The Elements of Excellent Forestry

Excellent Forestry as defined by the Forest Guild www.forestguild.org and as practiced by Butternut Hollow Forestry is a holistic approach to forest management. This approach recognizes that what we take from the forest must be balanced with the forest's ability to meet our needs, and that forests have intrinsic values above and beyond this. The individual elements that make up Excellent Forestry include: social, ecological, and economic considerations that are not mutually exclusive. All of these elements play a role and are often prioritized based on landowner objectives. This appendix explores these elements and their relationship to forest management and the environment in more detail. Some of the words and forestry terms may be further defined in the glossary, Appendix B.

Social Elements

Stewardship: Webster's dictionary defines stewardship as "the individual's responsibility to manage his life and property with proper regard to the rights of others." Along with the responsibilities of stewardship, a landowner and a land manager must develop a land ethic- which when followed, will result in actions that are grounded and respectful of both human needs and the ecology of the surrounding landscape.

Context: Excellent Forestry, while mindful of the details, considers the larger view of land management over a long period of time. A concept that has taken hold over the past 15 years or so is termed "ecosystem management." In New England, relatively small properties with fragmented ownership patterns makes true ecosystem management very difficult to practice. A better fit is "ecosystem-based management" where ecological processes are considered when making forest management decisions. This is very complex in practice, and many different approaches have been proposed.

The backbone of ecosystem-based management is looking at the big picture; considering forests as part of a larger natural system. Ecosystem-based management views the land and the resource base in its entirety, as a holistic and integrated entity. Human beings are recognized as an integral part of ecosystems; in fact, social responsibility is a large component of ecosystem-based management.

While ecosystem-based management techniques often involve very large ownerships and management on the landscape scale, the concepts can be applied to smaller ownerships as well. Many ownerships have unique attributes. The stewardship approach owners take on their own property could have an effect on nearby properties as well. This plays an important role in regional forest ecosystem health and function.

Ecosystem-based management considerations attempt to view a property in the context of the surrounding landscape and to determine how one's management might affect

the larger scale landscape. Sometimes, across boundary management can be explored with like minded landowners, especially as it relates to access, recreation, wildlife habitat, and land conservation. Basically, larger blocks of undeveloped forest, field, and wetlands provide better opportunities for sustainable forestry, wildlife habitat, and ecosystem function.

Local & community relationships: Forest land is a huge benefit to local communities. Local forests provide economic resources to rural communities through activities related to the harvesting of forest products, recreation, hunting, and tourism. Forests are a source of renewable resources that can be produced and used locally to counteract the effects of the globalization of our society. Forests also provide the "free" benefit of clean air, water, and a beautiful backdrop in which to live.

There are often mixed feelings among the general public concerning forest management and, in particular, timber harvesting. While many people use forest products, most do not fully understand where they come from and how they are produced. People's perceptions of what may be happening and what is actually occurring are often quite different. A timber harvesting project designed for wildlife habitat improvement, salvage cutting due to wind storm damage, or other natural disturbances may sometimes require the creation of large openings that could be offensive to some individuals. The idea of any type of tree cutting may upset people unless they understand that it was thoughtfully planned and done purposefully with due consideration for the environment.

Tours of properties for educational purposes can often stimulate interest in management and dispel negative assumptions. Often experts can be brought together to help the forester and the landowner with educational events.

Forest Guild meeting Keene, NH

Menomonee Reservation, Wisconsin

There are many professional, conscientious loggers that live throughout this region. Unfortunately, many of these skilled individuals are in their fifties or older, and there are few younger people learning the trade. Likewise, there are quite a few (but less over time), wood-using facilities. They range in size from small to quite large, and include sawmills, pulpmills, pellet plants, wood-to-energy plants, and firewood merchants. As time goes on, the demand for different products will vary, and perhaps new uses for wood products will emerge. It is a pretty sure bet that the world will continue to need sustainably produced

natural resources, which certainly includes trees. It would be most desirable and make the most sense for these products to be produced and used locally.

Aesthetics: Aesthetics, while not the highest priority of all landowners, are important to consider. Balancing aesthetic concerns with economics and ecology is a crucial task in land management. Trees blow down and lose limbs. Natural mortality creates or will create snags. Slash reduction following logging and crop tree release operations are vital for maintaining the visual quality of an area and reducing the risk of fire. However, slash is valuable for soil building and nutrient cycling. Brush piles for wildlife cover are an important component of habitat and could be built in areas that are not visually sensitive. Coarse woody debris or large pieces of trees can be left in areas not readily visible. Roads and trails should be designed so that they are pleasing to the eye and fit into the natural landscape; poorly planned and constructed trails or messy jobs contribute to the poor public perception of destructive logging operations. Proper cleanup of log landing areas is also important, as debris left from logging operations can be very unsightly. Debris can be brought back into the woods or buried following landing use. After the landing is cleared off, it can be graded, limed, fertilized, and seeded. Drainage and erosion control considerations can be addressed as well.

While the approaches to aesthetic management take extra time and hence, extra cost, it is well worth it in the long run. Conforming to stewardship principals while garnering public acceptance of logging, is all part of Excellent Forestry.

Archeological & Cultural features: Old homesteads, abandoned many years earlier are often found in the woods. Associated with these areas are various remnants including cellar holes, wells, barn foundations, root cellars, walls old dumps, etc. Old Native American sites are harder to locate and identify but they may be present as well. All of these areas should be protected and off limits to heavy equipment.

An old Model-T in a foundation

A 20 foot deep hand dug well

Forest Certification: One approach to assuring the public that wood products come from forests managed in a sustainable way is the concept of forest certification. In theory, the idea is relatively simple, but in practice it is somewhat more complex. The idea is that forest practices meet a stringent set of guidelines (social, ecological, and economic) set

forth, approved, and audited by a certification body. Several certification systems exist. The Forest Stewardship Council (FSC) www.fscus.org, and the American Forest Foundation Tree Farm Program www.treefarmsystem.org, are the most widely recognized. There is a lot of good information on the New Hampshire site www.extension.unh.edu/Forestry/TreeFarm.htm. Forest products that are generated from certified woodlands can be sold into the market place with a "green label". Over time, consumers may recognize that they have a choice in the products they buy, and some may want assurance that they are purchasing an environmentally friendly product. It is hoped that certified wood can bring that assurance, and also provide landowners and loggers a financial incentive to practice excellent forest management. This concept is starting to catch on, and likely will - if the "green" products are as affordable as the non-certified equivalent. This process is similar to the organic food movement which took many years to gain market share, and is now big business. Butternut Hollow Forestry can assist landowners with this certification process.

Conservation easements: A conservation easement is a powerful tool for assuring a landowner's long-term wishes for their property. It guarantees that the property will be left undeveloped while leaving a legacy of open space. The development rights and often conservation restrictions are conveyed by the landowner by selling or donating them to a qualified conservation organization. When sold, the rights are generally bought at the market value or as a "bargain sale" (less than market value) by a conservation group, land trust or the federal government's Forest Legacy Program www.na.fs.fed.us/legacy/index.shtm. Conveyance of these rights through a sale requires funds that are normally obtained through local private sources of regional conservation project funding through the legacy program. Another way to transfer the development rights is to "donate" them. By donating them, the value of the rights are forgone without direct monetary compensation to the landowner. This gift can then be deducted from federal and state taxes by the landowner.

Precluding or limiting development to certain portions of a property can help protect wildlife habitat, provide enhanced recreation opportunities, create biodiversity, and provide educational opportunities, while still allowing for timber management. This will help keep local rural communities vibrant in the future.

Ecological Elements

Natural Processes: One of the tenants of Excellent Forestry is to work in harmony with nature. Certain natural processes can be sped up, slowed down, or enhanced through management. Management can sometimes be used to "restore" or work towards a more natural state on degraded or abused land. Some processes in which nature sets the precedent cannot be "managed" at all. It is important to consider the role these processes play in management activities, and explore the major ones.

Succession: This is a process which takes place naturally on any piece of land, including forest, wetland, open land, or even developed land. The temporal scale on which this is viewed is significant. On a geologic time scale, processes such as glaciation, global temperature patterns, and plate tectonics all play a role. In the life of an individual, land-use patterns play the biggest role, but natural disturbances, insect and disease infestations, fire and natural aging processes are all elements of succession.

In terms of forest land in New England, certain trees species are predisposed to grow in certain conditions. The area where these trees and plants grow is commonly referred to as a natural community. In general, if allowed to develop naturally, a forest will develop from early successional species such as white birch, aspen and white pine, to late successional trees like hemlock, red spruce, sugar maple, beech, and yellow birch. An "old" aspen tree is 100 years old, while an "old" yellow birch is 300 years old. Wildlife habitat and the species that use a particular habitat change as succession progresses towards a natural state.

Wetland areas undergo change over the years as well. Areas of open water become filled in over long periods of time. Bogs generally exhibit patterns of zonation: on the fringes they are wooded, followed by a zone of partially decomposed peat, and towards the middle there may be open water. Streams change course gradually, forming oxbows and new channels. They also erode deep ravines and change the topography over time.

A wetland filling in

Stream bed likely formed from erosion

While management decisions cannot possibly be analyzed on every level, it is important to consider what the possible outcomes of a management decision might be. Through prudent consideration, management can be designed to achieve a set of desired outcomes, including accelerating or retarding successional trends.

Water & nutrient cycling: This natural process is crucial in maintaining the long-term stability of forested ecosystems. All types of vegetation, including trees, cycle nutrients and water. The removal of all trees and other vegetation from a site will lead to less water uptake and thus more runoff. Increased runoff often leads to the leaching of nutrients

from the soil which changes the down-stream water chemistry. Many nutrients are sequestered in trees and vegetation. The inevitable result of the removal of vegetation from a site is a loss of some nutrients. How water and nutrients are "managed" have important implications for forest productivity. Most of a tree's nutrients are concentrated in the leaves, limbs, and branches. The bole of the tree has relatively few reserve nutrients. There is some concern that whole-tree harvesting can deplete nutrients from a site because the entire tree is removed. In a thinning situation on productive soils where only a portion of the trees are removed, this is probably not a concern. In clear-cuts, or when whole-tree methods are employed on the same area repeatedly, the potential for nutrient loss is real. This could result in a loss of forest productivity. Several groups are looking at establishing guidelines for acceptable whole-tree removal, as it appears that the forest will be looked at to supply an increasing amount of biomass. Soil properties and site variations influence the nutrient status and leaching as much as the vegetation. Dry, sandy soils or thin soils on high elevations and ridgelines are inherently low in fertility and are prone to rapid leaching.

A whole tree chipper

A patch cut using whole tree removal

Adaptation: A plant's ability to adapt over time helps it to survive in a changing world. Furthermore, the passing of genes from one generation to the next allows the best adapted plants to thrive. Trees that are expressing themselves well are usually well-adapted to their environment. An example is a red spruce's ability to withstand the harsh growing conditions of the area in which it lives - at high elevation and with thin, dry soils. Red spruce has adapted to its environment over thousands of years. Well adapted trees should be encouraged through management decisions favorable to them. While the genetic makeup (genotype) of individual trees or stands of trees is not practical to determine, forest management should encourage trees of superior appearance (phenotype) and high vigor that are free from obvious defects.

Spruce and fir designed for snow and cold

Well adapted sugar maple trees

Disturbance: All natural systems are prone to disturbance, and forests are no exception. Ice storms, fire, micro-bursts of high winds, hurricanes, floods, long-term weather patterns, and insect and disease outbreaks all affect forests. Approximately 12,000 years ago, much of northern New England was covered by ice perhaps a mile thick. When the glacier first retreated, the resulting landscape resembled the arctic tundra. It has changed dramatically since them.

Small scale but more frequent disturbances are often responsible for creating a multi-age structure to a natural forest. A small area of blow-down created by a high wind will often regenerate to shade-intolerant species, thereby setting back succession. The 1938 hurricane and the 1998 ice storm which affected millions of acres of forest land in New England are examples of stand replacing natural disturbances that had wide spread effects but do not occur very often. If allowed to recover without human influence, the forest will over time and it will usually grow back with a more complex structure than it had before.

A fairly large 5 acre blow down

A smaller "gap" opening from a micro burst

No discussion about disturbances would be complete without considering human impacts. Debate over whether human influences are natural is probably best left for the anthropologists. Suffice it to say that human disturbances in recent history have done more to influence the present state of our landscape than any natural event. Human disturbances of the forest include forest clearing, livestock grazing, logging, fire, pollution, development, and the introduction of exotic species. In the 300 years since European

settlement, virtually all of the forests in New England have been cut; some areas have been cut more than five times. Much of the land was stumped and used for agricultural purposes. Soils were depleted by a lack of attention to runoff and erosion. Intensive development and subsequent paving of former forest land virtually eliminates natural processes for the foreseeable future. Air pollution and global warming pose real threats to our forests. The introduction of chestnut blight and Dutch elm disease virtually extirpated those species from our forests. The introduction of invasive exotic insects and disease pose similar threats. Invasive exotic plants are a cause of great concern due to their prolific nature and lack of natural controls. This enables them to vastly out-compete native plants, which has a drastic impact on biodiversity.

Biodiversity: As human populations continue to swell, they consume more and more of the Earth's resources. As development encroaches into more rural areas, it replaces natural systems with artificial ones. The ensuing loss of habitat leads to the loss or redistribution of flora and fauna. The introduction of exotic and invasive elements further threatens the native biota. As natural communities become simplified, there is a loss in biodiversity through the elimination of some species and reductions in genetic diversity in the species that remain. Humans should be concerned with a loss of biodiversity, because diversity is the key to sustainable life on this planet. Through research, we are just beginning to realize how complex our natural world is, and how all things are interrelated. The resilience of any natural system to change is controlled by its biodiversity. How humans interact with the natural world does play a role in the ultimate stability of our natural systems. "Ecoreserve" areas, both large and small, are important in helping to maintain biological diversity. They could play an important role in maintaining ecological integrity.

Natural Community approach: Management under Excellent Forestry uses nature as a guide and therefore is highly considerate of the concept of natural communities. To manage for natural systems one needs to know what they are, and once identified what are the natural dynamics of that system. To maintain high ecological integrity and diversity, siliviculture needs to be consistent with the scale and type of natural disturbance typically encountered on that particular site.

Sustainability: Another concept used in a wide variety of contexts and often poorly defined is the idea of sustainability. Like ecosystem management, the idea has been around for quite some time, but it has not been well practiced or understood. It is recognized that from a social, economic, and ecological standpoint, forests must be managed in a sustainable way that considers the long-term. Because trees can either naturally regenerate or be replanted when they have been harvested or otherwise die, trees are considered a renewable resource. For this reason, it is possible to harvest trees in a forest repeatedly in a way that is sustainable. This implies that portions of the forest may be regenerated using a variety of silvicultural methods. A balance or a variety of age classes is critical for long-term sustainability. If allowed to grow naturally, forests would reach some

type of "steady state" until a disturbance occurred. Any treatments carried out in the woods should be designed to be sustainable over the long term.

The current view of sustainability recognizes the need for the entire ecosystem to be sustained, not just one component of the system - like timber. If all components of the forest are considered, the entire system should be able to function in a sustainable fashion. The Northern Forest Lands Council in the 1990's identified the following benchmarks of sustainability:

- Maintenance of soil productivity
- Conservation of water quality, wetlands, and riparian zones
- Maintenance or creation of a healthy balance of forest size and age classes
- Protection of unique or fragile natural areas
- Conservation and enhancement of habitats that support a full range of native flora and fauna
- A continuous flow of forest products
- The improvement of the overall quality of the timber resource
- The consideration of aesthetic concerns during timber harvesting
- The continuation of opportunities for recreation

Excellent Forestry should strive to maintain these benchmarks.

Wildlife Ecology

Habitats: The American Heritage Dictionary defines habitat as "the area or type of environment in which an organism or ecological community normally lives or occurs". Wildlife habitat takes on many different forms. The components of habitat: *food*, *water*, *cover,* and *spatial relationships* - are all interrelated.

Food for animals varies widely. Herbaceous plants, woody plants, mast or nuts, fruits and berries, insects and grubs, prey, and carrion are all eaten by wildlife. The location and abundance of food sources plays a primary role in determining the quality of the habitat for any species.

Northern red oak acorns

A heavy acorn crop

Water is required by all living things. Standing water, running water, seeps, and springs are all used. Some animals use water periodically, while others live in and around it.

Cover is analogous to protective shelter. Cavities in trees, brush piles, nests, ledge outcrops, dense softwood cover, and holes in the ground are used to provide cover for different animals.

Spatial relationships or patterns, tie the habitat components together. If all the habitat requirements of a particular species are found within its "home range", the animal will probably remain in the vicinity. Creating the proper juxtaposition of food, cover, and water is important for wildlife to be attracted to and remain in a particular area. Travel corridors are used by many species to move from one habitat type to another. Ridgelines, streams, and other riparian areas commonly serve as travel corridors.

Habitat Types: Most of the undeveloped and un-fragmented landscapes in New England have a wide variety of habitat types available for wildlife, from large and small mammals to birds and amphibians. Open land, old pasture areas, dense hemlock, large white pine, mid-slope moderate and steep terrain, sapling-size trees, ledge outcrops, cliffs, streams, and wetlands are habitat types that add to diversity. Fruiting trees and shrubs as well as agricultural crops add food. Soft mast includes all of the berries and apples as well as cherry. Hard mast consists mainly of acorns, pine cones, birch seed, hickory nuts, and limited beech nuts. Butternut trees are declining and falling out of the landscape, but when present they can be a significant source of hard mast if they are still producing nuts. Browse is often available on recently cut tracts for white-tailed-deer, moose, hare, and turkeys.

Butternut

Bear scarred beech

A beech that has been climbed for years

On a property by property level, vegetation can be manipulated to highlight or create certain habitat components. When vegetation is cut or planted to improve or create certain habitat types, some species will benefit, and others will not. Often, habitats not found within the boundaries of an owner's land can be found on adjacent properties. Across boundary management could be beneficial to wildlife.

Forested Habitats: Forest habitats can be classified in several different ways. One is by species composition, another is through age-class or successional stage, and a third is the vertical diversity or the distribution of canopy layers within a forest.

Red oak, red maple, hemlock, and eastern white pine are often the most common trees in the river valleys, while sugar maple, white ash, yellow birch, beech, and spruce are more common at higher elevations. The upland hardwood areas attract species which browse and feed on hard mast, notably white-tailed deer, moose, turkeys, and black bear. Many resident and neo-tropical birds also use these upland areas. Birds such as the red-eyed vireo, white breasted nuthatch, chickadee, hermit thrush, and various woodpeckers are likely visitors to these areas.

Softwood communities, especially those along riparian zones, are used by many species. Furbearers such as mink, beaver, otter, fisher, raccoon, and ermine could all be expected. Some of the dense hemlock stands could be used both as a deer yard and as a corridor for wildlife movement.

In places, high populations of deer in the South and moose in the North can be a significant habitat problem. On some properties, there are so many deer or moose that they are adversely effecting the regeneration of most hardwood species because of intense browsing. Black bear populations are on the rise as the habitat for them expands. The elusive coyote is plentiful, but are rarely seen during the day. None of these species could live its life cycle entirely on small parcels because they have large home ranges. Female black bears, for example, are believed to have a home range of 3 to 15 square miles, while the male has a home range of approximately 40 to 100 square miles.

Bear often bite red pine to mark territory

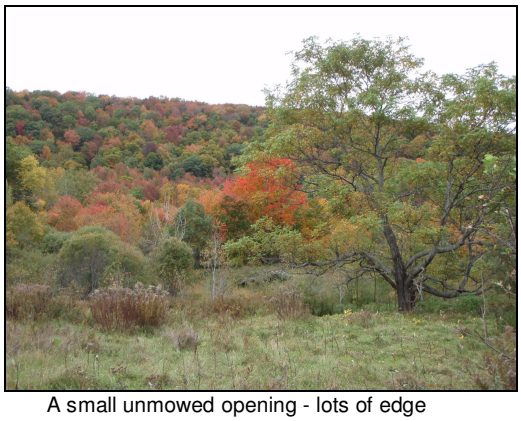
A large bear foot print

Wetland Habitat: In terms of resource value and diversity, riparian areas exceed all others in importance. The areas around streams and other wetland areas provide critical habitat including breeding and nesting sites for many species. Riparian areas also filter runoff, thereby keeping the water clean. Riparian areas such as those previously mentioned are used as travel corridors for animals, amphibians, and fish moving to different habitats and from property to property. Characteristics of good corridors include softwood for cover and steep stream banks which aid in providing the animals a sense of protection. There are many types of water-dominated features including lakes, ponds, brooks, forested and shrub wetlands, as well as vernal pools.

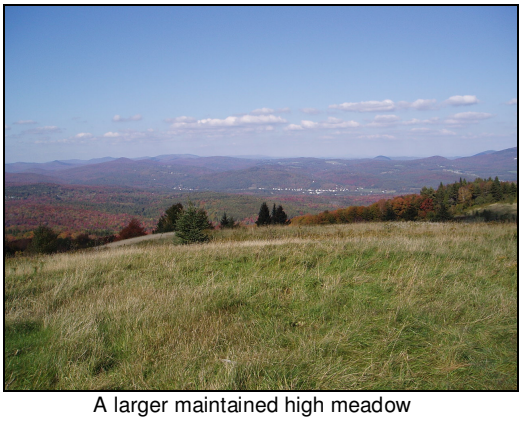
Two examples of beaver influenced wetland systems

Open and edge habitat: Non-forested habitats including maintained fields, reforesting old fields and pastures, orchards, and forest openings are limited in a region that is about 80% forested. Non-forested habitat is very important for many wildlife species. Some species, such as the bobolink and the meadowlark spend nearly their whole life in open land. Birds such as the woodcock need open land for roosting and mating rituals. Many animals, including white-tailed deer and black bear, eat grasses and other herbaceous growth, especially in the spring.
Birds of prey catch mice, voles, and other rodents in these openings. Delayed mowing thus encourages many birds.

The edge between open land and forest is one of the most highly used areas by wildlife. These areas provide food with nearby cover for many species. This is commonly where apple trees and other sources of soft mast are found. Species which eat grasses and early emergent vegetation also do so at the edges where the cover of the forest is not far away. The more gradual the transition between open and forested areas, the more valuable the edge becomes. A "soft" edge can be created and maintained through periodic vegetative management. Maintaining the open land around the house will help to provide this important habitat type.



A small unmowed opening - lots of edge



A larger maintained high meadow

Habitat Management Approach: Two approaches to wildlife habitat management are commonly considered for forests in this region. The *featured species* approach caters to one or two chosen species. Management specifically for white tailed deer or for ruffed grouse is an example. The *species richness* approach to habitat management is most applicable in most cases. This management technique attempts to provide habitats for as many different species as a property can support. The species richness approach encourages a diverse, healthy ecosystem. One of the goals for the management of many forests in the region is to maintain a forest structure typically found in a natural forest and to encourage natural forest processes. Manipulation of the forest to benefit a particular species could be a divergence from this concept. While certain management practices may be beneficial to some species and detrimental to others, the overall goal of Excellent Forestry is to create a rich and diverse habitat for wildlife.

Certain wildlife practices should be routinely followed during logging operations, or as separate wildlife habitat enhancement activities. An example is the practice of leaving or creating dead or dying snags where they do not endanger people or aesthetic values. Snags are very important to many species, especially birds and insects. Another practice is to leave or create some coarse woody debris on the ground for use by insects, invertebrates, and fungi. Coarse woody debris should include large diameter low-value trees, which are cut or fall naturally and left in place in the woods. These large pieces of decomposing wood are valuable for nutrient cycling, water retention, carbon sequestering, and microbial activities. Black bears often work these logs over looking for grubs and ants. Several reptiles and

amphibians utilize the moist cover provided by these decaying logs. Coarse woody debris is a component of the natural forest and contributes to ecosystem function.


A downed hemlock covered in moss


A very large yellow birch on the ground

Plant Ecology

Habitats: As with animal habitats, plant habitats are as varied as the ecological communities that support them. Broadly speaking, the four types of plant habitats are: alpine, upland, flood plain, and wetland. There are many micro-habitats found within each of the broad types, however.

As plants cannot move, they are dependent on the sites where they are located. Plants tend to group together, forming communities which often contain a predictable combination of species. Plant communities are formed based on several factors. Climate, soil types, and biotic conditions all play a role in the growth and distribution of plants. Climatic factors include temperature, light, atmospheric gases, humidity, precipitation, and wind. Soil factors include available water, temperature, the availability of oxygen in the soil, and soil chemistry. Biotic factors include soil organisms, insects, fungi, competition, symbiotic relationships, grazing and browsing, invasion by exotic species, and human impacts. For this reason "indicator plants" can be used to help identify certain natural communities when the tress may not be as indicative.


Squirrel Corn


Spring Beauties

Rare species and unique natural communities: An in-depth flora and fauna survey is usually not within the scope of a typical forest management plan, however that does not mean they should not be considered. These are among the most important areas to be aware of. There are forest ecologists who are experts in botany and natural community identification. Each state has a Natural Heritage Bureau, usually associated with a natural resource department and affiliated with The Nature Conservancy.

In Vermont the web site is www.vtfishandwildlife.com/wildlife_nongame.cfm and in New Hampshire it is www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/. The Bureaus maintain a data base of known occurrences of rare species. When developing a management plan on a particular property, the list should be consulted. When found on a property, these areas should be identified on the ground and on maps and protected from any activity that could disturb them. This is one way to maintain biodiversity.

Exotic and invasive problems: Invasive exotic shrubs, such as barberry, Japanese honeysuckle, and both glossy and common buckthorn are causing a new realm of problems because they are able to out-compete our native trees and shrubs. They are responsible for a decline in biodiversity and are capable of greatly impeding the re-growth of trees as they die or are harvested. Barberry and buckthorn were introduced as landscaping plants. Their great popularity and success are due to their prolific growing characteristics. Buckthorn was often planted as a hedgerow because of its fast and dense growth. Barberry is a common landscape shrub because of its attractive form and very hardy growing characteristics. Honeysuckle, ironically, was introduced as a wildlife conservation plant because of the great amount of soft mast or berries, it produces. All three produce great quantities of berries. The berries are eaten by songbirds, turkeys, and many other wildlife species which then spread their seeds through their excrement. The characteristics that made these shrubs so successful as introduced plants are the very reasons they are such a problem in the natural landscape. They are prolific, hardy, produce vast quantities of seeds, and virtually are able to out-compete all native vegetation. They typically leaf out earlier in the spring and keep their leaves longer into the fall, providing them a much longer growing season. Their seeds last many years in the soils and can build up to great quantities that germinate when conditions are favorable, such as an increase in sunlight on the forest floor after a harvest.

Honeysuckle fruiting

Buckthorn & pine competing for space

The problem doesn't end there. Controlling invasive exotic shrubs is nearly impossible after they have become established. Even if you eradicate them completely from your land, a daunting task at that, their seeds will continue to be distributed by birds and other wildlife. Still, putting an effort into controlling them will have short term benefits which may be enough to give native plants a chance to get established. The control techniques will be described in detail in the appendix, but briefly they consist of manual, mechanical, and chemical means. Knocking these plants back prior to a timber harvest will produce the greatest benefit. Ignoring them and opening up the forest through a harvest gives them the greatest advantage. While it may be impossible to eradicate certain plants, it may be possible to keep them in check so that natural processes can continue.

Exotic introduced pests and pathogens are also a real concern for tree species. Chestnut blight and Dutch elm disease have virtually eliminated those species from our forests. Beech bark disease and butternut canker have severely affected the health and viability of those species as well. The hemlock wooly adelgid has been found in our region. Emerald ash borer, Asian long-horned beetle, and sudden oak death are real threats; they have been found in neighboring states and Quebec.

Environmental Factors: Challenges beyond the control of the landowner or the forester including climate change, atmospheric deposition, air pollution, and ozone depletion can only be dealt with through government action. How forests react to changing weather patterns can be speculated about, but this is much too complicated to predict with any accuracy. Species ranges will likely migrate due to warming climates. Spruce trees in Germany and the United States have had adverse reactions to acid rain produced from the burning of coal. White pine and other trees are susceptible to damage from high ozone levels. All of these man-made changes to our environment will lead to a changed forest ecosystem.


Spruce decline


Rotten stumps from same tree


Spruce crown flagging

Economic Elements

The Concept of Silviculture: The practice of Silvicuture is elemental when removing products from the forest using Excellent Forestry principals. Silviculture is the art and science of growing forests for timber and other values. The art of forest management displayed by a forester is an expression of his or her passion and personal philosophy. Science is based on facts that have become known through research. A combination of the two is the key however, as there is more that is not known about forest ecosystems than is known.

If society did not have a need for forest products, there would be no reason to enter the woods and cut trees. If this were the case (as long as environmental factors were stable), then forests would tend towards a "natural" state and they would thus be a true expression of their natural community. At some point, applying silviculture will likely involve the cutting and the removal of trees - either for current economic gain, to set the stage for future economic gain, or in an attempt to restore the forest from past abuses.

Silvicultural actions in the forest involve adjusting species composition and density and structure. The two silvicultural systems available to foresters are even-age and uneven- age, and all prescriptions are based on one or the other. Even-aged management involves regenerating stands at one point in time. Depending on the size of the opening, this could be similar to a stand replacing - or even a landscape scale disturbance such as that which a hurricane, tornado, fire, or very large wind event might produce. Uneven-aged management is based more on gap disturbance regimes that create small openings. Individual tree failure, or the loss of groups of trees to events such as small scale wind events, ice storms, small disease and insect outbreaks, lightening strikes, etc., creates gaps in the forest that allow regeneration to grow as well as larger, older trees. Different silvicultural treatments can be implemented by foresters - often emulating disturbance patterns that may be found in nature.

Examples of silvicultural prescriptions common in northeastern forests include:

Shelterwood with reserves: A silvicultural treatment designed to regenerate the desired mix of species. This is an even-aged treatment. However some trees should be retained in perpetuity for structural and wildlife habitat considerations. This treatment is commonly applied when trying to regenerate white pine, red oak, and northern hardwood on their respective sites. This treatment can be done in 2 or 3 steps depending on the response of the regeneration.

Individual Tree/Group Selection: A silvicultural treatment designed to produce an uneven-aged stand structure. Trees are harvested in groups from a few to up to ½ acre, to secure regeneration of a wide array of species but primarily tolerant and mid-tolerant ones. Between the groups, single tree selection can be applied to release high quality trees. This treatment is well suited to almost all timber types but it is most commonly applied to

northern hardwood and spruce fir. When applied several times in the same stand, this treatment should create a multi-aged stand over time. Over browsing by deer or moose can make it challenging to get regeneration established in many places.

Patch cut: A silvicultural treatment designed for regenerating intolerant and mid-tolerant species. It is commonly applied in hardwoods where the trees are in poor health or the majority of the trees will not make it until the next scheduled treatment. Also, if the goal is to regenerate more shade intolerant trees, this is one suggested method. In spruce fir stands, it is commonly applied when advanced regeneration is present and it is being over topped by mature trees. It is often applied with the intent of creating a mosaic of patches within a stand. The effect is to create an uneven-aged stand consisting of small even-aged patches. If 1/4 of a particular stand is treated in this manner, then after 4 entries there should be 4 age classes of trees. Patches can range from 1/2 an acre to about 3 acres in size. Thinning in between the patches may or may not be done as individual situations warrant.

Clear cut: The removal of all the standing trees in an area of 3 acres or more. This should also be done with reserves.

Improvement Cutting: An intermediate silvicultural treatment designed to upgrade the overall stand quality. This treatment can be applied in even or uneven-aged management regimes with future cuttings determining stand structure. This technique is best applied in stands of low quality which in most cases have been high-graded in the past.

Thinning: An intermediate treatment in high quality stands designed to give competing trees more space to grow. The goal here is to adjust stocking levels. Some good quality trees are often cut. As with improvement cutting, this treatment can be applied in both even and un-even aged regimes. Regeneration is not really a concern at this stage.

Crop tree release: This treatment is sometimes commercial, but it is more often done at a cost. Crop tree release is used to free high quality growing stock trees from trees competing for the same space. Typically, 50 to 70 trees per acre are released.

Individual tree selection

Crop tree release

Excellent Forestry considerations for all prescriptions include natural community based decisions where possible, as well as the retention of structural components in the forest. These include snags and other large trees capable of becoming snags, downed logs, and other debris on the forest floor.

Value growth of trees: Economics are not always an overriding consideration of ownership, however. Having a forest that is performing well is possible while maintaining other forest attributes. The carrying costs of owning land alone are expensive. In addition, forestry services critical to proper long-term management involves some expense. In well-managed forests these costs are often viewed as necessary capital investments or annual expenses to achieve owner objectives. Ownership and management will be much more stable and sustainable over time if the forest is at a minimum self-supporting financially. Timber harvesting is currently the primary way for landowners to generate income from a natural and renewable resource through careful long-term management. Rarely is the earning power of unmanaged forests at a high level.

Trees add value in three ways. *Physical growth* accounts for the gains in volume over time. The faster an individual tree grows, the faster the tree increases in value if it is of sufficient quality. Whatever the product, additional volume increases value. An in-depth study of tree growth is too costly and statistically shaky for management plans of this type but some rules-of-thumb do apply. A tree's growth is directly related to the substrate (soil) on which it is located and the competition it has with other trees and plants for sunlight and water. Wet, ledgy, and dry areas do not promote rapid growth of trees. Lower elevation and cool moist, but well drained areas support better tree growth as the soils are deeper and more fertile. One important concept to consider is site productivity. In general, each acre of land is capable of producing a fixed amount of biomass per acre based on its inherent productivity. Through management and silviculture, growth can be shifted from trees with poor economic potential to trees with high potential. Due to less competition for resources, these trees can then grow more rapidly while adding value.

On average, trees in New Hampshire and Vermont grow at a rate of 2 to 4 percent per year. This corresponds to volume increases of approximately 0.5 cords or 250 board feet per acre per year. The U.S. Forest Service through its FIA program has additional data on tree growth.

The second way trees increase in value is through *product development*. As a sapling, a tree has no merchantable value. Pole timber can often be marketed as firewood or pulpwood. Once a tree grows into the sawtimber size class (and if it is of sufficient quality) it can be sold for sawlogs or even veneer. The per-unit value increase from pulpwood to sawlogs to veneer is very large, in some cases 1000% or more. It would be unwise from an economic standpoint to cut a pulpwood size tree that could eventually grow into a valuable sawlog. Furthermore, an individual tree growing rapidly into sawtimber size is a tree which will have a high rate of return.

The third way trees add, or possibly lose value is through *relative price changes* in the value of various forest products. The demand for forest products is cyclical, especially for low-value, bulk commodity items such as pulpwood and chip wood. While it is difficult to predict how trends operate in the short run, the long-term outlook is promising for high quality sawlogs and other wood products. Worldwide, there is an increasing demand for forest products, while the land base from which the products are obtained is shrinking. Furthermore, there is a trend toward the "green certified" forest products previously mentioned. Over time, these certified forest products may reward the landowner with higher returns. Also the forest is increasingly being looked at as a renewable source of energy. Wood for biomass electricity, firewood, and pellets is a reality while wood based ethanol and other products are not too far in the future.

Risk: The discussion about the economics of tree growth would be incomplete with out a discussion about risk. There are very few investments that do not involve risk- forest management included. Trees grow in competitive and harsh environments. The level and exposure to risk varies by region and location. Large scale damaging agents such as fire or wide spread insect outbreaks are less common in the East than they are in the West, but hurricanes do occur. The last major hurricane in this region was in 1938 when many thousands of acres of trees blew down in New England. A major ice-storm in 1998 also impacted huge tracts of forest land. Typically, in northern New England the risk is low - and value loss occurs on a smaller scale. The blow down or the death of a tree or two, or at most the loss of a few acres is the most common risk.

A hillside covered in ice

White pine bent over due to heavy ice loading

One role of management is to reduce value loss through the cutting of high risk trees, and to create conditions that lessen the impact of damaging agents when they happen. An uneven-aged forest with multiple cohorts of trees can recover much faster than an even-aged stand that has little structure and variability.

Timber harvesting options: The local logging capacity and regional infrastructure are in place to carry out the treatments prescribed in this plan. However, due to the volatility in the low-grade markets and erratic weather patterns many loggers are finding it difficult to

make ends meet. Currently, several different methods of logging are available to accomplish the proposed treatments. There are positive and negative aspects to each method, and the type of equipment should be matched to the terrain and the objectives of the job.

Typically, the most common method of logging involves the use of rubber-tired cable 'skidders', dragging away trees that are cut with chainsaws. This equipment is capable of working on steep, rugged ground with little difficulty. Large diameter trees are not a problem for well-powered skidders. A well-planned job can leave the forest appropriately stocked as skidders can maneuver quite well. There are however, some down sides to this method. The skidder operators have to be both highly trained and conscientious. Skidders can have an impact on soils if they are not operating at the right time of year or if they are not operated in a thoughtful, professional manner. Soil compaction and soil rutting can damage tree roots have detrimental impacts on long-term soil productivity.

A John Deere 540 cable skidder

A Timberjack 240A cable skidder

In the past 10 years, a more mechanized form of logging has become common in this region. Mechanical tree harvesters cut the trees instead of a chainsaw. The harvester is commonly on tracks, similar to an excavator. The machine has a harvesting saw-head mounted on a boom, with a 15 to 20 foot reach. Trees are cut and placed in bunches in the woods and are then dragged to the landing area by either grapple or cable skidders. This logging system has several benefits, most of which involve the mechanical harvester. The harvester has the ability to cut a tree, carry it upright, and place it anywhere. The trees are generally placed in bundles along a skid trail, avoiding damage to the trees left behind. A good harvester operator can cut enough trees to keep two or more skidders busy. As long as the harvester operator is skilled, the skidder operators can do their job with minimal damage to the residual trees. This system of logging is capable of producing a high volume of wood in a short amount of time. This may or may not be good, depending on the objectives. All of the soil compaction issues raised above are valid here as well.

A John Deere 640 Grapple skidder

A timberjack feller-buncher run by Simon

A Morbark whole-tree chipper

A Hood loader-slasher

Some of the low-impact logging methods currently available may involve the use of animals, bulldozers, or forwarders. The first two are slow, and they cannot economically drag wood very far. They can work on steep slopes, however. A forwarder is a skidder-like piece of equipment that carries the trees out of the woods, rather than dragging them. There is less ground pressure applied, so soil compaction can be kept to a minimum. The forwarder is highly maneuverable and it can work in very tight spaces. This logging method is often called a cut-to-length system because the trees are processed (bucked) where they lie. The cut up wood is then loaded onto the forwarder. When it heads to the landing it is not dragging 70 or more feet of tree behind it. Forwarders work best on fairly level ground and are not well-suited to steep or rocky ground. Forwarders have the ability to carry the wood quite a distance, and they require minimal landing space. The relatively high cost of this logging system could be offset by lower road construction costs.

A Tigercat forwarder with ecotracks

Low impact logging Maine style

New equipment for logging is always being developed. A push towards Excellent Forestry will result in the design of more environmentally friendly logging equipment. High flotation tires, tracked equipment, and biodegradable hydraulic and chainsaw oils are examples.

Water Quality Protection: Any time heavy equipment is used in the woods there is the potential for water quality problems. Skid trails in the wrong place or used during the wrong time of the year can cause soil erosion and sedimentation. To avoid water quality problems, proper planning is critical. The timing of the job is the most important factor in maintaining water quality. Access roads and skid trails should be initially laid out in a proper way. Soil compaction and rutting is the most eminent danger where the ground is wet. Knowledge of specific soil characteristics, drainage location and often winter logging, can minimize impacts.

Buffer strips along wetland areas, vernal pools, and other riparian zones should not be encroached upon. Predetermined buffer widths are somewhat impractical for planning purposes. It is better to use on-site indicators and conditions to determine adequate buffer widths - or if it is feasible to operate near wetlands. Factors such as topography, a distinctive change in forest cover type, evidence of travel corridors and concentration areas for wildlife, recreational use, and aesthetic concerns can all be used to determine appropriate buffer widths and locations. Depending on the situation, some thoughtful and sensitive individual tree harvesting can be done within buffers to encourage a diverse forest structure.

After any logging, water bars and other drainage-control structures should be installed. Landing areas or places of exposed soil should be seeded and mulch hay may also be required. All brook crossings should be properly restored with the banks mulched and seeded. The most effective safeguard of water quality is a careful equipment operator with common sense - and proper supervision from the forester.

Forest products utilization: Anytime a tree is cut, it is important that the tree is utilized in such a way that the most value is derived from it. The first step in proper

utilization is having an understanding the markets and the end uses for the wood. Specifications for forest products can vary widely from one mill to the next. Furthermore, product specifications are constantly changing as mill utilization becomes better. Once a destination for a particular product is chosen, each tree needs to be carefully evaluated before it is cut. A mistake that turns a veneer log into a sawlog can be very costly, especially if it recurs throughout the job.

Maximizing value depends on careful marketing. Traditional log and lumber grading rules are antiquated. Many mills have made expensive recovery upgrades over the past 10 to 15 years to increase yields from logs. Most sawmills are heavily capitalized and are more concerned with production than quality. Many white pine mills for example, would prefer to saw a 14 foot poor quality log than an 8 foot clear log. New markets are developing, especially for certified forest products. Many involve small operators with relatively low overhead. Portable or stationary band sawmills can produce quality lumber from small diameter and or short logs. Secondary manufacturing such as flooring or molding, or direct marketing of the product seems essential to maintain profitability for these operations.

With the exception of cut-to-length systems, most utilization decisions are made on the landing. A piece of equipment called the loader-slasher has become very common place with the advent of mechanized logging. The slasher portion is a circular saw which cuts the trees to length. The loader handles the tree and is capable of loading trucks and piling the tops of the trees to be chipped. This is a quick, economical way of processing the wood but it does have its drawbacks. The loader operator is quite a distance from the wood that is being sawn, thus high value logs may not be looked at and cut carefully enough. Sorting products is difficult; it takes space and is often handled by a grapple skidder on larger jobs.

The more traditional method of bucking the trees involves the chainsaw. The trees are skidded to the landing, measured, and cut by hand. The logger has more of an opportunity to look the entire tree over carefully. After the wood is cut, it is important to properly sort the wood by grade and product, facilitating the trucker's job of picking up the correct pile and trucking it to the mill.

An idea which may catch on is called "optimization", where wood is brought into a facility that makes the bucking decisions. The tree-length wood is cut up to yield the highest value possible- returning more to the landowner and the logger. Some of these facilities can use short pieces of wood that traditional mills cannot handle. An example is a 6 foot clear piece of sugar maple that some mills can now turn into a valuable end product.

Marketing products as "green certified" (see latter discussion), or by some other method to consumers who demand that their products come from a well-managed sustainable forest is a trend that is growing.

It all boils down to getting the most possible out of the trees that are cut so sustainable forest management can be profitable.

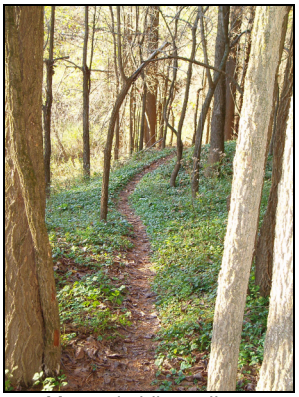
Marketing high value sugar maple veneer

A large pile of low value chipwood

Recreation: Recreational use on most properties is not an economic consideration but it is discussed in this section because it is possible to generate income through recreational activities. While most landowners have little interest in this, many people who do not own land want access to it. As time goes on and populations increase, open space will be more sought after and people will be willing to pay for the right to use land. Currently, hunting and hiking are probably the most common uses on many properties. Mountain biking, cross country skiing, nature viewing, camping, snowmobiling, ATV use, snowshoeing, and horse back riding all have followers looking for a place to recreate. It is important to note that different states have specific rules regarding fee recreation, especially as it relates to current-use taxation eligibility. Recreational activities by landowners are often one of the main reasons people own land.

Deep woods skiing

A multi-purpose natural materials bridge



Mountain bike trail

Ecosystem Services: An entirely new, but very realistic source of possible income is on the horizon for forest landowners. It is widely recognized that forest land provides many benefits to the public at large. Clean air, clean water, wildlife habitat, aesthetically pleasing forested landscapes, and a forest's ability to sequester carbon are all examples of ecosystem services that forests perform, currently for free. In certain communities, these

"services" are recognized as being crucial for the lifestyle of the people living there as well as generating tourism interest and dollars. Carbon is currently being traded on the Chicago Climate Exchange. Consequently, some forest landowners are being paid a fee because their land is keeping carbon out of the atmosphere - thus limiting climate change. Forests could play a major role if a "cap and trade" system is implemented in this country. Also, if other ecosystem services are deemed too valuable to lose, then these services will have a value - perhaps a substantial one.

Conservation incentive programs: For many years there have been federal incentive programs to encourage good stewardship and wildlife habitat improvement. Over the years the programs have changed. The funding is based on allocations made in the annual farm bill. During some years there is ample funding, and other years there is not - depending on allocations in the bill. While the process and paperwork can be somewhat cumbersome, the funding allows many great land improvements to be made. Currently the WHIP and EQUP programs are available to private forest landowners. This is administered by the Natural Resource Conservation Service NRCS www.nrcs.usda.gov/.

Apple tree release and pruning

A cost shared access road

Taxes: New Hampshire and Vermont both use "current use" taxation programs to keep the property tax burden reasonable for parcels of forest land. These laws reward owners who practice prudent timber management on their property. The laws and requirements vary from state to state. For example in New Hampshire, Certified Tree Farms automatically qualify for the lowest assessment ranges (stewardship category) allowed by the law. In Vermont, a state approved forest management plan is required.

Anytime timber is cut in the state of New Hampshire, a timber tax is assessed by the town where the wood is being cut. The tax is roughly 10% of the stumpage value, though it varies by species. Often, expenses related to harvesting timber, i.e. road or bridge building, are overlooked when the tax is levied. A road account should be established at the time of construction. Road costs can be spread out over the amount of timber accessed to lower the timber tax burden. If the assessing officials are made aware of expenses related to timber harvesting, the timber tax burden may be reduced. Grievances have been filed after some timber tax bills were levied and abatements have been granted.

Federal and state tax laws treat timber as a capital asset and it is thus subject to capital gains treatment. Also, as timber is cut it is subject to a depletion allowance under the Internal Revenue Service tax codes. A depletion account can be set up for any property. As wood is cut, an amount equal to the original cost basis of the timber at the time of purchase can be lowered to reduce tax exposure. To set up a depletion account, one must know the cost basis of the property and be able to determine the proportion of that value attributable to timber at the time of purchase.

Laws and permits: The states of New Hampshire and Vermont as well as many towns have laws pertaining to the harvesting of wood which must be followed. Many of the laws pertain to water and water quality. Both states have adopted best management practices, and encourage or require logging jobs to follow these practices.

Role of the Forester

The forester's job is really a balancing act between all of the competing interests that society has for the forest, and the forest ecosystem itself. The key for the forester is to try and match the owner's objectives with the actual capabilities of a particular tract of forest land. If that is not possible, then some sort of compromise much be reached. Excellent Forestry, when applied, should be bound by nature's laws and should be sustainable in the long-run regardless of external pressures. A forester should intuitively know where these boundaries are and when or if they have been crossed.

Foresters must also have an understanding of the markets for forest products as they will commonly be involved in determining where to sell various items. Along with this knowledge comes a wide range of relationships with numerous sawmills, log and pulp buyers, and logging contractors found in the region.

A seasoned forester is humbled by nature and recognizes that there is much more that we do not know about the forest than we do know. Thus, the practitioner of Excellent Forestry should always be on a quest for knowledge. There is no substitute for years of experience in the woods spent learning and observing. Nor is there a substitute for time spent in the woods with others, exchanging ideas and observations. As the Earth is continually being asked to provide more for humans, our planet is stressed to its limits. Foresters have to play a considerable role in determining how much we can take from the forest - without tipping this precious balance.

According to John Muir, "Tug on anything at all and you'll find it connected to everything else in the universe."