Vegetation Management

INTRODUCTION

The Monongahela National Forest (MNF) is located within the ecological units of the Allegheny Mountains and Northern Ridge and Valley Sections of the Central Appalachian Broadleaf-Coniferous Forest Meadow Province. Elevation ranges from 900 feet to nearly 5,000 feet at the highest point in West Virginia on Spruce Knob. Due in large part to its geographic location in the mid-Atlantic and its mountainous terrain, the MNF is one of the most ecologically diverse forests in the National Forest System. The MNF contains the northern-most populations of certain southern species and the southern-most populations of certain northern species. Many of the 70+ species of trees found in the MNF are extremely valuable for commercial wood products as well as wildlife habitat. Particularly valuable for both lumber and food for wildlife are black cherry and northern red oak. Dozens of shrub and woody vine species and hundreds of herbaceous plant species provide diverse habitats, from early successional to late successional, for a wide variety of wildlife.

Native American Indians lived here for thousands of years, at first hunting, gathering, and using fire to drive game animals and clear the land. Later agricultural-based villages were located in the rich fertile valleys along stream courses. About 250 years ago European settlers began arriving in the area that is now the MNF. From around 1880 to 1930, widespread logging and fires set to clear land for grazing and subsistence farming combined to change the landscape. When the MNF was established in 1920, nearly all of the land was devoid of the original pre-settlement forest. The extensive timber harvesting, subsistence agriculture, and uncontrolled fires that occurred 75 -125 years ago created a generation of even-aged mature stand conditions on the Forest that are now in the mid-to-late successional stage. These past activities, along with planned management over the past 85 years and natural regeneration of the forest, have formed the mostly even-aged forest that is here today. Within the past 85 years this Forest has gone from the extreme of being a mostly early successional habitat forest in 1920 and is now trending toward a mostly late successional habitat forest. Neither a large amount of early successional habitat nor a large amount of late successional habitat can provide the diversity of plant and animal life to maintain a healthy forest over the long-term. Providing a more balanced distribution of age classes or successional stages would provide a more diverse and healthy forest while providing sustainable non-commercial and commercial resources and products for future generations.

Restoring the forest to pre-settlement conditions may not be attainable or desirable. Those habitats and species that presently occupy the land within the proclamation boundary of the MNF have adapted to human and natural disturbances. The result of the dramatic shift from the human-caused disturbances over the past 100+ years is indicative of the resilient and adaptive capability of this ecosystem. However, a combination of active and passive restoration management goals and objectives to provide a better distribution of declining or recovering forest types at the landscape level should maintain or enhance a healthy, sustainable, and diverse forest.

Need for Change

In the 1986 Forest Plan, rotation ages along with age and size class direction are identified in Management Prescriptions where active vegetation manipulation is allowed. These Management Prescriptions provide direction for the types of harvest methods that may be used to manage timber and other resources to meet long-term needs for a sustainable supply of commercial forest products and mast for wildlife. These methods, in turn, can affect other resource values, such as vegetation diversity, wildlife habitat, and visual quality. Silvicultural systems and harvest methods are described in the *Timber Supply* section of this chapter.

Since 1986, vegetation management has broadened to encompass more than timber production and wildlife habitat needs. Maintaining or enhancing biological diversity, controlling or eradicating non-native invasive species, and a better understanding of disturbance regimes are now important components of a more ecological approach to managing vegetation. Non-native plants, insects, and pathogens have become more common and widespread since the 1986 Plan was developed. These newly added components in the forest can have substantial impacts on a range of resources by reducing native plant diversity and wildlife forage and changing soil structure. Mortality due to an aging forest and outbreaks by native and non-native insects and diseases is increasing fire hazard. Direction to address these issues was developed for the revised 2006 Forest Plan.

A good distribution of age or size classes across the landscape indicates long-term sustainability and improved forest health. Expectations to move toward a more balanced age or size class distribution were not fully achieved in the last planning cycle. Goals and objectives need to be adjusted in this planning cycle to help ensure that the desired composition and structure of forest vegetation, in those Management Prescriptions that allow active management, can be sustained into the future. Through Forest Plan revision, long-term desired conditions for age classes have been identified for those MPs where vegetation management is emphasized. Vegetation management in areas that allow such activities, combined with natural disturbances in areas of unmanaged forest, will help achieve these desired conditions. There is an opportunity in the revised 2006 Forest Plan to identify the desired species composition and age classes of forest vegetation communities and the distribution of these communities across the landscape.

Regeneration of oaks has been an issue for many years. Fire has been recognized as a major factor in the success of oak regeneration, and most oak species found on the Forest are considered fire adapted. With buds just under the soil surface that allow the seedling to sprout back after top-kill from a fire, oak seedlings are adapted to periodic surface fires. Oaks also have a growth strategy where energy is concentrated on developing a root system instead of increased shoot growth. Maples, a major competitor with oaks in our forests, put more energy into top growth and are unable to quickly recover from top-kill from a surface fire. Plan revision presents an opportunity to expand the potential for using prescribed fire in appropriate areas to:

- Maintain or improve vegetation diversity and to restore vegetation types that depend on or benefit from the use of fire.
- Decrease fuel loading in selected areas to reduce the potential for stand-replacing wildfires and improve forest health.

Issues and Indicators

Issue Statement for Issue #1

Forest Plan management strategies may affect the potential for vegetation diversity and sustainability across the Forest.

Background to Issue #1

The Forest Service is responsible for providing a diversity of plant and animal communities and tree species while providing for the overall multiple-use objectives of national forests (36 CFR 219.26). The Forest Service is also responsible for ensuring a sustainable flow of forest products (Multiple-Use Sustained Yield Act).

An estimated 70 to 80 percent of the Forest is currently the same approximate age (70-100 years) with similar stand conditions. Conversely, there are relatively few forest stands in younger age conditions. The effects of an aging forest include: 1) an increasing susceptibility to forest decline and mortality from insect and disease outbreaks; 2) a decrease in timber and mast productivity and wildlife habitat diversity; 3) an increase in shade-tolerant tree species; and 4) an increase in fuel loads from both down and standing dead trees that may result in a higher potential of more severe fires during periods of extended or extreme drought.

A mix of age classes across the Forest is more conducive to long-term sustainability and diversity to provide a variety of habitats and products in perpetuity. Forest management can affect the mix of age classes or successional stages by implementing regeneration harvests in those Management Prescriptions that allow or emphasize vegetation management. The amount and distribution of these Management Prescriptions vary by alternative, and therefore can be used as an indicator for potential even-aged regeneration harvests and successional stage changes by alternative.

Creating variety in the age class structure in forested stands across the landscape through use of even-aged regeneration harvesting, as opposed to greater variety in age class structure within a stand as a result of uneven-aged stand management, creates diversity that helps lessen the effects of aging and decaying forests. Increases in tree mortality, insects, disease, and shade-tolerant tree species are all part of the aging of a forest and are not inherently negative. However, the concern is that a very large percentage of the Forest will be going through these changes at the same time. Providing for diversity in age classes is one way to reduce the impacts of these changes across the landscape so that mast and timber production, regeneration of shade-intolerant species, and habitat variety are better sustained at the landscape level.

Indicator For Issue #1

Age Class Distribution by Alternative - This indicator will display the potential relative change in age classes under each alternative based on anticipated levels of management activities for Management Prescriptions that allow or emphasize vegetation management. Age class

distribution effects will be discussed in terms of potential impacts on forest health, sustainability, and diversity.

Issue Statement for Issue #2

Forest Plan management strategies may affect the potential for vegetation restoration in oak and spruce communities on the Forest.

Background to Issue #2

Species composition is best illustrated using forest types. A forest type indicates the dominant tree species or group of species present but does not always reflect all of the species present in a forested stand. Usually numerous other tree species are also present with the tree species that define a forest type, but in fewer numbers. On the MNF, plant species common to northern climates intermingle with plant species common to southern climates. This results in stands with a great number of species and species mixes. Over 40 commercial tree species occur on the Forest, and it is not uncommon to find 10 to 15 commercial species growing in a 10-acre stand. This high level of diversity is due to the unique geographic, climatic, and topographic features of this area. The intensive land use that occurred mostly in the late 1800s and early 1900s combined with management activities over the past 85 years created the present forest. Despite the intensive use, this resilient forest has grown to be considered a special place among the many people who visit, live, and work here.

More than 95 percent of National Forest System (NFS) land within the MNF is forested and includes at least 36 forest types, representing over 70 tree and associated shrub species. Under natural conditions, a single species seldom exceeds 70 percent of the stocking except in very small areas. Generally, a single-species forest type name will indicate that one species represents a plurality of the total stocking. In a multiple-species forest type, two or more species will represent a plurality of the total stocking.

Over time the forest type within a stand may change as some tree species that are short-lived (e.g., scarlet oak) succumb to natural mortality while longer-lived tree species, such as white oak, survive and become more prevalent within a stand. Other modifications may result from high mortality rates of specific species due to insects and disease, such as hemlock wooly adelgid or beech bark disease. Forest type modifications over time may result in altering wildlife habitat, scenic quality, forest product availability, and recreation opportunities.

Oak communities in particular are currently in decline due to changes in stand density, structure, and composition leading to a decreasing trend in vegetation diversity. In areas where fires helped perpetuate oak and oak-hickory forests, decades of fire suppression have created conditions where oak species are not competing well with species such as striped and red maple and American beech. Light conditions in the mid-story are not suitable for oaks to regenerate. Timber harvest and prescribed fire can be used to mimic the effects of historic fire regimes in areas where these activities are both allowed by Forest Plan direction and are considered ecologically appropriate.

Although red spruce has been slowly expanding its range over the past few decades, red spruce and spruce-hardwoods mixed forests once covered much more area than they do today (see the *Terrestrial Ecosystem Diversity* section for detailed description and estimates of pre-settlement extent of red spruce forests). While opportunities for active restoration of the red spruce community are limited in areas determined to be suitable habitat for the West Virginia northern flying squirrel, there are areas where red spruce and mixed red spruce-hardwood forests could be actively managed to increase red spruce dominance.

The oak and red spruce communities represent the ends of the spectrum of diversity on the Forest. Red spruce dominates at higher elevations, under cool moist conditions, while oak communities flourish under drier, warmer conditions at lower elevations. Fire was historically a frequent visitor to oak communities, usually about every 7 to 32 years in a given area, however the fires were typically low intensity, mainly affecting the ground surface. In red spruce communities fire is not the driving disturbance regime, as it may have only replaced stands every 300 to 1,000 years. However, when fire occurred in spruce stands it was most likely of high intensity, resulting in stand replacement.

There are social and economic consequences for all land management decisions on MNF land. Those effects will be examined in the social and economic impact analysis for this EIS. The vegetation analysis will focus on the potential biological effects from management prescribed under each of the alternatives, and how that management may affect the diversity, sustainability, and general health of forest communities within the MNF.

Indicators For Issue #2

1) **Acres of potential change in restoration of oak and spruce communities by alternative -** This indicator is a coarse measure of how each alternative addresses the issue of potential change through restoration activities in oak and spruce communities on the Forest. Lands suitable for timber harvest in MPs 2.0, 3.0, 4.0, 4.1 and 6.1 represent the areas most likely to be actively managed. Oak restoration will mainly occur in MP 6.1, although other MPs that allow restoration management activities may also be considered. Most of the spruce restoration assigned to MP 4.1 is designed for passive management. For most of MP 4.1 and for MPs that do not allow active management, the forest communities will continue to age naturally.

2) **Acres of Fire Regime I Condition Class 3 and Fire Regime III Condition Class 2 in MPs 3.0, 6.1, and 8.1 by Alternative -** These Fire Regime Condition Class (FRCC) areas are the areas of highest priority for returning fire to the ecosystem. These areas are at highest risk of losing key ecosystem components, namely the perpetuation of oak forests. Because prescribed fire may be used at the landscape scale and not necessarily tied to a commercial timber sale, both suitable and unsuitable lands are included in the indicator.

Scope of the Analysis

The affected area for direct and indirect effects to Issue #1 are lands administered by the MNF. This area represents lands that would be actively managed on the Forest. Effects will be

assessed for the first, fifth, and tenth decades of plan implementation to show how age class diversity would change over time. The affected area for direct and indirect effects to Issue #2 are NFS lands available for oak and spruce restoration activities under each alternative. Effects will be discussed for both the short (up to ten years) and long (up to 100 years) terms. The affected area for cumulative effects on vegetation is generally the forested lands in the counties that have NFS lands located within them. The State of West Virginia will also be used to provide context for some indicators. Effects will be discussed for both the short and long term.

CURRENT CONDITIONS

Age Class Diversity

Age class distribution can be defined by delineating age categories into successional stages that are found in forested stands. This analysis will compare changes in age class distribution from the current conditions by alternative. As used in the Forest Plan and EIS, successional stages include structural changes in plant communities as well as species compositional changes. Traditional successional stages describe just the changes in species composition that occur as forests age, and structural changes are described as forest development stages. The age classes described here incorporate both. As the forest ages, there are structural changes such as canopy closure, self-thinning, suppression of understory vegetation, death of overstory trees, and re-initiation of the understory. In general, there is also an increase in shade-tolerant species in the understory and a decrease in early successional plants such as black locust and blackberries. All these changes can vary by site factors such as elevation, slope, aspect, soil, and past management.

The amount and distribution of age classes or successional stages will result in variations of biological diversity from young forests to old forests, with potential impacts on wildlife habitat, biological diversity, scenic quality, types of forest products, and recreation opportunities. Most stands on the MNF are even-aged, meaning there is a relatively small difference in ages of the majority of trees within individual stands of trees. When age classes are more evenly distributed across the Forest, it is indicative of a long-term sustained yield capability to provide a variety of habitats and products in perpetuity. For analysis purposes, the age/forest succession stages to be used are shown in Table VE-1.

Table VE-1: Age Class and Corresponding Forest Succession Categories

Age	Stage
0-19 years	early succession
20-39 years	early to mid-succession
40-79 years	mid-succession
80-119 years	mid to late succession
≥ 120 years	late succession

Generally, commercial timber harvest has been the means by which the Forest manages age class distribution on lands available and suitable for commercial timber management. The 1986 Forest Plan determined there were an estimated 534,322 acres that were tentatively suitable for timber harvest. However, there were constraints on vegetation management in the 1986 Plan (e.g., WVNFS habitat and stream channel buffers) that were not considered during the determination for timber suitability. Specifically, many acres that were not truly available for regulated commercial harvest were not deducted from the suitable timber base. Counting those additional constraints, the 1986 Plan actually allowed for commercial timber management on about 331,000 acres. The remaining acres on the Forest were expected to change primarily through natural events and succession. On an estimated 23 percent of the Forest (5.0 Wilderness and 6.2 Backcountry Recreation MPs), natural forces were the only disturbance factors expected to affect forest type and age class diversity.

The large majority of stands on the MNF (92 percent) are over 40 years old. About 3 percent of MNF land is in young forested stands less than 20 years old. This indicates the age classes are currently not well distributed. A better distribution would ensure a sustainable supply of mast and forest products (e.g. 15% of acres in 0-19 year age class, 15% of acres in 20-39 year age class, 30% of acres in 40-79 year age class, etc.). With the existing poor distribution of age classes, the forest would continue to age beyond maturity, gradually declining in timber and mast production capability, and becoming more susceptible to insect and disease outbreaks and other age-related problems.

Table VE-2 shows the current age class distribution on the MNF by forest type. The “no-age” category represents areas that have not been classified in the database inventory.

Table VE-2 – Current Age Classes by Forest Type on the MNF

Forest Type	Age Class												Grand Total	
	0-19		20-39		40-79		80-120		>120		No Age			
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Eastern Spruce-Fir/Pine	2,497	7	3,363	9	18,460	50	10,507	29	1,430	4	550	1	36,807	4
Eastern White Pine-Eastern Hemlock	171	3	526	8	3,250	50	2,248	34	191	3	165	2	6,551	1
Pine-Oak	698	1	3,359	8	12,745	29	24,173	55	2,796	6	342	1	44,113	5
Mixed Oak (Oak–Hickory)	8,097	3	8,389	4	54,662	24	139,674	60	18,947	8	1,613	1	231,382	26
Bottomland Hardwoods	0	0	28	4	224	27	568	69	0	0	0	0	820	<1
Appalachian Mixed Hardwoods	11,201	3	17,139	5	129,048	36	196,392	54	5,732	2	1,129	<1	360,641	41
Northern Hardwoods	3,747	2	5,672	3	75,843	39	103,104	52	7,692	4	759	<1	196,817	22
Totals	**26,411**	**3**	**38,476**	**4**	**294,232**	**34**	**476,666**	**54**	**36,788**	**4**	**4,558**	**<1**	**877,131**	**100**

Forest Insects And Diseases

Pre-settlement patterns of insect/disease outbreaks are unknown but were probably cyclical with stand replacement events occurring rarely at unpredictable intervals. Post-settlement insect or disease outbreaks most likely have increased in quantity and intensity because of the introduction of non-native insects and diseases. Management strategies to control severe outbreaks of insects and diseases should include all landowners in the outbreak area. Passive or non-management of

insect and disease outbreaks by one landowner can have negative impacts on adjacent landowners or re-infestation of lands that have implemented control measures.

Native Insects and Diseases

Native insects and diseases are important components of a "natural" forest ecosystem. A "healthy" amount of native insects and diseases have many beneficial effects that include helping to decompose woody vegetation, contributing to diversity, enhancing habitat for plants and animals, and assisting the ecological succession of the forest. However, large outbreaks of native insects and diseases can have negative impacts such as reducing tree growth or value, causing large-scale tree die-back or mortality, decreasing water quality, increasing fire risk, creating safety hazards, diminishing scenic views, and reducing biodiversity. Examples of a native disease and insect pest are described below.

Oak Wilt – This disease that affects oak growth and can cause tree mortality was first discovered in 1942 in Wisconsin and in 1951 in West Virginia. It is now known to be present in all counties in West Virginia except Webster, Tucker, Brooke, and Ohio. In 2002, surveys of the four high disease infection centers in the state found 20 sites with oak wilt; 17 were located in Grant County and 3 in Hardy County (http://www.wvforestry.com/indassistance.cfm?menucall =industry). Oak wilt is a vascular disease caused by the fungus *Ceratocystis fagacearum*. The disease can be spread to healthy trees by sap-feeding beetles. Adjacent trees can be infested through root grafts. Trees in the red oak group are most susceptible to this disease, although trees in the white oak group may also be affected on occasion. The most effective control method appears to be removing the infected trees and susceptible adjacent trees. The roots should be severed by digging trenches around the infested trees to prevent the disease from spreading via root grafts. Injection of individual high-value trees with a fungicide is an alternative treatment but is cost prohibitive in a forest setting (USDA Forest Service 2002b).

Forest Tent Caterpillar (*Malacosoma disstria*) - This native insect is a defoliator and affects mostly sugar maple, blackgum, and several oak species throughout most of the United States and Canada. Significant tree mortality is rare unless trees are defoliated for 3 or more successive growing seasons, but dieback and loss of growth can be substantial. The caterpillar can be a major nuisance in recreation areas as they migrate from tree to tree, and defoliated trees cause negative visual impacts to Forest visitors. Native predators, insects, fungi, and viruses are natural controls. Extreme temperatures (hot or cold) also help to control this insect. There are several registered chemicals available to assist in control.

Non-native Invasive Insects and Diseases

Non-native invasive species (NNIS) have the potential to reduce native plant diversity and disrupt entire ecosystems. NNIS are plants, insects, animals, or diseases that come from countries or continents outside of North America. Many non-native species are harmless or beneficial, such as many of the grains and fruits now grown in the United States. However, some non-native species have the potential to become invasive because the natural control agents that kept them from spreading uncontrollably in their native habitat are not present here. NNIS

plants have their own section in this chapter. This discussion will focus on non-native invasive insects and diseases that can affect vegetation management on the Forest.

Some of the more well-known NNIS insects and diseases present on the MNF include gypsy moth, hemlock wooly adelgid, beech scale, chestnut blight, Dutch elm disease, butternut canker, and dogwood anthracnose. There is potential for other NNIS insects and diseases, present in other nearby states, to spread to West Virginia. The Asian long-horned beetle has so far been contained to New York, New Jersey, and Illinois. The impact of this insect could be devastating to native forests if it escapes from these areas because it may affect many species of hardwood trees. The emerald ash borer attacks all species of ash trees and has been found in Michigan, Ohio, Indiana, Virginia, and Maryland. Sudden oak death is caused by a fungus that had been contained to California until 2004 when plants from infected nurseries were shipped to numerous states in the Eastern United States. This fungus has killed millions of oak trees in California.

Described below are some of the non-native insects and diseases present on the MNF and that could have potential major effects to tree vegetation on the Forest.

Gypsy Moth (*Lymantria dispar L.*) – This insect was introduced, from France to the United States in 1869. The first defoliation outbreak occurred in 1889 (McManus, Schneeberger, Reardon and Mason 1989). Oak trees (especially white and chestnut oak) are the preferred host. Pine-oak and mixed oak forest types are most susceptible to this non-native pest, but the mixed hardwood and northern hardwood types may also be affected in severe outbreaks.

In the late 1980s and early 1990s, gypsy moth caterpillars were defoliating thousands of acres in the north and east sections of the MNF. A population crash in 1993, caused by a virus specific to gypsy moth and the fungus *Entomophaga maimaiga*, kept this insect under control for several years. High humidity, frequent periods of rain, and fairly constant temperatures between 14°C to 26°C are needed for the fungus to germinate and spread (Reardon and Hajek 1998). An increase in the number of gypsy moth egg masses on the Forest in 2000 resulted in a population build-up, causing defoliation in numerous hot spots in the eastern side of the MNF. The population increase was due to dry spring weather for the previous two years. A continued increase in the population with successive years of defoliation may cause extensive tree mortality. Several areas on MNF land were sprayed with *Bacillus thuringiensis*, a pesticide specific to insect larvae in the Lepidoptera family (moths and butterflies) in 2001. The spraying, accompanied by wet weather in June of that year, allowed the fungus to become active, causing another population crash. An egg mass survey in the late summer/early fall of 2001 revealed a severe drop in the number of egg masses. Populations began building again in 2002, resulting in spraying several hot spots on the east side of the Forest in the spring of 2003. A pesticide spray program for gypsy moth did not occur on MNF land in 2004, and there are no plans to spray in 2005.

Hemlock Wooly Adelgid (*Adelges tsugae*) - This sapsucking insect, introduced to the United States from Asia in 1924, was detected in Grant and Pendleton Counties in 1992 and in Pocahontas County in 1993 (Hutchinson 1995). The insect feeds on twigs, causing the foliage to discolor and drop prematurely. Defoliation and death usually occurs about 4 to 10 years after a tree is infested. Eastern hemlocks are highly susceptible to this insect and no resistant trees have

been located to date. However, several common and introduced predators of the adelgid, including *Laricobius* and *Pseudoscymnus* beetles, have been released and may prove to be an effective control (McClure, Salom, and Shields 2003; Kajawski 1998; Montgomery and Lyon 1996). Some of the predatory beetles have been released in the MNF and nearby state lands. Severe cold weather also seems to control this pest. In the winter of 1993-1994 severe cold weather (-20° to -28°F) greatly reduced populations (Souto, Luther, and Chianese 1995). Chemical control can be used in easy access areas within or near developed recreation sites or high-quality scenic areas. However, this is very costly, and repeated treatments are needed to control the pest.

Beech Bark Disease - The beech scale insect (*Cryptococcus fasigua*), native to Europe, arrived in Nova Scotia around 1890. By 1932 trees in Maine were dying from its infestation. The disease results when the bark is attacked by the beech scale, then invaded by fungi, primarily *Nectria coccinea* var. *faginata* and *N. galligena*, which eventually kill or severely injure beech (Houston and O'Brien 1983). Beech trees over 8 inches in diameter are more severely affected then smaller trees. Mortality occurs in about 30 percent of the trees that are infected. Over 90 percent of the remaining beech trees in a stand become severely injured and do not produce quality wood (Leak and Smith 1996). Once the stem of a beech tree becomes severely affected or dies, the roots grow sucker sprouts and can form dense thickets. These sucker sprouts are also susceptible to the disease but may live for many years. The dense regeneration of beech within the infested stands prevents the regeneration of other hardwood or conifer trees. As a result, the productivity of the stands decline as the disease progresses, decreasing stand health. Removing infected and high risk trees provides an opportunity to salvage some of the material and improve the health and diversity of the stand (Ostrofsky and Houston 1988). A recent study indicates the timing, harvest method, and treatment type of a cut may influence the root sprouting and the overall health of an infected beech stand. Cutting diseased trees in the summer or fall reduced sprouting. In clearcuts, leaving scattered unaffected beech trees increased sprouting of the healthy stems (Houston 2001).

Chestnut Blight (*Cryphonectria parasitica*) - This fungus was probably introduced through the importation of chestnut trees from Asia, and was first reported in the United States in 1904. Within 50 years the fungus occupied the tree's entire range and had killed 80 percent of the American chestnut (Kuhlman 1978). Nearly all the remaining live trees were infected with the fungus and dying. Prior to the infestation, the American chestnut was a major component of the eastern hardwood forest, comprising 25 percent of all tree species on over 200 million acres from New England to Georgia (MacDonald et al. 1978, Schlarbaum 1989). This tree, which once grew up to 120 feet tall and over 7 feet in diameter, now rarely attains heights over 30 feet with diameters up to 6 inches before the fungus kills the stem. The process starts over when the tree resprouts. A few resistant trees have been found. There is hope that some time in the future the American chestnut will return as a valuable timber and wildlife tree to the eastern hardwood forest (Newhouse 1990). The American Chestnut Foundation is working with researchers to develop blight resistant American chestnut trees.

Forest Community Restoration

With new knowledge of the role that repeated surface fires play in regenerating oaks, the Forest has re-defined the 6.1 Management Prescription to emphasize the restoration and maintenance of oak and oak-hickory forest communities. Coupled with the concern for regenerating oaks forests is the concern for creating diversity in age classes across the landscape. Mast production is generally abundant across the Forest most years; however with most stands the same age, age-related declines in mast production will likely cause large drops in mast at about the same time. Therefore, MP 6.1 also stresses the need for even-aged regeneration harvest to ensure stable mast supplies over the long term across the landscape.

Red spruce communities once covered much more of the Forest than they do now, and the Forest includes the highest elevations in the State that comprised much of this community. Habitat for the federally endangered West Virginia flying squirrel is found in this community and forms the core of MP 4.1. Additional areas were assigned this MP if determined, at a coarse scale, to be ecologically suited to red spruce or red spruce-hardwood forests. The creation of this MP represents a move away from single-species management (focus on WVNFS habitat) to a community or ecosystem approach that acknowledges both passive and active management in restoration and maintenance of this community.

The Oak Regeneration Problem

Acknowledgement of an oak regeneration problem has slowly grown through the years as the idea that abundant and widely distributed oak forests were considered self-perpetuating climax species on upland sites was challenged by reports of poor competition. Evidence began building that, while oak seedlings were found in the understory, other species were as well and competed better than the oaks. Weitzman and Trimble (1957) found that only 18 percent of the seedlings on good sites (site index 70) were oak species, and oaks comprised only 3 percent of the seedlings on excellent sites (site index 80). Oak seedlings do not live long under a canopy on good sites, often only persisting a few years, and young seedlings seldom respond to release. While competition from other species is a cause of oak regeneration failures, failures are not occurring because other species are so aggressive but because oaks are often poor competitors (Lorimer 1989).

The oak regeneration problem is not unique to the Monongahela National Forest, and is occurring in many areas where oaks dominate the landscape. Because the species and the regeneration problems span a wide geographic scope, a solution to the problem is likely similar in scope. The large scope of the problem led researchers and managers to explore the role of fire in the ecology of oaks and oak-dominated forests. Oak seedlings are able to sprout back rapidly after top-kill from fire, and large older oaks generally have thick bark that insulates them from damage from surface fires.

Oaks are not easily classified in the classic climax theory of succession. Unlike most early successional (pioneer) species dependant on disturbances, oak seedlings can be found under closed canopies but are usually slow growing and uncompetitive even under open conditions. However, oaks can form stable communities on dry sites where shade-tolerant competitors are

sparse. Oaks can invade moist sites after severe disturbance (such as after the turn of the 20th century logging), but perpetuation of the community seems to depend on fire.

Published proceedings of two symposia on oak ecology and regeneration problems represent the state-of-the science on oak regeneration issues (Loftis and McGee 1993, Spetich 2004). While fire is recognized as needed to perpetuate oaks on many sites, one burn is not enough, and often makes the situation worse for oak seedling competition. Repeated surface fire is needed (Van Lear and Waldrop 1989, Van Lear 1991, Keyser et al. 1996, Brose et al. 2001).

The mixed oak types are considered to be in Fire Regime Group I with a fire return interval of 7 to 32 years (Croy and Frost 2005). Most fires were contained at the surface level except in drought periods when higher intensity fires would create patches of openings in the canopy. Frequent surface fires prevent the mixed oak types from succeeding to mixed hardwood types. Effective fire suppression allows shade-tolerant, fire-sensitive species such as red maple and American beech to invade the mixed oaks and inhibit oak regeneration.

Prescribed Fire

The 1986 Plan allows for prescribed fire to establish, maintain, or control vegetation in some Management Prescriptions but does not discuss restoration needs. The 1986 Plan also briefly mentions managing activity fuels and discusses the need for fuel breaks, but fire regime condition classes are not mentioned. The Forest-wide standards and guidelines describe only prevention, detection, suppression, investigation, and rehabilitation needs. The Healthy Forests Restoration Act (HFRA) of 2002 promotes fire as a tool to maintain or restore healthy forest ecosystems. The revised 2006 Forest Plan also recognizes that prescribed fire can be an important tool for restoration, especially in fire-adapted ecosystems. Indeed, the 2006 Plan has a Forest-wide objective to:

> Over the next 10 years use prescribed fire on 10,000 to 30,000 acres. Emphasize use in areas to maintain, restore, or enhance wildlife habitat or other ecosystem components and/or reduce hazardous fuels and fire risk to property or investments.

The areas where this prescribed fire is most likely to occur are Fire Regime I, Condition Class 3, and Fire Regime III, Condition Class 2 in Management Prescription 6.1 because these areas are the most in need of ecosystem restoration and fuels reduction.

Over the past 20 years the MNF has averaged 8 wildfires per year, burning on the average 106 acres per year. Most of these fires are human-caused (92 percent) and 70 percent burned at a low-intensity level. In the preparation of the 1986 Forest Plan, the use of fire by the indigenous people and early European colonists was not clearly understood or recognized. Recent archeological studies found humans in the southern Appalachians have used fire selectively for at least 4,000 years (Delcourt and Delcourt 1997).

The MNF began using prescribed fire as a management tool in 1998, burning 85 acres. In 2003 the MNF burned 221 acres. The need for using prescribed fire as a management tool in this planning cycle is becoming more apparent as declining populations of mixed oak/hickory forests and other fire-adapted tree species are reducing the diversity of the forest vegetation ecosystems.

Successful fire prevention and suppression efforts have led to a decrease in fire-adapted species. The mixed oak/hickory forest types—as well as other less abundant tree species such as aspen, pitch pine, and table mountain pine—are declining. Oaks and hickories provide a valuable wildlife food source. Other tree species that are not as valuable a food source for wildlife—such as red maple, American basswood, sugar maple, and striped maple—are increasing in the forest understory due to the lack or absence of low-intensity wildfires. Ladder fuels—such as white pine saplings and poles, mountain laurel, and rhododendron—are also increasing in the forest understory.

A fire regime is a generalized description of the role of fire within an ecosystem characterized by fire frequency, predictability, seasonality, intensity, duration, and scale. The departure of current conditions from the natural historical frequency and severity of fires is identified as the fire condition class. Table VE-3 describes and categorizes the historic fire frequency and severity. Table VE-4 describes and categorizes the current vegetation composition and structure conditions and serves as rankings of severity risk.

Table VE-3 – Historic Natural Fire Regimes

Fire Regime Group	Fire Frequency (years)*	Fire Severity**
I	0-35	Low severity; surface fires with little to no mortality of upper canopy
II	0-35	Stand replacement severity; crown fires with high tree morality
III	35-100+	Mixed severity; surface fires with some mortality of upper canopy
IV	35-100+	Stand replacement severity; crown fires with high tree morality
V	>200	Stand replacement severity; crown fires with high tree morality

*Fire frequency is the average number of years between fires (return interval).
**Fire severity is the effect of the fire on the dominant overstory vegetation.

The current condition class is a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural change of vegetation, stand age, and canopy closure. This change may have been caused by one or a combination of activities or lack of activities such as timber harvesting, fire suppression, grazing, establishment of non-native invasive species, and/or insect or disease outbreaks. The result of the change is a potential increase or decrease in fire frequency, intensity, severity, or size.

Table VE-4 – Condition Class Descriptions

Condition Class	Fire Regime
1	Vegetation composition and structure are within historical range – risk of losing key ecosystem components is low.
2	Vegetation composition and structure are moderately altered from historical range due to an increase or decrease of historical fire frequency by one or more return intervals – risk of losing key ecosystem components is moderate.
3	Vegetation composition and structure are significantly altered from historical range due to an increase or decrease of historical fire frequency by multiple return intervals – risk of losing key ecosystem components is high.

About 118,000 of the MNF acres are in Fire Regime Group I (pine-oak and mixed oak forest types) and in Fire Regime Condition Class 3, which is defined as being at high risk for losing key ecosystem components due to a decrease in historic fire frequency. The historic natural fire regime for these drier sites indicates a fire frequency interval of 0-35 years for low severity fires. On an estimated 175,600 acres, the historic natural fire regime is 35-100+ years with mixed severity fire intensity levels; these areas are considered in Condition Class 2. These estimations are the result of a first rough look at the fire regime condition classes on the MNF and are subject to revision. Approximately 253,000 of these acres are located within Management Prescriptions (MPs) 2.0, 3.0, 6.1, and 8.0 that allow for prescribed fire in their standards and guidelines in the 1986 Forest Plan. Over 1,000 acres are in MP 7.0 that allows only for fuel management, and over 45,000 acres are in MPs 5.0 (5,200 acres) and 6.2 (40,000 acres) that do not allow for the use of prescribed fire. The remaining acres are in areas that presently do not have an MP assigned. An additional 6,000 acres that were recently acquired will most likely be added to Fire regime I, Condition Class 3, as the acres are located in the mixed oak and oak/pine forest types on the dry (east) side of the MNF.

Fire occurrence on the east (drier) side of the MNF was fairly common, except within the past 40 years. It has recently been documented that fires occurred here every 7 to 32 years. (Schuler and McClain 2003). The west (wetter) side of the MNF likely had substantial wildfires only during the driest years. Successful fire prevention and suppression efforts have greatly decreased the number and size of fires over the past 40 years. These efforts have increased fuel loading by allowing woody material to build up on the forest floor in the absence of fire. The number of standing dead trees will continue to add to the fuel load as the forest ages and mortality increases. A decrease in the amount of timber harvested has also contributed to the fuel load since many high-risk, damaged, or diseased trees that would have been removed in a timber sale were left to die, leaving standing snags and other dead trees to rot on the ground. Other factors contributing to an increase in fuel loading are an additional number of dead/dying trees from non-native pests such as beech bark scale/nectria complex disease, hemlock wooly adelgid, and gypsy moth. Ice and wind storms continue to contribute to fuel loading. Prescribed fire can be used to improve forest health by:

- Restoring the composition, structure, and functions of fire-adapted forest communities,
- Reducing accumulating fuel loads, thereby decreasing the potential risk of high-intensity wildfires and damage to resources and property.

The potential for high-intensity wildfires is increasing in some areas because of the accumulating fuel loads resulting from an aging forest that is also affected by mortality from non-native insects and diseases. This is compounded by the fact that a once rural area is now becoming increasingly populated, creating high-risk urban wildland interface situations. Numerous small development projects have constructed homes in areas that once were contiguous forests. These new homes are usually constructed in small openings surrounded by forest. Many of these developments are accessed on small, dead-end, one-lane graveled roads, and some homes may be several miles from a main highway. Of the 167 communities located in the vicinity of federal lands in West Virginia that are listed at high risk from wildfire (Federal Register 2001), around 90 are located either inside the MNF proclamation boundary or are within 5 miles of the boundary. Prescribed fire is needed to reduce the risk of high-intensity wildfires that have the potential to damage or destroy homes and communities.

Although woody material on the forest floor generally increases as the forest ages, the discussion on the increase in fuel loads is not currently applicable to fire probability and intensity on the entire Forest. On most of the Forest, climate and landform would likely continue to influence fire behavior such that large natural fires would be rare and prescribed fire would be difficult to implement due to generally wet conditions. However, wet conditions can dry out in extended or extreme drought, which has occurred in the past and could occur in the future. In the short term, though, our best opportunities for implementing prescribed fire and fuel reduction are in areas where fire is a more frequent part of the disturbance history – those areas considered to be in Fire Regimes I and III, about 118,000 acres as described earlier in this section.

Spruce Restoration

Vegetation management in the spruce-fir forest type over the next planning period will focus primarily on a passive strategy in WVNFS suitable habitat. The constraints from the 2004 Forest Plan Amendment on Threatened and Endangered Species allow primarily for research projects and administrative studies in areas considered suitable for WVNFS. However, active management (thinning to release established spruce trees, reforestation) in northern hardwood stands with a spruce component can be designed to help increase this component over time.

Since red spruce is shade tolerant, the recommended regeneration harvest methods most acceptable are in the uneven-aged silvicultural system. The two-aged, shelterwood, and seed-tree methods are not recommended because red spruce is so shallow-rooted that the residual trees tend to blow down before regeneration is established.

Both harvest methods of the uneven-aged system may be used to secure regeneration and are particularly applicable where scenic values, recreational use, and wildlife that are dependent on a healthy, continuous forest cover are of concern. Care must be taken on exposed areas not to open up the stand heavily enough to risk wind throw of the residual trees.

Forest Types and Vegetation Diversity

For the purpose of this analysis on vegetation, forest types will be used to discuss species composition, diversity, potential effects of NNIS, and maintenance or restoration of forest health. The amount of each forest type under each alternative will be compared to the existing condition and may change by alternative depending on the amount of activity allowed under each Management Prescription.

Eastern Spruce-Fir Type (including red pine) - A large portion of the red spruce forest community in the central Appalachians is located in West Virginia on the MNF. It has been estimated that red spruce originally occupied almost 470,000 acres in the mountains of northern and eastern West Virginia at elevations generally above 3,200 feet. The eastern spruce-fir type on the MNF represents about 4 percent of the forested area and consists mostly of red spruce although there are some small, scattered areas of balsam fir and plantations of Norway spruce and red pine. An estimated 83 percent of the acres in this forest type are in the mid to late successional stages, and 7 percent in stands less than 20 years old. Norway spruce and red pine were planted, in place of red spruce, due to the better survival rates and faster growth of these species. One small area also includes some Fraser fir that was artificially seeded in the 1930s. In the spruce areas, the climate is cool and humid, with annual precipitation in the neighborhood of 60 inches.

The intense fires that followed the clearcutting around the turn of the 20th century drastically reduced the amount of red spruce. Because the wildfires that reduced the acreage of spruce also reduced the depth of organic soil in which most of the spruce formerly grew, site quality was also reduced. The eastern spruce-fir type is considered to be in Fire Regime Group V where fire disturbance is rare (300 to 1,000 year return intervals) but severe (Gorman 2005). Large amounts of fuel buildup that would occur during that time period, combined with typical dense stands of spruce/fir type, increase the likelihood of rapidly spreading crown fires of stand-replacement intensity. Fires would occur only during periods of severe drought. Other disturbances from ice storms, wind throw, and insect attacks occurred more frequently (100-200 year return intervals).

The relatively small acreage of spruce in pure or nearly pure stands generally occupies areas of shallow rocky soils where site quality is fair to poor. Most of the spruce found on better sites occurs as scattered groups or as individual trees in northern hardwood ecosystems. By definition, the eastern spruce-fir type is comprised of stands with a plurality of spruce and/or fir. In many situations this type also includes stands composed of a large percentage of hardwood stems and can be considered a spruce-hardwood complex.

Red spruce grows in association with hemlock, red and sugar maple, yellow birch, pin cherry, beech, and black cherry, but it may grow in almost pure stands. Mosses, lichens, and club-mosses with occasional wood sorrel, trillium, and teaberry plants usually dominate the understory beneath closed stands of spruce. In openings and along edges or beneath open mature stands, rhododendron, mountain ash, and wild raisin are key shrubs. They may be associated with high-bush cranberry, mountain holly, mountain laurel, speckled alder, pin cherry,

serviceberry, brambles, blueberries, and huckleberries. Where the type intergrades with northern hardwoods, the understory is usually better developed.

Habitat for the federally endangered West Virginia northern flying squirrel (WVNFS) is found in this community and forms the core of MP 4.1. For the purpose of the vegetation analysis, red pine is included in this forest type because of the potential for WVNFS to use this habitat when in proximity to red spruce. Because of this potential to be included as suitable WVNFS habitat, it is unlikely active management will occur in red pine stands adjacent to red spruce stands during this entry. Additional areas were assigned this MP if determined, at a coarse scale, to be ecologically suited to red spruce or red spruce-hardwood forests. The creation of this MP represents a move away from single-species management (focus on WVNFS habitat) to a community or ecosystem approach that acknowledges both passive and active approaches to restoration and maintenance of this community.

Other wildlife species found in the eastern spruce-fir ecosystem includes snowshoe hare, wood warblers and other songbirds, rodents, and the federally listed Cheat Mountain salamander. Several game species such as bear, grouse, and deer are adapted to using the edges of mature spruce stands.

Pine-Oak Type - The pine-oak type is usually found on the eastern side of the MNF on dry ridges and generally on south- and west-facing slopes. All of the oak species on the MNF can be found in this type along with pitch pine, Table Mountain pine, and Virginia pine. The pine species are all intolerant of shade while the oak species range from intolerant to moderately tolerant. Most tree species found in this type are either fire dependent or require some level of disturbance to regenerate and grow.

Typically this type includes some of the less productive sites on the Forest due to lack of consistent moisture. The pine-oak type makes up about 5 percent of the vegetation types found on the MNF, with 90 percent in the mid to late successional stages and 1 percent in stands that are less than 20 years old. This type is a transitional stage from a mostly pine type to the oak-hickory type. Without silvicultural treatments associated with timber harvests—such as planting, herbicides, or prescribed fire (if there are no pine seedlings in the understory)—this type will continue to decline.

Tree species associated with this type include most of the hickory species, red maple, blackgum, sourwood, and yellow poplar. Blueberry, huckleberry, blackberry, greenbrier, azaleas, and mountain laurel are commonly found in the understory.

Historic fire return intervals for the pine-oak types are estimated at 3-15 years. The pine-oak types are considered to be in Fire Regime Group I with mostly surface and mosaic pattern (mixed severity) fires occurring at frequent intervals. Usually fires ranged in size from 10 to 50 acres but in dry years would exceed 300 acres (Fryar 2004).

Mixed Oak (Oak-Hickory) Type - Although mixed oak-hickory types occur over the entire Forest at elevations between 1200 and 3000 feet, the oak-dominated stands on good to excellent sites are classed with the Appalachian Mixed Hardwood type discussed elsewhere. Most of the

species found in this ecosystem are in the middle range in shade tolerance as exemplified by the oaks and hickories. However, considerable difference exists among species. For example, scarlet oak is relatively intolerant compared to white oak and red maple, while at the extremes, beech is very tolerant and black locust is very intolerant. Red oak is the most demanding oak in terms of site quality and is more abundant on the higher quality sites. Scarlet and chestnut oak are more commonly found at lower quality sites.

The five widely distributed upland oaks in this type are white, northern red, black, scarlet, and chestnut. Although less abundant, the hickories are consistent stand components. This forest type comprises about 25 percent of the forested area on the MNF, with 92 percent in the mid to late successional stages and 3 percent in stands less than 20 years old. Other commonly found associates are blackgum, beech, red maple, sourwood, sassafras, black locust, sweet birch, and pines. This type commonly will have less herbaceous vegetation in the understory but the shrub/vine layer may be very dense. Sassafras is a key shrub or small tree, while some others are flowering dogwood, serviceberry, sumacs, hawthorns, eastern hophornbeam, and redbud. Among the vines and small shrubs, the most common are greenbriers, blueberries, huckleberries, grapes, blackberries, raspberries, mountain laurel, azaleas, roses, and teaberry.

The continued presence of mixed oak forests is primarily related to maintaining or restoring conditions to ensure oak regeneration. Silvicultural treatments that create conditions to promote oak regeneration by reducing competition include prescribed burning and herbicides. Once the oak regeneration has grown to at least 4.5 feet tall, it should be released by a commercial timber harvest or a non-commercial pre-harvest activity to provide full sunlight to encourage growth of the young oak trees. Oak dominance can be maintained by non-commercial crop tree release of young stands, and by moderate fire return intervals in mid and mid-to-late successional stands.

The mixed oak types are considered to be in Fire Regime Group I, with a fire return interval of 7 to 32 years (Croy and Frost 2005). Pre-settlement fires were estimated to occur every 3 to 14 years. Most fires were contained at the surface level except in drought periods when higher-intensity fires would create patches of openings in the canopy. Frequent surface fires deter the mixed oak types from succeeding to mixed hardwood types. Effective fire suppression allows shade-tolerant, fire-sensitive species such as red maple and American beech to invade the mixed oaks and inhibit oak regeneration.

Non-native insects and disease have affected the mixed oak type over the years. In the early 1900s the American chestnut was a dominant tree in this forest type prior to the chestnut blight. Oaks and hickories filled the gaps where the chestnut grew. The gypsy moth is present in West Virginia and has defoliated thousands of acres. The oaks are the favored food source for gypsy moth but other hardwood and conifer species can be defoliated during severe outbreaks. Recently a fungus and a virus that specifically attack the gypsy moth have aided in keeping this non-native insect from spreading more rapidly.

Appalachian Mixed Hardwoods Type - Appalachian mixed hardwoods, commonly called cove hardwoods, is a forest complex found in rich, moist locations and is characterized by great diversity in composition. This type represents about 40 percent of the Forest and is found in topographic coves, on lower slopes with a northern or eastern aspect, and on gentle terrain.

About 92 percent of the acres in this forest type are in the mid to late successional stages with 3 percent of the area in stands less than 20 years old. Stands are characterized by a large number and variety of plant species. Overstory composition may range from nearly pure stands of northern red oak or yellow poplar to typical mixtures of 20 or more commercial species. Among the more important trees are yellow poplar, sugar maple, northern red oak, hickories, black cherry, white oak, basswood, aspen, cucumber tree, white ash, red maple, sweet birch, beech, elm, and black locust. The mixtures vary with site quality, past treatment, elevation, and latitude. Conifer species can include white pine, red spruce, and hemlock.

Among major Appalachian mixed hardwood species, shade tolerance ranges from very tolerant beech, hemlock, basswood, and sugar maple to the intermediately tolerant oaks, hickories, birches, and white ash to intolerant black cherry, black locust, and yellow poplar. Most intolerants and some intermediates will not survive long under a dense canopy. Sugar maple and beech seedlings, saplings, and poles can persist for a long time under a dense canopy and then respond to release. Many intermediate and intolerant species in these mixed hardwood stands developed in large openings due to windthrow, fire, snow, ice, logging, etc.

Reproduction of intermediate tolerant species usually follows a moderate opening of the canopy and can persist for several years. Seeds of white ash, yellow poplar, and black cherry germinate when favorable conditions of light, temperature, and moisture are created by canopy removal. Because of the abundance of different species in these stands, it is rare that seed crops do not occur for several of these species.

Sources of reproduction in these stands include buried seed, stump sprouts, root suckers, and advance regeneration. Seed of several species such as yellow poplar, basswood, white ash, black locust, and black cherry remain viable in the forest floor for at least three winters. Acorns and seed from maples, birches, and beech commonly remain viable over one winter. Nearly all hardwood species sprout vigorously especially when young, but as stems mature, sprouting decreases. Advance regeneration of tolerant species such as maples and beech occurs under dense canopies. Advance oak regeneration composed of seedlings an inch or more in base diameter, with a well-developed root system, is generally necessary for satisfactory growth after release. Logging usually does not kill advance regeneration because the damaged stems sprout vigorously. During their early years, sprouts grow rapidly, often dominating other forms of reproduction, and can produce high-quality trees for a number of species. Prolific sprouters include oaks, yellow poplar, basswood, black cherry, red maple, black locust, and beech.

Appalachian mixed hardwoods usually have a rich, varied understory and are noted for abundance of spring wildflowers. Spicebush is a key indicator shrub, and the typical large shrubs or small trees include flowering dogwood, sassafras, hawthorns, eastern hophornbeam, American hornbeam, striped maple, serviceberry, sumacs, and redbud. Among the lower-growing woody plants, vines often dominate over erect shrubs. These include greenbrier, grapes, blackberries, Virginia creeper, poison ivy, blueberries, witch hazel, spicebush, teaberry, and mountain laurel.

Due to the mesic conditions found in this forest type and typical locations in coves and on north- and east-facing slopes, fires were infrequent, of low intensity, and generally contained to the

surface. This type is considered to be in Fire Regime Group III, with fire frequency return intervals estimated at 30 to 100+ years (Davenport 2005). The variance of species in this type is related to precipitation cycles and proximity to the more fire prone mixed oak and pine-oak types. In those areas with less precipitation or closer to more fire prone types, there is a greater likelihood the species mix will include more shade-intolerant trees. Conversely, those areas with higher precipitation or locations near streams and shade- protected areas, the species mix will be of more shade-tolerant trees. Large-scale natural disturbances also provide opportunities to change from shade-tolerant trees to more shade-intolerant trees.

Northern Hardwoods Type - This type is normally found at the higher elevations, comprising about 22 percent of the forested area on the MNF, with 95 percent in the mid to late successional stages and 2 percent in stands less than 20 years old. At its highest limits, the type may merge with red spruce or may occupy areas where red spruce was formerly abundant but has been depleted by cutting and fire. When found at lower elevations on the good and excellent sites, this type often merges with Appalachian mixed hardwoods and, depending on the cutting practices, it may replace the Appalachian mixed hardwood type or be replaced by it. Repeated cuttings, wildfire, and past land use have created numerous combinations of stand conditions, age classes, and species.

Sugar maple, beech, and yellow birch are the major species and together comprise most of the stocking. Associated in varying mixtures are red maple, hemlock, black cherry, basswood, white ash, and red spruce. Noncommercial understory species include striped maple, hobblebush, eastern hophornbeam, witch hazel, pin cherry, viburnums and serviceberry.

Most commercial tree species typically reproduce from seed, and some also reproduce by vegetative means. Yellow birch seeds prolifically, producing reasonably good crops every other fall. White ash, sugar maple, and beech produce good crops at intervals of as long as 3 to 8 years. Red maple produces abundant seed nearly every spring and sprouts prolifically from stumps of young or mid-aged trees. Sugar maple, beech, and yellow birch sprout reasonably well from stumps of small trees. Beech sprouts on larger stumps generally are short lived but it root-suckers prolifically, especially following cutting. Striped maple also sprouts prolifically, while brambles and pin cherry reproduce from seed buried in the upper soil horizon for as long as 100 years, though numbers decline sharply after 40 years.

Species in this type differ in shade tolerance, longevity, and growth rate. Yellow birch, white ash, and red maple are all intermediate in shade tolerance, but while the latter two have moderately fast growth rates, yellow birch has only a moderate growth rate. Sugar maple, beech, and red spruce are shade-tolerant, long-lived species with moderately slow growth rates. Hemlock is also shade tolerant and long-lived and while it grows rapidly in diameter, it grows slowly in height. Tolerant small trees and shrubs such as striped maple, eastern hophornbeam, and hobblebush affect silvicultural procedures. Pin cherry, a very shade-intolerant small tree, can be a serious competitor in clearcuts.

Similar to the spruce-fir types, the northern hardwoods are considered to be in Fire Regime Group V, with rare but severe fire return intervals averaging 500 years. Without wind-associated events the stand-replacement frequency may be as long as 5,000 years (Cleland,

Merzenich, and Swaty 2005). This forest type is considered to be fire resistant because it is typically found in moister areas of the Forest. The higher moisture content results in more rapid decomposition of litter and fine woody debris on the forest floor. Low light and high humidity combine to inhibit the ignition and spread of fire. More frequent disturbances from ice storms, wind throw, and insect attacks contribute to fuel loads. As the fuel loads increase, they can dry quickly where the disturbed areas are large enough for the sun and wind to reach the downed woody material. These conditions may lead to severe fires during drought periods. However, the size of individual fires are typically smaller than in spruce-fir types because they usually remain on the surface and are not carried by a continuous conifer crown cover. Most fires that begin in the northern hardwood type tend to move slower or smolder in the duff of decayed organic material and die out before damaging overstory trees.

The highly shade-tolerant beech and sugar maple are the most common tree species in the understory of northern hardwood stands on well-drained sites. Red spruce and hemlock are more commonly found on wet or excessively well-drained sites. These species and the other long-lived tolerant species, when established, can respond to release after long periods of suppression. Yellow birch needs overhead light and a seedbed of moist humus or mineral soil for optimum early establishment and development. Yellow birch must become dominant early in life to survive to maturity. The capacity of birch and other less-than-tolerant species to respond to release after suppression is moderate to poor.

ENVIRONMENTAL CONSEQUENCES

Resource Protection Methods

Laws, Regulations, and Policies

Numerous, laws, regulations, and policies govern the management of vegetation on NFS lands. National laws and regulations have also been interpreted for implementation in Forest Service Manuals, Handbooks, and Regional Guides. Vegetation management activities and the timber suitability assessments must comply with these laws, regulations, and policies, which are intended to provide general guidance for the implementation of timber management practices, and for protection of resources. Some of the more important laws and regulations influencing timber management are listed in Table VE-5.

Forest Plan Direction

Forest Plan direction has been developed to enhance, maintain, or restore forest ecosystems through vegetation management to achieve desired conditions on NFS lands. Direction occurs at both the Forest-wide and Management Prescription levels. Goals and objectives have been designed to provide a range of age classes in forested stands with diverse vegetative composition and structure. This range of diversity provides habitats for native and desired non-native plant, wildlife, and aquatic species, while maintaining, enhancing, or restoring ecosystem functions and processes. Standards and guidelines have been designed to provide vegetation management direction, limitations, and advice while protecting other resources that could be adversely

affected by project activities. Some 1986 Plan direction has been removed such as items that repeated existing law or policy, if it conflicted with other resource management direction, or were no longer applicable due to changed conditions. Management direction for other resource programs was developed in an integrated manner to provide additional guidance for resource protection.

Table VE-5 – Major Laws and Policies Influencing Vegetation Resource Management

Act/Law/Regulation/Policy	Date	Law/CFR/FSM/FSH Number
Organic Administration Act	06/04/1897	30 Stat.11
Weeks Law	03/01/1911	P.L. 61-435
Knutson-Vandenberg Act	06/09/1930	P.L. 71-319
Sustained Yield Forest Management Act	03/29/1944	P.L.78-273
Federal Insecticide, Fungicide, and Rodenticide Act	06/25/1947	P.L. 80-104
Granger-Thye Act	04/24/1950	P.L. 81-478
Multiple Use-Sustained Yield Act	06/12/1960	P.L. 86-517
National Environmental Policy Act	01/01/1970	P.L. 91-190
Endangered Species Act	12/28/1973	P.L. 93-205
Eastern Wilderness Act	01/03/1975	P.L. 93-622
Forest and Rangeland Renewable Resources Planning Act	08/17/1974	P.L. 93-378
Federal Noxious Weed Act	01/03/1975	P.L. 93-629
National Forest Management Act	10/22/1976	P.L. 94-588
Forest and Rangeland Renewable Resources Research Act	06/30/1978	P.L. 95-307
Healthy Forest Restoration Act	12/03/2003	P.L. 108-148
Forest Service Manual (FSM) - Planning	Updated as needed	FSM 1900
FSM – National Forest Resource Management	Updated as needed	FSM 2060-2080
FSM – Environmental Management	Updated as needed	FSM 2150
FSM – Timber Management	Updated as needed	FSM 2400
FSM – Forest Pest Management	Updated as needed	FSM 3400
FSM – Fire Management	Updated as needed	FSM 5100
Forest Service Handbook (FSH) – Timber Resource Planning	Updated as needed	FSH 2409.13
FSH – Timber Sale Administration	Updated as needed	FSH 2409.15
FSH – Silvicultural Practices	Updated as needed	FSH 2409.17
FSH – Timber Sale Preparation	Updated as needed	FSH 2409.18
FSH –K-V Funds	Updated as needed	FSH 2409.19

Forest Plan Implementation

Proper vegetation management depends on current and site-specific information about environmental conditions and the effects that these activities may have on other resources. Some of these conditions are not appropriately addressed at the Forest Plan programmatic level. Detailed silvicultural prescriptions, prescribed burning plans, biological evaluations, and mitigating measures are written and approved prior to implementation of individual projects.

These descriptions and analyses are designed to address the current and on-the-ground resource conditions. Through the project implementation process, adjustments are made to address resource concerns in a timely, effective, and site-specific manner. Additionally, during project planning, site-specific evaluations are conducted to verify the suitability classification of National Forest System timber lands within the project area. Appropriate site-specific mitigations from the project planning documentation are then incorporated into implementation guides and contract specifications that are applied and administered by Forest Service personnel and contractors.

Effects Common to All Alternatives

Forest ecosystems are constantly changing due to natural processes of forest succession and human activity. These changes are dependent on inherent ecological capability and environmental variability such as soils, topography, and climate. Wind and ice storms, insect infestations, disease outbreaks, floods, and fires can occur locally within small stands or affect multiple large stands or even landscapes. Forest management activities—such as road building, prescribed burning, wildfire suppression, recreation, timber harvesting, grazing, wildlife management, and mineral extraction—can compound or enhance the natural changes. The introduction of non-native plants due to these management activities can have a major influence on native plants, soil structure, and fire regime conditions. Regardless of whether the cause is natural or human, forest succession is constantly changing and will continue on the MNF. Alternatives will differ based on the amount of acres allowed to grow with little or no human disturbance compared to the amount of acres where active management is allowed or emphasized.

General Effects from Managing for Age Class Diversity

Age class diversity, species or forest type composition, and forest health are all inter-related. A forest comprised of one species/forest type or one age is not diverse and is potentially more susceptible to insect or disease outbreaks, wildfire, and other disturbances. Sustainability is the capacity to manage the variety of resources in a forest over the long term thereby ensuring habitats and products are available for generations into the future.

The direct effects of creating early successional habitat through timber harvest are expected to be localized and generally short term (3-12 years). As the seedlings and stump sprouts respond to the increased light with associated increases of available moisture and nutrients, regeneration is usually established rapidly within the first 3 to 5 years. Crown closure of the young saplings normally occurs within 8 to 12 years. While the direct effects are short term, the long-term effect would be a greater diversity in age across the landscape, resulting in sustainable supplies of mast production and commercial timber products.

Creating young forests through deliberate actions creates diversity in forest structure and development stages across the landscape and over time. This diversity in structure creates a variety in habitat conditions for wildlife and plant species. With a greater diversity of ages and structure at the landscape level, the result would be a healthier forest with reduced susceptibility for large-scale pathogen outbreaks and other disturbances. Future age class distribution will vary

among alternatives depending on the management emphasis and intensity (amount and type of activity allowed).

General Effects from Not Managing for Age Class Diversity

Most of the Forest would not be actively managed to create diversity in the age classes. In these areas succession will continue, with some stands becoming dominated by shade-tolerant species such red and sugar. Trees that are intolerant or moderately intolerant of shade such as black cherry, oaks, hickories, yellow poplar, and ash will be less common. However, forest development would continue as stands grow in vertical structure through creation of small gaps from single tree or groups of trees dying. In unmanaged stands it is expected that standing dead and fallen trees would increase as the stands age.

With most of the mast-producing stands around a similar age, it is expected that hard mast production will begin to decline within the next 30 to 50 years. Young stands would not be created to replace older stands that are declining in hard mast production. The result would be a substantial reduction in hard mast production in the mixed oak-hickory and pine-oak forest types as they convert to mixed hardwood and pine forest types.

Natural, unplanned disturbance events such as fire, wind and ice storms, and insect/disease outbreaks will provide early successional habitat in scattered patches of various sizes on all forested lands within the MNF proclamation boundary. Wind and ice storms are usually low-level disturbance events and have occurred historically in unpredictable patterns and cycles. High-level disturbance storm events (stand replacement creating blocks of early successional habitat) occur very infrequently (100 to 1,000 years).

In general, old forests are more susceptible to insect and disease infestations, creating conditions for multi-aged stands to develop over time. Sustainability of commercial timber products is unlikely in passively managed areas of the Forest because commercial timber harvest generally is not allowed. However, in those MPs that allow active management, uneven-age silvicultural management practices would allow some sustainable commercial timber harvest, but the long-term effect would still be conversion of an even-age forest dominated by trees intolerant and moderately intolerant to shade to an uneven-age forest dominated by shade-tolerant vegetation.

General Effects from Active Spruce Restoration

Actively restoring red spruce would accelerate the rate of increase in red spruce dominance or regeneration that is occurring now. In areas where red spruce is found in the understory, commercial or non-commercial actions could be taken to release the understory, allowing red spruce to move into the overstory more quickly. The Spruce-Fir forest type would expand more rapidly toward pre-20th century conditions.

General Effects from Passive Spruce Restoration

Red spruce trees are regenerating naturally on the MNF. Because red spruce is tolerant of shade, it can persist and grow slowly in the understory for up to 100 years and respond to release as

surrounding trees die. However, the longer red spruce is suppressed in the understory the longer it will take to recover from a release, which may allow other faster-growing species to outgrow it. Many of the stands with a red spruce component in the understory are 70 to 90 years old. The red spruce that is in the understory most likely has been suppressed during this time. Since a release is not planned in most of these passive restoration areas, it is likely that much of the red spruce in the understory will die within the next 10 to 30 years. Overall, the range of red spruce would continue to expand toward pre-20th century conditions but at a much slower rate than areas actively managed.

American beech mortality due to beech bark disease and eastern hemlock mortality due to the hemlock wooly adelgid will likely create numerous openings for red spruce regeneration or release. However, beech sucker sprouting may interfere and suppress the regeneration and growth of red spruce seedlings. Without active management to reduce the competition from beech suckers, red spruce would continue to expand in its range but at a much slower rate.

General Effects from Active Oak Restoration

With the application of prescribed fire or herbicides the succession from oak-dominated forests to maple, birch, or beech-dominated forests would be slowed. With the reintroduction of prescribed fire as a recurring disturbance regime, oaks may again be self-perpetuating on many sites. Other silvicultural treatments—such as planting combined with fencing or tree shelter protection and crop tree release—can enhance oak survival and growth. Individual or combinations of site-specific prescribed treatments, along with deer population control, are needed to maintain a long-term sustainable supply of oak trees and hard mast production.

General Effects from Not Managing for Oak Restoration

Many stands currently dominated by oak species in the Mixed Oak forest type would gradually convert to the mixed hardwood forest type as maple, basswood, and other trees tolerant of shade grow in the understory and eventually replace oaks in the late successional stage. In areas where the overstory oaks are removed through commercial timber harvest but actions are not taken to ensure oak regeneration, stands would likely become dominated by species other than oaks.

General Effects from Disturbance Processes

Prescribed Fire and Wildfire - Fire is a disturbance event that is both natural and human-caused and has occurred in forested stands for thousands of years. Nature-caused fires are unplanned, sporadic events, while the human use of fire has increased over time until about 60 years ago when fire suppression became an active form of management. Periodic human-caused fires generally burn with low intensity in a mosaic pattern. Stand-replacement fires generally occurred only during periods of drought or after storm events left large amounts of dead and down trees that increased fuel loads. Oaks have increased in numbers and locations after humans learned to use fire as a tool several thousand years ago (Brose et al 2001). Although oaks do not require fire to be present in an area, fire appears to be an important factor in perpetuating oak dominance by eliminating or reducing the number of trees (such as trees with thin bark or trees

that do not sprout when the tops are killed or removed) that are more susceptible to mortality caused by fire.

Forest Insects/Diseases - Native insects and diseases are vital parts of healthy functioning forest ecosystems. It is not the purpose of active forest management activities to eradicate native insects or pathogens on a broad scale. They can influence forest type/species composition, diversity, and forest health by:

- Controlling populations of woody and herbaceous plants,
- Regulating carbon and nutrient cycling,
- Serving as a food source for vertebrates and invertebrates,
- Pollinating plants, and
- Acting as mycorrhizal symbionts.

In contrast, non-native insects and diseases are not normal parts of the ecosystems on the MNF. Although some of the influences are similar to native insects and diseases, the magnitude of the effects are more extreme and can greatly reduce or eliminate native plant populations. This is because predators, parasites, and diseases that controlled these non-native invasive insects and diseases in their home habitats are not present here, allowing unregulated growth of their populations (SAMAB 1996). It is unlikely that the introduction and spread of NNIS can be completely prevented. Projected low funding levels for integrated pest management activities, combined with increased access from management and recreation activities and a steadily increasing number of non-native species being introduced into this country, will make it difficult to prevent new occurrences. Increased access would make it more likely that new infestations could be treated more rapidly and cost efficiently, although the increased access also makes it more likely that NNIS would be introduced into the area. However, in those remote areas without access and little or no management activities, any NNIS introduction may become widespread before it is discovered, making eradication or control efforts more difficult and costly.

Pre-settlement patterns of insect/disease outbreaks are unknown but were probably cyclical with stand-replacement events occurring rarely at unpredictable intervals. Post-settlement insect or disease outbreaks most likely have increased in quantity and intensity because of the introduction of non-native insects and diseases.

Direct and Indirect Effects by Alternative

Issue #1 - Age Class Diversity

Age Class Distribution in MPs 3.0 and 6.1 by Alternative

The amount of regeneration harvest treatments in those MPs that allow active management would affect the future quantity of successional stages or age classes. MPs 3.0 and 6.1 have by far the most potential for change related to regeneration harvest. Under Alternative 1, MPs 2.0 and 4.0 allow commercial timber harvest, but MP 2.0 emphasizes uneven-aged harvest on only 13,700 acres, while MP 4.0 is only comprised of 400 acres. For Alternatives 2, 3, and 4, MP 4.1 allows commercial timber harvest, but regeneration harvest for age class diversity would only

occur on a relatively small portion of the total acres. The majority of this MP would emphasize passive restoration of spruce or spruce-hardwood ecosystems, or active thinning or release treatments to promote spruce ecosystem recovery.

Age class changes were computed by the SPECTRUM model, using a combination of current conditions, predicted treatments, and management constraints. See Appendix B of this EIS for more information on vegetation modeling using the SPECTRUM model.

Table VE-6 shows the age class changes predicted as a result of vegetation management in MP 3.0 by alternative at the end of the first, fifth, and tenth decades of management.

Table VE-6. Age Class Distribution Percentages in MP 3.0 by Alternative After Decades 1, 5, and 10

Alternative 1 – MP 3.0					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	4.6	4.8	31.1	54.1	5.4
End of 1st Decade	5.9	4.8	31.1	52.7	5.5
End of 5th Decade	15.4	17.1	10.7	19.2	37.6
End of 10th Decade	9.4	12.7	19.4	17.9	40.6

Alternative 2 – MP 3.0					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	4.2	4.5	33.0	54.5	3.8
End of 1st Decade	13.2	4.6	33.0	45.4	3.8
End of 5th Decade	20.0	19.0	17.8	17.9	25.3
End of 10th Decade	15.9	18.2	23.4	21.9	20.6

Alternative 2M – MP 3.0					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	4.2	4.4	33.0	54.6	3.8
End of 1st Decade	13.1	4.5	33.0	45.6	3.8
End of 5th Decade	20.0	19.1	17.6	17.8	25.6
End of 10th Decade	15.8	18.0	23.7	22.0	20.6

Alternative 3 – MP 3.0					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	4.3	4.5	32.5	54.7	4.0
End of 1st Decade	13.0	4.5	32.5	46.0	4.0
End of 5th Decade	20.0	17.9	17.5	17.8	26.8
End of 10th Decade	14.5	18.5	24.6	22.2	20.2

Alternative 4 – MP 3.0					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	4.1	4.4	34.3	53.5	3.7
End of 1st Decade	13.9	4.4	34.3	43.7	3.7
End of 5th Decade	19.8	19.5	16.4	13.3	31.0
End of 10th Decade	11.8	15.7	26.5	23.5	22.5

Table VE-7 shows the age class changes predicted as a result of vegetation management in MPs 6.1 by alternative at the end of the first, fifth, and tenth decades of management.

Table VE-7. Age Class Distribution Percentages in MP 6.1 by Alternative After Decades 1, 5, and 10

Alternative 1 – MP 6.1					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	3.8	4.8	32.2	54.6	4.6
End of 1st Decade	9.6	4.8	32.2	48.8	4.6
End of 5th Decade	14.7	12.8	14.4	21.0	37.1
End of 10th Decade	14.9	13.2	18.7	16.1	37.1

Alternative 2 – MP 6.1					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	3.7	4.8	23.9	61.6	6.0
End of 1st Decade	8.3	4.8	21.7	59.4	5.8
End of 5th Decade	10.2	8.1	13.1	18.4	50.2
End of 10th Decade	11.2	10.5	15.3	13.3	49.7

Alternative 2M – MP 6.1					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-119 years)	Late (≥120 years)
Current Distribution	3.8	5.0	23.7	61.4	6.1
End of 1st Decade	8.5	5.0	21.7	58.8	6.0
End of 5th Decade	10.2	7.9	13.5	18.3	50.1
End of 10th Decade	11.4	10.9	15.3	13.4	49.0

Alternative 3 – MP 6.1					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-120 years)	Late (>120 years)
Current Distribution	4.1	4.8	25.6	59.6	5.9
End of 1st Decade	5.8	4.8	25.6	57.9	5.9
End of 5th Decade	9.2	9.1	10.6	20.4	50.7
End of 10th Decade	10.0	9.7	14.2	12.7	53.4

Alternative 4 – MP 6.1					
Time Frame	Percent of Age Class or Successional Stage				
	Early (0-19 years)	Early to Mid (20-39 years)	Mid (40-79 years)	Mid to Late (80-120 years)	Late (>120 years)
Current Distribution	3.6	4.6	24.1	61.7	6.0
End of 1st Decade	12.3	4.6	22.1	56.0	5.0
End of 5th Decade	10.6	7.4	17.0	15.7	49.3
End of 10th Decade	9.8	10.1	18.0	15.1	47.0

Alternative 1 – MPs 2.0, 3.0, 4.0, and 6.1 contain an estimated 332,200 acres of MNF lands that can be actively managed for timber in this alternative. One major constraint that restricts regeneration harvests on suitable timber lands is the 200-year rotation cycle for most forest types. This averages to ½ percent per year of regeneration harvest to attain a balanced age class distribution on those acres that can be actively managed. On 332,200 acres it would be necessary to annually regenerate an average of 1,661 acres to balance age classes over the 200-year rotation cycle. If this alternative were to achieve desired conditions in the 2006 Forest Plan in a 10-decade time frame, it is estimated that annually, 4,200 acres would be regenerated into early successional stands, or about 0.5 percent of the total MNF acres.

On the remaining 585,200 acres, only natural disturbance events would contribute to creating early successional habitat. A balanced age class distribution is not achievable through natural processes in a 200-year rotation cycle.

Alternative 2, 2M, 3, and 4 - In Alternatives, 2, 3, and 4 a maximum of 15 percent of the acres may be regenerated over the next decade in the MPs that allow timber harvest activities. Most of these acres would come from the mid- and mid- to late successional stage stands, which presently make up 88 percent of the acres on the MNF. Meeting the maximum allowable regeneration would substantially increase the amount of early successional habitat on the Forest. However, a large majority of the Forest would remain in the older age classes.

Acres were re-allocated in MP 6.1 in these alternatives, placing more of the high-quality mixed hardwood forest types into 3.0 MP and the low-quality mixed oak forest types into MP 6.1. Due to this reallocation the Spectrum model preferred to harvest the high-quality sites first in the earlier decades in MP 3.0 and the lower-quality sites in MP 6.1 in the later decades. Most likely this is why the age classes are more evenly distributed by the end of the fifth decade in MP 3.0 areas. However, in MP 6.1 areas in all alternatives there is still a high percentage of acres in the

late successional stage, ranging from 37.1 percent in Alternative 1 to 53.4 percent in Alternative 3 by the end of the 10th decade.

Alternative 2 – In MPs 3.0, 4.1, and 6.1, approximately 330,300 acres are available for active management in this alternative. Annually, an estimated maximum of 3,400 acres would be regenerated into early successional stands, or about 0.4 percent of the total MNF acres. Another way of interpreting this is, on an annual basis approximately 99.6 percent of the MNF acres would continue to move toward older age classes. An estimated 587,100 acres are not suitable for timber management in this alternative, and only natural events would contribute to creating early successional habitat in these areas.

In this alternative there would be a maximum increase of 7.3 percent in MP 3.0 in the early successional age class by the end of the first decade compared to Alternative 1.

Alternative 2 Modified – In MPs 3.0, 4.1, and 6.1, approximately 329,400 acres are available for active management in this alternative. Annually, an estimated maximum of 3,400 acres would be regenerated into early successional stands, or about 0.4 percent of the total MNF acres. Another way of interpreting this is, on an annual basis an estimated 99.6 percent of the MNF acres would continue to move toward older age classes. An estimated 588,000 acres are not suitable for timber management in this alternative, and only natural events would contribute to creating early successional habitat in these areas.

In this alternative there would be a maximum increase of 7.2 percent in MP 3.0 in the early successional age class by the end of the first decade compared to Alternative 1.

Alternative 3 – Approximately 253,400 acres are available for timber harvest in MPs 3.0, 4.1 and 6.1 in this alternative. Annually, an estimated maximum of 2,400 acres would be regenerated into early successional stands, or about 0.3 percent of the total MNF acres. In this alternative about 99.7 percent of MNF acres, on an annual basis, would continue to move toward older age classes, with about 664,000 acres that would not be suitable for timber management.

In this alternative there would be a maximum increase of 7.1 percent in MP 3.0 in the early successional age class by the end of the first decade compared to Alternative 1.

Alternative 4 - This alternative has about 346,700 acres available for timber harvest in MPs 3.0, 4.1, and 6.1. Annually, an estimated maximum of 5,200 acres would be regenerated into early successional stands, or about 0.6 percent of the total MNF acres. About 570,700 acres are not suitable for timber harvest in this alternative.

In this alternative there would be a maximum increase of 8.0 percent in MP 3.0 in the early successional age class by the end of the first decade compared to Alternative 1.

Over the majority of the MNF, 64 to 72 percent of the forested acres that are not suitable for timber management (depending on the alternative) would continue to age and move into older age classes. Alternative 4 has the fewest acres that are not suitable for timber management, while Alternative 3 has the most acres that are not suitable.

Issue #2 - Vegetation Restoration

Acres of Potential Passive and Active Spruce Restoration by Alternative

The vegetation management strategy for spruce restoration is much the same across all the alternatives because it is essentially derived from the Forest Plan Threatened and Endangered Species Amendment of 2004. Land mapped as suitable habitat for West Virginia northern flying squirrel would receive relatively little active management, as the overall strategy is to allow red spruce and spruce-hardwood stands to grow older through time and develop an uneven-aged stand structure. Management may occur to enhance or maintain this habitat, or for research related to how best to achieve this objective, but the amount and intensity of management is expected to be relatively low under any alternative.

The total amount of potential restoration (both passive and active) that could occur is shown in Table VE-8 by alternative. These acres were calculated by adding all the areas of spruce and spruce-hardwood ecosystems that will be at least 80 years old 50 years from now in MPs 4.1, 6.2, 5.0, 5.1, and 8.0 (including the 8.1 NRA in the action alternatives) by alternative, plus any additional spruce or spruce-hardwood stands in other areas that would receive little or no active management, such as WVNFS suitable habitat, Indiana bat key areas, stream channel buffers, eligible Wild and Scenic River corridors with a Wild classification, etc.

Table VE-8. Total Acres of Potential Spruce Restoration Areas

Alternative 1	Alternative 2	Alternative 2M	Alternative 3	Alternative 4
130,000	140,000	140,000	140,000	140,000

Table VE-8 shows that there is little difference in overall potential spruce restoration under any alternative, and no difference among the action alternatives that could be implemented under the 2006 Forest Plan. The 10,000-acre difference in the No Action Alternative is a result of northern hardwood areas that fall within MPs 3.0 or 6.1 that would emphasize even-aged regeneration harvests instead of spruce restoration.

West Virginia northern flying squirrel habitat is captured by OA 832 in Alternative 1, and within portions of MP 4.1 in Alternatives 2, 2M, 3, and 4. MP 4.1 was also designed to include areas on the Forest that are not now suitable for WVNFS habitat, but have the potential to grow spruce and become suitable habitat at some point in the future. In fact, MP 4.1 has the following vegetation management objective:

> Within stands where spruce can be restored, enhanced, or maintained, conduct approximately 1,000 to 5,000 acres of species composition and habitat structure enhancement work over the next 10 years.

Alternative 1, No Action, has no such objective. Although active spruce restoration treatment could occur under any of the action alternatives, there are Management Prescription areas with spruce restoration potential in each alternative where commercial timber harvest is essentially

prohibited. These areas are MPs 5.0 (Wilderness), 5.1 (Recommended Wilderness), 6.2 (Backcountry Recreation), and some 8.0 (Special Areas such as Biological Areas, Scenic Areas, National Natural Landmarks, and candidate Research Natural Areas). The 5.0 areas do not change by alternative, but the 5.1, 6.2, and 8.0 MP areas do. Therefore, the amount of acres available for active spruce restoration varies somewhat by alternative. These differences are shown in Table VE-9 as the acres of northern hardwood stands in MP 4.1, but not in WVNFS suitable habitat, that would be at least 80 years old at the end of the fifth decade.

Table VE-9. Acres Available for Active Spruce Restoration 50 Years From Today

Acres Available for Restoration	Alt. 1	Alt. 2	Alt. 2M	Alt. 3	Alt. 4
All Potential Acres in MP 4.1	0	23,000	24,000	9,000	34,000

Although the acres in Table VE-9 are only intended as a relative comparison of areas that could provide opportunities for active spruce restoration under each alternative, the analysis indicates that opportunities would likely be the greatest under Alternative 4, followed in descending order by Alternatives 2M, 2, 3, and 1.

The most important difference among the alternatives is that Alternative 1, represented by the 1986 Plan as amended, has no desired condition or objective to restore spruce and spruce-hardwood ecosystems, whereas the action alternatives do. Restoration would still occur in Alternative 1, but it would likely be at a slower pace because it would be dependent on the ecological processes associated with natural succession. However, under all alternatives most spruce restoration would occur passively, as a result of these natural processes.

Acres of Oak Forest Types Within MP 6.1 by Alternative

Unlike spruce restoration described above, oak restoration would focus on active vegetation management tools such as even-aged timber harvest and prescribed fire. Although some harvest-related oak restoration could also occur in MPs 3.0 and 8.1, most of the direction and opportunities for oak restoration are associated with MP 6.1. This MP area not only includes a majority of the declining oak communities on the Forest, but it also has suitable timberlands with a wildlife habitat management emphasis. Suitable acres of mixed oak and pine-oak forest types in MP 6.1 are shown in Table VE-10 by alternative. These acres represent the most likely area where oak restoration would occur using commercial timber harvest as a tool.

Table VE-10. Acres of Oak Forest Types Within MP 6.1 by Alternative

Oak Types within MP 6.1	Alt. 1	Alt. 2	Alt. 2M	Alt. 3	Alt. 4
Acres of mixed oak in MP 6.1	66,300	97,500	97,300	55,700	106,000
Acres of pine-oak in MP 6.1	18,600	28,500	28,500	12,200	31,200
Total Acres	84,900	126,000	125,800	67,900	137,200

Alternative 1 – The No Action Alternative has an estimated 84,900 acres of oak forests in 6.1 areas where active harvest-related restoration would be most likely to occur. However, it is

important to note that the 1986 Forest Plan has no desired conditions or objectives related to restoring oak ecosystems, in MP 6.1 or otherwise. Desired conditions for MP 6.1 include:

> Management emphasis will focus on manipulation of the naturally occurring tree species composition to optimize hard mast production, age class distribution, and ensure a continuous mast supply. (p. 165)

This statement can be interpreted that management should strive to maintain or enhance oak species and communities, as they are primary producers of hard mast, but there is no explicit direction or information in the 1986 Plan about the need to restore these declining ecosystems, or the amount of restoration that should occur.

Alternatives 2, 2M, 3, and 4 – The action alternatives have specific emphasis and direction to achieve oak restoration under MP 6.1. Specifically, desired conditions for MP 6.1 in the 2006 Forest Plan include the following statement:

> On sites where existing vegetation includes an oak component, oak restoration management focuses on achieving and maintaining oak-dominated species composition, as well as developing the more open stand structure that likely existed in these communities prior to a period of extensive fire suppression that began about 70-80 years ago. (Chapter III, MP 6.1, Desired Conditions)

There is a corresponding goal (6102) in the revised 6.1 management direction to:

> Maintain, restore, or enhance the oak component within oak-pine and oak-hickory communities to provide long-term mast supplies, sustainable timber, and habitat diversity.

The revised MP 6.1 also includes the following management objectives (6104, 6106) designed to achieve the oak restoration desired conditions:

> Within oak ecosystems that can be restored, enhanced, or maintained, conduct 10,000-15,000 acres of prescribed fire over the next 10 years to enhance species composition and stand structure.
>
> Over the next 10 years regenerate the following amounts of forest vegetation to begin moving toward desired age class and habitat diversity conditions for these forest types:
>
> White oak: 2,000-3,000 acres
> Red oak: 6,000-7,000 acres
> Mixed oak: 3,000-4,000 acres

This suite of revised direction provides much clearer emphasis and guidance for restoring oak ecosystems than that found in the 1986 Plan under Alternative 1.

Alternative 2 – This alternative has an estimated 126,000 acres of oak forests in 6.1 areas where active harvest-related restoration would be most likely to occur. This represents a substantial increase (over 41,000 acres) over the amount of land available for oak restoration in Alternative 1, representing the 1986 Plan as amended.

Alternative 2 Modified - This alternative has an estimated 125,800 acres of oak forests in 6.1 areas where active harvest-related restoration would be most likely to occur. This represents a

substantial increase (nearly 41,000 acres) over the amount of land available for oak restoration in Alternative 1, representing the 1986 Plan as amended.

Alternative 3 – This alternative has an estimated 67,900 acres of oak forests in 6.1 areas where active harvest-related restoration would be most likely to occur, considerably less than either Alternatives 1, 2, 2M, or 4. A substantial amount of the available 6.1 land in Alternatives 1 and 2 is shifted to MPs 5.1 and 6.2 under Alternative 3, and commercial timber harvest is prohibited in these prescriptions, lessening the opportunity for oak restoration. The management emphasis and direction for oak restoration under Alternative 3 would be the same as in Alternative 2, but the opportunity would be diminished over the long term.

Alternative 4 - This alternative has an estimated 137,200 acres of oak forests in 6.1 areas where active harvest-related restoration would be most likely to occur, the most of all the alternatives, and 52,300 acres more than Alternative 1. The management emphasis and direction for oak restoration under Alternative 4 is the same as in Alternative 2, but the opportunity would be increased over the long term because there would be more land available for treatment.

For all alternatives, additional oak forests would be available for treatment outside of the suitable acres displayed in Table VE-10. These areas could be treated with a mixture of timber harvest and prescribed fire to achieve oak regeneration; however, funding would likely have to come from different sources than the Timber program. The most total oak forests available would be in Alternative 4 (213,700 acres), followed by Alternative 2 (191,900 acres), Alternative 2M (188,500 acres), Alternative 1 (136,800 acres), and Alternative 3 (110,400 acres).

Acres of FRCC 3 and 2 in MPs 3.0, 6.1, and 8.1 by Alternative

Another important aspect of oak restoration is the use of prescribed fire, either alone or in combination with timber harvest, as an active vegetation management tool to help manage ecosystem composition, structure, and function. Due largely to the intermingled land ownership patterns and the relatively long list of investments and property to protect, management direction in both the 1986 and 2006 Forest Plans emphasizes wildfire suppression across the Forest. Therefore, prescribed burning, rather than natural fire, will be used to return fire to its ecological role on the landscape.

The majority of the declining oak communities on the Forest are found on the eastern portion of the Forest. Over the short and long term, fire management would focus on those areas considered most at risk due to their departure from their natural fire regimes. On the MNF these areas have been identified and mapped as Fire Regime I, Condition Class 3, and Fire Regime III, Condition Class 2. Table VE-11 shows the acres of these FRCC that occur in MPs 3.0, 6.1, and 8.1 by alternative. This combination of MPs and FRCCs represent the most likely areas where oak restoration would occur using prescribed fire as a tool. Prescribed fire would likely be used sparingly in other MPs due to access restrictions, motorized equipment restrictions, scarcity of oak types, other management emphasis, or a combination of the above.

Table VE-11. Acres of FRCC 3 and 2 in MPs 3.0, 6.1, and 8.1 by Alternative (mixed oak and pine-oak forest types only)

Alternative	Management Prescription	Acres by Fire Regime (FR) and Condition Class (CC)		MP Subtotal Acres	Total Acres for All MPs
		FR I, CC 3	FR III, CC 2		
Alt. 1	MP 3.0	13,800	32,200	46,000	**183,200**
	MP 6.1	78,000	59,200	137,200	
Alt. 2	MP 3.0	3,000	16,400	19,400	**198,200**
	MP 6.1	75,100	79,000	154,100	
	MP 8.1	21,100	3,600	24,700	
Alt. 2M	MP 3.0	3,000	16,400	19,400	**195,700**
	MP 6.1	73,200	78,400	151,600	
	MP 8.1	21,100	3,600	24,700	
Alt. 3	MP 3.0	3,000	15,800	18,800	**129,900**
	MP 6.1	31,200	55,200	86,400	
	MP 8.1	21,100	3,600	24,700	
Alt. 4	MP 3.0	3,000	16,400	19,400	**217,300**
	MP 6.1	86,000	87,200	173,200	
	MP 8.1	21,100	3,600	24,700	

Alternative 1 – An estimated 84 percent of the acres in the fire-adapted pine-oak and mixed oak forest types are in MPs 3.0 and 6.1. MP 8.1 does not exist under this alternative. As seen in Table VE-11, this alternative has an estimated 183,200 acres of FR I CC 3 and FR III CC 2 in MP 6.1 where active oak restoration using prescribed fire would be most likely to occur. However, it is important to note that the 1986 Forest Plan has no desired conditions, goals, or objectives related to restoring oak ecosystems in MP 6.1 or using fire to do so. Indeed, prescribed fire is merely allowed in MP 6.1 in the 1986 Plan by the following "general direction":

> Prescribed fire may be used to establish, maintain, or control vegetation. (p.181)

This statement provides no emphasis or direction to use fire to achieve specific ecological goals, objectives, or desired conditions. More importantly, the Forest Plan Amendment for Threatened and Endangered Species (2004) has a Biological Opinion that limits the amount of prescribed fire the Forest may use to 300 acres of year. At that maximum rate, it would take the Forest 611 years to treat the 183,200 acres of the high priority FRCC areas once.

Alternative 2 – An estimated 90 percent of the acres in the fire-adapted pine-oak and mixed oak forest types are in MPs 3.0, 6.1, and 8.1. As seen in Table VE-11, this alternative has an estimated 198,200 acres of FR I CC 3 and FR III CC 2 in these MPs where active oak restoration using prescribed fire would be most likely to occur. In addition, Alternative 2 has specific emphasis and direction to conduct oak restoration under MP 6.1, as described under the first Oak Regeneration indicator above. This suite of revised direction would provide much clearer emphasis and guidance for restoring oak ecosystems than that found in the 1986 Plan under

Alternative 1. At a maximum of 30,000 acres of prescribed fire a decade, it would take the Forest 66 years to treat the 198,200 acres of high-priority FRCC areas once.

Alternative 2 Modified – An estimated 89 percent of the acres in the fire-adapted pine-oak and mixed oak forest types are in MPs 3.0, 6.1, and 8.1. As seen in Table VE-11, this alternative has an estimated 195,700 acres of FR I CC 3 and FR III CC 2 in these MPs where active oak restoration using prescribed fire would be most likely to occur. Like Alternative 2, this alternative has an emphasis on oak forest restoration. At a maximum of 30,000 acres of prescribed fire a decade, it would take the Forest 65 years to treat the 195,700 acres of high-priority FRCC areas once.

Alternative 3 – An estimated 59 percent of the acres in the fire-adapted pine-oak and mixed oak forest types are in MPs 3.0, 6.1, and 8.1. As seen in Table VE-11, this alternative has an estimated 129,900 acres of FR I CC 3 and FR III CC 2 in these MPs where active oak restoration using prescribed fire would be most likely to occur, considerably less than either Alternatives 1 or 2. A substantial amount of the available 6.1 land in Alternatives 1 and 2 shifts to MPs 5.1 and 6.2 under Alternative 3. Although prescribed fire may be used in MPs 5.1 and 6.2 to help restore or maintain fire-dependent ecosystems, there is no particular emphasis or objective to do so. In addition, Alternative 3 would be under the same prescribed fire limit (300 acres maximum a year) as Alternative 1. At that maximum rate, it would take the Forest 433 years to treat the 129,900 acres of high-priority FRCC areas once listed in Table VE-16 above.

Alternative 4 – An estimated 99 percent of the acres in the fire-adapted pine-oak and mixed oak forest types are in MPs 3.0, 6.1, and 8.1. This alternative has an estimated 217,300 acres of FR I CC 3 and FR III CC 2 in MP 6.1 where active oak restoration using prescribed fire would be most likely to occur, the most of any of the alternatives. The MP 6.1 management emphasis and direction for fire-related oak restoration under Alternative 4 would be the same as in Alternative 2, but the opportunity would be increased somewhat over the long term because there would be more land available for treatment. Also, this alternative would have a maximum prescribed fire limit of 7,500 acres a year (see Alternatives Considered in Detail, Chapter 2). At that maximum rate, it would take the Forest 29 years to treat the 217,300 acres of high-priority FRCC areas once listed in Table VE-11.

Cumulative Effects

Issue #1 - Age Class Diversity

Meeting desired age class diversity conditions will require more than one or two decades due to the large amount of acres currently in the mid- and mid-late successional stage. It would be beneficial in the long term to regenerate more acres in this entry period than allowed in the 1986 Plan in order to move toward a better distribution of age classes. This is more critical now because fewer acres were regenerated than anticipated in the previous entry period. With the forest aging, many stands will begin to decrease in mast and timber productivity over the coming decades. Most hard mast tree species take 30 to 50 years to attain optimum mast production. If substantial gains in regenerating stands are not made during the next two to three decades, then a sharp decline of hard mast production will begin to occur in the ensuing decades and continue

indefinitely. But even with an increase in regenerated stands now, there will be a period of decline for a couple of decades or more until the regenerated trees grow into their optimum mast-producing years. The most efficient way to sustain large-scale age class diversity through time is to create a young age class on a regulated basis.

The desired condition for most of the forest types in those MPs that have land suitable for timber management is to have 10 to 25 percent of the acres in the 0-19 year (early successional) age class. This means that if the maximum of 15 percent is harvested this decade then in the next decade 0 to 10 percent should be regenerated, depending on the forest type. Conversely, if only 5 percent is harvested this decade, then 5 to 20 percent should be regenerated in the next decade to move toward a more varied distribution of age classes. Any lands managed under the uneven-aged silviculture system remain in the same age class because many of the older aged trees would be retained in the stand after harvesting.

MNF and County Land Age Classes - All forested lands have been categorized into size classes within the counties containing MNF lands and for the MNF. These size classes can be loosely interpreted into successional stages. The seedling/sapling size class can generally be defined as the early successional stage, the poletimber size class as the mid-to-early and mid successional stages, and the sawtimber size class as the mid-to-late and late successional stages. Table VE-12 shows the percent size classes of timber land in counties within the proclamation boundary and on MNF lands. Greenbrier, Nicholas, Grant, and Pendleton Counties have about twice as many acres in the seedling/sapling size class than the other counties within the MNF boundary. In all counties and MNF land the sawtimber size class (mid-to-late and late successional stages) has the majority of the timber land acres. Barbour County only has 11 acres of MNF land and was therefore not included in this analysis.

Table VE-12. Timber Size Classes by Counties with MNF Lands

County	% Sawtimber	% Poletimber	% Seedling/Sapling
Grant	51	39	10
Greenbrier	58	29	13
Nicholas	68	18	13
Pendleton	76	18	6
Pocahontas	75	20	5
Preston	69	21	10
Randolph	86	10	4
Tucker	73	24	3
Webster	75	21	4
Monongahela NF	**78**	**18**	**4**

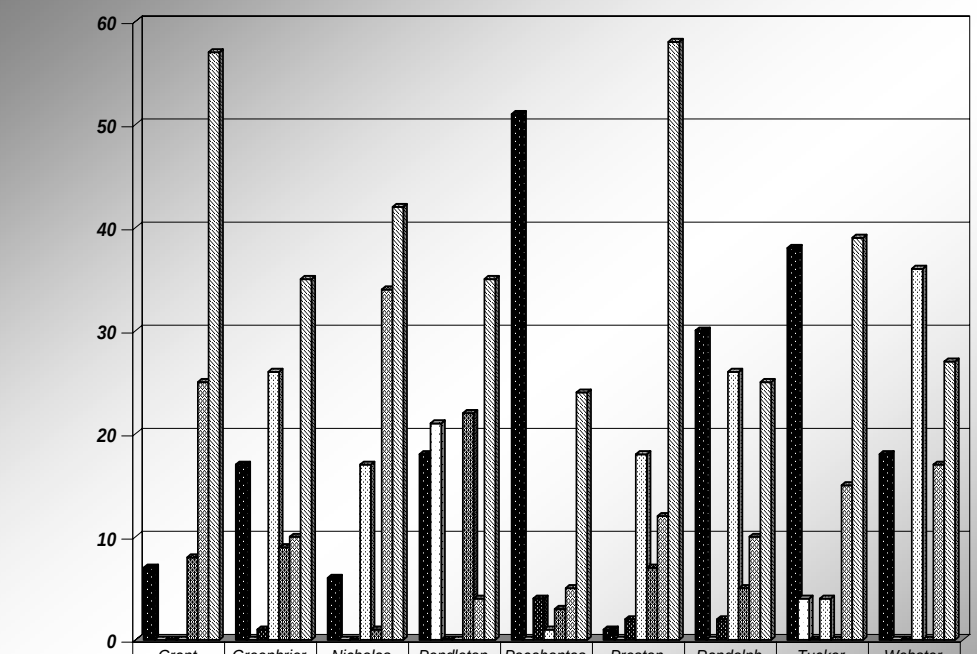
Source: Forest Statistics for West Virginia 1989 and 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-157 and Forest Resource Statistics for the Monongahela National Forest: 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-161.

Greenbrier and Nicholas Counties have the most acres in the seedling/sapling stage within the MNF proclamation boundary and Tucker County has the fewest acres. Grant County has just over 50 percent of timberland in the sawtimber size class, while Randolph County has more than 80 percent in sawtimber. Grant and Greenbrier Counties appear to be the closest to balancing

size classes on timberland within the county, while Randolph County has the least balanced size class distribution.

Figure VE-1 displays the percent of acres in each county within the MNF proclamation boundary by land ownership class. Pocahontas, Randolph, and Tucker Counties have over 30 percent of their lands under MNF ownership. Pendleton County also has more than 30 percent in federal ownership (Monongahela and George Washington National Forests). These counties have over 70 percent of their timberland in the sawtimber size class and the smallest percentage of acres in the seedling/sapling size class for those counties with MNF lands. Conversely, the counties with the highest percentage of acres owned by individuals, corporations, and industry (Grant, Greenbrier, Nicholas, and Preston) have the smallest percentage of acres in the sawtimber size class and the highest percentage in the seedling/ sapling size class.

Figure VE-1. Land Ownership by County



	Grant	Greenbrier	Nicholas	Pendleton	Pocahontas	Preston	Randolph	Tucker	Webster
MNF	7	17	6	18	51	1	30	38	18
Other Federal	0	0	0	21	0	0	0	4	0
State	0	1	0	0	4	2	2	0	0
Industry	0	26	17	0	1	18	26	4	36
Farmer	8	9	1	22	3	7	5	0	0
Corporate	25	10	34	4	5	12	10	15	17
Individual	57	35	42	35	24	58	25	39	27

Source: Forest Statistics for West Virginia 1989 and 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-157 and Forest Resource Statistics for the Monongahela National Forest: 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-161.

It is difficult to predict what will happen to timber size or age classes on non-federal lands within or adjacent to the MNF proclaimed boundary, but a couple of factors are worth considering. First, development for housing, industry, recreation, and agriculture is much more likely to occur at any scale on non-federal lands than on federal lands. If and when this type of development occurs on forested land, it would convert that land to a non-forested condition. This conversion may or may not affect age class diversity, but it would reduce the forested land base within the counties, and it would eliminate the potential for sustainable timber management on those lands.

Second, a portion of the non-federal lands in the cumulative effects area is owned and managed by timber industry or by private and state landowners that periodically sell timber for profit. These lands will likely continue to be managed for timber supply, with a steady or increasing amount of younger age classes over time. The timing, amount, and intensity of harvest on these lands could have an indirect effect on MNF vegetation management. For example, if private and/or state lands are heavily harvested in a watershed or Indiana bat primary range that is shared by the MNF, the Forest may choose to forego or delay harvest in the shared area in order to avoid undesired cumulative effects to age class distribution, soils, wildlife habitat, or other resources.

Forest Insects and Diseases – As noted in the *General Effects* section, native species of insects and diseases would tend to increase in unmanaged stands as they grow older and their biomass and decay increase. Whether these endemic pathogens ever reach epidemic proportions depends on many factors, some of which are unpredictable, like climatic events or even management on adjacent lands. Managed stands with younger, fast-growing trees are more resistant to stress and attacks from native insects and diseases. Thus, a patchwork of managed and unmanaged stands is likely to be less affected by endemic insects and diseases over time than large-scale contiguous stands of older trees. The pattern of federal and non-federal management on interspersed lands could play an important role on the distribution and spread of native forest insects and diseases in the future.

The effects of non-native invasive insects and diseases are even harder to predict. Unfettered by their native predators or environmental controls, these species can have significant impacts to tree mortality, age class diversity, and species composition on the Forest and well beyond. Control efforts in the past have been implemented at the regional scale, and such efforts will need to be similarly coordinated across agencies and ownerships in the future. Because these invaders are relative newcomers to this area, knowledge of their life and feeding cycles is often limited, and their control or eradication can be a long and complex process. Treatments to eradicate or limit the spread of many species have not been fully developed, and some effective biological or chemical controls are not well accepted by the public. Also, there is always potential for new species to become established, with associated adverse effects.

Integrated Pest Management (IPM) is the use of a variety of tools or practices to control pests and is the preferred process for developing and implementing projects on the Forest. IPM is a complex process that requires considerable research, but the end results are generally the most effective, cost efficient, and least harmful to other forest resources and non-target pests. Preventing or reducing the spread of non-native forest pathogens would be a futile effort without the cooperation of private landowners and other federal, state, and local government agencies.

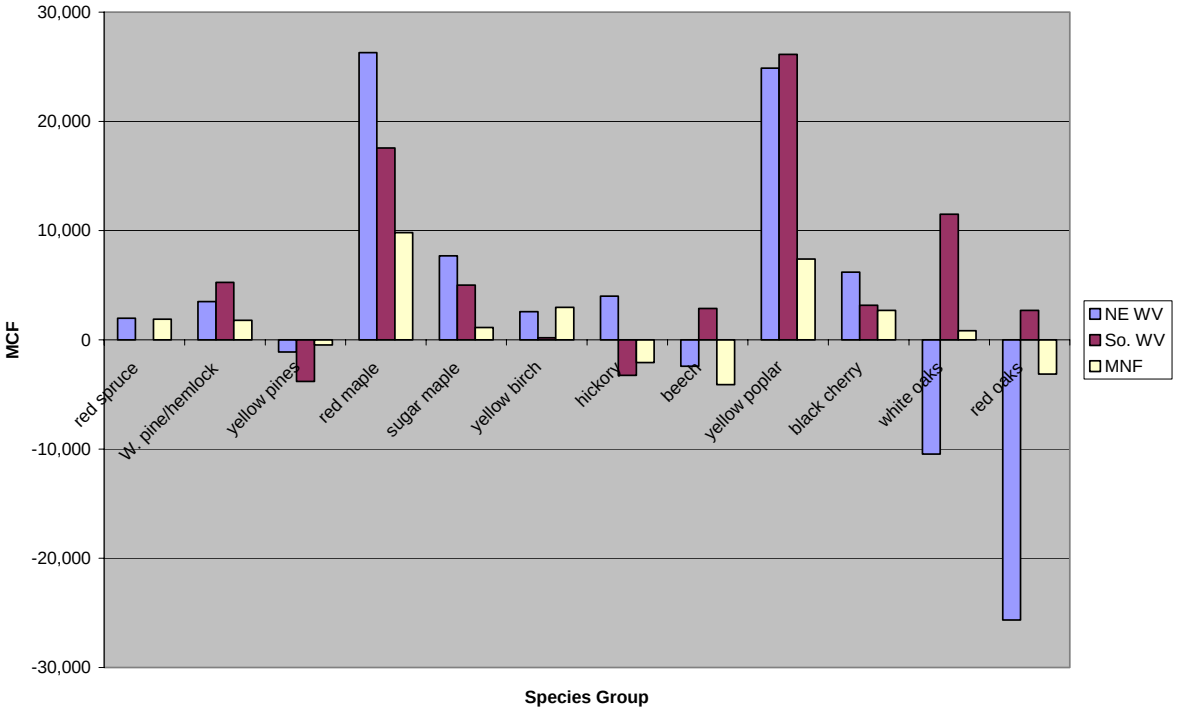
The West Virginia Department of Agriculture (WVDA) and the Forest Service coordinate management efforts in the State, utilizing IPM methods, to control or eradicate pathogens on private, state, and federal lands. WVDA and the Forest Service coordinate gypsy moth detection and spray programs. Both agencies are spraying infected hemlock trees in accessible areas and releasing beetles in an effort to control the hemlock wooly adelgid. Implementing coordinated IPM techniques on the MNF and adjacent lands will help meet the challenge of this ever-increasing management concern.

Issue #2 - Vegetation Restoration

Species Composition on the MNF and West Virginia - Species composition is gradually changing on MNF lands and in West Virginia. Figure VE-2 shows the annual average growth of sawtimber volume measured in thousands of cubic feet (MCF) by species groups on timberland within West Virginia and on MNF lands. Total growing stock volume increased by 6.5 percent to 22.4 billion cubic feet in West Virginia, with the average volume per acre increasing from 1,763 cubic feet in 1989 to 1,895 cubic feet in 2000. An estimated 64 percent of the timberland on the MNF is fully stocked or over-stocked compared to 46 percent of all timberland in West Virginia. About 78 percent of forest land on the MNF is in the sawtimber size class compared to 70 percent in West Virginia.

Figure VE-2

Average Annual Net Change of Growing Stock Volume (1989-2000) by Species Group (MCF)



Source: Forest Statistics for West Virginia 1989 and 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-157 and Forest Resource Statistics for the Monongahela National Forest: 2000, USDA Forest Service, Northeastern Research Station, Resource Bulletin NE-161.

The northeastern and southern units (as described in the FIA analysis) shown in Figure VE-2 contain counties with MNF lands. All of the spruce/fir forest types occur in the northeast section of West Virginia in Pendleton, Pocahontas, and Randolph Counties with nearly 80 percent of red spruce growing on MNF lands.

Red maple and yellow poplar have the greatest net growth of all species. Yellow pines, hickory, beech, white oaks, and red oaks are showing declines in net growth in one or more of the three units shown above in Figure VE-2. The decline in beech is most likely due to the beech bark disease complex. The southern unit shows an increase in net growth of beech because the killing front of the disease had not reached many of the southern counties in West Virginia when these data were collected. Hemlock is not showing a decline in the figure above because the most recent data collected are from 1999 and 2000. Hemlock wooly adelgid has spread further into West Virginia in the past 5 years and mortality has increased. Hemlock will continue to decline unless a remedy is found to control or eradicate the adelgid from the eastern United States.

The cumulative effect of change in species composition is trending toward a higher percentage of red maple, sugar maple, and yellow poplar with a lower percentage of hemlock, beech, yellow pines, hickories, and oaks. This overall trend of reduced diversity, combined with larger areas of forested land not being actively managed, may result in pine-oak forest types converting to white pine or mixed hardwood and mixed oak forest types converting to mixed or northern hardwood forest types.

Prescribed Fire and Wildfire - The yellow pine, hickory, white oak, and red oak species groups are considered to be fire-adapted forest communities. The decline of these species groups seen in Figure VE-2 may, in part, be caused by successful fire suppression and control efforts. Without disturbance these species groups are not able to compete for sunlight and nutrients as well as other species like red maple and yellow poplar. Red maple grows well in the shade and the crowns block out much of the sunlight that the seedlings of shade-intolerant species need to become established. Yellow poplar simply grows more rapidly in full sunlight to maintain dominance for available sunlight. Without fire to reduce the competition for sunlight and nutrients, the fire-adapted species succumb to the shading of trees adapted to growing in the shade or to more rapidly growing tree species.

The WVDNR, MeadWestvaco Corporation, and the MNF all have conducted prescribed burns within West Virginia. Only WVDNR and MNF have annual programs, with WVDNR burning an average of 760 acres per year over the past 6 years, most of this occurring outside of the MNF proclamation boundary. The MNF has not burned more than 300 acres in any year since 1998. MeadWestvaco Corporation does not have an annual prescribed burning program but occasionally conducts burns for research studies on its Ecological Research Forest in Randolph County. If substantial annual prescribed burning program are not implemented, the cumulative effect is that fire-adapted ecosystems will continue to decline, species that grow well in the absence of fire will become more abundant, thereby decreasing diversity, while hazardous fuel loads will continue to increase. Funding levels, available trained personnel, and climatic constraints may be the most limiting factors on whether the Forest will achieve the maximum amount of prescribed burning allowed on an annual basis.

Although the potential for high-intensity wildfires is not currently high on the Forest, it is increasing in some areas because of the accumulating fuel loads resulting from an aging forest that is also seeing an increase in tree mortality from native and non-native pathogens. This situation is compounded by the fact that a once rural area is becoming increasingly populated, creating more wildland-urban interface. Many small developers have constructed homes in areas that once were contiguous forests. New homes are usually constructed in small openings surrounded by forest. Many of these developments are accessed on dead end, one-lane gravel roads, and some homes may be several miles from a main highway. Of the 167 communities located in the vicinity of federal lands in West Virginia that are listed at high risk from wildfire (Federal Register 2001), 90 are located either inside the MNF proclamation boundary or are within 5 miles of the boundary. Prescribed fire and timber harvest used for ecological restoration can also lower fuels, create fuel breaks, and reduce the potential for wildfires to damage or destroy homes and communities.

Wildfires will continue to be suppressed as they occur except possibly within wilderness areas where a wildland fire use policy may be implemented if there is no danger to life or property. Wildfire suppression is usually a cooperative effort with local fire departments, West Virginia Division of Forestry, and the MNF. Extended periods of drought would increase risk of escalating fire intensity, and could result in stand-replacement events and potential damage to resources and property. It is unknown when or where wildfires would occur or how large they would grow before they are controlled. There is no method to predict the pattern or cycle of human or lightning-caused fires for any of the alternatives. However, it is likely that wildfires will burn more intensely in periods of drought, and due to the build-up of fuel loads from the increased mortality of trees caused by an aging forest and escalating pathogens. The risk of damage to life, property, and resources will most likely continue to increase but the cumulative effects cannot be predicted to any level of certainty.