3.7 Old Growth

Affected Environment

Old growth forest stands are those with: large, mature or overmature trees (both healthy and decadent) comprising a plurality of stocking; a multi-layered canopy in trees of various age classes; and, dead trees and relatively large amounts of decaying material on the forest floor (USDA Forest Service 1989, Muller and Liu 1991, Greenberg et al. 1997, Hardt and Swank 1997). Attributes that need to be considered in managing old growth at a landscape level or ecosystem context include: patch size, structural diversity, overstory and understory species composition, standing snags, downed coarse woody debris, landtype association, slope, soil type, aspect, ownership patterns, disturbance factors, and spatial arrangements to other areas containing similar or additional attributes (Greenberg et al. 1997). Mature stands on the FEF, notably the Biological Control Area, Watersheds 4, 10, and 13, and Compartment 8E are beginning to develop attributes that make them desirable for consideration in management of future old growth habitat. These areas would be classified as being in the understory reinitiation stage, with the main cohort emanating from first logging that occurred circa 1905-1912, although some of the trees that exist in each of these stands predate that period. None of the alternatives within this EIS would change the status of these areas as reference areas (i.e., unmanaged areas used to make comparisons to managed areas). Recent research using these compartments documented conditions with respect to productivity and woody species diversity (Schuler 2004), coarse woody debris (Adams et al. 2003), and individual tree characteristics (Wiemann et al. 2004). However, while these stands exhibit some traits of old-growth, they are not considered old-growth from either a process or a structural perspective (Oliver and Larson 1996).

Direct, Indirect, and Cumulative Effects of Alternative A: No-Action

Because no old growth stands exists on the FEF, no direct effects would result from this proposed alternative. Unharvested areas such as those noted above would continue to develop according to robust patterns of stand development and gain more structural attributes of old-growth forests through time (e.g., several more decades). However, there are risks associated with the development of future old-growth stands and the no action alternative. One of the greatest risks is the potential for invasive exotic species to displace indigenous species in both the overstory and herbaceous strata (Meffe et al. 1994, Miller 2003). The no-action alternative does not allow for the control of invasive exotic species on the Fernow. Species such as Japanese stiltgrass and tree-of-heaven have the potential to become exceedingly abundant on the Fernow, invading managed and unmanaged areas as disturbances, both natural and anthropogenic, facilitate. Potential old-growth stands with significant amounts of either of these species would be less useful as reference areas and the invasives would likely alter functional characteristics of these stands as well.

Direct, Indirect, and Cumulative Effects of Alternative B: Proposed Action

Because no old growth exists on the FEF, no direct effects would result from this proposed alternative. Unharvested areas such as those noted above in the affected environment would continue to develop according to patterns of stand development and gain more structural attributes of old-growth forests through time (e.g., several more decades). However, similar to the no-action alternative (Alternative A), this alternative does not allow for the control of invasive exotic species on the Fernow, including the unmanaged compartments. Anthropogenic disturbances can facilitate the spread of invasive species through several means, including the physical movement of seeds and alteration of environments more suitable to exotic species establishment (Meffe et al 1994, Miller 2003). While this alternative directly affects only managed compartments, which will not develop old-growth attributes, the managed compartments could become sources of exotic species that spread throughout the Fernow to unmanaged compartments. Thus, indirectly this alternative could eventually cause the potential old-growth stands to harbor invasive species.

Direct, Indirect, and Cumulative Effects of Alternative C: Management Action

Because no old growth exists on the FEF, no direct effects would result from this proposed alternative. Unharvested areas such as those noted above in the affected environment would continue to develop according to known patterns of stand development and gain more structural attributes of old-growth forests through time (e.g., several more decades). Unlike the Alternatives A and B, this alternative does address the spread of invasive exotic flora: tree-of-heaven and Japanese stiltgrass. Both species have the potential to significantly alter the old-growth forest characteristics that may develop in the unmanaged areas of the Fernow. Efforts to control these species using herbicides (Judge et al. 2001) could protect the biological integrity of these areas (Meffe et al. 1994). While this alternative directly affects only managed compartments, which will not develop old-growth attributes, controlling exotic species in managed compartments would reduce the probability of the spread to the unmanaged compartments. Thus, indirectly this alternative lessens the probability that the unmanaged references areas on the Fernow will be impacted by exotic species as they develop structural features similar to old-growth forests.

3.8 Forest Fragmentation

Affected Environment

The FEF occurs in a heavily forested portion of the central Appalachians where open and early successional habitats, rather than closed, mature forest, are limited on the landscape. Forest fragmentation issues common to other portions of the country such as the conversion of forest land to agriculture or the continuation of urban sprawl into forested areas (Robbins 1988, Rich et al. 1994, Donovan et al. 1995, Marini et al. 1995, Robinson et al. 1995, Rosenblatt 1999, Freeman et al. 2003) are not serious issues threatening the forested areas around the FEF in West Virginia (Weakland 2000). Despite the recent changes in forests across the United States, areas around the FEF have remained virtually unchanged over the past 25 years. Most of the FEF and surrounding land continues to be dominated by closed, mature forest. For example, within a 5 mile radius of Big Springs Cave on the FEF, a 100 ft buffering of roads, permanent openings, and regeneration areas less than 10 years of age shows a landscape of 83.9% closed forest. Even a liberal buffering of 325 ft, 243 ft beyond the distance where biologically relevant effects were detected on the Monongahela National Forest (DeMeo 1999), produces a core area of 69.1% closed forest.

Effects

Fragmentation occurs when openings create breaks in continuous forest blocks. Openings are caused by natural disturbances such as blowdown and fire or anthropogenic factors including farm fields, homesites, wildlife openings, roads, powerlines, timber harvests (regeneration cuts such as clearcuts, seed-tree harvests, and shelterwood harvests), recreational areas (ski resorts), wind turbines and surface mining (Faaborg et al. 1995, Osborn et al. 2000, Weakland 2000, Hadley and Wilson 2004). Single-tree selection and diameter limit harvesting are not considered fragmentation events at the landscape level. Timber harvesting effects are transitory because the new stand develops and openings disappear. From a wildlife perspective, research has shown that timber harvest techniques such as diameter limit harvesting and single-tree selection has actually improved wildlife habitat (particularly songbird habitat) and did not fragment the landscape from a wildlife perspective (Weakland et al. 2002).

The amount and impact of fragmentation depends on the configuration and spatial dispersal of the openings in the forest. Because of the “edge effect”, the more irregular in shape and the more dispersed openings are, the larger the fragmented area (Franklin and Forman 1987). Fragmentation changes light and moisture regimes at the microsite level. Additionally, site conditions can be altered enough to affect populations of wildlife and vegetation dependent on conditions produced by intact, interior forest stands. It is important to understand that interior habitat conditions take time to develop and fragmentation cannot only result in habitat loss but also ineffective habitat as well (Jules 1998).

Interior habitat is an important consideration because some faunal and floral species are documented interior-obligates (Harris 1984, Robbins 1988, Dononvan et al. 1995, Jules 1998). Donovan et al. (1995) hypothesized that 40% core area represented a threshold where there was no difference between source and sink habitats for neotropical migratory songbirds in the landscape. Research on the Monongahela National Forest confirms that no adverse effects occur to songbird nesting, reproduction, and survivorship in areas with as little as 42% core area (DeMeo 1999). The majority of the Monongahela National Forest that surrounds most of the FEF boundary has core area in excess of 75%, with some large blocks in the adjacent Otter Creek Wilderness Area in excess of 90% core area.

Species favored by fragmentation are those associated with edge and habitat diversity within patches (Forman and Godron 1986). Species that can be adversely affected by fragmentation are those requiring interior conditions for at least part of their life cycle (Forman and Gordon 1986). Of the 126 neotropical migratory songbird species that breed in the central Appalachians and northeastern United States, 74 species are associated with edge conditions and 52 are interior species (Smith et al. 1993, Costello et al. 2000). Seven of these birds are interior species that are showing significant population declines regionally for the last 20 years. It is important to note, however, that 22 edge species similarly are showing declines over this period. In western Virginia, Conner and Adkisson (1975) noted that interior species such as the wood thrush returned to clearcut areas when the stand reached pole-stage (about 20 years on the FEF). Across landscapes with 42% to 81% forested core area on the Monongahela National Forest, fragmentation effects on songbirds were only apparent at very localized scales within 75-100 ft. of edge, with no pervasive landscape-scale effects noted (DeMeo 1999). Edge type (hard vs. soft) effects were noted, with overall nesting success higher at the edge of regenerating clearcuts than along road edges. The same study noted that the wood thrush is associated with diverse forest understories resulting from edge creation on the Monongahela National Forest. In fact, numbers of other interior species such as worm-eating warbler, cerulean warbler, scarlet tanager, and eastern wood peewee were not significantly related to forest fragmentation within the aforementioned ranges. For interior species on the intensively managed Mead-Westvaco Ecosystem Research Forest (MWERF), only ovenbird numbers were positively correlated with increasing percent core area of intact forest (Weakland 2000).

Some mammal species such as bats and deer have also been found to benefit from the mosaic of forest conditions created by forest fragmentation. Research on the Monongahela National Forest and MWERF has shown that bat species such as hoary bats and silver-haired bats had higher activity levels in clearcuts and deferment cuts than other forest stands with more intact forest conditions (Owen 2000, Owen et al. 2004). A white-tailed deer study on the MWERF showed that clearcuts were an important component of browsing habitat for deer during the summer (Campbell et al. 2004).

Conversely, some mammalian species are adversely affected by forest fragmentation. Smaller more maneuverable bat species like the northern myotis, eastern pipistrelle and the Indiana bat are probably negatively affected by fragmentation. Research has shown

that these smaller bat species have higher activity levels in interior forests than more open habitats (Owen 2000, Owen et al. 2004). Additionally, research has shown that salamanders are adversely affected by forest fragmentation due to the changing conditions of the forest floor after harvest (Knapp 1999, Knapp et al. 2003).

The question of "How much fragmentation is acceptable?" must therefore consider both edge and interior species. Given that 3 times as many edge songbird species as interior species are showing population declines, the key challenge of land management might be to provide for edge species concurrent with protecting sufficient interior habitat (Ambuel and Temple 1983, Blake and Karr 1984, Askins 1993, Livaitis 1993, Costello et al. 2000). Many songbird species are associated with shrub-scrub habitats that are best provided in the central Appalachians by regenerating timber harvest areas (Conner and Adkisson 1975).

Direct, Indirect, and Cumulative Effects of Alternative A: No-Action

Percent core area of closed forest would realize a small gain from the No-Action Alternative as planned timber harvests and disturbance events do not proceed. Overall, however, there would be no significant biological impact to forest fragmentation from the No-Action.

Direct, Indirect, and Cumulative Effects of Alternative B: Proposed Action

Overall impact of the proposed actions to the continuity of the FEF would be minor. Because the area to be treated in the Proposed Action is small relative to the entire FEF and landscape within a 5 mile radius of the FEF, there would be no direct, indirect, or cumulative effects on forest fragmentation of this Alternative. Although there will be a new area (313.9 acres) proposed for treatment through the "Prescribed burning and variable intensity overstory mortality for enhanced wildlife habitat structure and long-term oak restoration" project, this treatment will involve single-tree treatments and therefore will not fragment the habitat from a landscape or stand level perspective.

Direct, Indirect, and Cumulative Effects of Alternative C: Management Action

Overall impact of the proposed actions to the continuity of the FEF would be minor. Because the area to be treated in the Proposed Action is small relative to the entire FEF and landscape within a 5 mile radius of the FEF, there would be no direct, indirect, or cumulative effects on forest fragmentation of this Alternative. Although there will be a new area (313.9 acres) proposed for treatment through the "Prescribed burning and variable intensity overstory mortality for enhanced wildlife habitat structure and long-term oak restoration" project, this treatment will involve single-tree treatments and therefore will not fragment the habitat from a landscape or stand level perspective.

3.9 Forest Vegetation

Affected Environment

In this section of the analysis, the affected forest vegetation is described within a context of hierarchical ecological units as described by McNab and Avers (1994) and plant associations described by Braun (1950) and Barrett (1995). Although such units incorporate both physical and biological components, the analysis in this section focuses on floral characteristics.

The FEF is a small part of the Central Appalachian Broadleaf Forest (Province M221) as designated by McNab and Avers (1994), which includes parts of Georgia, North and South Carolina, Virginia, Maryland, Pennsylvania, and West Virginia. The area of this province is about 68,000 square miles and represents almost 2% of the total area of the United States. This area represents the largest contiguous, temperate hardwood forest in the world (Barrett 1995).

The Central Appalachian Broadleaf Forest is divided into four sections known as the Ridge and Valley, the Allegheny Mountains, the Northern Cumberland Mountains, and the Blue Ridge Mountains (McNab and Avers 1994). The Affected environment addressed in this EIS is entirely within the Allegheny Mountains section (M221B). The potential natural vegetation of M221B is strongly influenced by elevation and aspect and includes northern hardwoods, red spruce, mixed mesophytic, and oak communities.

The FEF is part of the Allegheny Front Sideslopes (M221Ba10) Land Type Association (LTA), which is the next level of ecological unit. LTAs are differentiated by landforms, natural overstory communities, and soil associations and often are thousands of acres in size. M221Ba10 represents over 99,000 acres on the Monongahela National Forest alone. This LTA contains some of the best examples of the highly productive mixed mesophytic vegetation type found anywhere (DeMeo et al. 1995).

The Ecological Land Type (ELT) is the next lower level of ecological unit (McNab and Avers 1994) and integrates landform, soils, and natural vegetative communities and often ranges form tens to hundreds of acres. The Fernow encompasses 30 ELTs and most of these would be within the affected environment of both action alternatives. The broad range of areas affected is due to experiments that are designed to measure the response of treatments across a range of ecological conditions. The ELTs also represent several major plant associations and include the white oak-black oak group, the red oak-sugar maple group, and the yellow-poplar—mixed hardwoods group (Barrett 1995).

Before proceeding with a description of the forest vegetation it should be noted that vegetative communities rarely achieve stasis. The groups described here do not represent stable or climax communities. The vegetative composition present on the Fernow today is due to a large number of factors – both biotic and abiotic. Species composition has been strongly influenced by climatic changes that have occurred since the end of the Wisconsin glaciation (c. 18,000 yrs. B.P.), and the past disturbances – both

natural and anthropogenic. Pollen analysis of sediment cores from Big Run Bog in Tucker County, West Virginia reveals dramatic changes in species composition from tundra-associated sedges and grasses (17,000 yr B.P. to 13,860 yr B.P.), to red spruce and balsam fir domination (13,860 yr B.P. to 10,500 yr B.P.), to a mixed conifer - northern hardwood forest (10,500 yr B.P.). For the last 8000 years, oak, birch, and American chestnut dominated the upland forests surrounding Big Run Bog (Larabee 1986).

Dendroecological analysis of old-growth remnant stands suggests past disturbances such as wind-throw and fire may have played an important role in maintaining oak species on mesic sites (Abrams and Nowacki 1992, Abrams et al. 1995, Schuler and McClain 2003). In the Ridge and Valley Physiographic Province of central Pennsylvania, disturbance from fire and other events occurred on average every 20 years on ridges and about every 30 to 60 years on the bottomlands (Nowacki 1995). In several studies of past fire regimes, the results are notable in their similarities with fire recurrence intervals ranging from one to two decades in mixed-oak forests (Shumway et al. 2001, Schuler and McClain 2003).

Species composition is still being influenced by biotic and abiotic factors. Biotic factors such as white-tailed deer density and the accidental introduction of exotic pathogens (e.g., gypsy moth, Dutch elm disease, beech bark disease, chestnut blight, and potentially sudden oak death syndrome) have already dramatically influenced virtually all of today's forests in the Central Appalachian region. In most cases, these factors reduce species richness and may lead to the unintended establishment of invasive exotic species. Replacing indigenous species with exotics represents a loss of ecosystem integrity. Timber harvesting also can influence species composition in different ways. In a recent study, single-tree selection, which results in uneven-aged stands, caused a significant decline in woody species diversity over the past 50 years (Schuler 2004). However, in this same study, it was also shown that unmanaged stands (i.e., no cultural treatments or harvests) experienced similar declines in diversity. In both instances, a dramatic increase in shade tolerant sugar and/or red maple resulted in the decline of virtually all other species. Some regeneration techniques can reverse this trend and significantly increase the percentage of shade intolerant species such as yellow-poplar (Brashears et al. 2004). Natural regeneration following large disturbances such as tornado damage or larger clearcuts (e.g., 25 acres) often result in the predominance of species that are capable of a rapid recovery and fast growth. These are often species that are shade intolerant and have the potential for abundant regeneration, either from seed or sprout. Predicted climate change over the next century may also alter the geographical range of species distributions (Iverson et al. 1999). Iverson and others (1999) predict ongoing warming would shift species distributions to the north. For example, sugar maple, an important species in the Central Appalachians today, would not be widely distributed in 50 to 100 years if warming trends continue. Thus, while it is feasible to make some generalizations regarding plant associations, it should not be construed that these groups are static and would remain as they are today if the no action alternative is adopted.

Throughout the region, species composition of the Central Appalachian Broadleaf Forest is becoming less dominated by oaks, and increasingly dominated by more shade-tolerant

species. Recognition of and concern for inadequate oak regeneration has been the prelude to several major conferences (Clark 1993). Much of the research reported at these meetings has been based on attempts at manipulating current stand conditions using silvicultural techniques. Attempts at solving the oak regeneration problem have included under-planting (Johnson 1984, Johnson 1992), shelterwood treatments (Loftis 1990, Schlesinger et al. 1993, Schuler and Miller 1995), prescribed fires (Wendel and Smith 1986, Van Lear and Waldrop 1989, Brose and Van Lear 1998), herbicide treatment of understories (Loftis 1990, Schlesinger et al. 1993, Schuler and Miller 1995), and clearcutting or shelterwoods combined with plastic tree shelters protecting planted or natural oak seedlings (Tuley 1983, Lantagne et al. 1990, Smith 1993, Lantagne 1995, Gillespie et al. 1996, Schuler and Miller 1996). While some progress is being made, definitive and economically justifiable silvicultural prescriptions have not materialized from these efforts. Intermediate cuttings, such as thinnings, often accelerate the trend to more shade-tolerant species (Schuler and Gillespie 2000). Nevertheless, certain forest types are still widely recognized. Some of the characteristics of these commonly defined types follow.

White Oak-Black Oak Type Group

The white oak-black oak type on the FEF represents fair growing sites and has an oak site index$_{50}$ of approximately 60. It represents stands with fair to medium productivity relative to other sites in the Central Appalachians but is the lowest productivity class on the FEF. These stands are similar to those described by Braun (1950) as oak-chestnut forests, although due to chestnut blight, chestnut is no longer an overstory constituent. Site locations are often characterized as ridgetops or south and western exposures. Species composition in this group on the FEF is often characterized by chestnut oak, pignut hickory, red maple, and American beech. Common shrubs include blueberry, mountain laurel, greenbrier, and serviceberry.

Average annual growth rates of 50 cubic feet or about 200 board feet per acre is expected. However, over the past 50 years on the Fernow Experimental Forest, sites of this productivity class have exceeded 300 board feet per acre per year when managed by periodically reducing stocking levels (Schuler 2004).

Red Oak-Sugar Maple Type Group

This group on the FEF represents good to excellent growing sites and has an oak site index$_{50}$ of about 70 to 80. Productivity ranges from good to excellent. Site locations are often on north and east facing exposures and on middle to lower slopes. Species composition is described as mixed mesophytic and includes northern red oak, yellow-poplar, sugar maple, black cherry, white ash, basswood, cucumbertree, white oak, and American beech. Understories can be quite diverse and include spicebush, eastern hophornbeam, serviceberry, striped maple, and great rhododendron. Throughout the region, species composition of this group is becoming less dominated by oaks and is increasingly dominated by more shade-tolerant species, often sugar maple. Intermediate cuttings, such as thinnings, seem to accelerate this change (Schuler and Gillespie 2000).

Average annual growth rates are expected to range from 300 to 400 board feet acre per year. However, over the past 50 years on the FEF, managed sites of these productivity classes have averaged 375 and 437 board feet per acre per year, for oak site $index_{50}$ 70 and 80, respectively (Schuler 2004).

Yellow-poplar—Mixed Hardwoods

This group is a highly productive combination of hardwood species and is usually dominated by yellow-poplar. It is found on land with an oak site $index_{50}$ of 86 and above (Barrett 1995). On the FEF, this group is closely integrated with the red oak- sugar maple type and occupies smaller coves within broader spatial units designated as oak site $index_{50}$ of 80. The primary difference is that the percentage of the stand occupied by yellow-poplar increases as site quality increases. The studies described in the proposed action alternatives do not incorporate any entire compartments of this productivity class; however, it does exist within some study areas on smaller scales. Even-aged regeneration methods in this forest type usually result in the continued dominance of yellow-poplar because of its capability for rapid height growth.

Herbaceous Layer

There are three plant species (one tree species, 2 herb layer species) listed as sensitive which occur or may occur on the FEF: butternut, white monkshood, and Appalachian blue violet. One federally endangered plant species, running buffalo clover (RBC) is known to occur on the FEF. See the Biological Assessment for details on the sensitive species.

Four watersheds on the FEF with different management histories but similar parent materials have been intensively evaluated (Gilliam and Turrill 1993, Gilliam et al. 1995) and provide the basis for this description. Cover, biomass, richness at two spatial scales, and diversity were evaluated. Stand age ranged from about 20 years of age to greater than 80. Common herbaceous species included stinging nettle and wood nettle, species of violet, greenbrier, species of blackberry, Christmas fern and shield fern. Species composition could not be correlated with stand age or management history. The investigators found little difference between watersheds evaluated. Species diversity appeared to be predominantly related to physiographic properties of the individual watersheds. The herbaceous layer was also described in areas of the Fernow derived from limestone parent material (Madarish and Schuler 2002, Morris et al. 2002). These sites often support running buffalo clover and some common associates such as panic-grass, white snakeroot and hog peanut. In contrast to the findings of Gilliam et al. (1995), running buffalo clover does seem to be correlated with management history. A complete list of species found on the FEF was recently completed (Madarish et al. 2002).

Running buffalo clover has a high affinity for calcium-rich soil, which is abundant in the western portion of FEF. It is most often found in locations underlain by limestone or other calcareous bedrock and research has shown that it does not fix nitrogen (Morris et

al. 2002). This species persists in mesic woodlands with partial sunlight and periodic disturbance (Madarish and Schuler 2002). Running buffalo clover has been documented in Compartments 72, 5, 7, 9, 8, Biological Control Area, 13, 17, 16, 18, and 20. Monitoring of RBC has occurred annually on the Fernow since 1994 and the number of known plants (i.e., rooted crowns – the commonly accepted unit of measure) was 6513 during the 2004 monitoring season (June – August), which was the greatest number recorded since monitoring began in 1994. The increase is partially a function of finding new populations during each monitoring season. RBC is most commonly found on skid roads on the FEF and it has clearly been shown that the use of these skid roads for logging purposes diminishes the number of plants temporarily, but that population densities recover in about 3 to 5 years (Madarish and Schuler 2002). RBC may need periodic disturbances to persist in forested understory environments. Disturbances to the canopy increase sunlight and ground disturbance reduces competition from other herbaceous species. Ground disturbance may also increase germination via mechanical scarification of RBC seed. White-tailed deer may be a factor in the movement of RBC seed locally, but digestion of RBC seed by deer did not change RBC seed germination rates (Ford et al. 2003). See Biological Assessment for further details.

Elsewhere in similar forest types, Ford et al. (2000) found little difference among understory herbaceous communities of different ages in the southern Appalachian mountains of northern Georgia. In southern Indiana, aspect was the dominant factor determining ground layer species distributions when stands of different ages and management histories were evaluated (Jenkins and Parker 1999). Jenkins and Parker (1999) speculate that disturbances associated with forest management are usually not severe enough to shift ground layer species composition. Ground layer species resiliency (i.e. the ability to recover to predisturbance characteristics following a disturbance) may also be a function of patch size and connectivity to patches of similar characteristics (Ford et al. 2000).

The effect of clearcutting on herbaceous composition has been the subject of some controversy (Duffy and Meier 1992, Johnson et al. 1993, Elliott and Loftis 1993). However, the importance of assessing the entire disturbance history, not just the forest management history, has been emphasized (Johnson et al. 1993). Jenkins and Parker (1998) found that stands that originated after subsistence agriculture were notably different from stands of a similar age that were not farmed or grazed.

Direct and Indirect Effects of Alternative A: No-Action

Under this alternative, succession would continue to favor development of shade tolerant species of red maple, sugar maple, and beech. Advanced regeneration of oaks and cherry would be expected to decline as competition for light and moisture increases. Older trees would be more common and these trees would invariably die and ultimately become dead standing trees and large woody debris on the forest floor. Nutrients would cycle and once again become available to forest vegetation, both herbaceous and woody. Larger blow downs would occur as stands became more susceptible to high winds. This would create

opportunities for some shade intolerant species to persist. The percentage of oak would continue to decline.

Invasive species, especially Japanese stiltgrass and tree-of-heaven, would not be controlled, but the lack of ground-based disturbance caused from experimental silvicultural manipulations would limit the spread, especially that of tree-of-heaven. Japanese stilt grass would likely continue to spread, but primarily along the edges of roads used by the public for recreational access to the Fernow.

RBC would persist for the time period considered within this EIS but may decline in some compartments where sunlight and competition form other species begins to displace RBC. RBC needs periodic (e.g., 10 – 15 years), moderate level ground and canopy disturbance to thrive and this alternative does not include any scheduled disturbances.

Cumulative Effects of Alternative A: No-Action

The No-Action Alternative does not change the overall landscape patterns from either the current conditions or from either of the action alternatives. The percent of the canopy that is classified as open does not change materially at either the scale of the FEF or the larger scale assessed (See Alternative A for details).

Manipulative research on the Fernow regarding RBC would terminate. No other research entity is conducting such research on wild populations of RBC. Discontinuing this research would make it more difficult to achieve the goals of the RBC recovery plan. The Endangered Species Act is designed, in part, to prevent species from becoming imperiled and to recover species once they have. Success in these endeavors requires more than protection, it requires new knowledge. This alternative would not be consistent with ESA.

Aside from RBC, we do not expect the No Action alternative to directly affect the herbaceous community with respect to composition or diversity. Physiographic features of different sites would be the dominant factor controlling ground layer composition (Gilliam and Turrill 1993, Gilliam et al. 1995, Jenkins and Parker 1998). Under this alternative there may be a reduced chance of introducing invasive exotic floral species. Invasive exotics are most often introduced in disturbed areas such as along roadsides (Bergelson et al. 1993).

Effects of Mitigation –Alternative A: No-Action

There are essentially no mitigations to this alternative. Measurements of existing forest vegetation likely would continue. Trends from past disturbances would be evaluated.

Direct and Indirect Effects of Alternative B: Proposed Action

Silvicultural treatments which include some level of harvesting would be applied to about 493 acres (Figure 2-1). This total is broken down as follows: single-tree selection would be applied to 169.8 acres, the diameter-limit method applied to 32.7 acres, patch clearcuts (0.4 acres) applied to 23.2, the financial rate of return method applied to 189.9, and the shelterwood method in combination with prescribed fire would be applied to 77.2 acres. An 84.7-ac watershed would be treated with ammonium sulfate fertilizer which is part of an ongoing study. And in a new study, about 376.1 acres would be treated with a combination of prescribed fire and herbicides/girdling to enhance Indiana bat summer habitat and oak restoration (Figure 2-1).

The silvicultural treatments in this alternative are not to be construed as optimal with respect to timber resources or the herbaceous layer. The purpose of the proposed actions is to compare a range of silvicultural systems that are currently being utilized throughout the Central Appalachian region. Indeed, research has shown that some uneven-aged regeneration systems, such as single-tree selection, tend to accelerate the dominance of more shade tolerant species and often reduce diversity (Schuler and Gillespie 2000, Schuler 2004). Other studies comparing changes in diversity of woody species related to silvicultural or management activities have documented significant changes with respect to treatment effects. In comparing diversity of plant species on two watersheds in New Hampshire 10 years after perturbation, Gove et al. (1992) found that harvesting regime is a significant consideration. Similar results were reported 10 years after harvesting in northern Georgia (McMinn 1992). To assess changes over longer periods, others have compared species diversity in second-growth forests with old-growth forests or older second-growth forests on similar sites (Swindel and Grosenbaugh 1988, Gilliam et al. 1995). Studies of temporal changes in old-growth forests in the eastern United States have revealed a decline in many oak species with concomitant increases in sugar maple, red maple, or other shade tolerant species (Parker et al. 1985, Abrams and Downs 1990, Abrams and Nowacki 1992, Mikan et al. 1994). The decline of oak may portend other significant changes not yet fully understood.

Although uneven-age regeneration methods usually hasten the decline of oak, natural regeneration is robust in the black oak-white oak and red oak-sugar-maple types and would assure abundant regeneration in harvest units. Regeneration is derived from existing understory stems, stump and root sprouts from cut trees, and seedlings derived from the seedbank. Planting is not required and only possible when intensive management practices are utilized. The composition and growth rates of the newly established regeneration are of principal interest. Deviations from expected trends may represent the effect of changes in the biotic and abiotic factors influencing the forest environment.

Logging damage to residual trees would occur during various stages of the logging operation. This impacts residual trees directly. Skid trails and temporary haul roads are needed to access timber. Mitigation measures described in Chapter 2 would reduce these impacts. However, it is one of the goals of research proposed in this alternative to

evaluate such effects over time with respect to different forest management practices. We expect some differences in residual stand quality with respect to silvicultural treatments.

Overstory removal that creates gaps about 0.4 acres in size or larger would change the microclimate and species composition of the understory. Gaps created from tree removal (Study No. 62 and one treatment of Study No. 2) would increase light penetration to the forest floor. Any advance regeneration would immediately take advantage of the increased light. Intolerant tree species such as yellow-poplar and black cherry would be favored but shade-tolerant species such as sugar maple and American beech would not be excluded. Woody species diversity at the patch scale (i.e. 0.5 to 2.5 acres) often increases following the creation of canopy gaps (Schuler and Gillespie 2000).

We do not expect this alternative to significantly influence the herbaceous community with respect to composition or diversity. The research conducted on the FEF and elsewhere in the eastern United States suggests that the proposed treatments are not severe enough to have long-term impacts on this stratum of forest vegetation (Gilliam and Turrill 1993, Johnson et al. 1993, Elliott and Loftis 1993, Gilliam et al. 1995, Jenkins and Parker 1998, Jenkins and Parker 1999, Ford et al. 2000). Use of streamside management zones will further protect many sensitive plants.

Individual RBC plants will be crushed as a result of harvesting. However, the overall effects of the proposed action should benefit RBC because of its apparent requirement for periodic disturbance. In such cases as this, a determination of "may affect, is likely to adversely affect" is made. (See the Biological Assessment for details). However, it should be noted that although individual RBC plants will be destroyed following the adoption of this alternative, population viability analysis using the diffusion approximation approach (Dennis et al. 1991) results in a very low probability of extinction (POE) (POE < 0.01) for RBC on the Fernow during the next 20 years. The POE would be even less during the next 5 years considered in this EIS.

The prescribed fires proposed in this alternative will primarily effect smaller woody vegetation (less than 3 inches DBH). During the past 5 years, prescribed fires have reduced understory density of woody stems less than one inch DBH. Stem reduction of saplings (1 to 5 inches DBH) has been less consistent and primarily limited to striped maple and American beech less than 3 inches DBH. We expect this trend to continue with little impact on larger overstory trees. Approximately a 10% reduction in canopy leaf area index (LAI) was estimated as a result of a prescribed fire in research compartment R1 (Thomas Schuler,Northeastern Research Station, unpublished data). We anticipate that prescribed fire in these compartments over the next five years 2005 to 2009 will continue to reduce the number of stems that are in the lower canopy strata. Some trees not directly killed by fire may be prone to storm damage and/or attack by insects or disease. We anticipate that the total reduction in leaf area may be up to 25% but not greater than that level. Such a reduction in canopy leaf area, a reduced forest floor litter layer, and an abundant acorn crop, could result in an increase in oak seedlings

in the herb layer and a reduction in most other shade tolerant species (e.g., sugar, red, and striped maple and American beech).

In Compartment 45, it is anticipated that a similar effect would be realized if the proposed low intensity understory prescribed fires are implemented. Reductions in overstory density from the use of girdling and stem injection herbicide would promote the development of more understory stems. The resulting stand structure would be more open and have more standing dead snags. Such a structure may be more favorable for the endangered Indian bat during the summer months for roosting and foraging.

The effects on the vegetation due to the fertilizer application of WS3 is an important research topic. Eventually, watershed acidification could lead to base cation depletion, nitrogen saturation, negatively affect individual tree health, and reduce site productivity. Effects on site productivity on the FEF were recently evaluated and found no evidence that the fertilization/acidification treatments have altered site productivity (James Kochenderfer, Northeastern Research Station, unpublished data). In fact, for the period from 1990/91 to 1996, productivity of the treated WS3, measured as stemwood cubic volume, actually exceeded the productivity of WS7, a nearby watershed with similar stand age and characteristics. From 1996 to 2004, no treatment effect with regards to stemwood productivity was discernable between WS3 and WS7. Watersheds 3 and 7 also were compared in terms of biomass production. In most cases there were no differences that could be statistically validated. However, in a comparison of plots with a high proportion of black cherry and yellow-poplar, WS3 actually exceeded that of WS7 in terms of biomass production.

Herbaceous-layer composition and plant species diversity were evaluated in WS3 and compared to several other watersheds. Gilliam et al. (1995) found stinging nettle, violets, seedlings of striped maple, and several fern species were common on all of the watersheds, regardless of age or acidification treatment. The herbaceous layer of WS3 was quite similar to other watersheds evaluated. There were no significant differences with respect to percent cover, biomass, or species richness. Gilliam and Turrill (1993) also studied herbaceous communities of watershed 3 and concluded that species composition was most strongly influenced by soil characteristics early in stand development; however, as stands mature, they speculated that this linkage is less important. Abiotic symptoms of nitrogen saturation for WS3 have been documented (Peterjohn et al. 1996, see Section 3.3 also), but biotic symptoms of nitrogen saturation remain equivocal and of great interest.

Cumulative Effects of Alternative B: Proposed Action

To assess the spatial impact of the proposed action we evaluated the percent of the forest canopy that was classified as “open” or “closed”, using GIS analysis. Open areas were defined as stands less than 10 years old or permanent openings (e.g. heliport, reservoir, skid roads, truck roads, rain gauge openings, buildings (corridors 100 feet wide), and the reservoir. These are openings that are not influenced by the next five years. Permanent openings as defined include 95.3 acres. Proposed actions in both action alternatives

would add about 75.2 acres to the "open" classification in the next five years. We applied the same analysis to an area about ten times the area of the FEF. In the larger spatial scale analysis, the "open" classification also included agriculture, urban, and industrial areas. The larger spatial scale analysis was based on a circular area within a 5-mile radius centered at Blowing Springs Cave, encompassing approximately 50,000 ac.

For the FEF, the present condition is about 98% closed and about 2% open. The proposed actions would change this ratio to 96.4% closed and 3.6% open (including a 100-foot buffer around each new opening). In the larger spatial context, the present condition is 94.4% forest and 5.6% open, adding a 100 foot buffer to all nonforest categories increases the percent open to 10.3. Further identifying all roads within the 5 mile area and buffering all roads with a 100 foot wide buffer strip on each side increases the percent opening to about 15.7%. The proposed alternative would have little effect on the overall landscape pattern. It should also be noted that the FEF lies adjacent to the 20,000-acre Otter Creek Wilderness Area, which cannot be disturbed by timber harvesting, road building, or creation of wildlife openings. Thus the FEF and the adjacent Otter Creek Wilderness Area represent a core of predominantly unfragemented, closed forest habitat.(See section 3.8)

With respect to the herbaceous layer, populations of running buffalo clover (RBC) on the FEF are critical to the recovery of the species. The RBC recovery plan (U.S. Fish and Wildlife Service 1989) delineated a goal of 30 self-sustaining populations before delisting this species as federally endangered. Only 13 small populations were known to exist when the recovery plan was written. Currently, over 100 populations or elemental occurrences (EO) have been documented (Harman 1996). A revised recovery plan has been formulated (2004) but not yet formally adopted by the US Fish and Wildlife Service. More than 30 populations have been tracked for more than 5 years. Recent PVA analysis (Schuler unpublished data) using the diffusion approximation approach predicted a very low probability of RBC extinction. The FEF population is the second largest population on record, although it is widely distributed over about 2000 acres. Most of the Fernow RBC plants are found in managed areas underlain by limestone parent material. This species is moving towards reclassification to threatened from endangered, in part by the research and monitoring conducted on the FEF. Continued silvicultural manipulations proposed under this alternative would provide additional opportunities to study how this species responds to disturbance.

Anecdotal evidence suggests periodic disturbance is necessary to maintain viable populations of RBC in mesic woodlands. This may result from the relief of competition from more invasive herbaceous species. As with many species, RBC appears to be disturbance-dependent in most forested ecosystems. The RBC Recovery Plan states that appropriate habitat management techniques are needed and should be evaluated experimentally. The proposed action would continue existing RBC research on the FEF previously approved via letters of concurrence by the US Fish and Wildlife Service for the years 1998 through 2000.

Effects of Mitigation – Alternative B: Proposed Action

The effects of mitigation refer to the actions common to all studies delineated in Chapter 2 of this document and pertain to the effects on forest vegetation only.

By limiting logging operations from October through April, we are potentially increasing the percentage of yellow-poplar in even-aged regeneration systems. Season of logging, though not of critical importance, does have some effect on establishment and growth of yellow-poplar seedlings (Trimble and Tyron 1969). In West Virginia, Ohio, and Indiana, summer logging produced fewer seedlings than logging at other times of the year. Apparently, in summer-logged stands most of the seeds did not germinate until the following year, and these small seedlings were not able to compete as well with the vegetation that started the previous year. Nevertheless, cuttings in summer months usually have produced sufficient seedlings where a good seed source previously was present.

Butternut would benefit by not being removed by timber harvesting. However, historical reports and pollen records indicate that butternut has not occurred in abundance on the FEF or in eastern West Virginia. It is not likely to increase substantially due to the proposed mitigation. Hickory would usually not be removed from the FEF. This would benefit the abundance of hickory in the overstory relative to other species. However, hickories are relatively short-lived relative to many sympatric species and in stands that are not cut, the ratio of hickory may decline. Perhaps more important for maintaining hickory in stands where it has been present historically, is to determine the means for achieving reliable natural regeneration protocols. This has not been a focus of past research, partially due to the relatively low commercial value of the species. However, the importance of hickory as a source of mast and as a roost tree for the endangered Indiana bat suggests an increased focus on hickory is warranted.

The preferred logging systems would be chosen to minimize soil disturbance. With respect to forest vegetation, soil disturbance can be either positive or negative depending on the autecological characteristics of the species. RBC seems to benefit, at least indirectly from some measure of soil disturbance, perhaps because it inhibits the competing vegetation more than it does RBC. Also, because of its stoloniferous character, RBC may benefit from the scraping away of some vegetation because it becomes easier for its stolons to become rooted as they advance over the surface of the soil.

Practicing Best Management Practices, closure of skid roads, reclaiming decks, and avoiding logging during wet periods minimizes soil compaction, erosion, and loss of productivity. All of these factors affect forest vegetation in that the potential productivity of the site is measured by the total primary productivity (i.e. the amount of forest vegetation that can capture solar energy and store it - photosynthesis). Avoiding logging on wet soils and preventing erosion is a simple but effective way of preserving the productivity of the land and practicing good land stewardship.

The stream-side management zones are proposed to buffer and protect aquatic resources from sedimentation and increases in stream water temperature, among other issues. However, the relatively high levels of canopy cover required in these zones would have a long-term effect on the species composition of these areas. Without larger canopy openings, species composition would change, to include more shade tolerant species. Many of the non-perennial streams, which also include ephemeral streams, are also a part of the highly productive yellow-poplar – mixed hardwood cove sites. These sites are capable of producing the highest quality with high monetary value hardwoods. However, without larger canopy openings, such species as black cherry would no longer be able to compete successfully on these sites. Not cutting trees from stream banks would protect the channel and provide a structural barrier to trap large woody debris. Streamside management zones would also protect certain sensitive plant species which are commonly found in riparian areas, by eliminating vehicular traffic in these areas. However, many of these species protecting stream channels today are shade intolerant species. They would be replaced by more shade tolerant species as the existing trees die or are blown down during storm events.

Direct and Indirect Effects of Alternative C: Management Action

The direct and indirect effects of Alternative C would be similar to Alternative B, except that the control and spread of primarily two invasive species – Japanese stiltgrass and tree-of-heaven-- would be addressed. Tree-of-heaven is not common on the Fernow but can be found in a few locations. Stem injection of herbicide is the most effective for control of larger woody stems of this species because it prevents sprouting from the roots and root collar. A control program using stem injection of herbicides would likely prevent tree-of-heaven from becoming a management problem on the FEF. All herbicides would be applied under the supervision of a Certified Public Applicator as sanctioned by the State of West Virginia or the USDA Forest Service. Glypro Plus (EPA Reg. No. 62719-322) will be used for the herbicide stem injection treatments using a 50 percent solution of concentrate and water. Stem injection will be accomplished using one incision per inch of diameter at breast height evenly spaced around the stem using 1.5 ml of solution per incision. Injections will not be made during periods of high sap flow (March, April, May) and will terminate before November. All handling and directions of the product (Glypro Plus) label will be adhered to.

Japanese stiltgrass is present along the truck road adjacent to Compartment R1, along 2 skid roads in Watershed 5, and adjacent to Compartment 7. Control of this species is more problematic because broadcast sprays are likely to affect other species. Also, because this species is known to produce seed that can remain viable for several years, application of herbicide should be repeated until Japanese stiltgrass is largely controlled. Applications will not occur more frequently than on an annual basis for the next five years. Some nontarget species would likely be affected. However, this can be minimized by waiting until later in the growing season to apply the foliar herbicide. As with the stem injection treatments, Glypro Plus will be used as the foliar spray but using a 2 percent solution of the product with water. Glypro Plus contains a surfactant so none will be added. During application, the foliage will be completely wetted during a rainfree

period. All directions on the product label will be strictly followed. Since applications will occur no more frequently than once each year, any new growth from dormant seed will be easily treated without interference from previously treated plants. Since glyphosate has no soil activity, spring ephemerals would not be affected if application is done in either July or August, before stiltgrass sets seed. Although, some nontarget species may still be impacted by the herbicide application, it is important to control Japanese stiltgrass before it becomes invasive along skid roads and in wet areas throughout the FEF. Such invasive characteristics would displace endemic species and seriously erode the largely intact forest ecosystem that exists on the Fernow.

Cumulative Effects of Alternative C: Management Action

This alternative does not differ from Alternative B with respect to the long-term studies being conducted on the FEF, the landscape effects of those studies, or the cumulative effects on RBC. See Cumulative Effects for Alternative B for a discussion of these issues.

Effects of Mitigation - Alternative C: Management Action

This alternative does not differ from Alternative B with respect to the long-term studies being conducted on the FEF, the landscape effects of those studies, or the cumulative effects on RBC. See Cumulative Effects for Alternative B for a discussion of these issues.

3.10 Recreation Resources

Affected Environment

Tucker County is a noted outdoor recreation destination within the Allegheny Highlands. The FEF is used heavily for recreational purposes, i.e., hunting, fishing, hiking, and wildlife and scenic viewing. Annually from 1999 to 2003, >1,600 buck and antlerless white-tailed deer are harvested in Tucker County during bow, regular gun and muzzleloader seasons (http://www.wvdnr.org/hunting/BGB2003DeerDeerHarvest.shtm). Because white-deer populations in northeastern West Virginia are at or approaching "sociological" carry-capacity thresholds, the West Virginia Division of Natural Resources has liberalized bag limits to increase white-tailed deer harvest in the region. On the FEF, deer hunting as well as bear hunting with and without dogs, and spring and fall wild turkey hunting are among the most popular outdoor activities. Squirrel hunting and ruffed grouse hunting also occur on the FEF. Fishing, primarily for brook trout, occurs along the main stem of Elklick Run.

The FEF also is routinely used for wildlife and scenic viewing, and is listed as a resource for the West Virginia Watchable Wildlife Program. Spectacular spring wildflowers and colorful fall foliage attract both local and out-of-region visitors to the FEF. Camping is not permitted on the FEF, but is permitted on the adjacent lands of the Monongahela National Forest. Main roads on the FEF are open year-round, unless significant fire hazard leads to their temporary closure.

The FEF is surrounded on three sides by the Monongahela National Forest. To the west is the 1977 acre Fork Mountain Opportunity Area (OA), of which 1069 acres are National Forest land. To the southwest, is the McGowan Mountain OA (5424 total acres, 4987 federally owned). The McGowan Mountain Road (FR 324), which runs south from the Fernow along the western edge of Otter Creek, and through the McGowan Mountain OA, ending at the Yellow Creek trail head, is gated April 15- August 15 to minimize disturbance to wildlife. When the road is open to the public, it is routinely accessed by hunters and campers, and for non-consumptive wildlife and scenic viewing.

The FEF also shares a common boundary with the 20,000-acre Otter Creek Wilderness Area, managed by the Cheat Ranger District of the Monongahela National Forest. Set aside by Congressional action in 1975, this area now supports a second-growth mixed mesophytic forest at lower elevations and a northern hardwood and red spruce forest types at higher elevations, with dense thickets of rosebay rhododendron and mountain laurel along mountain streams throughout. All recreational activities within Otter Creek are dispersed backcountry activities. No wheeled/motorized are permitted. Hiking, camping, hunting and fishing are the main activities pursued by visitors to Otter Creek.

There are 45 miles of trails within Otter Creek, many following old railroad grades, remnants of the turn of the century logging. On the FEF, there are 2 trailheads for the Otter Creek Wilderness trail system, Big Springs Gap and Turkey Run. Approximately 4500 visitors hike through or camp in Otter Creek per year using these trailheads, the

majority of those during the summer months, for an average of 8768 Visitor Days (statistics provided from trailhead registers maintained by Cheat Ranger District). Approximately 40% of the visitors are local or from West Virginia, with most remaining visitors from surrounding states (Ohio, Maryland, Pennsylvania, Virginia and the District of Columbia). The trailhead parking areas at Big Springs Gap and Turkey Run often are near capacity during summer months, particularly on weekends.

Direct and Indirect Effects of Alternative B: Proposed Action and Alternative C: Management Action

Because of the small acreages and short duration of the prescribed burning treatments (14-20 days total during the next 5 years), the impact on the recreational resource would be minimal. However, it is expected that there would be temporary impacts to scenic views, day-hikes, and wildlife watching on days when burning occurs. Spring burning could interfere with spring turkey (gobbler) season and fall burning could interfere for a short time with bow-hunting for white-tailed deer and squirrel hunting on 77.1 and 376.1 acres, respectively due to partial road closure or actual burning. The areas planned for the prescribed fire treatment would be secured from the general public during the activities. Recreational visitors would be informed of alternative areas open to their use, and of the nature and purpose of the research resulting in the closure.

Research logging has been conducted on the FEF since 1949, during which white-tailed deer, black bear and wild turkey numbers in Tucker County and on the FEF have either increased or remained constant. The number of recreational visitors (both hunting and fishing and scenic and wildlife viewing) has not decreased during the interim. There may be some temporary effects for visitors seeking a Wilderness experience hearing or seeing ongoing logging for research or by visiting recently harvested plots. However, the research logging occurs during the winter dormant season, when visitor use of adjacent Otter Creek Wilderness Area is lowest, so impacts would be minimal. The number of visitors to Otter Creek using the FEF trailheads has not decreased during the last five years, so there is no evidence to suggest that research logging would have any direct or indirect effect on recreational resources in the Otter Creek Wilderness area.

Cumulative Effects of Alternative B: Proposed Action and Alternative C: Management Action

The FEF is located adjacent to an area of 26,056 acres of the Monongahela National Forest, where no cutting or burning activities are planned within the foreseeable future. Therefore, the cumulative effects of the proposed activities on recreational resources are likely to be insignificant or positive. By ensuring a diversity of habitat and forage for game species, hunting activities and wildlife viewing opportunities are likely to be maintained or enhanced over the long-term through habitat changes as a result of research logging and prescribed burning as indicated in the section 3.6 (Wildlife Resources). Additionally, treatment of invasive exotic plants in Alternative C also will have similar positive impacts by rehabilitating degraded native wildlife habitat.

Direct and Indirect Effects of Alternative A: No-Action

Direct and indirect effects of the No-Action Alternative on the recreational resource should be minimal. A cessation of logging and prescribed burning will immediately reduce annual soft-mast production of species such as blackberry and blueberry and woody browse production that are important to many game species, such as white-tailed deer and black bear that are valued by the hunting public. There would be no visible forest management activities that may deter some users or impair the recreational experience of those viewing scenic resources.

Cumulative Effects of Alternative A: No-Action

Cumulative effects of the No-Action Alternative include: The curtailment of logging and prescribed burning will begin to accelerate the shift of forests on the FEF to older, shad-tolerant community types that provide less hard mast (acorns) and certain soft mast (black cherry and wild grape) in future forests critical for game species such as white-tailed deer, black bear and wild turkey and therefore could reduce available hunting opportunities.

Skidroads and landing decks that remain open and in an early successional stage are heavily used as travel corridors and foraging areas by wildlife. With the no-action alternative, these would eventually revert to denser vegetation. Reduction of these areas would impact hunter access and diminish hunter success on the FEF, particularly for white-tailed deer and ruffed grouse harvest opportunities. Similarly, abandonment of these skidroads also would prevent the access of many wildflower enthusiasts and birdwatchers to interior, off-road portions of the FEF.

3.11 Heritage Resources

The FEF has importance in several areas: prehistoric, historic, and as an experimental forest. Heritage Resource surveys were conducted on the FEF during the spring of 2000, involving 4615 acres. All sites found during surveys are confidential and specific locations will not be disclosed in this report.

Background Information

The FEF consists of lands that were originally granted to Francis (or Frances) and William Deakon (or Deakins) in 1783. Deakon's heirs sold the land to Jonathan Arnold in 1856, and Arnold's son Thomas J. sold the timber rights to the Elk Lick Lumber Company in 1901. The Elk Lick Lumber Company built a logging railroad, and cut timber between 1903 and 1911 (Trimble 1977).

Arnold's holdings of 7,123 acres were the first purchase unit of the Monongahela National Forest. The sale took place in November of 1915. Within the area purchased was a 3,640 acre tract that became in 1934 the original Experimental Forest, named for Bernhard E. Fernow, a pioneering forester. Early maps show limited access into the area, and only one house location.

During the 1930s, the Civilian Conservation Corps built roads, bridges, culverts, a dam, and a water line. After World War II, forest research and experiments began in earnest.

Physical Setting

The FEF is located south of Parsons, West Virginia, and lies between the Black Fork and the Shavers Fork, both forks of the Cheat River. The original Fernow was limited to the watershed of Elklick Run and its tributaries. With the southwestern addition, a portion of the Shavers Fork watershed was added. Elklick Run flows into the Black Fork across from the town of Hambleton. The Elklick watershed lies between Fork Mountain on the west, and McGowan Mountain on the south and east. The Elklick has eleven tributaries, and provides abundant water to the area. However, limestone on McGowan Mountain creates a karst area of sinkholes, with sinking and rising streams, which make parts of McGowan Mountain quite dry. This same limestone contains inclusions of chert used as a raw material by prehistoric peoples to make tools.

Flat ground on the Fernow is scarce, providing little arable land. Most ridge tops are narrow with steep slopes creating V-shaped valleys with little or no flat ground adjacent to streams. There are several flat dry benches on the western slopes of McGowan Mountain of limited size.

Survey Methods

The FEF consists of a wide variety of landforms, ranging from steep slopes, to benches, saddles, and low-lying narrow flats. The model of site location probability and survey methodology agreed to between the Monongahela NF and the WV Division of Culture and History was used during this survey (Ruth Brinker, personal communication). High

probability areas, consisting of relatively level areas close to water, as well as unique landforms and features such as rockshelters, were visually examined and shovel-probed. Medium probability areas, consisting of moderately steep slopes large upland benches, were visually examined. Low probability areas include steep slopes without overhangs. These areas were simply observed at a distance to locate roads, overhangs, or other disturbed areas that would indicate human use. Shovel probes are small holes dug with a standard shovel with contents screened through ¼ inch hardware cloth. Standard distance between probes is 20 meters, but when a probe is positive for cultural remains, the distance was reduced to 10 meters.

The archaeological survey work referenced here meets the requirements set forth in the Programmatic Agreement entered into between the West Virginia Division of Culture and History and the Monongahela National Forest, as well as all federal laws, regulations, and agency standards. The archaeological and historic resources of the FEF are under the stewardship of the Heritage Resources program on the MNF. Any future archaeological site protection, consisting of coordination during project implementation to ensure avoidance of unevaluated or eligible cultural resources, will be conducted by the MNF Heritage Resources program in cooperation with the FEF.

Results

A total of 25 sites were located by the survey. Fourteen of these are historic and eleven prehistoric. Eight sites have been evaluated as not eligible for the National Register of Historic Places; the remaining 17 have not been evaluated. The 15 historic sites include 5 culverts, 2 farmsteads, 2 lumber camps, two bridges, a quarry, a railroad, and a reservoir. All prehistoric sites are lithic concentrations or scatters.

All results of survey work on the FEF have been sent to the State Historic Preservation Office (SHPO), as have the Forest Service's findings of eligibility. The SHPO has concurred with these findings.

Those sites that have been found to be not eligible need no further consideration and effects to them do not have to be taken in consideration during project planning or implementation. Keeping with standard Forest Service practice, all unevaluated sites will be avoided during all project actions. The presence of sites within proposed timber compartments, and their National Register status and recommended management is shown in Table 3.10.

As is evident from examination of this table, four unevaluated sites are located in proposed action areas; these sites will be avoided during all phases of project implementation.

Areas not surveyed for this EIS should be surveyed prior to planning any projects in these areas in the future.

Direct, Indirect, and Cumulative Effects of Alternative B: Proposed Action and Alternative C: Management Action

Log skidding has the greatest potential to disturb prehistoric sites identified in the surveys. Skidding disturbs the ground surface and has the ability to undermine the integrity of archaeological and historic sites and therefore have adverse effects upon their research potential. All log skidding operations will avoid disturbing the unevaluated sites shown in Table 3.9. Therefore there will be no direct effects to archaeological or historic sites as part of the proposed actions under either Alternatives B or C.

All areas surveyed are located on or surrounded by National Forest lands. Future management actions on federal lands would require that these sites either be evaluated as to their National Register eligibility or avoided. Areas that have not been surveyed and have the potential for site disturbing activities in the future would also have to be surveyed in order to identify archaeological or historic resources prior to the beginning of project work. Since a majority of the land in the area is in federal ownership the probability of impacts from adjacent private land to these sites is extremely low. The potential for cumulative adverse effects is therefore not significant under either Alternatives B or C.

Direct, Indirect, and Cumulative Effects of Alternative A: No Action

Under this alternative, there would be no adverse impacts to identified heritage resource sites. The potential for cumulative adverse impacts are the same as that described for the proposed action.

3.12 Economic Resources

This analysis focuses on incremental economic differences between the Action Alternatives (B and C). The analysis includes only variable costs associated with the alternatives. Since fixed costs such as general administration and program management do not change among alternatives, these costs are not included. Furthermore, the costs used in the analysis are only those that would be incurred by the Federal Government. The intent is to provide the Responsible Official a comparison of each of the alternatives.

Financial returns are based on appraisals of market value for timber and the expected timber volume. Each alternative also produces other benefits, such as increased habitat diversity for wildlife and improved access for the public in some areas in addition to information gained through research. However, these benefits are not quantified in the economic analysis because it was not possible to estimate monetary values for them on a project basis.

Economic analysis utilized the Quick-Silver program. Program inputs and outputs are found in the analysis files for this EIS, available at the Timber and Watershed Laboratory.

Effects of Alternative A: No Action

There are no costs or revenue associated with implementing this alternative. Much of the long-term research pertaining to the effects of acidic deposition on forest ecosystems would be terminated. No invasive plant control measures would be initiated. Continued erosion and sedimentation of FR 701 would result in long-term adverse affects to aquatic resources. Hunting activities on the FEF would decrease due to potential long-term changes in early successional wildlife habitat. This would have a small, but currently unquantifiable, economic effect on the local economy for the long-term.

Direct and Indirect effects of Alternative B: Proposed Action

This alternative harvests about 2.3 million board feet of timber using conventional logging systems.

Costs include both fertilizer and application costs for study 4300-FS-NE-4301-59 and –63, logging costs, TES surveys, cultural resource surveys, NEPA analysis and implementation of mitigation measures.

The benefit/cost ratio for this alternative is estimated at 2.51. Non-revenue benefits include invaluable knowledge gained from continuing the long-term research studies, control of invasive plants, increased recreational use of the area (particularly during hunting season) and an increased variety of habitat conditions beneficial to some wildlife species.

Effects of Alternative C: Management Action

This alternative also harvests about 2.3 million board feet of timber using conventional logging systems.

Costs include both fertilizer and application costs for studies 4300-FS-NE-4301-59 and –63, logging costs, TES surveys, cultural resource study, NEPA analysis and implementation of mitigation measures. Additional mtigation measures have been added to this alternative and include $20,000 for additional erosion control and annual herbicide costs ($500) for control of invasive species.

The benefit/cost ratio for this alternative is estimated at 2.46. Non-revenue benefits include invaluable knowledge gained from continuing the long-term research studies, control of harmful invasive plants, increased recreational use of the area (particularly during hunting season) and an increased variety of habitat conditions beneficial to wildlife.

3.13 -- Effects on Consumers, Civil Rights, Minority Groups and Women

Forest Service activities must be conducted in a discrimination free atmosphere. Contract work that may be generated from this document would include specific clauses offering civil rights protection. The Forest Service will make a concerted effort to enforce these policies. Executive Order 12898 of February 11, 1994, Environmental Justice as Part of the National Environmental Policy Act (NEPA), calls for consideration of the environmental, health and economic effects to minority and low-income areas including the consumption patterns for fish and wildlife. The alternatives were assessed to determine whether they would disproportionately impact minority or low income populations, in accordance with Executive Order 12898. No local minority or low income populations were identified during scoping or effects assessment. No alternatives considered in detail, including the no action alternative, will have a disproportionate impact on minority or low income populations. All affected communities have been involved in the NFMA and scoping portions of this project and will have an opportunity to comment on the DEIS. No minority or low income populations are expected to be impacted by implementation of any of the alternatives.

Tucker County's population consists of 18.1% low-income and 1.4% minority. West Virginia populations consists of 17.9% low-income and 4.8% minority population (U.S. Census 2000). To qualify as an environmental justice community, the percent of low-income and minority population much be at least twice that of the state of West Virginia (target of 35.8% income and 9.6% minority). Therefore, demographic information indicates that Tucker County does not qualify as an environmental justice community.

3.14 Research Program and Implications

Forestry research has been conducted at the FEF since 1933. Current silviculture and watershed research programs began in 1948 and have continued without interruption to date. Treatments over the years have included a wide variety of disturbances: even-aged, uneven-aged and two-aged management systems, fertilization, herbicides, and liming. To accomplish research objectives, about 500,000 board feet (International ¼ inch rule) of timber has been harvested annually since 1949 from the FEF. Watershed research traditionally focused on the effects of forest management activities and implications for water resources. More recently, air pollution effects analyses have been added to watershed level studies and a larger wildlife component has been added to the silviculture research. Overall, there is a concerted focus on more process-oriented, ecosystem-level research. Federal, state and university scientists continue to broaden research areas to include aquatic ecology, avian ecology, amphibian ecology, small mammal ecology, and landscape ecology.

Research conducted on the FEF and by project staff has been used to develop Best Management Practices for the State of West Virginia, and to provide input into management decisions of many landowners, including state, private and federal landowners. In excess of 800 publications have been produced and distributed nation- and world-wide describing FEF research activities and outcomes (Godwin et al. 1993, unpubl. data on file USDA Forest Service Northeastern Research Station). The research at the FEF is a significant part of the Long-Term Ecosystem Monitoring research program of the U.S. Forest Service. The FEF is also part of other national research and monitoring programs, including the Long-Term Soil Productivity Program, the National Atmospheric Deposition Program, the National Dry Deposition Network, the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and international networks such as the Global Terrestrial Observing System/Terrestrial Ecosystem Monitoring Sites network.

The FEF also functions as an outdoor classroom, hosting 1,000 or more visitors per year for educational programs ranging from a few hours to several days. These visitors range from elementary school children to university students to professional foresters, wildlife biologists and land managers to scientists from the U.S. and around the world. Programs use research areas of the FEF to demonstrate basic ecological principles, sound forest management, and basic nature study.

Existing long-term studies on the FEF are unique. Research Study 2 (see Chapter 2 for a detailed description) was established in 1949 to evaluate the effects of various silvicultural techniques on forest productivity, species composition, log quality and regeneration. The treatments in this study have been applied consistently over time since 1949. No other such study exists in the central hardwood region. Such studies are a valuable national resource, which could not be replicated within the span of several generations.

Research is also being conducted on the ecology of the running buffalo clover and the Indiana bat, both federally listed species. This research will be an important part of the recovery plan for both species. No other such research on the running buffalo clover is being conducted anywhere in the United States. The planned research activities would benefit running buffalo clover populations throughout its range, and are necessary for understanding how to restore this species. Moreover, Indiana bat research at the FEF addresses a subset of questions particular to populations within the Appalachian Mountains that are currently not addressed in the core of its distribution to the west in the lower Ohio Valley and mid-Mississippi Valley.

Direct and Indirect Effects of Alternatives B: Proposed Action and C: Management Action

The Action Alternatives would continue important long-term research (Study 2) that are among the oldest forest experiments in eastern North America. Because trees are long-lived organisms, and because forests are complex ecosystems, the long-term, larger-scale research that is conducted on the FEF is critical to improving our understanding of forest ecosystems and to providing information for sound management decisions on both public and private lands. The proposed action would allow the continuation of existing long-term studies that evaluate productivity, log quality, species composition, and regeneration, as well as forest management effects on other biota or facets of the forest system. These studies are a valuable national resource, which could not be replicated in the span of two generations if suspended, even temporarily. The proposed actions would benefit and help restore running buffalo clover and Indiana bat populations.

The action alternatives would have a positive effect on the research program of the FEF, and on forestry and ecological research in general.

Cumulative Effects of Alternatives B: Proposed Action and C: Management Action

The research program would be strengthened through the continued treatment and monitoring of these long-term experiments. Other new research by cooperators at academic institutions, government research facilities, and non-governmental conservation organizations would further enhance the research program and the knowledge that is produced. The FEF would continue to participate in experiments with scientists from other parts of the United States and from other counties.

Direct and Indirect Effects of Alternative A: No-Action

The No-Action Alternative would halt all manipulative research on the FEF, and effectively end several important long-term research studies and prevent the establishment of important long-term Indiana bat and oak ecology and prescribed fire research. Monitoring of the vegetation, water flow and chemistry, atmosphere and wildlife would continue, but the results would only be narrowly applicable and without the strength of full inference, lessening in importance over time. Important new research

on effects of fire on hardwood ecosystem linked to Indiana bats would not be conducted, and this important gap in our knowledge would not be addressed by the research program at the FEF.

Cumulative Effects of Alternative A: No-Action

Important long-term research would be discontinued, and would no longer be a resource, and a catalyst for other research. Scientists in West Virginia and the central Appalachians would find their research opportunities curtailed as a result of the change in the research program of the FEF. This would impair the ability to develop sound land management guidelines for a variety of landowners, and would also slow the growth of ecological knowledge about this resource.

3.15 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are actions that change either a nonrenewable resources (such as heritage resources or minerals) or a renewable resource to the point that it can be renewed only after 100 years or more. The construction of permanent roads for timber harvesting is an example of an irreversible action because of the time it takes for a constructed road to revert to natural conditions. There is no permanent (haul) road construction proposed in this EIS.

Irretrievable commitment of resources includes lost production or lost use of renewable resources due to management decisions. Such decisions are reversible, but the production opportunities foregone are irretrievable. As an example, deferring treatments, including harvesting, at this time would be an irretrievable commitment of research activities that are on a prescribed schedule. The commitment is irretrievable rather than irreversible because future activities could treat those areas if they are still available.

Measures to protect resources that could be irreversibly affected by timber harvest have been incorporated in the mitigation measures developed in the action alternatives of this EIS. These mitigation measures protect site productivity, soil stability, endangered, threatened and sensitive species, riparian areas, water quality, and heritage resources from irreversible loss.

3.16 Adverse Effects Which Cannot Be Avoided Should the Proposal Be Implemented

Both action alternatives incorporate mitigation measures to reduce adverse impacts to resources. In most cases adverse effects can be eliminated. For instance, avoiding sites identified in surveys would eliminate impacts to heritage resources. However, other adverse effects can only be reduced by the use of mitigation measures. Adverse sediment effects may occur to some streams including Elk Lick Run from implementing either of the action alternatives. Substantial reductions in long-term sediment are expected with improvements of skid trails and decks. This would reduce adverse effects to water,

riparian and aquatic resources significantly but would not eliminate them. Mitigation measures have been used to reduce adverse effects to sensitive species to the point that there may be effects to individuals but project work is not likely to cause a trend to federal listing or a loss of viability. Adverse effects on two federally listed species may occur. For Indiana bat, the probability of an adverse effect is low because of seasonal constraints of logging activities, but could occur due to felling trees in which bats would use for roosting in the spring and summer. For running buffalo clover, the proposed actions will result in the taking of individual plants, but will provide the periodic disturbance needed to ensure the species' survival. Other adverse impacts may occur to soils, wildlife and its habitat, vegetation, and air quality. However, the intensity and magnitude of these effects are limited in duration and area because these effects are occurring only on a small portion of the total area considered in the analysis.

3.17 Relationship Between Short-term Uses of the Environment, and the Maintenance and Enhancement of Long-Term Productivity

The mission of the FEF is to explain the role of natural and human-induced factors in the sustainability of central Appalachian forest ecosystems and to provide management guidelines therein. Additionally, the productivity and diversity of the soil, water, and other forest resources must be protected. Many of the research activities have been ongoing since the 1950's, quantifying management practices on public and private land and environmental effects. These data are critical to future management in the central Appalachian region and beyond for the maintenance and enhancement of long-term productivity. The data and research collected would improve our understanding of ecosystem processes and lead to better management practices that protect natural resources.

3.18 Possible Conflicts Between the Proposed Action and the Objectives of Federal, Regional, State, and Local Land Use Plans, Policies, and Controls for the Area Concerned

The FEF occurs within the boundary of the Monongahela National Forest. The US Forest Service manages system roads and lands. Direction for its management is found in the Land and Resource Plan, Monongahela National Forest, currently under revision. Management of the FEF is consistent with this management plan, and with the Plan revision. A Biological Assessment was prepared for activities on the FEF, and has been provided to the US Fish and Wildlife Service. Informal consultation with the US Fish and Wildlife Service regarding impacts to threatened and endangered species will assure shared goals and understanding. Documentation of findings from consultation would be made part of the record prior to a final decision.