape vines indicate that these forests all grew up all at once, likely when the pasture was abandoned. Butternut and red oak are also found, but with much less frequently through this area. In this transition area between the Sugarbush and the Northern Hardwoods that are in old field pine succession, there are areas with 50 or 60 year old ash that would be suitable for harvest. There are also small sawtimber stands where small gaps could be created as pre commercial thinnings. Sugar maple is the canopy dominant throughout most of the lower elevation forests on the property, with some nearly pure sugar maple stands in the areas marked Northern Hardwood Forest seeming to have also been managed as sugarbushes in the past. The active sugarbush was surveyed in 2021, with the following results:

Figure . The active sugarbush in Stand 1-9.

- % Basal Area per acre by species:
  sugar maple 70%, black cherry 18%, red maple 4%, quaking aspen 4%, and white ash 3%
- AGS BA/acre 73
- UGS BA/acre 28
- MBF/acre 3.24
- Pulp cords/acre 17
- Q-Factor 1.17
- QMSD 13.37
- Soil Type: 42C, Macomber-Taconic complex, 8-15% slopes, rocky
- Site Index & Species: sugar maple 65
- Site Class: 1
- Age class structure: unevenaged
- Invasives: very low densities of invasive buckthorn and Japanese barberry throughout stand
- Regeneration: low densities of established eastern hophornbeam, American beech, sugar maple, striped maple, and white ash throughout the stand
- No water resources in sugarbush
- Inventory Date: 10/11/2021
- Prism Factor: 10
- # of Inventory Points: 8

Montane Yellow Birch-Red Spruce Forest (~960 acres)

On mountain slopes and low summits, **Montane Yellow Birch-Red Spruce Forest**

characterizes the upslope transition from **Northern Hardwood Forest. Montane Yellow Birch-Red Spruce Forest** occurs between 2,000 and 2,900 feet, depending on the climate (Thomson and Sorenson 2000), and at SHC starts at 2,300 to 2,400 feet and reaches around 3,000 feet before transitioning to **Montane Spruce-Fir Forest** at higher elevations.

Soils in this forest type are well drained to moderately well drained and bedrock is often close to the surface. In the southern, north facing **Montane Yellow Birch-Red Spruce Forests** on the SHC property, one can observe exposed boulders and ridges. At lower elevations of this forest type on the SHC property, we observed sugar maple, red maple, and American beech in the canopy, along with yellow birch and red spruce. At higher elevations, yellow birch and red spruce co-dominate. In early successional areas of the forest, paper birch, pin cherry, yellow birch, and aspen are common, as in the large patch cut in Stand 1-4, described in the **Northern Hardwood Forests** section of this document. In the SHC southern forests, we also encountered a significant amount of understory beech at the lower elevations of this forest type (as noted in Stand 2-7). Groundcover can include Canada mayflower, trout lily, wood fern, Christmas fern and Northern Hardwood Forest perennials, depending on the richness of the soil, which in the northern facing slopes was rich. In higher elevations, understory vegetation is suppressed due to presence of red spruce blocking the sun, however in gaps and in lower elevations, hobblebush and striped maple are prevalent. The SHC forests have been logged for yellow birch and spruce, and may have been highgraded and managed as uneven aged stands back around the 1960s. The legacy of this is still visible with the more homogenous vertical canopy structure. Over time red spruce is likely to become more prominent than yellow birch in these forests but slope instability may contribute to the prominence of yellow birch.

Montane Spruce-Fir Forest (~417 acres)

Along the spine of the Green mountains, and on a few peaks in the Taconic Mountains, **Montane Spruce-Fir Forests** are dominant. They occur mostly above 2,800 feet in elevation, though they can have a lower limit range of 2,500 feet (Sorenson and Thompson, 2000). Below this elevation, Montane Yellow Birch-Red Spruce is the dominant community. Montane forests are an important source of water capture and water filtration. Soils in these communities are spodosols: acidic, leached soils low in fertility and vulnerable to disturbance and erosion. In the SHC Montane Spruce-Fir Forests, we saw possible evidence of past fire, where softwoods were younger and/or birch had grown in. There was a notable amount of spruce canopy die back. Wind and cold air creates harsh conditions, and trees in these higher elevations are smaller than their lowland counterparts. In the cloudy, cold environment, mosses such as sphagnum cover much of the forest floor, and herbaceous species include clubmoss. The canopy of this natural community type consists of balsam fir and red spruce. In the SHC forest subcanopy atop Dorset Peak, we also encountered mountain ash, hobblebush, and the occasional paper or yellow birch.

Figure 34. Balsam fir and red spruce growing in the understory of the Montane Spruce Fir Forest around Dorset Peak. Moss grows on trees and on the forest floor at these high elevations.

The presence of moose in this forest type, as well as reported Bicknell's Thrush by recreational birdwatchers in June of 2020, confirm the value of this forest type at SHC, and we recommend monitoring it for other special wildlife, at least with trail cameras and possibly with new technology like autonomous recording units, if collaborators can be found to analyze the audio. There were many small patches of downed trees at the top of Jackson peak especially, possibly from wind downbursts; larger-scale disturbance like fir waves are to be expected at longer time scales, which may naturally improve habitat for the Bicknell's Thrush with edges of early succession.[7] As in much of Vermont, the SHC Montane Spruce-Fir forests have been logged historically and had skid trails through parts of them. For example, in the 1930s, a lot of high elevation spruce was harvested and pulped. Due to the steepness of the slopes, the rarity of this forest type in Vermont, the relative instability and unproductivity of the soils, and its importance for water quality and wildlife, logging is not recommended about 2,500 feet, and any activities in the forest should be conducted with care.

Alder Swamp (~83 acres)

The largest swamp on property is in the wet lowlands where Mill Brook begins to flow through SHC and is altered by beavers, which have created ponds with their dams. Stand NP-2 in the mid-western area of SHC shares essentially the same boundaries as the natural community zone made up of this large complex of alder swamp and its immediate surroundings on both sides of Danby Mountain Road. Other instances of swamp habitat can be found in the eastern pocket of Stand NP-2 in the Keeler Road stands, and in

[7] Learn more about fir waves from the Vermont Center for Ecostudies at https://vtecostudies.org/wildlife/plants/balsam-fir/.

some slivers of swamp within Stand 2-1a, which may be impacted by Mill Brook running nearby on the north, and an unnamed tributary flowing on the east. Despite being very narrow and located in the middle of a white pine stand, this small swamp strip had featured wetland species like the eponymous speckled alder, as well as Bebb's willow, Southern arrowwood, sensitive fern, and shrubby cinquefeuille; in contrast, the beaver pond area was surrounded by thickets of red-osier dogwood. The latter two species indicate likely calcareous groundwater enrichment.

Figure 35. A beaver dam at the edge of a wetland.

While it is hard to ascertain from aerial imagery when the beaver activity started at SHC, most of the swamp areas on property did seem to show signs of a natural hydrological impact on the vegetation and land use in 1962, if not as early as 1942. The two small portions of alder swamp that are separate from the beaver wetland have the potential to change naturally into more forested conditions. The narrow area within Stand 2-1a may face the impacts of hardwood succession from conifers in coming decades; Stand 2-1a had very sparse tree cover in 1942, and in just twenty years was densely covered in conifers, but with an outline around the swampy spot (see Figure 8). In the case of the pocket of swamp between Stands K-2 and K-5, white ash and red maple are already present in the area, and may take over the shrub cover in all but the wettest spots. As for the region directly influenced by the beaver dam, the natural disturbance from this flooding has created the alder swamp, but typically beavers will abandon the area after many years of eating all the surrounding vegetation. Eventually the pond dam will fail, changing the habitat yet again, with new stages of succession over the course of several years before returning to woody plants and possible beaver recolonization.

Open/Idle Agriculture (~119 acres)

Across the matrix of forested and farmed landscape at SHC, there are seven plots of open, idle agricultural land that are not being actively utilized, and which are in a range of states of early successional or grass habitat. Some areas are mowed more frequently than others, and several of these areas have young saplings—generally of white pine but also red maple—starting to provide further cover among the grass and shrubs. This land can be left idle to continue natural succession toward Northern Hardwoods, likely via old field pine relay floristics, but could also be managed according to NRCS guidelines for pollinator or meadow habitat. This more open space can juxtapose well with neighboring forest, contributing diversity in forage and shelter options for

wildlife that benefit from habitat edges. There is a wide array of resources available for native grassland restoration or pollinator-friendly wildflowers, with corresponding management prescriptions including burning, mowing, herbiciding, or leaving alone. Often there is funding available for cost-sharing by the NRCS for some of these practices.

*Further Reading*s

Xerces Society for Invertebrate Conservation, "Establishing Pollinator Meadows from Seed"

NRCS, Vermont Biology Technical Note #4 - Pollinator Habitat

Chapter 3 of the book, Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast, titled "Maintaining and Restoring Grasslands," is a good resource written for the lay reader to peruse and get a sense of what is involved, and what grass species to consider

NRCS and Ducks Unlimited Canada, "Vegetating with Native Grasses in Northeastern North America"

SHC Forest Management Strategies and Recommendations

SHC's mission of stewardship and conservation for their working forests encourages silviculture that enhances ecological function. Wildlife habitat and connectivity, forest resilience to climate change and pests, and recreational or educational opportunities in the forest can all be managed in tandem with timber harvest at SHC. These values align well with the New England Forestry Foundation's (NEFF) Exemplary Forestry standards, which in 2019 were developed for the Acadian Forest (see Further Readings), and are relatively adaptable to the northern hardwoods at SHC. Given that NEFF holds the conservation easements on SHC's forests, this makes future collaboration especially viable, and we recommend continuing a dialogue as NEFF designs EF management standards that are more relevant to this region of Vermont.

Below we summarize management recommendations that have been discussed elsewhere in the main body of the management plan, and are mostly applicable to the various Northern Hardwood sections of the property. Some of these recommendations are also detailed in the sections below the table. All of these should be considered as examples of the types of options that can be used to achieve the various conservation goals of SHC. There are other silvicultural methods for achieving these goals beyond those listed here, and as silviculture is always evolving, best practices may change over time. As all silviculture is highly site-specific, requiring a thorough, on-the-ground assessment of the forest area under consideration, we recommend that SHC work closely with a consulting forester should it decide to pursue any silvicultural treatments to benefit wildlife, improve forest health and vigor, regenerate species, and protect unique features of the property. As a general consideration, the stands prioritized for silvicultural treatments should be the ones that are the least vigorous, and the most degraded from prior high grading or management, because these are the areas that could stand to benefit the most from improvement through thoughtful and considered silviculture.

Appendix F contains an example of the type of detailed inventory that would be required before deciding on an active management approach for any given stand in the Smokey House forests. Consulting forester Steve Handfield conducted sample stand inventories for the western halves of stands 1-8b (Northern

Hardwoods, sugar maple dominant) and 2-5 (Sugar Maple forest, 75% sugar maple). For both of these stands, he quantified, via systematic random point sampling, the existing conditions of the timber resource. His write up details the species composition, volume, and the board foot and pulp values of the timber in the stands, while providing data-informed stand descriptions, with more information on species composition, age class and distribution, and logging operability. In 1-8b he finds signs of decline in overstocked areas, and in 2-5 he finds competition for sunlight among trees in the upper canopy is becoming a limiting growth factor. He recommends uneven-aged harvest as an appropriate treatment for both stands, and this is something that SHC could explore in the future, if it so chooses. The section headings below are for rough categorization but not meant to be mutually exclusive.

Activity	**Goal**
Wildlife Habitat	
Maintain forest buffers for streams, rivers, vernal pools and seeps	Preserve water quality, essential habitat for wildlife
When harvesting, maintain at least 6 snags or tree cavities per acre, with one larger than 18 in, two larger than 16 in, 4 downed trees per acre (VT Wildlife Habitat Landowner Guide)	Shelter for mammals and birds
Leave slash (branches, limbs) on forest floor when stands have low coarse woody material to start with	Shelter for mammals, birds, reptiles, amphibians, invertebrates
Create 5 to 20 acre patches of young, early successional forest habitat where appropriate (about 5 percent of the forest should be young forest) (VT Wildlife Habitat Landowner Guide)	Forage and nesting grounds for mammals and birds
Designate areas to become old forests (can be passively managed or actively managed to develop the characteristics of old forests).	Re-wilding, aesthetic value, diversity and habitat
Forest Health and Vigor	
Treat some even-aged areas that are in stem exclusion with variable density thinning (*Silviculture with Birds in Mind, Silvicultural Guide for Northern Hardwoods in the Northeast*)	Distribute growing space, allow more light to reach forest floor, increase structural diversity
Treat some stands that have maturing trees showing signs of competition with crown thinnings *(Silviculture with Birds in Mind* recommends removing trees of low-vigor to reduce crown cover to 70–75% in small poles, 75–85% in larger poles. Recommends removing most overtopped individuals, 50–60% of intermediate crown class, 10–25% co-dominant crown class.)	Reduce tree stress, improve remnant trees; can help sugar maple stands resemble old growth, and increase acorn mast production in oaks
Treat some mature, homogeneous even-aged or two-aged forest areas with a selection system to switch to uneven-aged.	Increase structural diversity, create ground cover and forage for wildlife
In a section that is right for it, create an irregular shelterwood with large reserve trees (*Silviculture with Birds in Mind, Silvicultural Guide for Northern Hardwoods in the Northeast*)	Boost mid-tolerant species and increase juxtaposition with edges for early successional species
Leave some sections of young forest as well as some maturing and mature areas of the forest in even-aged stand structure.	Allow for maximum diversity across the forest, minimize the impact of harvesting.

Invasive plant control	Reduce competition for space with native plants
Monitor for hemlock wooly adelgid, EAB, butternut canker, etc.	Ability to respond quickly to threats
Regenerate/Restore Species	
Beech regeneration and management (see below)	Conserve and create wildlife forage and forest diversity
Butternut restoration (see below)	Conserve wildlife forage, forest diversity, cultural value
Sensitive or Unique Features	
Camera traps in Montane Spruce-Fir areas	Monitor for martens, moose, and other animals
Limit harvest above 2,500 feet in Montane Spruce-Fir forests	Protect fragile soils and unique habitat

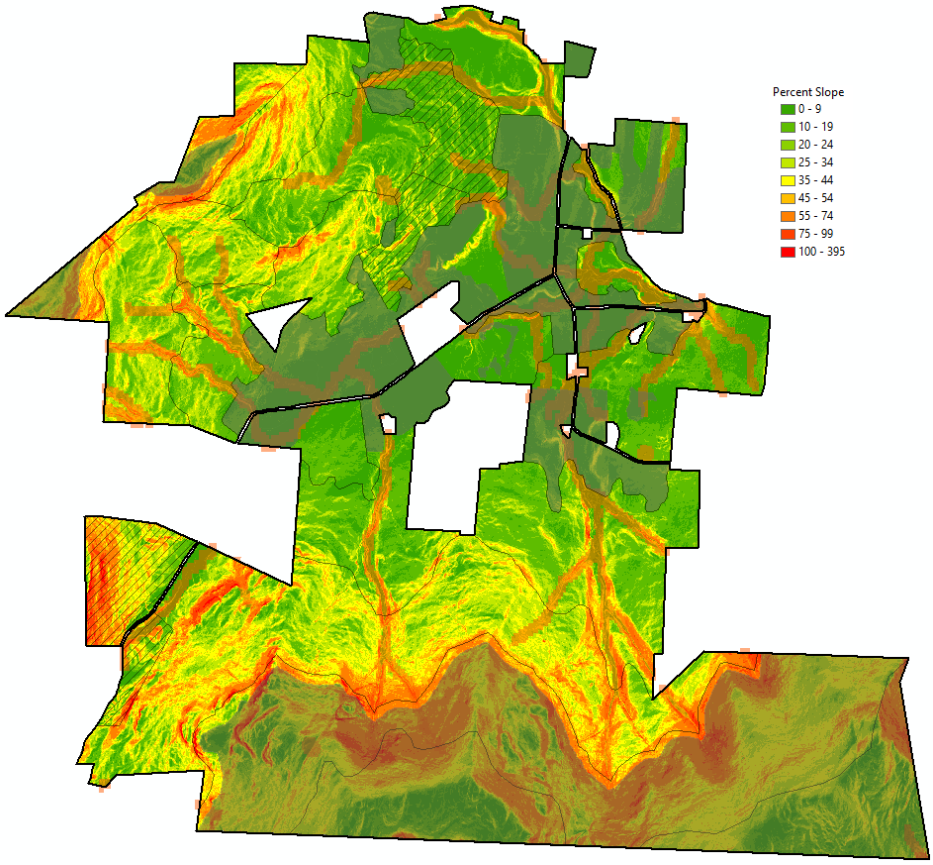


*Figure SEQ Figure * ARABIC 36. Gradient of percent slope values across SHC, with high elevation (>2,500 fasl), swampy, and open/agricultural land shaded out, sugarbush and gravel pit areas shown with striping, and orange ~100ft buffers around official streams and observed pools and seeps.*

Figure 36 indicates areas on the property that might be suitable for applying the management recommendations related to harvesting trees, depending on harvest methods. The orange stream buffer and greyed out high elevation areas should be excluded when considering these approaches, except for those that directly reference such habitat. For reference, skid trails should not exceed a 20% grade, some harvesting equipment should not be used above a 25–35% grade, and it can be unsafe to operate harvests on slopes over 35%. Consult with a Vermont licensed forester to address specific cases. For any future harvesting, SHC should also expect to refer to and follow the most recent Vermont Acceptable Management Practices for Vermont Water Quality, which were revised in 2018 and will likely continue to change over time.[8]

[8] Available from the Vermont Department of Forests, Parks and Recreation at https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Forest_Management/Library/FullDocument-7.29.pdf.

Management Strategies for Significant Tree Species at SHC:

The fact that SHC is not solely reliant on timber harvest revenues provides a rare opportunity for targeted conservation efforts at the scale of thousands of acres of forest. Across New England there are certain tree species that are beleaguered by invasive insects; in some cases private landowners attempt to liquidate all that timber before the trees are inevitably attacked, hoping to not lose too much monetary value, or possibly to make room for more commercially desirable trees. SHC has the land and the expertise available to think differently. Ash, beech, butternut, and hemlock have uncertain futures in the region, and SHC can play a role in giving these species a chance at restoration and retaining diversity across the forest.

- **White ash**: In addition to the recommendations mentioned in the Impending Threats section, when planning a harvest at SHC consider treating the species like you would any other species. That is, do not attempt to salvage extra ash in advance of EAB, in case there is innate resistance in certain individuals.
- **Butternut:** Several butternuts were observed at rich sites at SHC, but their resistance to the Oc-j fungal pathogen is unknown. Following Pike et al. (2021), we recommend collecting seeds and seedlings to attempt restoration—this can be incorporated into SHC educational programming in a very hands-on and child-friendly way. Small patch cuts near healthy, seed-producing butternuts, followed by soil disturbance and protection from deer browse, are a potential silvicultural approach to restoring the species while addressing other management goals of diversifying stand age and structure. Observed butternut (and red oak) locations are in Appendix D.
- **Red oak:** While not a rare species, these trees are uncommon enough in the northern hardwoods, and a valuable source of hard mast for wildlife, to recommend that SHC avoid harvesting red oaks when possible, in order to retain them into the future. While regenerating oak is difficult in these forests, the available seed trees are only around 80 years old and should last several more decades, or even another century or two, in the canopy.
- **Eastern hemlock:** Retain both as thermal cover for wildlife and for possible resistance as the woolly adelgid makes incursions into the immediate vicinity.
- **Red spruce:** Variable thinning with gaps could be useful in promoting red spruce where regeneration is already present but under hardwoods. Increasing red spruce (and hemlock where available, despite adelgid) should help keep sites cooler as temperatures get warmer.
- **American beech:** Manage for BBD and mast yield. This species is struggling, but there is hope in the pocket of larger-sized and sometimes seemingly healthy beech on the foothills of Jackson Peak, within the Rich Northern Hardwoods just downslope of the Montane Yellow Birch-Red Spruce zone. SHC has a responsibility to maintain this small stronghold of beech, and steward them if they are indeed resistant—even partially—to BBD, with the goal of regenerating further beech in this zone and, in doing so, taking steps toward the restoration of the species in New England's northern hardwoods.

American beech is normally one of the few truly long-lived and persistent tree species in Vermont's forests—along with eastern hemlock and sugar maple. At SHC, it is also the main source of hard mast for wildlife, apart from the occasional red oak or butternut. Beech mast is an important resource for black bear, deer, mustelids, turkeys, grouse, and small mammals and songbirds. Even when cut, or toppled by wind, during the first year a downed tree can clonally sprout a thicket of root suckers, allowing it to stay dominant in the vegetation layer even through disturbances.

Beech bark disease has changed this dynamic for beech, since the root suckers are genetically identical to the parent tree and will suffer the same effects of scale attack and fungal entry. A very small proportion of trees manage to stay totally resistant to the scale insect, and some trees can stay relatively healthy despite a scale infestation (these are called "partially resistant"). Removing any beech showing BBD symptoms is not recommended, as some of these may be partially resistant and continue to produce mast. Instead, refraining from harvesting any healthy beech is preferred; while some people worry about beech outcompeting the more commercially desirable sugar maple in northern hardwood forests, beech tends to excel in drier, upland soils that are not as mesic and calcareous as sugar maple's preferred sites. Therefore the dominance of beech is very reliant on site conditions and these sites should not be viewed as ideal sugar maple locations.

rees used
ast production

As a late successional, thin-barked species, American beech is susceptible to sunscald (a winter and spring injury to the bark caused by freezing temperatures followed by warming from direct sun exposure), so harvesting near healthy beech should be approached with caution. VT ANR has guidelines for buffer zones that can protect trees from sunscald by shading the south side of beech boles. To increase mast yield, ANR recommends uneven-aged silvicultural management, with crown release being a key strategy for both crop tree improvement and for enhancing tree vigor when BBD is present. We suggest examining the block of northwest-facing hillside highlighted in Figure 38 more closely to determine if it might be managed to qualify as a "Beech Mast Production Area," by following the 2011 optimization guidelines for BBD reduction and healthy mast production.

Points with noted American beech on the
-6, and 2-7. While much of this beech is
ly-looking trees within the blue oval, and
the purple circle that qualify the spot as a
' ANR definitions in the 2011 management

Further Reading:

Exemplary Forestry for the 21st Century: Managing the Acadian Forest for Bird's Feet and Board Feet at a Landscape Scale. New England Forestry Foundation.

Silvicultural Guide for Northern Hardwoods in the Northeast. USFS.

Managing Rich Northern Hardwood Forests for Ecological Values and Timber Production: Recommendations for Landowners in the Taconic Mountains. The Nature Conservancy.

Voluntary Harvesting Guidelines for Landowners in Vermont. Vermont Department of Forests, Parks and Recreation.

Silviculture with Birds in Mind: Options for Integrating Timber and Songbird Habitat Management in Northern Hardwood Stands in Vermont. USFS and Audubon Society.

Ten Recommendations for Managing Ash in the Face of Emerald Ash Borer and Climate Change.

Forest Stewards Guild.

Management Guidelines for Optimizing Mast Yields in Beech Mast Production Areas. Vermont Agency of Natural Resources.

Vermont Water Quality Acceptable Management Practices: Manual For Logging Professionals. Vermont Agency of Natural resources, Department of Forests, Parks and Recreation.

Forest Resilience and Climate Change

New England's climate has already changed in the last hundred years: winters are shorter, rains and winds are more intense and unpredictable, and temperatures are higher. Spring is occurring earlier in the year, but frosts haven't shifted accordingly, leaving trees vulnerable to damage during reproduction and growth. Droughts are also predicted to be more common. Invasive species are expected to benefit from many of these direct stressors to native trees, whether due to expanded growing range or simply out of a competitive advantage in the new conditions, exacerbated by the fact that deer prefer to browse native vegetation.

In order to foster resilience in SHC's forests, reducing the number of stressors on trees is essential. Controlling invasives, pests, and disease; providing trees healthy growing space to enhance their vigor; harvesting carefully to retain healthy soils and waterways; and managing successional stages (and allowing hunting) across property to balance deer browse all play a part in giving trees the opportunity to weather changing conditions.

Diversity, which we discussed in the Fish and Wildlife Habitat section, also plays a significant role in forest resilience, whether it be a variety of species, ages, sizes, or arrangement. Managing SHC to maintain such complexity is a relatively simple matter, as the stewardship undertaken since the late 1980s has for the most part created a healthy forest diversity today.

In their publication, "Increasing Forest Resiliency for an Uncertain Future," Paul Catanzaro, Tony D'Amato, and Emily Huff recommend promoting species that are future-adapted, or more competitive in the conditions that will exist during climate change. In Northern New England under a high-emissions scenario, the species that are predicted to have increased suitable habitat in the year 2100 are oaks and hickories, along with black birch, black cherry, and basswood. All the dominant northern hardwood trees (sugar maple, American beech, yellow birch) as well as red spruce and balsam fir are projected to have decreased suitable habitat, however are expected to persist on sites that are most suited to them. Active management can serve as a way of keeping northern hardwoods healthy and growing at SHC into the future. While these expected changes are unsettling for anyone who loves the northern forests of Vermont, the authors emphasize that the best strategies for promoting forest resilience are to keep forest forested and connected, reduce stressors and vulnerability, and provide refuge through diversity.

SHC's forests are already diverse, thanks in part to the range of underlying bedrock and topographic conditions. Despite the homogenization that clearcutting and high grading caused in the early 20th century, silvicultural actions taken since the 1980s have balanced the age and size classes through much of the forest, and species diversity has followed the range of conditions on the property, as evinced by trees like red oak favoring the drier south-facing slopes in the northern half of SHC, and large yellow birch excelling in the cool, moist north-facing foothills of the mountains in the southern half of SHC.

Further Reading:

Increasing Forest Resiliency for an Uncertain Future. Paul Catanzaro, Anthony D'Amato, Emily Silver Huff.

On Benefits and Drawbacks of Active Vs Passive Management for Carbon Storage: Forest Carbon: An essential natural solution for climate change. Paul Catanzaro, Anthony D'Amato.

How the Climate Crisis and Pests Are Impacting Four Tree Species in Vermont's Woods. Margaret Grayson. Seven Days.

Appendices

Appendix A. Aerial Images

Figure 39. *1985 Satellite imagery via Google Earth. The main takeaway from this blurry image is that conifer cover may have extended further on Woodlawn (especially the back side off SHC property) than it does now, although this is unclear.*

Figure 40. *1994 USGS imagery via Google Earth.*

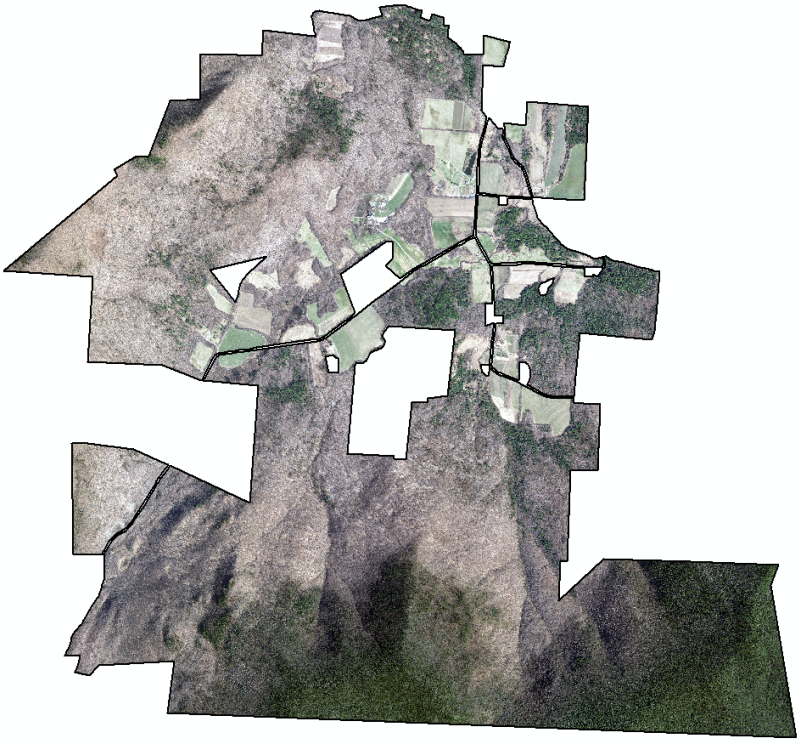


Figure 41. *Vermont 2016 orthoimagery at 3-meter resolution, and excluding outparcels at SHC. Some of the conifer cover south of Woodlawn seems less dense since 1994, and different patch cuts are now visible on the north end of the property.*

Appendix B. Soil Map

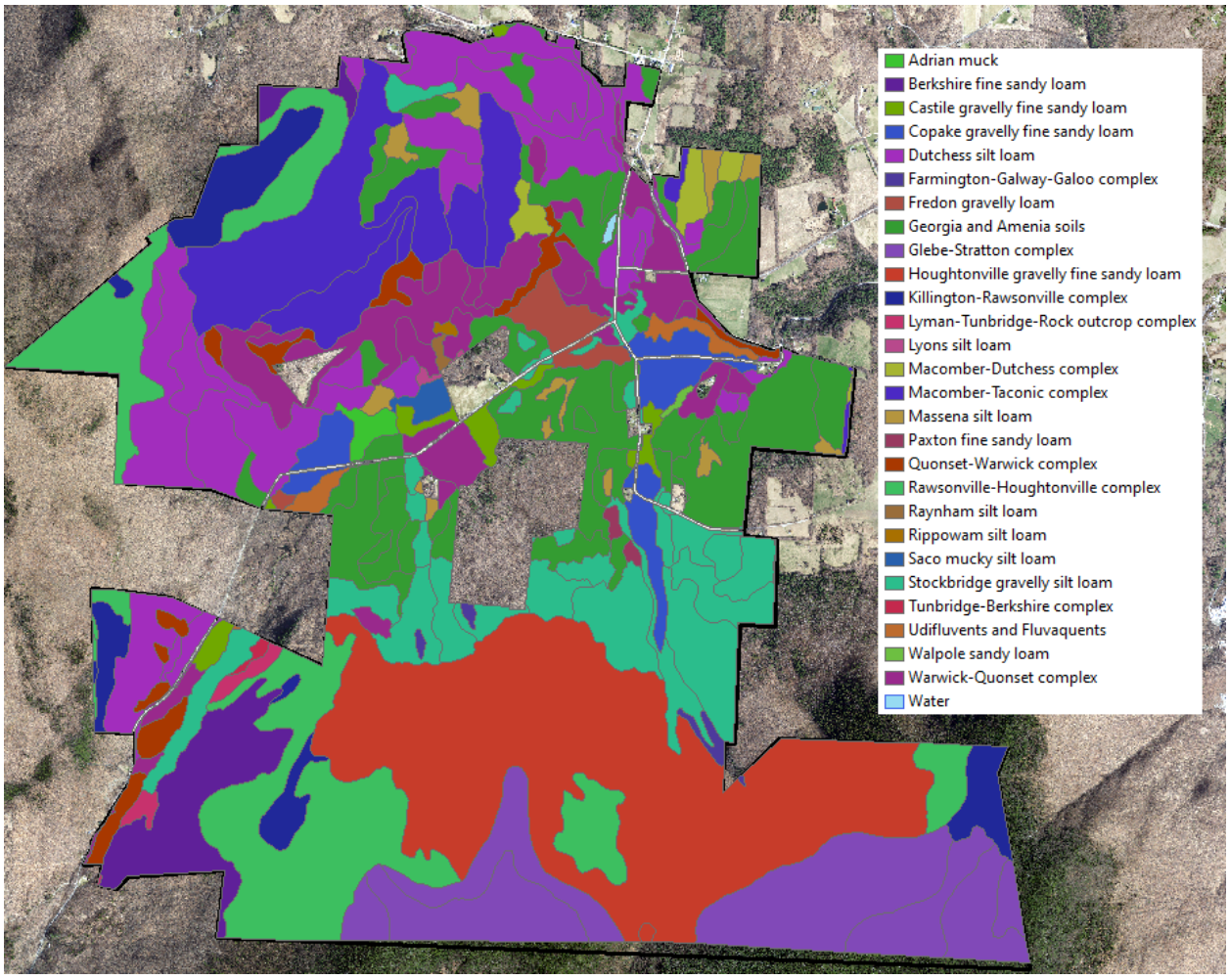


Figure 42. *A map showing all the soil complexes on the property. Source: NRCS*

Appendix C. Sugar Maple Site Index

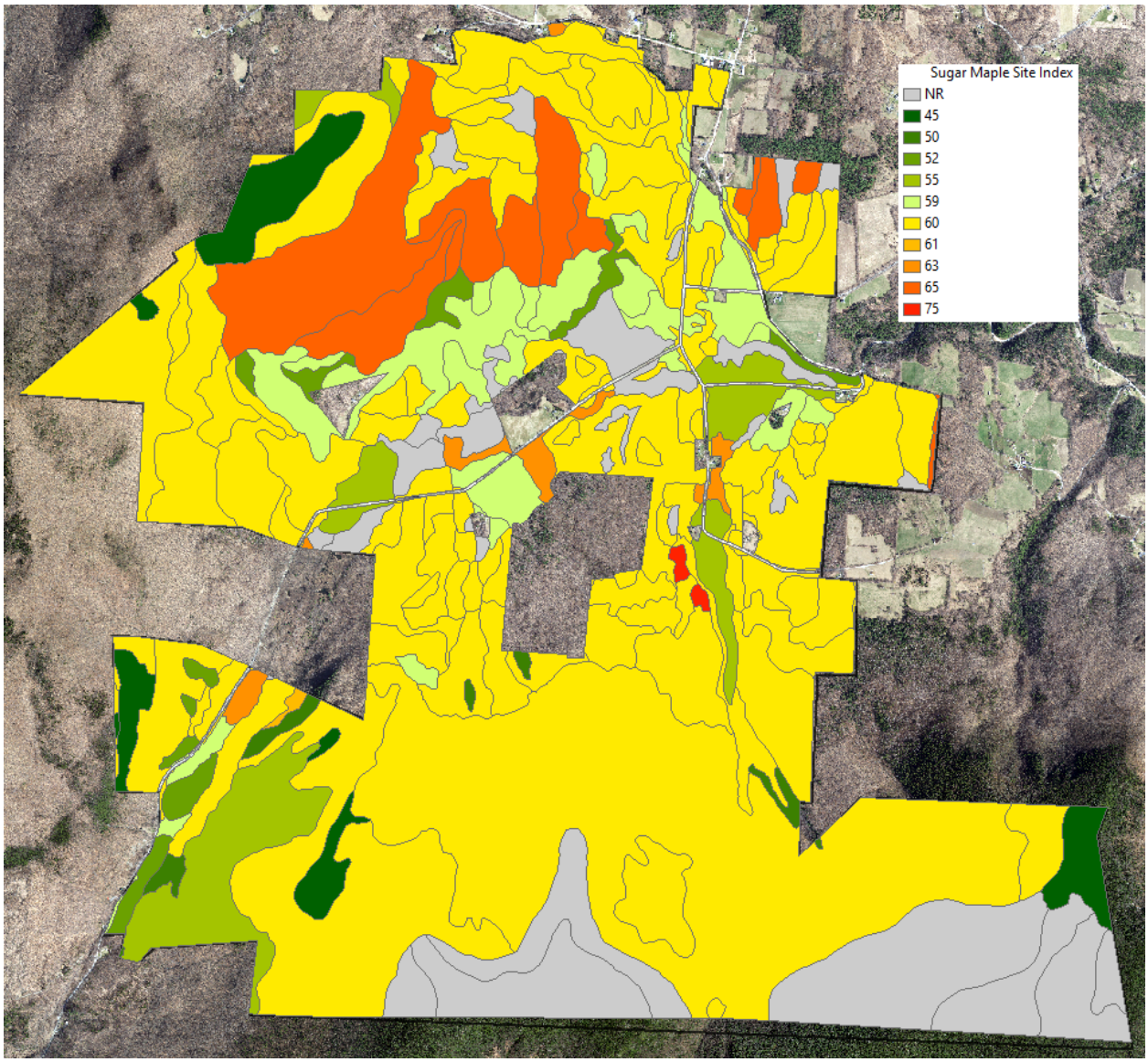


Figure 43. *Soils categorized by sugar maple site index. Source: NRCS*

Appendix D. Butternut and Red Oak Map

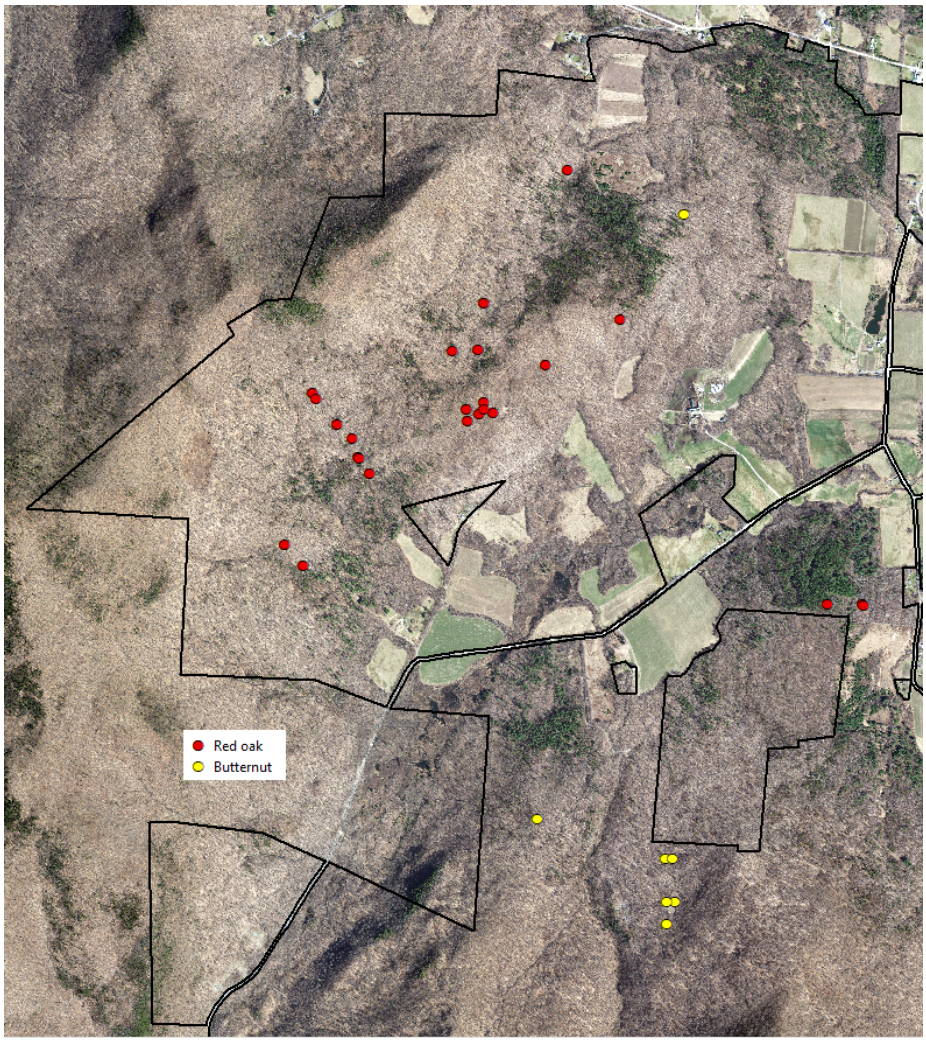


Figure 44. *Locations where butternut and red oaks were observed during April and May, 2021. Butternuts are not necessarily Oc-j resistant and should be re-examined to then report viability to the TreeSnap mobile app and/or the VT FPR Forest Biology Lab (trish.hanson@vermont.gov).*

Appendix E. Board Survey Questions

SHC Conservation Vision and Values
A survey by Blanca Begert and Seth Inman to inform Smokey House Center's forest conservation plan.

1. The current Smokey House Center ten-year forest management plan considers multiple values. Those are listed here, along with other values mentioned in the NEFF Easement and in the SHC mission statement. Recognizing that many of these values are interrelated, please rank what you view as the top priorities in the order of 1-10.

Soil productivity
Soil stability (re: erosion)
Timber harvesting
Protecting and creating habitat for endangered, rare, threatened species
Increasing the richness of plant and animal species (biodiversity)
Protecting and creating regional wildlife corridors
Protecting sensitive areas of high ecological value (ie wetland and riparian areas, high elevation areas, vernal pools, old forests, natural communities of statewide significance)
Aesthetic beauty
Recreation (non-commercial)
Forest carbon storage and sequestration
Forest climate resilience and adaptation
Protection and improvement of water quality
Non-timber forest products (ie: maple sugar)
Promoting a rural way of life and land-based livelihoods
Protecting areas of historical value and other cultural features of the landscape
Education activities related to forestry
Education activities related to ecology and conservation
Employing and training youth
Research
Other_____

2. Recognizing that many terms we use to talk about forests are subjective, please elaborate on your top three choices explaining how you understand these values and why you chose them.

3. How are working lands / forests and conservation related in your mind?

4. What do you consider to be the benefit and goal of maintaining working lands as part of Smokey House's forest management plan? (ie: support rural economy, preserve forestry-based livelihoods and culture, support SHC income, promote forest resilience through active management)

5. The term re-wilding has come up in some discussions. What do you take re-wilding to mean? (Does it have to do with restoration / reintroduction of species? With a hands-off, never cut approach to forests? What does a "wild" Smokey House forest look like? Is this desirable and why or why not?)

6. What makes Smokey House a special place? What is the role of forests in the work and mission of the Smokey House Center? (answer could reference ecological, cultural, or economic attributes - ie: high elevation habitat, scale, working lands mission, aesthetic beauty, educational opportunities)

7. Considering SHC's mission to engage people in meaningful ways, including through educational programming, please rank the following 1-10 in order of priority for public engagement related to forests.

Education / demonstration of silviculture, conservation, and natural resource management approaches for landowners
Education / demonstration of conservation and natural resource management for the general public
Employment of foresters, loggers, and others in the local timber economy

Employment of maple tappers and others in the local non-timber forest product economies
Training youth for jobs forestry and other land-based livelihoods
Training youth for jobs in conservation and natural resource management (apart from forestry and farming)
Providing an outdoor classroom for student education (school and general interest related vs job focused)
Providing an outdoor lab for forest/conservation research
Providing access to hiking for the public
Providing access to other types of non-commercial recreation
Other___

8. Please explain why you selected your top three choices.

9. Who are other people that you think would be important to involve in decision-making about what happens at Smokey House? (ie: neighbors, other land managers in regional wildlife corridors, local teachers, Abenaki and Mohican tribes, conservation professionals in state agencies, funders)

10. What does it look like for Smokey House to be successful with forest conservation? Do the Smokey House forests of the future look different than they do now? Are different activities happening in them?

Appendix F. SHC 2021 Forest Stand 1-8b & 2-5 Inventory Summary

Prepared by Steve Handfield May 17th, 2021

On May 12th 2021, the western halves of Stands 1-8b (29.7+/- acres) and 2-5 (97.4+/- acres) underwent a systematic random 10 BAF point sample to quantify the existing conditions of the timber resource. The following information could be used now or in the future to develop silvicultural prescriptions as required to harvest timber on land enrolled in the conservation land category of the Vermont Use Value Appraisal Program (UVA or "current use").

Values used to estimate the timber value of the sampled stands were based on log market conditions on May 17th 2021, though the estimated timber *volumes* could be used to estimate timber values in the future as log markets change. Average values per MBF were used for generating the estimated timber values. These do not take into account the possibility of higher than typical proportions of more valuable veneer quality sugar maple logs, or conversely the possibility of "large hearted" sugar maple logs of lesser value.

The timber values represent the estimated total timber value of all merchantable trees 10"+ at DBH in the stands, or the "liquidation value". This is useful to know for forest management and asset planning purposes, and to give SHC board members and stakeholders an idea as to the standing value of the timber resource in just a few small areas of the several thousand acres of productive forestland.

The emphasis of actively managing portions of the forestland at SHC has been to help shape and promote vigorous, resilient forests. Harvests have aimed to create and maintain tree and plant species diversity, as well as maximize structural diversity to the extent possible that creates habitat conditions suitable to as many wildlife species as possible. Not having to pressure the forest for revenue, rather managing to promote it's long term viability in the face of climate change and increasing exotic forest pests, sets the forests at SHC apart from many ownerships in the area. A nice byproduct of managing for these non-timber objectives is the periodic revenue from the trees that are cut!

Total Timber Value to SHC after Logging & Trucking Costs:

Western Half of Stand 1-8b, 29.7+/- acres: $64,621.30
Western Half of Stand 2-5, 97.4+/- acres: $331,361.40

Stand 1-8b Inventory Map

Stand 1-8b Timber Volume by Species, 29.7 acres				
Species	**Total MBF**	**Total Pulp Cords**	**Total MBF Values**	**Total Pulp Values**
White Pine	17.58	3.86	$1,758.20	$8.49
Sugar Maple	61.71	219.48	$37,026.00	$1,097.40
Yellow Birch	0	21.68	$0.00	$108.40
Paper Birch	0	11.88	$0.00	$59.00
White Ash	63.37	51.38	$15,842.00	$256.90
Popple	0	31.77	$0.00	$158.85
Black Cherry	25.12	106.62	$7,536.00	$533.10
Basswood	3.80	1.78	$190.00	$3.91
Elm	0	8.61	$0.00	$43.05
STAND TOTAL	**171.58**	**457**	**$62,352.20**	**$2,269.10**

minimum 12" at DBH for hard logs, ≥ 10" DIB at Small End
minimum 10" at DBH for soft logs, ≥ 8" DIB at Small End
minimum 8" at DBH for pulp tree, ≥ 6" DIB at Small End

Stand 1-8b Timber Volume by DBH		
DBH Class	**Total MBF**	**Total Pulp Cords**
< 12"	0	59.69
12-14"	23.43	165.13
16-18"	59.04	129.19
20-24"	67.80	97.11
26"+	21.31	5.94
STAND TOTAL	**171.58**	**457**

1-8b Sugar Maple Volume	
DBH Class	**Total MBF**
< 12"	0
12-14"	9.88
16-18"	21.16
20-24"	26.88
26"+	3.79
TOTAL / ACRE	**61.71**

1-8b White Ash Volume	
DBH Class	**Total MBF**
< 12"	0
12-14"	11.80
16-18"	25.35
20-24"	26.22
26"+	0
TOTAL / ACRE	**63.37**

Stand 2-5 Inventory Map

Stand 2-5 Timber Volume by Species, 97.4 acres				
Species	**Total MBF**	**Total Pulp Cords**	**Total MBF Values**	**Total Pulp Values**
Red Maple	4.96	18.51	$992.00	$92.55
Sugar Maple	494.79	1041.21	$296,874.00	$5,206.05
Yellow Birch	18.79	86.69	$5,637.00	$433.45
Paper Birch	0	20.45	$0.00	$102.25
Beech	3.40	82.79	$170.00	$413.95
White Ash	82.49	129.54	$20,622.00	$647.70
Hophornbeam	0	11.69	$0.00	$58.45
Black Cherry	0	16.56	$0.00	$82.80
Butternut	0	5.84	$0.00	$29.20
STAND TOTAL	**604.43**	**1413**	**$324,295.00**	**$7,066.40**

minimum 12" at DBH for hard logs, ≥ 10" DIB at Small End
minimum 10" at DBH for soft logs, ≥ 8" DIB at Small End
minimum 8" at DBH for pulp tree, ≥ 6" DIB at Small End

Stand 2-5 Timber Volume by DBH		
DBH Class	Total MBF	Total Pulp Cords
< 12"	0	89.60
12-14"	39.73	502.33
16-18"	219.44	402.26
20-24"	291.31	327.26
26"+	53.95	91.55
STAND TOTAL	604.43	1413

2-5 Sugar Maple Volume	
DBH Class	Total MBF
< 12"	0
12-14"	28.83
16-18"	160.82
20-24"	261.83
26"+	43.31
TOTAL / ACRE	494.79

2-5 White Ash Volume	
DBH Class	Total MBF
< 12"	0
12-14"	5.29
16-18"	39.27
20-24"	29.57
26"+	8.36
TOTAL / ACRE	82.49

<u>Stand 1-8b (Western Half)</u>

History: No evidence of past logging was observed.
Acres: 29.70
Forest Type: Northern Hardwoods

Species Composition (BA%): sugar maple 49
white ash 20
black cherry 16
yellow birch 4
quaking aspen 3

Inventory Date: May 2021 **Prism Factor:** 10 **Number of Points:** 9

Soil Type: 44C, Dutchess silt loam, 8-15% slopes

Site Index spp: sugar maple **Site Index:** 60

Site Class: 1, determined from Rutland County Soil Survey

Age Class Structure Existing: uneven

Age Class Structure Desired: uneven

QMSD: 11.21" **Q Factor:** 1.24 **Trees Per Acre:** 173

Total BA: 119 **AGS BA:** 98 **UGS BA:** 21

Basal Area Size Class Distribution			
Size	AGS	UGS	TOTAL
6-10"	27	4	31
12-16"	41	4	45
18-22"	22	11	33
24"+	8	2	10
TOTAL	98	21	119

Board Feet Per Acre: 5,777 **Total Board Feet:** 171,576
Pulp Cords Per Acre: 15.38 **Total Pulp Cords: 457**

Regeneration: Established sugar maple saplings were present at low densities throughout the stand.

Forest Health: No significant damaging agents or invasive plant species were observed.

Water Resources: A sizeable stream runs west to east through the middle of the stand. There is also a vernal pool near the middle of the stand. The southwestern section of the stand is generally wet.

Stand Description:
Stand 1-8b consists of 29.70 acres of northern hardwoods type forest, sugar maple dominant. The aspect is eastern and the slope is 8-15%. The terrain ranges from nearly level to gently sloping. The stand is uneven-aged and fully stocked (at A-line) for northern hardwoods type forest. The site is very productive, well suited to growing high quality hardwoods. Logging operability and access is excellent, and the site would be workable during frozen winter or dry summer conditions. All AMP's were in place on existing trails.

The majority of the stand consists of pole to large sawtimber sized sugar maple, with lesser amounts of pole to large sawtimber sized white ash and pole to medium sawtimber sized black cherry, and scattered pole to medium sawtimber sized

yellow birch and small to medium sawtimber sized quaking aspen. Associate species include paper birch, eastern white pine, American beech, red maple, eastern hophornbeam, basswood, and American elm. Established sugar maple saplings were present at low densities throughout the stand. Overall quality is excellent (83% AGS), and most of the UGS are poorly formed sugar maple and black cherry.

Tree spacing and species distribution is fairly uniform throughout the stand. The site is fully occupied, as evidenced by signs of decline (flagging) in overstocked areas. Most of the sugar maple and black cherry appeared to be vigorous, while many of the white ash appeared to be in decline from an unknown causal agent (not emerald ash borer, EAB). The timber production potential of the stand is excellent. An uneven aged harvest is warranted. In light of EAB infestations in nearby towns, salvaging many of the AGS sawtimber sized white ash is recommended, with a focus on retaining vigorous, structurally sound trees of the other species present.

Stand 2-5 (Western Half)

History: Based on the absence of stumps, and some discernible skid damage, the majority of stand appears to have been cut 25+/- years ago.

Acres: 97.40 **Forest Type:** Sugar Maple

Species Composition (BA%):		
sugar maple	75	
white ash		9
yellow birch	7	
American beech		7
red maple		2

Inventory Date: May 2021 **Prism Factor:** 10 **Number of Points:** 25

Soil Type: 125E, Berkshire gravelly fine sandy loam, 35-50% slopes, very stony

Site Index spp: sugar maple **Site Index:** 52

Site Class: 3, determined from Rutland County Soil Survey

Age Class Structure Existing: uneven

Age Class Structure Desired: uneven

QMSD: 14.30" **Q Factor:** 1.19 **Trees Per Acre:** 95

Total BA: 107 **AGS BA:** 84 **UGS BA:** 23

Basal Area Size Class Distribution			
Size	AGS	UGS	TOTAL
6-10"	5	6	11
12-16"	32	10	42
18-22"	35	5	40
24"+	12	2	14
TOTAL	84	23	107

Board Feet Per Acre: 6,205 **Total Board Feet:** 604,430

Pulp Cords Per Acre: 14.51 **Total Pulp Cords:** 1,413

Regeneration: Established sugar maple, American beech, and striped maple saplings were present at low to medium densities throughout the stand.

Forest Health: No invasive plant species were observed. Most of the American beech showed signs of and are in varying stages of decline from beech bark disease (BBD).

Water Resources: A small stream runs southeast to northwest through the northern section of the stand.
Stand Description:

Stand 2-5 consists of 97.40 acres of sugar maple type forest. The aspect is western and northwestern, and the slope is 35-50%. Portions of the stand are nearly level to gently sloping, though most of the stand terrain can be characterized as strongly sloping to steep. The stand is uneven-aged and adequately stocked (between A-line and B-line, nearer A-line) for sugar maple type forest. Site productivity is excellent, and well suited to growing high quality hardwoods. Logging operability and access is good for skilled hand-cutters, and the site would be workable during frozen winter or dry summer conditions. All AMP's were in place on existing trails.

The majority of the stand consists of pole to large sawtimber sized sugar maple, with lesser amounts of small to large sawtimber sized white ash, pole to large sawtimber sized yellow birch, pole to small sawtimber sized American beech, and small to medium sawtimber sized red maple. Associate species include paper birch, eastern hophornbeam, black cherry, and butternut. Established sugar maple, American beech, and striped maple saplings were present at low to medium densities throughout the stand. Overall quality is good (79% AGS), and most of the UGS are poorly formed sugar maple and diseased American beech in advanced stages of decline from BBD.

Tree spacing is fairly uniform throughout the stand. Species distribution varies in that the southwestern 1/4th of the stand is still sugar maple dominant, but contains most of the white ash, yellow birch, American beech, and red maple. The northeastern 3/4th of the stand is near-pure sugar maple. Competition for sunlight among trees in the upper canopy is becoming a limiting factor. The timber production potential of the stand is excellent. An uneven-aged harvest is warranted.

Appendix G. New England Wildlife by Forest Habitat

Adapted from General Technical Report NE-144 by the Northeastern Forest Experiment Station, USFS, 1992.

G1 – Animals that forage and shelter in coarse woody material

1. Marbled salamander
2. Jefferson salamander
3. Silvery salamander
4. Blue-spotted salamander
5. Tremblay's salamander
6. Spotted salamander
7. Red-spotted newt (eft)
8. Mountain dusky salamander
9. Redback salamander
10. Slimy salamander
11. Four-toed salamander
12. Five-lined skink
13. Northern ringneck snake
14. Northern black racer
15. Black rat snake
16. Eastern milk snake
17. Northern copperhead
18. Ruffed Grouse
19. Winter Wren
20. Worm-eating Warbler
21. Canada Warbler
22. Virginia opossum
23. Masked shrew
24. Smoky shrew
25. Long-tailed shrew
26. Pygmy shrew
27. Eastern chipmunk
28. White-footed mouse
29. Southern red-backed vole
30. Gray fox
31. Black bear
32. Marten
33. Fisher
34. Ermine
35. Long-tailed weasel
36. Mink
37. Striped skunk
38. Lynx
39. Bobcat

G2 – Animals that use slash piles for denning sites and hiding cover

1. Red-spotted newt (eft)
2. Redback salamander
3. Wood frog
4. Eastern box turtle
5. Northern brown snake
6. Northern ringneck snake
7. Northern black racer
8. House Wren
9. Winter Wren
10. Virginia opossum
11. Eastern cottontail
12. New England cottontail
13. Southern red-backed vole
14. Black bear
15. Ermine

G3 – Animals that forage on hard mast (e.g., beechnuts and acorns) and soft mast (e.g., blackberries, dewberries)

1. Ruffed Grouse
2. Wild Turkey
3. Red-headed Woodpecker
4. Hairy Woodpecker
5. Blue Jay
6. American Crow
7. Common Raven
8. Black-capped Chickadee
9. Tufted Titmouse
10. White-breasted Nuthatch
11. Brown Creeper
12. Northern Mockingbird
13. Brown Thrasher
14. Cedar Waxwing
15. Common Grackle
16. Virginia opossum
17. Eastern chipmunk
18. Gray squirrel
19. Red squirrel
20. Southern flying squirrel
21. Northern flying squirrel
22. Deer mouse
23. White-footed mouse
24. Southern red-backed vole
25. Woodland vole
26. Meadow jumping mouse
27. Porcupine
28. Coyote
29. Red fox
30. Gray fox
31. Black bear
32. Raccoon

33. Striped skunk
34. White-tailed deer

G4 – Animals that exhibit a preference for closed overstory canopy conditions:

1. Red-breasted Nuthatch
2. White-breasted Nuthatch
3. Brown Creeper
4. House Wren
5. Winter Wren
6. Eastern Bluebird
7. Prothonotary Warbler
8. Virginia opossum
9. Little brown myotis (bat)
10. Keen's myotis (bat)
11. Indiana myotis (bat)
12. Silver-haired bat
13. Big brown bat
14. Gray squirrel
15. Red squirrel
16. Southern flying squirrel
17. Northern flying squirrel
18. Porcupine
19. Gray fox
20. Black bear
21. Raccoon
22. Marten
23. Fisher
24. Ermine
25. Long-tailed weasel

G5 – Animals that rely on a strong ground vegetation layer (0- to 2-foot zone at greater than 50 percent coverage) to forage, seek cover, or nest:

1. Eastern ribbon snake
2. Eastern smooth green snake
3. Ruffed Grouse
4. Wild Turkey
5. Red-headed Woodpecker
6. Least Flycatcher
7. Eastern Kingbird
8. Purple Martin
9. Tree Swallow
10. Northern Rough-winged Swallow
11. Barn Swallow
12. Eastern Bluebird
13. Northern Shrike
14. Blue-winged Warbler
15. Golden-winged Warbler
16. Tennessee Warbler
17. Nashville Warbler
18. Yellow Warbler
19. Prairie Warbler
20. Palm Warbler
21. Black-and-white Warbler
22. Mourning Warbler
23. Common Yellowthroat
24. Hooded Warbler
25. Indigo Bunting
26. Field Sparrow
27. Song Sparrow
28. Lincoln's Sparrow
29. White-throated Sparrow
30. Dark-eyed Junco
31. Common Grackle
32. Common Redpoll
33. American Goldfinch
34. Least shrew
35. Hairy-tailed mole
36. Eastern cottontail
37. Deer mouse
38. Meadow vole
39. Woodland vole
40. Meadow jumping mouse
41. Woodland jumping mouse
42. White-tailed deer

G6 – Animals that rely on a strong shrub vegetation layer (deciduous, coniferous, and ericaceous shrubs and seedlings within 2- to 10-feet tall, usually but not always with an overstory canopy present) to forage, seek cover, or nest:

1. Northern spring peeper
2. Wild turkey
3. Northern Bobwhite
4. Black-billed Cuckoo
5. Yellow-billed Cuckoo
6. Whippoorwill
7. Ruby-throated Hummingbird
8. Olive-sided Flycatcher
9. Yellow-bellied Flycatcher
10. Acadian Flycatcher
11. Alder Flycatcher
12. Willow Flycatcher
13. Eastern Kingbird
14. Carolina Wren
15. House Wren
16. Winter Wren
17. Veery
18. Gray-cheeked Thrush
19. Swainson's Thrush
20. Hermit Thrush
21. Wood Thrush
22. Gray Catbird
23. Northern Mockingbird
24. Brown Thrasher
25. Cedar Waxwing
26. Northern Shrike
27. White-eyed Vireo
28. Solitary Vireo
29. Philadelphia Vireo
30. Blue-winged Warbler
31. Golden-winged Warbler
32. Tennessee Warbler
33. Nashville Warbler
34. Yellow Warbler
35. Chestnut-sided Warbler
36. Magnolia Warbler
37. Black-throated Blue Warbler
38. Yellow-rumped Warbler
39. Prairie Warbler
40. Palm Warbler
41. Blackpoll Warbler
42. Black-and-white Warbler
43. American Redstart
44. Worm-eating Warbler
45. Northern Waterthrush
46. Louisiana Waterthrush
47. Mourning Warbler
48. Common Yellowthroat
49. Hooded Warbler
50. Wilson's Warbler
51. Canada Warbler
52. Yellow-breasted Chat
53. Northern Cardinal
54. Rose-breasted Grosbeak
55. Indigo Bunting
56. Rufous-sided Towhee
57. American Tree Sparrow
58. Chipping Sparrow
59. Field Sparrow
60. Fox Sparrow
61. Song Sparrow
62. Lincoln's Sparrow
63. White-throated Sparrow
64. Dark-eyed Junco
65. Red-winged Blackbird
66. Common Grackle
67. Common Redpoll
68. Pine Siskin
69. American Goldfinch
70. Short-tailed shrew
71. Least shrew
72. Hairy-tailed mole
73. Eastern mole
74. Star-nosed mole
75. Hoary bat
76. Eastern cottontail
77. New England cottontail
78. Eastern chipmunk
79. Woodchuck
80. White-footed mouse
81. Southern red-backed vole
82. Meadow vole
83. Woodland vole
84. Meadow jumping mouse
85. Red fox
86. Black bear
87. Ermine
88. Bobcat
89. White-tailed Deer
90. Moose

Additional Literature Cited:

Ackerly, D. D, Loarie, S. R., Cornwell, W. K., Weiss, S. B., Hamilton, H., Branciforte, R., Kraft, N. J. B. (2010). The geography of climate change: implications for conservation biogeography. Diversity and Distributions 16:476–487.

Anderson, M. G., and C. E. Ferree. (2010). Conserving the Stage: Climate Change and the Geophysical Underpinnings of Species Diversity. PLoS ONE 5(7).

Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery, B. (2016). Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

Beier, P., and Brost, B. (2010). Use of land facets to plan for climate change: conserving the arenas, not the actors. Conservation Biology 24:701–710.

Calhoun, A. J. K. and P. deMaynadier. 2004. Forestry habitat management guidelines for vernal pool wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

DeGraaf, Richard M.; Yamasaki, Mariko; Leak, William B.; Lester, Anna M. 2006. Technical guide to forest wildlife habitat management in New England. Burlington, VT: University of Vermont Press, and Hanover, NH: University Press of New England. 305 p.

Evancie, Angela. "What Is The Status Of The Abenaki Native Americans In Vermont Today?" https://www.vpr.org/post/what-status-abenaki-native-americans-vermont-today

Fernandez-Going, B. M., Harrison, S. (2013). Climate interacts with soil to produce beta diversity in Californian plant communities. Ecology 94: 2007–2018.

Keppel G., Van Niel, K. P, Wardell-Johnson, G. W., Yates, C. J., Byrne, M., Mucina, L., Schut, A. G. T., Hopper, S. D., Franklin, S. E. (2012). Refugia: identifying and understanding safe havens for biodiversity under climate change. Global Ecology and Biogeography 21: 393–404.

Mark S. Ashton and Matthew J. Kelty. Chapter 24: Silviculture for Wildlife Habitat. *The Practice of Silviculture: Applied Forest Ecology*. Tenth Edition. 2018 John Wiley & Sons Ltd.

Peterson, David L., et al. (1997). Gradients, Vegetation and Climate: Spatial and Temporal Dynamics in the Olympic Mountains, U.S.A. Global Ecology and Biogeography Letters 6(1): 7–17.

Pike, C., Williams, M., Brennan, A., Woeste, K., Jacobs, J., Hoban, S., Moore, M. and J. Romero-Severson. (2021). Save Our Species: A Blueprint for Restoring Butternut (*Juglans cinerea*) across Eastern North America. Journal of Forestry 119(2): 196–206.

Thompson, Elizabeth H., Eric R. Sorenson, and Robert J. Zaino. 2019. *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont, 2nd Edition* Montpelier; White River Junction: Vermont Fish and Wildlife Department.