A Model of the Integrated Forest Inventory: Combining Conservation and Commodity Values Using the Natural Community Classification System and the Forest Examination Inventory

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Abstract

The current trend in forest management toward an ecosystem approach warrants a revision in forest inventory methods. In Vermont it has been suggested that the more traditional Forest Examination (FOREX) inventory system could benefit from being combined with the Natural Heritage Program's "natural community" inventory system, which could supply more comprehensive information about regional biological diversity. A field test was conducted on Mt. Mansfield to answer if combining the two is practical and informative. The concept of "a sense of place" is then explored in relation to the management shift to an ecosystem perspective, out of which the need for integrated inventories, such as the above, has arisen.

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Introduction: The evolution, description, and creation of the integrated forest inventory

Historical changes in forest management philosophy

The philosophy of resource management in the United States has changed drastically from its beginnings in the late 19th century. Originally, federally owned land was distributed freely to citizens, encouraging them to pick up their belongings and move westward to seek their fortune. Land management under the Homestead Act of 1862 was absent, and private use of lands was almost completely unrestricted (Loomis 1993). The creation of the United States Forest Service in 1905 began a philosophy of active land management. In an age of industrial expansion, managers intervened in the rapid privatization of public lands, worried that the resources on them would eventually be depleted if no action was taken (Loomis 1993).

In the post-World War II era, the nation found itself growing more interested in public lands for their recreation value. "Increasingly in the 1950's and 1960's wilderness preservationists [were] faced with the problem of too much popularity for wilderness..." (Nash 1967:323) As awareness of the public lands grew, so did the concern for how they were being managed. The public and a faction of the scientific community became dissatisfied with the widespread logging that occurred at the expense of wildlife habitat and wildlands used for recreation. The legislative responses to this public and scientific discontent included the Multiple Use, Sustained Yield Act (MUSY) of 1960 and the National Forest Management Act in 1976 (Loomis 1993). These acts changed the mandate of the Forest Service from managing single, separate uses, to managing multiple-uses on public lands in a way that would sustain their productivity over time. The types of values in National Forests broadened to include outdoor recreation, wildlife, fisheries, and wilderness.

Both of these management policies focused too much on achieving certain amounts of forest uses at the expense of the resources themselves. "Emphasis on the use aspect of multiple use can lead to unsustainable commodity production levels that jeopardize native species of flora and fauna." (Wood 1994:7) As a result, forests have been overcut, and rangelands have been overgrazed among other emerging problems. A new idea of forest management has evolved out of the failures of the previous management philosophies.

The latest management philosophy, called ecosystem management, doesn't completely discard the frameworks or values of the previous systems, but builds on them, adding a new context to forest management. The novel element in this philosophy is its recognition of the actual place forest uses occur- the ecosystem (Wood 1994). The rationale for focusing less on particular uses and more on the environment where they occur is rather simple. The human uses and values (recreation, timber, wilderness, etc.) are inseparable from the forests where they occur and if the integrity of the forest (aquatic, grassland, etc.) ecosystem is compromised, so too are the uses that depend on the forest. Another important addition of ecosystem management recognizes that ecosystem boundaries overlap political and social boundaries. Consequently this framework encourages cooperation among the people and the political institutions affected by management decisions.

What we see is an evolution in management philosophy toward acknowledging the intricacies of the land and the inherent interconnectedness of all managed resources within the ecological, social, and political context of a certain place. As resource management philosophy exchanges the view of the landscape as fragmented individual uses for one of forest uses as integrated and inseparable from the forest out of which they originate, revised views of how to partition the landscape into management units arise.

Elements of an integrated forest inventory

Emerging thought in forestry has moved toward a model of management called "forest zoning" which includes three types of forest management areas (Hunter 1990). First, forests of special ecological significance or high biodiversity value are preserved. Second, high productivity forests with no special ecological significance are managed in a way analogous to intensive agriculture, placing value on the lumber yield. Third, and most challenging, are the "working landscapes" which integrate both economic and ecological values on the same pieces of land. This third type, where multiple uses occur together, is much more widespread than the other two types of forest (Poleman 1996a). It is therefore important to define a responsible management planning process for these working landscapes that integrates different, and sometimes conflicting, values.

Poleman (1996a) identifies 5 stages of the forest management planning process: 1. determining objectives, 2. assessing current forest condition, 3. determining desired forest condition, 4. designing and implementing a management plan, and 5. monitoring results of the management plan. Of these five, this study focuses on the second, assessing current forest condition: the forest inventory. It is an important step since a forest management plan designed without knowledge of a forest's biological, ecological and physiographical character lacks a foundation on which to stand.

As management perspectives evolve, so must the types of information gathered in forest inventories. Since management practices are tending toward the integration of various values, forest inventories necessarily are shaped to inform this goal. This study explores a model of forest inventory that informs integrated management in what Poleman (1996b) has termed an "integrated forest inventory."

An integrated inventory informs management by combining various values in a forest ecosystem. "Integration implies more than just employing different approaches side by side; it is the merging of objectives so that (1) information gathering activities inform both conservation and commodity perspectives (and are therefore cost-effective), and (2) management prescriptions promote both objectives simultaneously" (Poleman 1996a). In order to construct an integrated inventory, one must choose which values to focus on, whether human use values or conservation values. It is important to understand the components of a forest inventory before delving into specific examples and then trying to construct an integrated inventory out of them.

The forest inventory

At the basis of any inventory is a value judgment of what is important in a forest. Different types of data are collected depending on the lens one chooses to look through. If timber is important, then tree girth, height, and quality will be measured. If conservation of biological diversity is the focus, then species composition and distribution will be emphasized.

Two tools are used to describe the forest. First is a classification system that draws boundaries around relatively homogenous patches of vegetation that recur across a landscape called "landscape elements" (Poleman 1996a). The criteria for classification is commonly the dominant vegetation, whether that means the plants that dominate the canopy, or are the most abundant in non-forest ecosystems (Noss 1987). Bailey (1996:1) summarizes the purpose of this tool well: "Land classification is the process of arranging or ordering information about land units so we can better understand their similarities and relationships." It can give context to an individual tract of forest within a larger landscape.

The second tool is a detailed inventory of the landscape element composition (Poleman 1996a). The inventory does not attempt to measure and describe every square inch of each landscape element, an endeavor that would be extremely time consuming and virtually impossible. Data is collected in a systematic fashion from representative samples across a tract of land. The results are then generalized to the rest of the parcel as an estimate of its actual composition.

Because of budget and time constraints, usually it is critical that an inventory be carried out as efficiently as possible. One doesn't want to gather too much relevant information or gather excessive information that ultimately doesn't inform the original goals of the inventory. Doing either of these could make the inventory procedures too cumbersome and/or expensive to implement (Poleman 1996a).

Ideas for the creation of an integrated forest inventory can be drawn from systems that already exist; there is no need to start from scratch since the best of existing inventories can be combined. First, the values that are going to be integrated must be chosen. Poleman (1996a) posed the question, can the two primary ways the public views forests, as an economic entity for the extraction of products and as habitat for plants and wildlife be integrated? These commodity and conservation values will be the goals integrated in this inventory. The Forest Examination inventory of the Vermont Parks and Recreation Department, a modified timber cruise, informs the timber value of a forested parcel and will be the first inventory used in this study. The Natural Heritage Program's inventory of the "elements of diversity" is specifically tailored to locate biodiversity and inform conservation decisions, and therefore is an appropriate system to assess the conservation value for this integrated inventory.

Forest Examination (FOREX)

Forest Examination (FOREX) is modeled after a traditional approach to inventory called a timber cruise, focusing on the volume, type and quality of lumber on a forested parcel (Vile 1989). It classifies the dominant vegetation using the Society of American Forester's *cover type* . The advantage of cover type is that it is easy to identify and delineate using aerial photographs. The detailed inventory utilizes both a variable plot method (using a 10 factor prism) to assess basal area, augmented with optional fixed radii plots for understory analysis (Vile 1989). FOREX represents a step toward the integrated inventory by incorporating information about wildlife habitat and significant physiographic features on an assessed parcel of land. However, FOREX doesn't collect enough information on biodiversity to inform conservation decisions. Biodiversity data includes information on some game species such as deer and the understory vegetation data gathered is oriented toward plant species that may inhibit the regeneration of commercially important tree species (Poleman 1996b). Therefore it serves as an effective analysis of standing timber, but not the ideal tool for biodiversity inventory.

The Natural Heritage Program's "Elements of Diversity" inventory

The "elements of diversity" inventory system used by the Natural Heritage Program is designed to inventory and catalogue biological diversity and therefore could serve as a valuable supplementary tool for FOREX. It was created by The Nature Conservancy in 1974 with the goal of standardizing conservation inventory attempts which previously had been localized, short term, and unconnected (Jenkins 1978). This new inventory system included an ongoing state by state inventory that focused on the "Elements of Diversity" rather than on specific sites (Jenkins 1978). These elements are at two different levels of biological organization, individual species and natural communities, and also include significant physiographic features that influence biological patterns across the landscape (Noss 1987). The advantage of this approach is that the abundance and rarity of each element can be compared across its range. Since this system is an ongoing inventory, the status of each element can be monitored over time and conservation energies can be redirected as the condition of certain elements change. The scope of this inventory system is now expanding from state wide to a regional and eventually national system so that rarity can be assessed over much larger areas.

It is a hierarchical classification system that utilizes a "dual filter" approach. The "coarse filter" searches for natural communities which are characterized by the dominant plant species that recur in recognizable patterns across a landscape. By preserving a full range of natural communities that occur in a particular region, other species associated with the dominant plants will be conserved as well. In this way, this system serves as a "filter" or net catching the dominant and associated species together. The Nature Conservancy estimates that 85-90% of the species can be conserved this way (Hunter et al. 1988). This inventory system is an iterative process by which natural community designations are refined and further delineated as more time is spent in the field identifying them. Simultaneously, a second filter or "fine filter" approach is used which catalogues and indexes rare and endangered species that may have been missed by the coarse filter approach.

Within this classification system, as stated above, natural communities are the fundamental units, delineated by the Natural Heritage Program for each state using secondary sources such as scientific literature, herbaria and museums, knowledgeable people, and new fieldwork (Noss 1987). The inventory is conducted by outlining potential communities on aerial photos, then visiting the sites and adjusting the boundaries of the natural communities using a quadrat methodology.

The Integrated Inventory- combining conservation and commodity values

In order to make this integrated inventory worthwhile, I selected the aspects of each of these two systems that were most useful, and eliminated the aspects though to overly burden fieldwork. Since one goal of this inventory is to supply information about the economic potential of a forest parcel, the two tools of FOREX, inventory and classification system, are necessary. The other goal, to provide information for biodiversity conservation, can be addressed by using the natural community classification system. Since this integrated inventory is designed for use by anybody from landowners to state foresters, the detailed inventory of the natural community system using quadrats would be, I hypothesize, too time consuming to implement and therefore will be excluded. The estimation of natural communities can be done comparing site characteristics to the community descriptions summarized in the guide by Liz Thompson (1996) called Natural Communities of Vermont: Uplands and Wetlands.

The information gathered in this integrated inventory, I hypothesize, will reveal more than if FOREX and the natural community classification inventory were conducted separately. The value of the natural community classification lies in the relative rarity ranking, from S1- S5 (S1 being the most rare and S5 the most common; S stands for State) which allows the managers of a forest parcel, whether public or private, to make decisions based on this rarity rather than just on the economic value of an area. In addition to information on the rarity of natural communities are the "element occurrence rankings" or an assessment of the quality of individual occurrences. This is designated by the community's 1)"quality" or representativeness, 2) "condition" or degree of naturalness, 3) long term survival based on surrounding natural buffers 4) how imperiled a community is by current human activity (The Nature Conservancy, date unknown). This is difficult to incorporate into the integrated forest inventory since it requires more research and mapping, and has not been included for the sake of efficiency. The rest of the study is spent answering the following three questions: 1) Are natural communities relevant evolutionary and ecological units? 2) Is this integrated inventory practical and useful? 3) What is a "sense of place" and how does it relate to new management perspectives?

Literature Review: The evolutionary and ecological relevance of Natural Communities

Natural communities defined

Sperduto (1996) justifies using natural communities as conservation inventory units for two reasons: 1) A combination of physical factors and disturbance agents in a certain region create recognizable vegetation patterns, and 2) In order to preserve biodiversity conservationists need a way to sort out these ecological patterns in a logical and understandable manner. Despite their obvious utility as a conservation unit, the following question must be asked: What is the ecological and evolutionary relevance of natural communities?

Natural communities are "recurring assemblages of organisms found in particular physical environments" (Sperduto 1996). Human influences are small or absent, hence the term natural, but may have affected the area in the past (Thompson 1996). Thompson (1996) outlines the subtle differences among the terms "natural community", "ecosystem", and "plant community". An "ecosystem" is much like a natural community and includes all the plants and animals within their physical environment, but this is not limited by scale. An ecosystem can occur under a pebble or can encompass a whole mountain range. A "plant community" includes only plants in its definition to the exclusion of animals and physical setting. The "communities" used in natural community classification include both natural and plant communities depending on how dependent the community's occurrence is on its physical environment (Noss 1987).

There are some similarities between ecosystems and natural communities that can illuminate important characteristics of the latter. Rowe and Barnes (1994) attempt to clarify the word "ecosystem" offering a division into two categories, one based on landform (soil, aspect, topography, hydrology) and one based on biotic associations. The former is referred to as "geo-ecosystems" and the latter are "bio-ecosystems". Since natural communities emphasize the plants and animals that occupy a given site, they would fall into the category of bio-ecosystems.

Whether geo-ecosystems or bio-ecosystems are used as the basis of a land classification unit depends on the managers' goals since both ways of framing ecosystems are valuable. A geo-ecosystem will emphasize a much more static unit of land, but will take the emphasis off immediate associations of biodiversity. In contrast, using a bio-ecosystem definition will do the opposite-- focus on the plants and animals on a given site while taking the emphasis off the more permanent physiographic characteristics.

The evolutionary significance of natural communities

Hunter et. al. (1988) do not believe that natural communities are a relevant unit on an evolutionary time scale. They recognize and agree with the basic premise of the natural community system: "Our concern is in identifying the best strategies for maintaining a high level of species diversity" (Hunter et. al. 1988:382) but find two problems with natural communities:

1. They are transitory assemblages of plant and animal species.
2. They are impractical for predicting the distribution of very rare, patchily distributed species.
3. Community dominant species may not be as sensitive to environmental change as the associated species are.

Concerning the first problem, Hunter et al. (1988) use the paleoecological record (determined from pollen frequency in bog cores) as a confirmation that natural communities shouldn't be the units of conservation. Instead, ecosystems based on physiographic characteristics should since natural communities have changed their composition many times over the last 10,000 years with the end of the Wisconsonian glacial period (Davis 1981). For example, the oak-chestnut forests of the Appalachian mountains have contained chestnut as a dominant species for 5,000 years, while the oak-chestnut forests of Connecticut have included chestnut for only 2,000 years (Davis 1981). Metaphorically speaking, the justification for using geo-ecosystems is that the theater should be preserved, not the theatrical production that occurs within it. There is an immediacy to conservation efforts, though, that make utilizing a geo-ecosystem approach problematic. Wilson (1986) describes an unprecedented fragmentation of habitats and loss of biodiversity occurring in the modern world. The time scale that we are working with is much shorter than the scale at which geo-ecosystems function, and if preserving biodiversity is the goal, a natural community approach is better suited.

The second problem raises the concern that the coarse filter method is too coarse, and rare species will go extinct through habitat loss because they were not found in time. The Nature Conservancy admits these species oversights by the very name they gave to this system: the "coarse filter". The system is meant to preserve a majority of species and then, to the degree that is possible, rare species will be found and protected by the "fine filter" approach using special conservation attention, such as the Endangered Species Act and/or private conservation efforts such as land trusts (Noss 1987).

The third problem involves situations where the dominant plant species grow in areas with different environmental characteristics that would change the understory plant species. For example a red spruce/balsam fir community in the Northeast can occur at high elevation in well drained soils or within lowlands in poorly drained soils, conditions which may change the understory composition (Hunter et. al. 1988). If this pattern is initially missed, an inconsistent community description, when discovered, can be split into two or more communities to account for new found variation.

The ecological significance of natural communities

Noss (1987) questions the actual ecological significance of natural communities because of the sampling methods used. Sampling occurs in relatively uniform homogenous areas of vegetation and therefore avoids forest edges and other heterogeneous community types. He argues that each natural community is part of a larger landscape and therefore doesn't contain ecological processes that take place on a larger spatial scale across these uniform patches of vegetation. Whole disturbance regimes are not necessarily included (depending on the type and scale), and a single community may not be connected to other community types that, when combined, are important for the life history and foraging of certain animals species.

The developers of the natural community system admit to its shortcomings. It was never meant as the definitive land classification system. Communities shift based on natural disturbance (fire, flood, blowdown), human land use (tree harvesting), and successional stage. Although natural communities are not enduring entities, this system is useful for identifying and cataloging biological diversity at various scales.

Methodology

To assess the potential benefits of combining the natural community approach with FOREX a study integrating the two was conducted in a forest managed by the Vermont Forest Ecosystem Monitoring, Inc. (VForEM) on the west side of Mt. Mansfield in Underhill, Vermont (Figure 1). The 210 acre parcel is located just south of Stevensville Brook and extends from about 1400ft to 2500ft in elevation. The relatively small size of the parcel will be an asset considering the short time frame in which the study was conducted. FOREX inventory data was previously gathered by a VForEM researcher during the summers of 1995 and 1996. Therefore the data gathered in this study was only of the natural communities occurring within the parcel. If this integrated inventory were actually employed in a real situation, data collection for FOREX and the natural community classification would be conducted simultaneously.

Preestablished systematic plots were laid out on the parcel for the FOREX inventory by the VForEM. Each FOREX plot was revisited taking compass bearings from the Butler Lodge Trail which vertically divides the parcel. A natural community designation was given at each plot using the Natural Communities of Vermont: Uplands and Wetlands (Thompson 1996). Revisiting these plots made comparing the FOREX data and the gathered natural community data easier since there was an actual area with which to compare the two data sets. The decision of what natural community was present was a subjective measure, whereby site characteristics were compared with community descriptions in the natural community guide.

Natural communities were designated during the "leaf off" season since many forest inventories are conducted during the winter months for maximum tree visibility (Poleman 1996 pers. comm.) This will help address the question of whether the natural community approach is viable when combined with FOREX and conducted in winter. The potential problem with a winter inventory is that the herbaceous ground layer is mostly covered by snow, and therefore cannot contribute to field identification of communities.

Results

Within the study area, five stands were outlined by the VForEM using the FOREX inventory. Generally, timber was of low quality and not currently harvestable. Specific stand descriptions and management prescriptions are summarized in Appendix 1.

Two natural communities were found on the parcel. Mesic northern hardwoods forest community (Appendix 2) began at the lower extent of the parcel at 1400 ft and made a transition into a high-elevation hardwoods-spruce forest community (Appendix 3) between 2100 and 2300 ft. The mesic northern hardwood forest carries a S4 ranking while the high-elevation hardwoods-spruce forest is ranked S3. In Natural Communities of Vermont: Uplands and Wetlands, Liz Thompson (1996:32) writes,

S3 High quality examples are uncommon in the state, but are not rare; the community is restricted in distribution for reasons of climate, geology, soils, etc., or many high quality examples have been severely altered.

S4 The community is widespread in the state, but the number of high quality examples is low <u>or</u> the total acreage is relatively small.

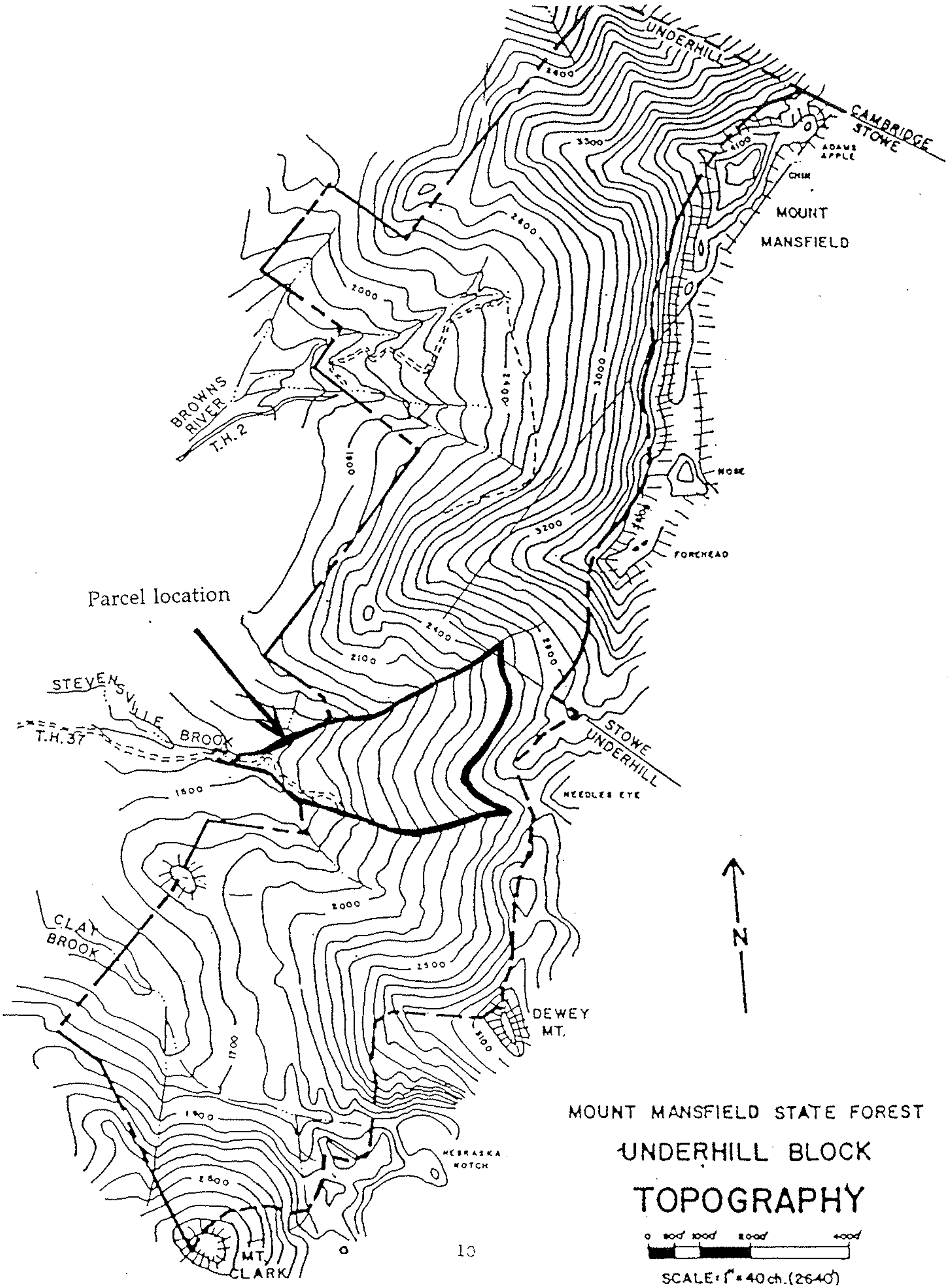


Figure 1. Location of the Vermont Forest Ecosystem Monitoring (VForEM) parcel on Mt. Mansfield. Underhill, Vermont.

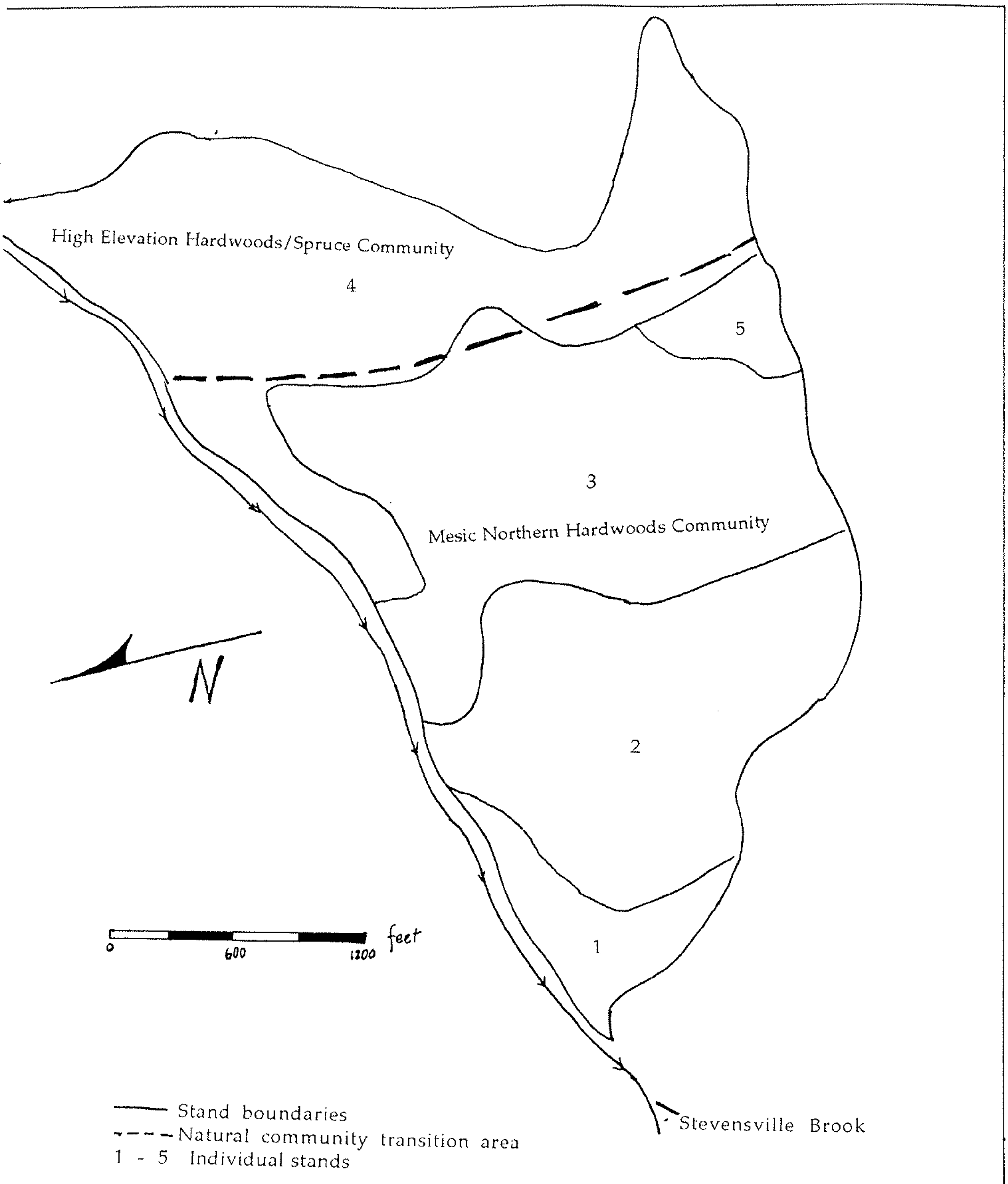


Figure 2. The stands and natural communities within the Stevensville Brook Parcel on Mt. Mansfield. Underhill, Vermont.

Figure 2 shows the relationship between the stand and natural community boundaries on the Stevensville Brook parcel. The transition of the mesic northern hardwoods to transitional hardwoods occurs between the 2100 and 2300 ft. and seems related to, but doesn't exactly mirror, the boundary drawn between Stands 3 and 4.

Discussion

Advantages of natural community classification

The natural community classification provides a different way to look at forests than through a timber cruise lens. I found that my attention to communities raised my awareness of the different layers of the forest. I noticed tree species, the understory, any animal tracks left in the snow and how these factors combined to express the character of the place I was in.

The next step in making the natural community classification system a valuable management tool, though, is to specify how the rarity designations should affect management prescriptions. What does it mean that the mesic northern hardwoods community is an S4 or that the transitional hardwoods is an S3 community? When should a rarity designation make a landowner cautious about cutting? Is an S4 community common enough that one should not worry about its fate? The S3 and S4 communities found within the Stevensville parcel pose some gray area in how management decisions are affected by them. In general, an S1 or S2 designation are both rare enough, I would venture, that managers should be cautious about altering them.

The Nature Conservancy and the Heritage Programs select their conservation priorities based on a combination of both the state and individual occurrence rankings. In light of this, introducing natural community occurrence rankings into this integrated inventory may lessen the ambiguity surrounding the meaning of the "S" rankings. For example, if a community has a S2 ranking, but is a poor example of one, then managers should be more willing to change the character of the area than if the community occurrence was of a high quality. As mentioned above, though, introducing occurrence rankings would require more work by the organization conducting the inventory, so an efficient system that assesses occurrence quality would need to be developed.

There are many advantages to using this natural community approach to assessing biodiversity on a parcel. First of all the classification system already exists, therefore saving the time and effort of assembling a new biodiversity classification system from scratch. Secondly, it has proven effective at cataloguing biodiversity and setting conservation priorities. Thirdly, it is an efficient, low technology system, which doesn't require any excess equipment besides the natural community guidebook and/or a working knowledge of natural communities in a particular region. Fourth, the system is an evolving inventory that grows in value as information about natural communities is updated and refined (Jenkins 1986). Lastly, many community descriptions provide information about associated wildlife species (both game and nongame) and substrate, and provide more information for managers to consider.

Another possible advantage to using the natural community classification system in this integrated inventory is it's potential to help the Vermont Nongame and Natural Heritage Program (VNNHP) add information to their ongoing database. The VNNHP ecologist, Eric Sorenson (1996 pers. comm.) mentioned that having another source of information that helps update their database on community occurrences in Vermont would be extremely valuable. Their staff of five can only do so much fieldwork and research, so if coordinated and applied correctly, the integrated inventory could supplement the VNNHP's efforts.

Difficulties and drawbacks of natural community classification

An obvious point, but one that needs to be stated, is that in order for the natural community system to work, the correct community designations need to be applied to communities in the field. From my personal observations, there are some difficulties that may affect applying the proper designations. While identifying natural communities within the Stevensville Brook parcel, I was usually second guessing myself, no area on the parcel seemed to completely fit any one community designation. I can think of two reasons for this.

First is the difference between a "stand" and a natural cozmmunity. A stand is "a forested landscape element with uniform cover type and uniform age and size classes, often reflecting cutting (or other disturbance) history" (Poleman 1996a:8). A stand will therefore emphasize the age and size of trees while communities will emphasize the plant associations regardless of age and physical quality. That natural communities are not defined by vegetation age structure made it possible for Tetreault (1996) to develop a system of classifying potential upland and wetland natural communities in a portion of New Hampshire. Hypothetically, all one would need to know to classify potential communities are the landform (cliff, river terrace, etc. for uplands, and basin, seep or floodplain for wetlands), parent material, the physiognomy for wetlands and soil depth, drainage, and aspect for uplands, and to have all of these factors correlated with existing natural communities in a particular region.

Each physical occurrence of a natural community can contain different concentrations of its component species and I found this internal variation confusing at first. Using qualitative observations, Stand 1 includes Sugar maple *(Acer saccharum)*, American beech *(Fagus grandifolia)* , red maple *(A. rubrum)*, and yellow birch *(Betula allegheniesis)*, whereas Stand 3 is dominated largely by mature sugar maple with some large yellow birch and a few beech, yet they both receive the same community designation of Mesic Northern Hardwoods (See Figure 2). A more rigid protocol that outlines how communities are identified in the field needs to be developed so that it is less of a subjective measure.

The second problem I encountered is related to the fundamental problem of any classification system. Thompson (1996:3) illuminates this by recognizing we are trying to draw boundaries in forests where naturally there aren't any, "The use of this or any classification must recognize that natural communities intergrade with one another in sometimes imperceptible ways, and that any place on the landscape is unique. These truths about nature make classification difficult." Any classification system will force a given area in the landscape into categories that already exist. Noss (1987:12) writes about the necessity for any classification system to be as thorough as possible: "It is especially important that a classification system be comprehensive. If important combinations or patterns of vegetation are missed in the classification, they will not be inventoried, and hence may not be protected." This is an unavoidable limitation of the natural community system. It necessarily homogenizes places that seem similar, but fails to expose the subtle differences that make individual forests unique in a landscape.

It would be wrong to assume that we should not classify forests, since classification systems help us in our attempt to understand vegetation patterns and ultimately to be good forest stewards. We should recognize the utility of classification systems, but also understand the inherent limitations. The weakness of the natural community system is therefore its strength. It doesn't try to fully describe the uniqueness of each site, but in doing so, gains the ability to compare and contrast the abundance of natural communities across a larger area. It therefore has the potential to fulfill its purpose of informing conservation values within this integrated inventory when the rarity designations are further defined and become meaningful to managers.

A slight bias exists in the natural community system. Both the Vermont Nongame and Natural Heritage Programs and The Nature Conservancy have a vested interest in identifying rare or endangered species or communities in landscapes. Because of limited resources, classification efforts are focused on identifying and protecting rare elements of diversity, and not necessarily refining descriptions of more common community types. A slight bias in classification results so that rare communities are described with more detail and divisions, while more abundant ones, such as the mesic northern hardwood community, ones are "lumped" together so that some variation may be missed (Thompson 1997 pers. comm.)

In this case study, there were fewer natural communities than stands. Hypothetically, there may be cases where the opposite is true-- more natural communities present than stands. For example, if the ground flora reflects a change in the substrate, but the dominant canopy species remain the same, then the cover type classification system would fail to pick this subtlety up, but a natural community classification (if one exists for the transitional community) would reveal this change. Few, if any, Vermont forested natural communities are defined solely by a change in the herbaceous layer composition. Because of this, it is unlikely that conducting this inventory in the winter months would make identifying natural communities harder.

Conclusions

The integrated inventory combining the natural community classification system and the FOREX inventory is a potentially useful tool for Vermont State and private forestry operations. It provides a more detailed classification system that locates a given parcel within the context of a state's natural communities. The rarity designation attached to natural community descriptions is the potentially useful element for managers. This designation will by useful when the specific rankings of S1 to S5 are modified to include suggestions and details of how management perscriptions should be changed in light of a certain community's abundance. The Vermont Parks and Recreation Department is the most obvious organization to coordinate and further refine the methods of this system since it already processes the data collected in its own and private timber cruises employing the FOREX methodology.

Using this system in winter may pose problems to selecting natural communities defined by the herbaceous vegetation layer which is largely dead and covered by snow in this season. In Vermont, there doesn't appear to be any forested communities that are solely characterized by the ground layer at this time, but as communities are further defined, this may become a consideration during winter inventories (Thompson 1996).

A sense of place

I hypothesize that the desire to manage ecosystems rather than individual resources is, at least in part, a product of an increasing "sense of place", or simply, of where we live. The problem with previous management philosophies has not been the selection of resources from forests for human use, which is necessary for a society's physical and cultural survival. "From the many objects and organisms around them, people identify a certain subset as 'resources' things to be drawn into the human community and turned to useful ends" (Cronin, date unknown). The problem lies in the failure to acknowledge the relationships between the useful and non-useful parts of ecosystems and that the non-useful elements are just as vital to maintaining an ecosystem's integrity. By trying less to filter out the useful from the non-useful and by inquiring about the unique ecological relationships of specific places through scientific questioning and description, we are beginning a process of rediscovering where we live.

Americans evolved out of a tradition that imposed its ideas and way of life on the previously unknown ecology and people of this continent. "Our trouble with the New World-- a world that was intended to refuel an Old World which had in some sense grown effete-- has been that from the beginning we have imposed, not proposed. We never said to the people or the animals or the plants or the rivers or the mountains: What do you think of this? We said what we thought, and bent to our will whatever resisted" (Lopez 1990:17). We are now opening a dialogue with natural world we should have begun long ago.

Changing the type of information collected in forest inventories is part of this process of fostering a sense of place. In an ecosystem framework, a forest inventory collects information about the biotic and environmental elements of an ecosystem, and the processes that govern them. Its ultimate goal is to define the uniqueness of individual places in order to conduct effective management. In our search to discover a sense of place, natural community classification is a useful tool. It provides a more thorough description of forest composition than the traditional *cover type* classification. The long term usefulness of any inventory information is limited, though. "[An inventory of] existing ecosystem capabilities determine what is possible in a human time frame, say a generation to a century. Any longer than that the basic capabilities of ecosystems may change and our ability to predict outcomes is rather poor" (Salwasser and Pfister 1992:151). Places change over time, and so does our knowledge of them.

An integrated ecosystem inventory could contain parts of the natural community classification, the ecosystem classification approach using geo-ecosystems (ECOMAP) being developed by the US Forest Service (USFS 1993), and FOREX. It could include information on landform, soils, geology, topography, overstory composition, size and quality of trees, commercial regeneration, ground flora, wildlife habitat, and natural communities, and cruise information. Any such inventory will be more labor intensive and time consuming to implement, but the information is extremely valuable and will help define responsible management practices.

Ecosystem management is not a remedy for our tresspassings, nor does it necessarily embrace a new ethic of land stewardship. Its focus, at least in the realm of public land management, is to sustain human use of forest ecosystems over time, not to recognize the intrinsic value of a place.

While management perspectives shift, we are given a new opportunity to investigate society's relationship with ecosystems. "A sense of place must include at the very least, knowledge of what is inviolate about the relationship between a people and the place they occupy, and certainly, too, how the destruction of this relationship, or the failure to attend to it, wounds people" (Lopez 1990:40). As we seek to define this healthy relationship with places, we are coming to realize that it is not only management practices that need to change, but also our expectations of how much ecosystems can provide for us.

Our relationship to place is coming to include more than just a utilitarian ethic, which regards the land as a passive source of wealth and resources for humans. In the writings of Aldo Leopold, Wendell Berry, and Gary Snyder a new ethical relationship is fostered in which we recognize that we have an obligation to the land, to treat it with care and maintain its heath. This new tendency may be mistaken for romanticism, but it has a very practical and understandable basis, "And the wisdom of [addressing the land], the ineffable and subtle intertwining of living organisms on the Earth, is confirmed today by molecular biology and atmospheric chemistry. To acknowledge the interdependence is simply a good and wise habit of mind" (Lopez 1990:18). The first law of ecology is "everything is connected", which includes us and what we are managing. Therefore, we should be careful in our treatment and use of ecosystems, and mindful of the mystery that surround their very existence. Hopefully, as we understand more about where we live through an increasing sense of place, we will be able to define what a "healthy relationship" with the natural world is, and pursue it wholeheartedly.

BIBLIOGRAPHY

Cronun, W. Date unknown. Kennecott Journey: The paths out of town. Alaskan Wildlands Studies Reader. Compiled by Nancy Cook.

Davis, M.B. 1981. Quaternary history and the stability of forest communities. Chapter 10 in: Forest succession: concepts and application. D.C. West, H.H. Shugart, D.B. Botkin eds. Springer-Verlag, New York. pp. 132-153

Grumbine, R.E. 1994. What is ecosystem management? Conservation Biology 8: 27-38

Hunter, M.L., G. L. Jacobson, T. Webb. 1988. Paleoecology and the coarse-filter approach. Conservation Biology. 4: 375-385

Hunter, M.L. 1990. Wildlife, Forests, and Forestry. Principles of Managing Forests for Biological Diversity. Regents/Prentice Hall, Englewood Cliffs, NJ.

Jenkins, R.E. 1978. Heritage classification: The elements of ecological diversity. The Nature Conservancy. 28(1):24-30

Jenkins, R.E. 1986. Information methods: Why the heritage programs work. The Nature Conservancy. 35(6): 21-23

Leopold, A. 1949. A Sand County Almanac. Oxford University Press, New York.

Lopez, B. 1990. The Rediscovery of North America. Vintage Books, New York.

Loomis, J.B. 1993. Laws and agencies governing federal land management. Chapter 2 in: Integrated Public Land Management. Columbia University Press, New York. pp. 18-66.

Nash, R. 1967. Wilderness and the American Mind. Vail-Ballou Press, Binghamton, NY

Noss, R. F. 1987. From Plant Communities to Landscapes in Conservation Inventories: A look at the Nature Conservancy (USA). Biological Conservation. 41:11-37

Noss, R. F. 1993. Sustainable Forestry or Sustainable Forests? In Defining Sustainable Forestry. G.H. Aplet, N. Johnson, J.T. Olson, and V.A. Sample editors. Island Press. Washington D.C.

Poleman, W. 1996a. A Guide to Integrated Forest Planning for Land Managers in the Northern Forest. The Conservation Fund. Draft.

Poleman, W. 1996b. Forest Ecosystem Inventory and Assessment: A Northern Forest Case Study. Masters Project. University of Vermont Field Naturalist Program

Rowe, J. S. and Barnes, B. V. 1994. Geo-ecosystems and Bio-ecosystems. Bulletin of the ecological society of America. 1: 40-41

Schaeffer, D.J., E.E. Herricks, and H.W. Kerster. 1988. Ecosystem heath: I. Measuring ecosystem heath. Environmental Management 12: 445-455

Sperduto, D. D. 1996. A Guide to the Natural Communities of New Hampshire. New Hampshire Natural Heritage Program and the Nature Conservancy. Review Draft.

Stolzenburg, W. 1992. Detectives of Diversity. Nature Conservancy. 23-27

Tansley, A. G. 1935. The use and abuse of vegetational concepts and terms. Ecology 16:284-307

The Nature Conservancy. 1994. Rare Plant Communities of the Coterminous United States. A report for the US Fish and Wildlife Service.

The Nature Conservancy. Date unknown. Natural Heritage Ranking System. Science Division of The Nature Conservancy, Arlington, VA.

Tetreault, M.J. 1996. Ecological mapping to establish conservation priorities on public and industrial forestland in northern New Hampshire. Master's project. University of Vermont Field Naturalist Program

Thompson, E. 1996. Natural Communities of Vermont: Uplands and Wetlands. Nongame and Natural Heritage Program.

USFS. 1993. National Hierarchical Framework of Ecological Units. ECOMAP. Washington, D.C.

Vile. C. 1989. Forest Examination (FOREX) Vermont's Comprehensive Forest Resource Inventory System.

Wilson, E.O. 1986. Current State of Biodiversity. In Biodiversity E.O. Wilson ed. National Academy Press. Washington D.C.

Wood, C.A. 1994. Ecosystem management: Achieving the new land ethic. Renewable Resources Journal 12(1): 6-12

Appendix 1.
Silvicultural Treatment Plan for the Stevensville Brook parcel on Mt. Mansfield, Vermont.
Designed by the Vermont Forest Ecosystem Monitoring, Inc.

Vermont Forest Ecosystem Monitoring, Inc.

Ecosystem Monitoring Demonstration Project

Phase I

Silvicultural Treatment Plan

Background

This Silvicultural Treatment Plan documents the goals and desired future outcomes of the silvicultural treatments planned for the Ecosystem Monitoring Demonstration Project study site. Other documents provide supplemental information on the overall project goals, study site ecological history, and research plans associated with this project.

The purpose of the selected silvicultural treatments is to improve the condition of the forest at the study site using both methods normally implemented in Vermont and new techniques that could overcome regeneration problems. As much as possible, this project will mimic "normal" forest management procedures with the intent to demonstrate how management affects forested ecosystems. As an integral part of this plan, therefore, are accommodations to facilitate implementation of research studies in conjunction with the planned forest management.

Study Site Information

The forest included in this study is in the Stevensville Brook watershed of the Mount Mansfield State Forest, Underhill, Vermont. The entire watershed stretches from the forehead at the summit (3900 feet) across state ownership down to 1400 feet, and onto private ownership at lower elevations.

Land above 2500 feet on the mountain is designated as natural area land, and is managed as a forest preserve. From the base of the mountain up to the summit, the area is highly valued for recreational use, with numerous hiking and cross country ski trails maintained for year-round use. It is therefore desireable that the EM Demonstration Project incorporate the needs of these other land uses and ownerships into the design and implementation of the study.

The area available for management under this study, therefore, are the forested stands from 1400-2500 feet on State Forest land (Map 1). This includes 210 acres of forest, a 1 acre open area, and 7 acres of land buffering streams. The forest is composed of 5 distinct stands with unique characteristics (Table 1 & 2).

Stand 1 is a low elevation, small acreage stand intersected by both the Butler Lodge Trail and the Frost Trail. This poorly drained stand has low quality sawtimber, inadequate regeneration, is of small size and has such high recreational use that no silvicultural treatment is appropriate.

Stands 2 & 3 comprise 112 acres of hardwood forests with sugar maple the predominant species. For the purposes of this treatment plan, Stands 2 & 3 will be considered as one stand. For research purposes, they should be considered as two distinct stands. The commercial trees are generally of low quality. Commercial regeneration is present, but is not "free to grow", as it is shaded and outcompeted by shrub species like hobble bush and striped maple. Therefore, the silvicultural goal for these stands is to promote regeneration of commercial species by removing much of the overstory. But this alone may not provide desired regeneration conditions for species like yellow birch, so part of the area will also receive a soil scarification treatment.

Stand 4 includes high elevation hardwoods, predominantly yellow birch, and remnant old growth red spruce. These 74 acres in general have low quality commercial sawtimber. Understory regeneration of red spruce is inhibited by hobble bush, mountain maple and striped maple. The site index for red spruce in this stand is I (indicating desireable growing conditions for this species) and III for yellow birch (undesireable growing conditions). Therefore, the silvicultural treatment in this stand is to remove competing vegetation from the understory to promote regeneration of red spruce, leaving the overstory intact.

Stand 5 is a small stand comprised of some characteristics found in both Stands 3 and 4. For the purposes of the silvicultural treatment it will receive the same treatment as Stand 3. However, since it is a transitional stand we recommend no research be conducted in this stand.

Silvicultural Treatments

Stand 1 will receive no treatment (Table 3).

Stands 2 & 3 will be divided into 2 overstory treatment areas: an untreated area extending from the northern part of the watershed across the Butler Lodge Trail and 100 feet south of the trail; and an extended shelterwood treatment (ca. 80% overstory removal) to the remaining area of the stand to the south. In addition, the treated area will be subdivided: the southern most area will undergo a soil scarification treatment, the northern most area will be untreated (Table 3). The overstory cutting will remove the existing low quality trees and provide a medium to promote growth of regeneration. The soil scarification, while not a technique normally employed in Vermont, is meant to gain information on it's use in promoting regeneration of yellow birch which is typically difficult to propogate on unscarified soils. The overtory cutting would be conducted in the winter and the soil scarification would be done in the summer following the logging.

Stand 4 will be divided into 2 understory treatment areas: an untreated area extending from the northern part of the watershed across the Butler Lodge Trail and 100 feet south of the trail; and a treatment consisting of removing competing vegetation surrounding red spruce saplings. This will be done in the 0 - 30 foot vertical structure zone. The removal will be conducted in the spring or early summer to minimize the potential of sprouting in cut material.

Stand 5 will receive a shelterwood treatment as in Stands 2 & 3.

Implementation of Treatments

Timeline

1995	Conduct forest inventory of study site. Begin treatment planning.
1996	Researchers input into treatment plan.
1997	Distribute Silvicultural Treatment Plan to researchers and interested parties.
1998	Develop timber sale specifications and contract sale.
1999	Winter: Conduct shelterwood treatment in Stands 2, 3 & 5. Spring & summer: Conduct understory removal of competing vegetation in Stand 4. Fall: Conduct soil scarification in Stands 2,3 & 5 .

Responsibilities

The Department of Forests, Parks and Recreation will be responsible for implementing the silvicultural treatments. The timber sale will be conducted as with other sales on State Forest lands: specifications of the sale, including restraints due to associated research, will be advertised with loggers, and the highest bidder chosen; designated cut areas will be marked by Forestry Division staff; normal timber removal operations will be conducted according to the specifications of the sale.

The VForEM will be responsible for coordinating activities between cooperating organizations. This will include coordination of a project plan, design, documentation, site coordination, research participation, public outreach, data management and publication of results.

Table 1. General stand information

Stand no.	Forest type	SAF no.	Site quality	Size class	Density	Sawlog Condition	Basal area	Mean stand diameter	Median stand diameter	Acres
1	sugar maple, beech, yellow birch, red maple	25	III	sawtimber	C	low quality	68	10	11	10
2	sugar maple	27	I	sawtimber	C-B	low quality	107	12	14.5	48
3	sugar maple	27	III	sawtimber	C	low quality	92	8.75	12.2	64
4	yellow birch, red spruce	30	III-northern hardwoods, II-red spruce	sawtimber	C	low quality	95	11	13	74
5	sugar maple, yellow birch	31	III	sawtimber	C	two aged, low quality	100	9.6	13	6

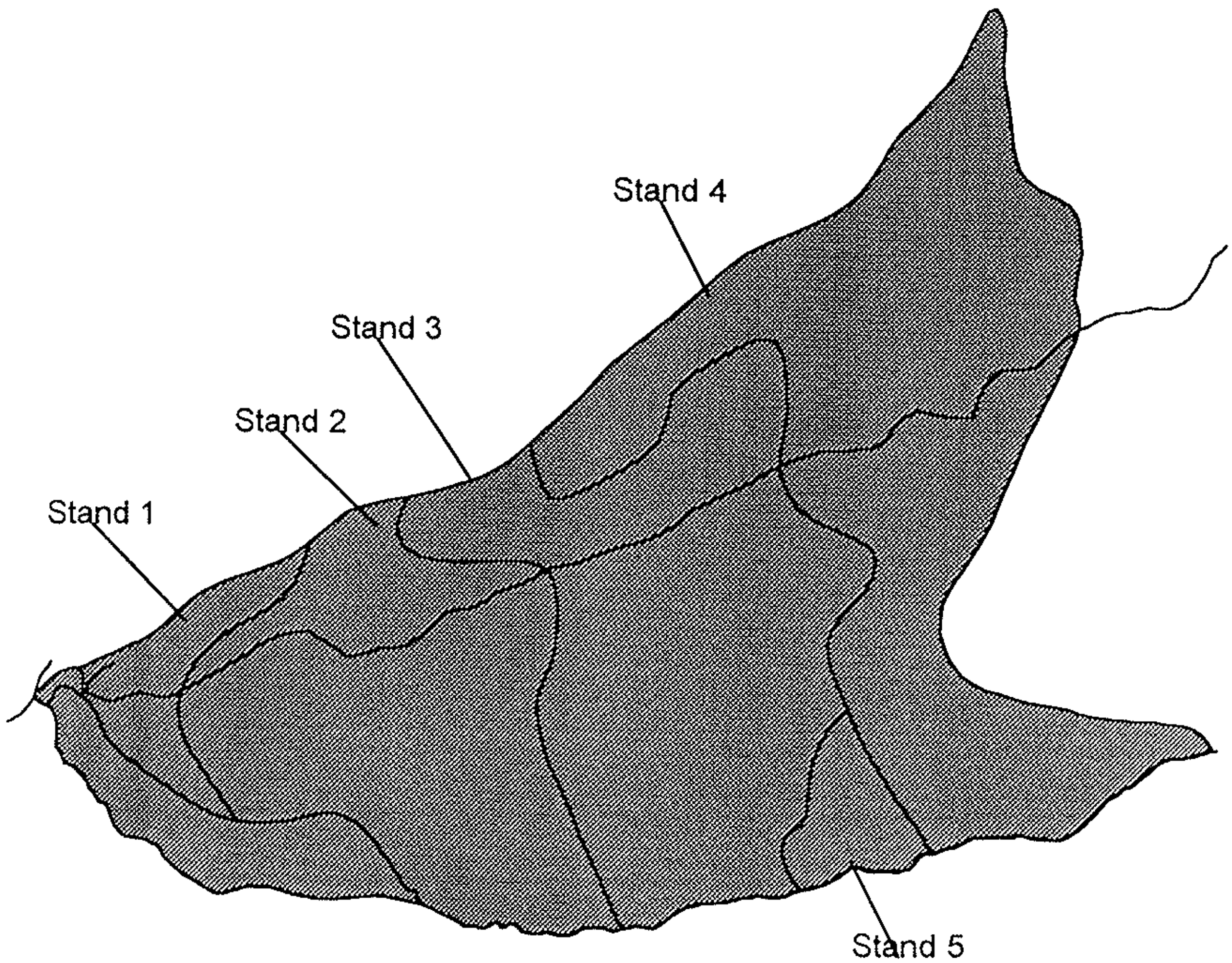
Table 2. Stand understory information

Stand no.	Commercial regeneration			Ground structure for wildlife habitat	Understory vegetation: 0-2' zone		Understory vegetation: 2-10' zone	
	Adequacy	Species	Interfering vegetation		Abundance	Species	Abundance	Species
1	inadequate	sugar maple, yellow birch balsam fir	yes	dead & down trees; forest litter	intermediate, sparse	clumped ferns, grass-sedge, hobble bush	moderate	hobble bush, stripped maple, beech suckers
2	inadequate	sugar maple(71%) yellow birch(36%) ash(21%) red spruce (7%)	yes(37%)	dead & down trees; forest litter	intermediate	clumped ferns, club moss	abundant	beech suckers, striped maple, hobble bush
3	adequate	yellow birch(71%) sugar maple(38%) red spruce (20%)	yes(55%)	dead & down trees; forest litter	intermediate	clumped fern, club moss	abundant	striped maple, beech suckers, hobble bush
4	inadequate	red spruce yellow birch	yes(76%)	dead & down trees; forest litter	intermediate	clumped fern, hobble bush, mt. maple	abundant	hobble bush, mt.maple, striped maple
5	sapling FTG	red spruce beech		dead & down trees; forest litter	sparse	clumped fern, club moss	abundant	hobble bush, beech suckers, r.spruce

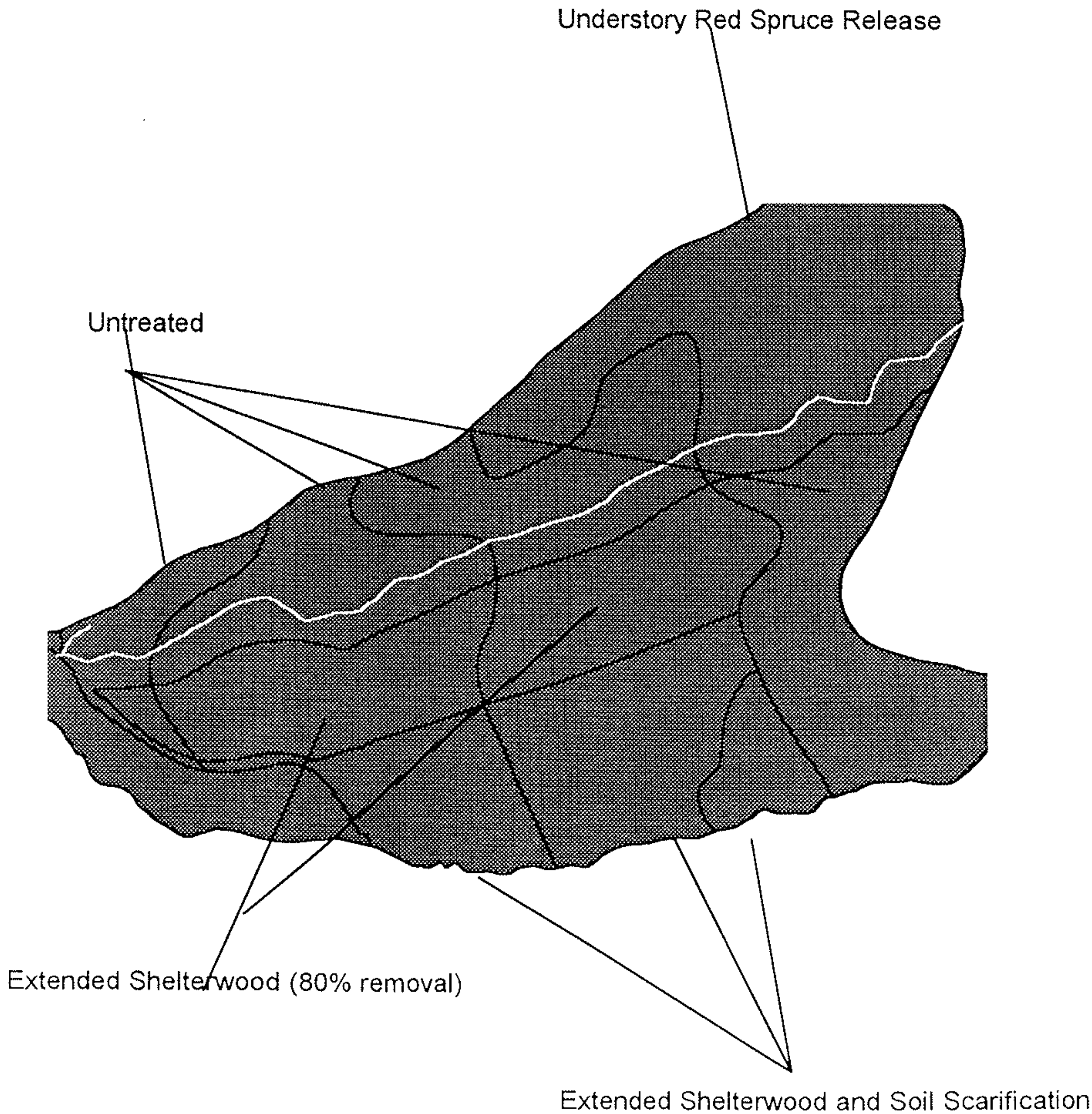
Table 3. Silvicultural Treatments

Stand	Treatment 1	Treatment 2	Treatment 3
1	No treatment		
2 & 3	No treatment	Shelterwood cut & no soil scarification	Shelterwood cut & soil scarification
4	No treatment	Understory red spruce release	
5	Shelterwood cut & soil scarification		

Stand Boundaries



Treatments


Understory Red Spruce Release
Untreated
Extended Shelterwood (80% removal)
Extended Shelterwood and Soil Scarification

Appendix 2.
Description of the mesic northern hardwood forest natural community.
Taken from Liz Thompson's extended community descriptions in the Vermont Non-game and Natural Heritage Program's guide to Vermont upland and wetland natural communities.

MESIC NORTHERN HARDWOOD FOREST (Beech-Birch-Maple Forest)

Description

This is a broadly defined community type. Beech-birch-maple forest is the most common forest type in Vermont and characterizes the Northern Hardwoods Formation. These forests are dominated in the canopy by sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis) and/or American beech (Fagus grandifolia). Shrub and herb layers can be quite diverse, depending upon the site. A variant of this forest type is Rich Northern Hardwood Forest (see page 11). Other variants may be definable with more data.

This type is equivalent to SAF Type 25, sugar maple-beech-yellow birch.

Characteristic Species

Sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis) and American beech (Fagus grandifolia) are the most common canopy species. Also present in smaller numbers are eastern hemlock (Tsuga canadensis), red maple (Acer rubrum), white ash (Fraxinus americana), white pine (Pinus strobus), black cherry (Prunus serotina) and basswood (Tilia americana) (the latter two are common on richer sites). As this forest type makes the transition to spruce-fir forest, red spruce (Picea rubens) and balsam fir (Abies balsamea) may be mixed in. Common shrubs are hobblebush (Viburnum alnifolium), striped maple (Acer pensylvanicum) and shadbush (Amelanchier spp.). Typical herbs are evergreen woodfern (Dryopteris intermedia), christmas fern (Polystichum acrostichoides), shining clubmoss (Lycopodium lucidulum), sarsaparilla (Aralia nudicaulis), red trillium (Trillium erectum), and white wood aster (Aster acuminatus). Spring ephemerals (plants which flower early in spring, before trees leaf out) are very characteristic of this forest type. Some characteristic birds are rose-breasted grosbeak (Pheucticus ludovicianus), ovenbird (Seiurus aurocapillus), red-eyed vireo (Vireo olivaceus), black and white warbler (Mniotilta varia), black-throated blue warbler (Dendroica caerulescens) and veery (Catharus fuscescens).

Uncommon Species

Broad beech-fern (Thelypteris hexagonoptera), male fern (Dryopteris filix-mas), and three-birds orchid (Triphora trianthophora) are among the rare plant species that may occur in these forests. Some of the species that occur in Rich Northern Hardwood Forests may occur in this community as well.

Distribution in Vermont

Throughout at elevations below 2500 feet. A common community, present in every county. Most examples of this community have been altered by human activities such as clearing for agriculture, selective timber cutting, or sugaring. Very few undisturbed examples remain.

Mesic Northern Hardwood Forest (Beech-Birch-Maple Forest)

State Rank: *S4*

Comments on State Rank: This is a common community throughout Vermont, generally below 2500 feet elevation. It is perhaps our most common forest type.

State EO Ranking Guide: Use chart below to determine a preliminary EO rank. Then take into account any other factors that seem important to determine a final EO rank. A and B ranked occurrences will be tracked by NNHP.

Condition ↓ Size, acres →	500+	100+	50+	10+	5+
Old growth (see introduction); surrounding land is forest or other natural habitat	A	B	B	C	C
Old growth (see introduction); surrounding land shows significant impact of human activity (agriculture, development, major roads, etc)	A	B	B	C	D
Many trees over 100 years old, no major human alteration in past 70 years; recovering well; surrounded by forest	B	C	C	D	D
Many trees over 100 years old; no major human alteration in past 70 years, but forest is adjacent to open land or is otherwise vulnerable to disruption of natural processes	B	C	D	D	D
Severely altered within last 70 years	C	D	D	D	D

Appendix 3.

Description of the high elevation hardwood-spruce natural community.

Taken from Liz Thompson's extended community descriptions in the Vermont Non-game and Natural Heritage Program's guide to Vermont upland and wetland natural communities.

HIGH-ELEVATION HARDWOOD-SPRUCE FOREST

Description

This is the forest that is transitional between northern hardwoods and montane spruce-fir forests. It is common at higher elevations in the mountains, usually from about 2000 to 2500 feet elevation. Yellow birch (*Betula alleghaniensis*) and red spruce (*Picea rubens*) are codominant in mature stands of this type. White birch (*Betula papyrifera*) dominates the successional stage of this community. The understory vegetation varies locally, depending upon the relative dominance of spruce or birch: in spruce dominated areas, the understory vegetation is quite sparse due to the dense shade provided by the canopy. This is equivalent to SAF Type 30, red spruce-yellow birch (Eyre 1980). A variant dominated by yellow birch may be recognized; more data area needed.

Characteristic Species

In the canopy are red spruce (*Picea rubens*) and yellow birch (*Betula alleghaniensis*), with a lesser component of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), hemlock (*Tsuga canadensis*) and balsam fir (*Abies balsamea*). Paper birch (*Betula papyrifera*), pin cherry (*Prunus pensylvanica*) and trembling aspen (*Populus tremuloides*) are common in disturbed areas. Common species in the shrub layer are hobblebush (*Viburnum alnifolium*), striped maple (*Acer pensylvanicum*) and mountain maple (*Acer spicatum*). Characteristic herbs are mountain woodfern (*Dryopteris campyloptera*), mountain sorrel (*Oxalis montana*), twinflower (*Linnaea borealis*), blue-bead lily (*Clintonia borealis*), Canada mayflower (*Maianthemum canadense*) and sarsaparilla (*Aralia nudicaulis*). Some typical birds are winter wren (*Troglodytes troglodytes*), blackburnian warbler (*Dendroica fusca*), Swainson's thrush (*Catharus ustulatus*), Canada warbler (*Wilsonia canadensis*), and solitary vireo (*Vireo solitarius*).

Uncommon Species

Lesser pyrola (*Pyrola minor*), northern mountain-ash (*Sorbus decora*), mountain sweet-cicely (*Osmorhiza chilensis*), and blunt-fruited sweet-cicely (*Osmorhiza depauperata*) may be found in these forests.

Distribution and Abundance

Common at middle elevations (2000 to 2500 feet) throughout the state.

Most examples of this community have been logged. Very few pristine examples remain.

Example

Camel's Hump, Duxbury and Huntington. This site is within Camel's Hump State Forest.

High-elevation Hardwoods-Spruce Forest

State Rank: *S3*

Comments on State Rank: This is a common community at high elevations in Vermont, generally above 2000 feet elevation. It is found at mid to high elevations in the Green Mountains as well as at the highest elevations in the Taconics and in the eastern highlands.

State EO Ranking Guide: Use chart below to determine a preliminary EO rank. Then take into account any other factors that seem important to determine a final EO rank. A and B ranked occurrences will be tracked by NNHP.

Condition ↓ Size, acres →	500+	100+	50+	10+	5+
Old growth (see introduction); surrounding land is forest or other natural habitat	A	A	B	C	C
Old growth (see introduction); surrounding land shows significant impact of human activity (agriculture, development, major roads, etc)	A	B	B	C	D
Many trees over 100 years old, no major human alteration in past 70 years; recovering well; surrounded by forest	B	B	C	C	D
Many trees over 100 years old; no major human alteration in past 70 years, but forest is adjacent to open land or is otherwise vulnerable to disruption of natural processes	B	C	D	D	D
Severely altered within last 70 years	C	D	D	D	D