Terrestrial Management Indicator Species and Other Species of Interest

INTRODUCTION

Management Indicator Species

NFMA regulations require Forests to select Management Indicator Species (MIS) to estimate the effects of each alternative on fish and wildlife populations (36 CFR 219.19). The regulations further direct that MIS should be chosen that indicate the effects of management activities. Categories from which MIS are selected, where appropriate, can include endangered and threatened species, species with special habitat needs that may be influenced by management, game species, non-game species of special interest, and other species whose population changes are believed to indicate the effects of management on other species of major biological communities (36 CFR 219.19(a)(1)). Planning alternatives must be evaluated in terms of habitat and population trends of MIS (36 CFR 219.19(a)(2)), and MIS are to be monitored during Forest Plan implementation and relationships to changes in habitat determined (36 CFR 219.19(a)(6).

MIS were not identified as a major Need for Change issue. MIS were identified as a minor Need for Change issue because the Forest needs to update the MIS list, but the need to do so is not expected to generate substantial controversy or high public interest. However, strategies to address the Vegetation Management Need for Change issue are expected to affect MIS habitat and populations.

The Forest revised its MIS list for several reasons. Experience has shown that some of the MIS chosen for the 1986 Forest Plan are habitat generalists whose populations cannot easily be related to management-related changes in habitat (e.g., white-tailed deer [*Odocoileus virginianus*]), or are wide-ranging species for which controlled studies are difficult (e.g., black bear [*Ursus americanus*]). Other species have proven difficult to monitor because of low populations, sparse distributions, or cryptic habits (e.g., snowshoe hare [*Lepus americanus*]). Also, experiences of National Forests across the nation have shown that MIS lists need to include as few species as possible to ensure that all of the MIS can be monitored adequately within realistic monitoring budgets. The Forest's 10-species MIS list under the 1986 Forest Plan has challenged our ability to collect meaningful monitoring data.

Other Species of Management Interest

Many species on the Forest are important to the public, regardless of whether they are threatened and endangered species, sensitive species, MIS, or other species with viability concerns. Wildlife habitat was not identified as a major Need for Change issue. However, wildlife habitat is likely to be affected by strategies to address the Vegetation and Remote Backcountry major Need for Change issues. The Forest is home to two high-interest game species that are not included in the other wildlife categories analyzed in this EIS: white-tailed deer and black bear.

The white-tailed deer is the most popular game animal in West Virginia (Evans et al. 1998). However, in addition to its value as a game animal, the white-tailed deer is a voracious browser, and high deer densities can affect the composition and structure of forest communities. At high population densities, deer becomes a keystone species with the capacity to hinder forest regeneration, change the composition and structure of the understory, and affect other wildlife species through direct competition and changes in habitat (Feldhamer 2002). While white-tailed deer does not work well as an MIS, its population changes are nonetheless important for management of the Forest.

The black bear is a popular game animal in the region, and is also popular with wildlife watchers. Compared to most other wildlife, black bears have large home ranges and require habitats with low densities of open roads to serve as refuges from disturbance and hunting mortality (Brody and Pelton 1989). Because of this special requirement for large blocks of relatively remote habitat, the Forest provides much of the prime bear habitat in the region. Due to large home ranges, black bear population changes in relation to management activities are difficult to monitor. Therefore, black bear does not make a good MIS. However, it is an important species to consider during management, and it will therefore be analyzed in this EIS.

Issues and Indicators

Issue Statement

Forest Plan management strategies may affect habitat for MIS and other species of management interest.

Background

MIS are used to gauge the effects of National Forest Management on wildlife habitat in general. MIS are expected to reflect the effects of the Forest Plan alternatives on ecological communities of management interest. In revising the MIS list, we have emphasized species that are closely associated with habitats of interest. We have also concentrated on species that can produce meaningful data about the effects of Forest management activities on a few major communities of interest. Additionally, we have minimized the list of MIS so that the required level of monitoring effort is something we can reasonably expect to accomplish. Regarding our ability to monitor the species, the general paradigm used was to select species that can be monitored regularly on a Forest-wide basis, but also can be monitored on a site-specific basis from time to time in conjunction with selected management activities. The following specific criteria were used to screen potential MIS:

- Species occurs in a habitat that we are likely to affect through our management, or in a high-interest habitat that drives our management direction.

- Species is closely associated with the habitat of interest, and population levels respond to changes in that habitat (ecological indicator species).

- Species' basic biology (habitat requirements, demography, threats, etc.) is well-known.

- Species is not so rare or cryptic that its populations cannot be monitored effectively with a reasonable amount of effort.
- Species occurs at a scale that allows us to monitor populations in replicated treatment and control units.
- Species is the subject of currently planned or ongoing monitoring that will provide data sufficient to track Forest-wide distribution and trends.
- Species can be monitored at a smaller scale such that controlled, site-specific or watershed-specific studies can be conducted on selected managed areas.
- Populations respond to management quickly enough to allow before-and-after monitoring within a reasonable time frame.

Table MIS-1 summarizes the revised MIS list.

Table MIS-1. Management Indicator Species for the 2006 Forest Plan

Species	Habitat Represented	Reasons for Selection
Wild (naturally reproducing) brook trout (*Salvelinus fontinalis*)	Coldwater streams	High-interest game fish. Top-level predator, population changes reflect an integration of effects to water quality and stream conditions across aquatic ecosystems influenced by management on National Forest System lands. The Forest is developing an aquatic monitoring strategy that will include brook trout.
Cerulean warbler (*Dendroica cerulea*)	Late successional hardwood forests	High-interest non-game species. Associated with large trees, gaps, and complex canopy layering characteristic of old-growth forests. A forest interior species that is believed to be sensitive to fragmentation. The Forest and WV DNR are cooperating on an ongoing songbird point count monitoring program that is expected to provide Forest-wide data on this species.
Wild turkey (*Meleagris gallopavo*)	Mast-producing oak forests with diverse age class distribution and interspersed maintained openings	High-interest game species. In the Appalachians, strongly associated with oak mast. Requires herbaceous openings for brood range and is expected to reflect the effectiveness of the cooperative Forest-WV DNR wildlife opening management effort. Uses shrub/sapling stands for nest sites. Ongoing harvest data collected by WV DNR provides a Forest-wide population index.
West Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*)	Mature and late successional spruce and northern hardwood/spruce forests	High-interest endangered species. Appears to be associated with certain late successional characteristics (snags, canopy gaps, moist microclimate, co-dominance by spruce). The Forest is developing a long-term, Forest-wide monitoring program in cooperation with WV DNR and USFWS.

Habitat indicators for the terrestrial MIS and other species of management interest are described below; indicators for brook trout are discussed in the *Water, Aquatic, and Riparian Resources* section. A limited habitat-related discussion is included here for West Virginia northern flying squirrel, whereas a more detailed analysis for this species is included in the *Threatened and Endangered Species* section.

Many species on the Forest—other than viability concern species, threatened and endangered species, sensitive species, and MIS—are important to the public. While analyzing every species on the Forest is not practical, a few other high-profile game species warrant consideration. As with any species, Forest management activities have the potential to affect habitat for these species.

Indicators

Effects to the following habitats for MIS and other species of interest are analyzed and compared by alternative:

- **Optimum habitat for cerulean warbler** – area of mid-late and late successional (80+ years old) mixed mesophytic and cove forests.

- **Optimum habitat for wild turkey** – area of oak and pine-oak forest of optimum mast-producing age (50-150 years old), plus openings, within Management Prescriptions 2.0, 3.0, 6.1, and 6.3.

- **Optimum habitat for West Virginia northern flying squirrel** (area of mid-late and late successional spruce forest) and potential active spruce restoration areas (roughly - approximated by area of mid-late and late successional northern hardwoods in MP 4.1, outside of current suitable flying squirrel habitat).

- **Edge habitats providing abundant browse for white-tailed deer** – all early successional forest (0-19 years old) plus openings.

- **Optimum habitat for black bear** – 50 to 150-year-old oak and pine-oak forest in MPs with limited public motorized access (MPs 4.1, 5.0, 5.1, 6.1, 6.2, 6.3, and remote backcountry portions of the NRA).

Scope of Analysis

Habitat indicators are discussed in terms of current conditions and projected conditions through the 100-year planning horizon under each of the alternatives. Analysis of indicators for the entire planning horizon allowed us to evaluate the effects of management through a period when existing forest communities will age substantially relative to current conditions. The entire planning horizon also allowed time for management strategies to make progress toward desired conditions. Limiting the analysis to the early decades of the planning horizon would have ignored important changes in the age structure of forested communities in later decades that will result from the current condition and the effects of management activity in the early decades.

However, projections beyond the first decade or two must be viewed with caution because of the potential for changes in management emphasis, as well as substantial uncertainty over factors beyond the control of the Forest, such as continued acid deposition, global climate change, and human population growth. Unless otherwise stated, it was assumed that species population trends would follow habitat trends.

Habitat indicators were projected for Forest Service land to reflect direct and indirect effects of expected future Forest Service management. To the extent possible, habitat indicators were projected qualitatively for non-Forest Service land within the Forest boundary as a way of analyzing the cumulative effects of Forest Service management when combined with past, present, and reasonably foreseeable actions on private land. However, accurate quantification generally was not possible for private land.

CURRENT CONDITIONS

Optimum Habitat for Cerulean Warbler

Mid-late and late successional mixed mesophytic and cove forest is most likely to contain key structural features that are believed to be important for breeding populations of cerulean warblers. These features include tall, large-diameter trees, a mostly closed canopy but with some canopy gaps and complex vertical structure, and large tracts with forest interior conditions (Hamel 2000 and references therein). Estimates of mixed mesophytic and cove forests from the ecosystem diversity analysis were used to depict current conditions, although the age class breakdown was somewhat different from that presented in the ecosystem diversity analysis. Future conditions under the alternatives were projected using Spectrum modeling outputs for the mixed hardwoods forest type group. This group includes the same forest types used to estimate the current extent of mixed mesophytic and cove forests for the ecosystem diversity analysis.

Currently, mid-late and late successional mixed mesophytic and cove forest covers approximately 200,000 acres on Forest Service land. While cerulean warblers do not necessarily inhabit all of this area, and may inhabit other areas not included in this indicator, this forest area is believed to contain the best potential habitat for this species.

Optimum Habitat for Wild Turkey

Acorns are a preferred food of the wild turkey, and availability of acorns can affect their movements, condition, survival rates, vulnerability to hunting, and reproduction rates (Steffen et al. 2002, Ryan et al. 2004). Hard mast-producing hardwood stands are generally considered to be the cornerstone of wild turkey habitat in the eastern U.S. (Wunz and Pack 1992). However, turkeys also need other habitat types interspersed with mast-producing hardwoods. Numerous authors have noted the need for interspersed herbaceous openings, which turkeys use for brood-rearing habitat (e.g., Wunz and Pack 1992, Everett et al. 1985, Pack et al. 1980). Turkeys also need dense, shrubby cover for nest sites. Although such cover can exist and is used by turkeys in mature forest, often turkeys select shrubby nest cover along the edges of openings and in recent even-aged harvest units (Wunz and Pack 1992, Everett et al. 1985). Therefore, the indicator

chosen for optimum turkey habitat is those oak and pine-oak sites of optimum mast-producing age, plus openings, within MPs 2.0, 3.0, and 6.1, excluding areas within West Virginia northern flying squirrel suitable habitat. Because of age class diversity goals, these MPs will provide shrubby regeneration areas that can enhance nesting habitat, whereas other MPs that are largely unmanaged are not likely to provide substantial amounts of young regeneration.

The optimum mast-producing age range for the oak and pine-oak forest type groups was considered to be 50 to 150 years. This is a compromise between the optimum mast-producing age range for the white oak group of approximately 70 to 200 years and the optimum range for the red oak group of approximately 50 to 120 years. These age ranges were inferred from information on mast production and longevity presented in Burns and Honkala 1990, Larson et al. 2003, Guyette et al. 2004, Black 2003, Abrams et al. 1997, and Gribko et al. 2002. White oak and red oak optimum ranges were combined because the forest types in CDS did not allow separation of white oaks from red oaks in the Spectrum model.

Current amounts of optimum turkey habitat were estimated using forest types and stand origin dates in CDS for lands in MPs 2.0, 3.0, 6.1, and 6.3, excluding areas within West Virginia northern flying squirrel suitable habitat. Spectrum model outputs for the oak and pine-oak forest type groups aged 50 to 150 years in MPs 2.0, 3.0, 6.1, and 6.3, excluding areas within West Virginia northern flying squirrel suitable habitat, were used to project optimum mast-producing habitat under the alternatives, and openings were estimated by assuming the desired condition of 5 percent maintained openings will be met in MPs 2.0, 3.0, 6.1, and 6.3.

According to this indicator, Forest Service land currently contains approximately 230,000 acres of optimum turkey habitat. Although turkeys inhabit most areas of the forest, this is believed to represent the best potential habitat.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas

West Virginia northern flying squirrels are closely associated with spruce and mixed hardwood-spruce forests (USFWS 2001, Ford et al. 2004, Menzel 2003). Research conducted on and near the Forest suggests that the probability of occurrence of West Virginia northern flying squirrels increases rapidly as the conifer component passes about 30 percent of the overstory (Ford et al. 2004). Although they have been captured in stands of various ages, northern flying squirrels are believed to prefer mature to old-growth stands that feature widely spaced large trees, a moist microclimate, and abundant snags and fallen logs (USFWS 2001, Wells-Gosling and Heany 1984, Ford et al. 2004).

These habitat features are most closely approximated by mid-late (80-120 years old) and late successional (>120 years old) spruce and spruce-hardwood forests. In this analysis, spruce forests are defined broadly to include those mixed hardwood-spruce forests with at least 30 percent spruce, so the spruce forest type group likely includes most of the best habitat. We estimated current optimum West Virginia northern flying squirrel habitat using forest type and stand origin data in CDS. Forest types selected to represent spruce forest were the same as those used to construct the conifer-spruce forest type group for the Spectrum modeling. We projected

future optimum habitat using Spectrum outputs for mid-late and late successional conifer-spruce forests. The conifer-spruce forest type group includes some low-elevation hemlock forests that likely are not suitable for West Virginia northern flying squirrels. However, such stands make up less than 1 percent of the area of the forest type group and are not likely to affect the estimates.

We also tracked potential active spruce restoration areas as a secondary indicator of the likely effects of management on West Virginia northern flying squirrel habitat. Although restoration areas may not develop into optimum habitat within the planning horizon, such restoration is an important component of the Forest's strategy to assist in recovery of the species. Because most current spruce forest is already considered occupied habitat and is protected by Forest-wide direction, most of the differences among alternatives with respect to West Virginia northern flying squirrel habitat will occur in spruce restoration areas. Therefore, as an indicator of potential habitat improvement, we tracked the area of mid-late and late successional northern hardwoods allocated to MP 4.1 that are not already considered to be suitable habitat for the flying squirrel. Other forest type groups in MP 4.1 include stands with spruce in the understory or overstory, and based on Forest Plan direction, these areas will be actively or passively restored to spruce. However, northern hardwoods in MP 4.1 represent the areas where active restoration of spruce is most likely to occur.

Forest Service land currently contains about 23,000 acres of mid-late and late successional spruce forest. MP 4.1 does not exist in the current Forest Plan, so currently there is no northern hardwood forest in MP 4.1. While West Virginia northern flying squirrels certainly occur in many areas other than those covered by these indicators, based on recent research, these indicators are believed to represent the optimum potential habitat.

It should be noted that the habitat indicators used here for optimum West Virginia northern flying squirrel habitat do not correspond to the criteria that are currently used to define suitable habitat for the purpose of ESA consultation at the project level. To capture all habitat that might be occupied, the definition of suitable habitat used for project-level consultation is much broader than the optimum habitat indicators used herein. Use of the optimum habitat indicators in this EIS does not imply a change in the suitable habitat definition for project-level consultation. Suitable habitat currently is estimated at approximately 149,000 acres on Forest Service land.

Edge Habitats Providing Abundant Browse for White-tailed Deer

White-tailed deer are adaptable to a wide variety of habitats. The white-tailed deer is an edge species that does best in a mixture of forests, thickets, and fields (DeNicola et al. 2000). Such mixed habitat provides a combination of abundant browse, mast, and cover. Therefore, the area of early successional forest plus the area of herbaceous openings provides a simple index to the availability of edge habitats and browse. Because a very high percentage of National Forest System (NFS) land will remain forested under any possible management scenario, cover and hard mast are not likely to limit deer populations and are not included in this indicator. Within the range of management activity that is likely to occur under any alternative, an increase in young forest and openings is likely to increase the habitat capability for deer.

For existing conditions, early successional forest (0-19 years) was estimated from stand origin dates in the CDS database, and herbaceous openings were estimated using the "open" forest type in CDS. For each alternative, early successional forest was projected using Spectrum modeling outputs, and herbaceous openings were projected by assuming that the goal of 5 percent maintained openings will be met in MPs 2.0, 3.0, 4.0, 4.1, and 6.1, excluding areas within West Virginia northern flying squirrel suitable habitat. This indicator should not be construed as an estimate of actual white-tailed deer habitat, because deer will make at least some use of just about every habitat on the forest. Rather, the indicator serves merely as an index to the degree of edge interspersion within forested habitats.

While habitat capability is important in determining the theoretical deer density that the land can support, hunting is the primary tool used to manage actual population levels (Evans et al. 1999). Most yearling and adult mortality is caused by legal hunting (Pennsylvania Game Commission 2003). To maintain a stable deer population, does should comprise 40 percent of the deer harvested; assuming a recommended hunting pressure of one hunter per 20 to 50 acres can be achieved. Harvests consisting of more than 40 percent does will tend to reduce the population, while harvests of less than 40 percent does will allow the population to increase toward the carrying capacity of the habitat (Crum undated). Deer harvest data for the Forest from 1999 through 2003 show that does have comprised well below 40 percent of the harvest in all areas of the Forest (Crum undated). Under this type of harvest scenario, deer populations should increase toward the carrying capacity of the habitat, and an increase in the edge habitat indicator should portend an increase in the deer population.

Currently there are approximately 47,000 acres of early successional forest and openings on NFS land. This acreage represents the areas of the forest where, other factors being equal, deer populations are likely to be the highest.

Optimum Habitat for Black Bear

Black bear population densities in the Appalachians are inversely related to road densities (SAMAB 1996). Black bears in the Appalachians also depend heavily on hard mast as a fall food source. Hard mast is the key to successful over-wintering and reproduction (Pelton 1989). Therefore, the rough indicator of optimum bear habitat includes areas with low open road densities that also have high mast production potential. Areas with low open road densities include MPs 4.1, 5.0, 5.1, 6.1, 6.2, 6.3, and remote backcountry portions of the NRA. Optimum mast-producing areas include oak and pine-oak forest types in the optimum oak mast age range of 50 to 150 years. Estimates for current conditions were constructed using existing MP boundaries and forest type/year of origin data in CDS. Future conditions under the alternatives were projected using Spectrum modeling outputs for 50 to 150 year old oak and pine-oak types in the primarily non-motorized MPs.

Currently there are approximately 190,000 acres of 50 to 150-year-old oak and pine-oak forest in the primarily non-motorized MP areas on NFS land. Although black bears use a wide variety of habitats throughout the Forest, this indicator is believed to represent optimum habitats with the potential to produce surplus bears to populate less optimum areas within and nearby the Forest.

ENVIRONMENTAL CONSEQUENCES

Resource Protection Methods

Laws, Regulations, and Policies

Numerous laws, regulations, and policies govern the management of MIS and other species of interest on NFS land. National laws and regulations have also been interpreted for implementation in the Forest Service Manual and Handbook. Some of the more influential laws, regulations, and policies governing management of MIS and other species of interest are listed in Table MIS-2 below:

Table MIS-2. Major Laws, Policies, and Regulations Influencing Management and Protection of MIS and Other Species of Interest on National Forest System Land

Act/Law/Regulation/Policy	Law/CFR/FSM/FSH Number
Fish and Wildlife Coordination Act	16 U.S.C. 661-667e
Multiple Use-Sustained Yield Act	16 U.S.C. 528-531
Sikes Act	16 U.S.C. 670a-670o
National Forest Management Act	16 U.S.C. 1600-1614
Fish and Wildlife Conservation Act	16 U.S.C. 2901-2911
NFMA implementing regulations regarding wildlife, MIS, and habitat management	36 CFR 219.19; 219.27(a)(6), (b)(6)
Directives for Habitat Planning and Evaluation	FSM 2620
Directives for Fish and Wildlife Habitat Management	FSM 2630

Forest Plan Direction and Implementation

Forest Plan direction for MIS and other species of interest occurs at two levels, Forest-wide and Management Prescription. Forest-wide direction includes general goals to provide habitat diversity to maintain populations of MIS and other species of interest, including those that provide hunting, fishing, trapping, and wildlife-viewing opportunities. Forest-wide goals, objectives, standards, and guidelines encourage creation and maintenance of age class diversity, water sources, and herbaceous openings, which benefit wild turkey and white-tailed deer, among other species. Specific direction for West Virginia northern flying squirrel essentially limits vegetation management in suitable habitat to small-scale research and habitat management that has been shown to benefit the squirrel. The revised Forest-wide direction contains direction aimed at avoiding or mitigating population-level negative impacts on Migratory Birds of Conservation Concern, as well as direction to maintain and restore habitat for these birds. Such direction offers some protection to cerulean warbler. The revised Forest-wide direction also includes a general guideline to manage human-caused disturbances to limit disruption during critical life stages. This guideline offers some protection to turkeys and bears, which are sensitive to disturbance.

The individual MPs contain a number of items to protect and enhance MIS and other species of interest. All MPs in the suitable timber base contain goals, objectives, or other direction to maintain a percentage of the MP in permanent openings, which will benefit turkey, deer, and other species. Except for the revised MP 3.0, all MPs in the suitable timber base also contain direction for retention of culls and snags. Retained culls and snags benefit a wide variety of species, including black bear and West Virginia northern flying squirrel. MPs 4.1 and 6.1 contain direction that limits road density to benefit turkey, bear, and other disturbance-sensitive species.

MP 6.1, which emphasizes mast production, a variety of wildlife habitat, and remote habitat for disturbance-sensitive species, has additional direction that protects or otherwise benefits MIS and other species of interest. Much of this direction deals with limiting disturbance, such as direction to harvest no more than 40 percent of a prescription unit in a 10-year period. Other disturbance-related direction includes limitations on road and trail density, direction to close most roads to public motorized use, limitations on disturbance due to special uses and mineral development, and seasonal limitations on green firewood sales. This disturbance-limiting direction protects turkey, bear, and other disturbance-sensitive species. MP 6.1 direction also emphasizes mast production through direction to favor mast-producing trees, shrubs, and vines during timber stand improvement and site preparation work. The revised version of MP 6.1 also contains direction to maintain and restore oaks on appropriate sites through prescribed fire and mechanical vegetation treatments. Direction emphasizing mast production benefits turkey, deer, bear, and many other species.

Effects Common to All Alternatives

Mineral Exploration, Development, and Leasing

Optimum Habitat for Cerulean Warbler - Mineral exploration, development, and leasing activities that occur in mid-late and late successional mixed mesophytic and cove forest will reduce optimum habitat for cerulean warbler anywhere that activities involve removal of the forest canopy. Natural gas leasing is the most common form of mineral development on the Forest. Effects of gas development on major forested communities usually are minor. Typically the maximum surface disturbance associated with each gas well is about 15.5 acres. This includes about 2 acres for the well site, about 2 acres for access roads, and about 11.5 acres of pipelines. Pipelines are approximately 15 to 40 feet wide, and monitoring on the Forest has shown that the tree canopy usually closes over the pipeline within 3 to 5 years. Thus the long-term effects of each gas well amount to the conversion of about 4 acres of forested habitat to non-forested habitat. The maximum density of gas wells in most areas is about one well per 640 acres. Therefore, the long-term effects to optimum cerulean warbler habitat are estimated to include the conversion of less than 1 percent of the habitat in a given area to non-forested habitat.

Development of other federal minerals currently is rare on the Forest, but such development could occur in the future under any of the Forest Plan alternatives. Effects from development of minerals other than gas are difficult to predict because they vary depending on the mineral being developed, recovery methods (subsurface vs. surface mining), the intensity of surface disturbance, and the effectiveness of reclamation. However, any mineral development activity

that occurs in mid-late and late successional mixed mesophytic and cove forest is likely to involve at least some long-term loss of optimum cerulean warbler habitat.

Optimum Habitat for Wild Turkey - Surface activities involved with natural gas exploration and development create small herbaceous openings that contribute to optimum turkey habitat. They also remove hard-mast-producing trees when they occur in mature and old oak and pine-oak forests. Generally the areas involved are small, and the beneficial effect of creating herbaceous openings in an otherwise forest-dominated landscape probably outweighs the removal of a few mast trees. At the watershed and Forest-wide scales, the reduction in acreage of mast-producing forest is likely to be negligible. Because the optimum habitat indicator includes mast-producing forest and openings, the conversion of forest to openings will not change the amount of the indicator.

Effects from development of other federal minerals will vary depending on the degree of surface modification. Small operations that create scattered openings are likely to enhance turkey habitat, whereas large operations that remove mast-producing forest over dozens to hundreds of acres would likely be detrimental to turkey habitat, at least at the local and watershed scales.

Any mineral exploration and development would likely have human disturbance associated with the construction, operation, and maintenance activities. While such disturbance is not reflected in this indicator, it can be an important negative influence on nesting and brooding success. However, most optimum turkey habitat occurs in MP 6.1, which contains a standard allowing for restrictions to limit disturbance associated with these activities. Any such effects due to human disturbance would not be reflected in this indicator.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Mineral exploration, development, and leasing activities that occur in mid-late and late successional spruce forest will reduce optimum habitat for West Virginia northern flying squirrel anywhere that activities involve removal of the forest canopy. For natural gas development, the amount of habitat modified is small enough that the effects are likely to be negligible at the watershed and Forest-wide scale. Effects due to other mineral development activities are not likely to be substantial because Forest Plan direction prohibits any habitat modification that would adversely affect the squirrel.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Surface activities involved with natural gas exploration and development create small herbaceous openings that increase the amount of edge habitat. Generally, the amount of surface modification associated with natural gas development is a small part of the overall area developed, so the amount of new edge habitat created is likely to be minor. Effects of other mineral development activities will vary depending on the amount of surface modification. Larger areas of surface modification will create larger amounts of edge habitat. As surface modification approaches dozens to hundreds of acres, the interiors of the openings become less suitable for deer due to lack of cover, which begins to reduce the effect of the increase in edge habitat.

Optimum Habitat for Black Bear - The small amounts of open habitat created by natural gas exploration and development are not likely to have substantial negative impacts on optimum

black bear habitat. The reduction in hard-mast-producing habitat generally amounts to less than 1 percent of the area developed, and that small loss may be offset to some degree by increased soft mast production around the edges of the openings. Construction, operation, and maintenance activities have the potential to increase human-caused disturbance, but due to activity restrictions in the remote MPs in which optimum bear habitat occurs, these activities are not likely to cause long-term loss of the remote character of the habitat. Access roads and utility corridors associated with gas development will not be open to public motorized access in these remote MPs. However, they could increase foot travel, potentially facilitating a small increase in hunting-related mortality.

Effects of other mineral development will vary according to the amount of surface modification. However, any effects are not expected to be substantial because surface modification that reaches dozens to hundreds of acres probably would be determined to be incompatible with the management emphases of the remote MPs where optimum bear habitat occurs.

Vegetation/Timber Management – Mechanical Treatments

Optimum Habitat for Cerulean Warbler - Even-aged regeneration harvesting in mid-late and late successional mixed mesophytic and cove forest eliminates optimum cerulean warbler habitat in the regenerated area for approximately 80 years. Once desired conditions are achieved within the MPs that are in the suitable timber base, even-aged regeneration harvesting would limit the mid-late and late successional stages to the desired proportion of the landscape. For mixed mesophytic and cove forest in areas that are not otherwise restricted (e.g., West Virginia northern flying squirrel habitat, Indiana bat primary range, spruce restoration areas), the mid-late and late successional stages would be limited to 29 to 50 percent of the landscape in MP 3.0 and 20 to 35 percent in MPs 6.1 and 4.1.

Uneven-aged harvesting and intermediate treatments, such as thinning and timber stand improvement, do not reset the stand age. Therefore, they do not change the amount of optimum cerulean warbler habitat as measured by this indicator. Uneven-aged harvests and intermediate treatments do change forest structure, so they have the potential to affect the quality of the habitat. Such treatments have the potential to speed up development of large trees, canopy gaps, and complex vertical habitat structure, which are believed to be important components of cerulean warbler habitat (Hamel 2000 and references therein). However, some studies have noted declines in cerulean warbler population density and nesting productivity immediately following natural disturbances that created extensive canopy gaps (Hamel 2000 and references therein, Jones et al. 2001). Therefore, it is possible that intensive intermediate treatments could degrade habitat quality, at least in the short term.

Optimum Habitat for Wild Turkey - Even-aged regeneration harvesting in 50 to 150 year-old oak and pine-oak forest eliminates mast-producing forest in the areas harvested. However, such harvesting creates potential nesting habitat, which is one of the factors that contributes to optimum turkey habitat. Also, such harvesting has the potential to regenerate oaks that otherwise might be replaced by shade-tolerant trees; therefore, it contributes to the long-term maintenance of mast-producing capability. Within the MPs that contribute to this indicator, desired conditions call for no more than 24 percent of the landscape to consist of regenerating forests

less than 20 years old. Such levels of early successional forest contribute to nesting habitat availability without a major detrimental effect on the amount of older mast-producing forest. However, the optimum habitat indicator measures such harvests as a slight decline in habitat.

Uneven-aged harvests and intermediate treatments do not reset the stand age, so they do not change the amount of optimum turkey habitat as measured by this indicator. Such treatments have the potential, however, to change habitat quality in ways not measured by the indicator in the short term. Uneven-aged harvests and intermediate treatments, to the extent that they favor mast-producing species, have the potential to increase mast production in the retained trees. These treatments also can contribute to the open stand structure that is preferred by turkeys, as long as the treatments do not open up the canopy enough to stimulate dense shrub and sapling growth. However, if uneven-aged harvesting is continued indefinitely, it can cause oaks to be replaced by shade-tolerant species, thereby reducing mast production over the long term. Such a change should be reflected by a change of forest type, which would be measured by this indicator as a reduction in the amount of optimum turkey habitat.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Essentially all mid-late and late successional spruce forest is considered suitable habitat for the West Virginia northern flying squirrel. Forest Plan direction requires that vegetation management in suitable habitat be part of research into the effects of management on squirrel habitat, or be part of habitat improvement that has been shown by research to be beneficial to the squirrel. Therefore, any vegetation management that occurs in mid-late and late successional spruce forest is not likely to decrease measurably the amount or quality of this habitat. Any management to improve squirrel habitat is not likely to reset the stand age and, therefore, would not change the amount of this indicator. However, such management may improve the quality of the habitat in ways not measured by this indicator.

Spruce restoration areas that are outside of suitable habitat are not subject to the same restrictions on vegetation management. However, management direction for MP 4.1 emphasizes mainly uneven-aged harvest and intermediate treatments in these areas, which would not reset stand age and, therefore, would not change the amount of the indicator. However, such vegetation treatments could improve habitat quality in ways not measured by the indicator.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Even-aged regeneration harvesting creates edge habitat. Even-aged harvesting will be reflected by an increase in the amount of this indicator. Uneven-aged harvesting and intermediate treatments do not reset the stand age; therefore they do not change the amount of edge habitat as measured by this indicator. Uneven-aged harvesting and intermediate treatments can affect the amount and quality of deer browse if they stimulate understory growth, but such effects would not be captured by this indicator.

Optimum Habitat for Black Bear - Even-aged regeneration harvests in optimum bear habitat eliminate mast-producing forest in the harvested areas, which causes a decline in the amount of this indicator. However, in many areas such harvests may be necessary to maintain oak dominance over the long term, so such harvests can slow or prevent long-term declines in optimum bear habitat. Within MP 6.1, which is the only suitable-base MP with an extensive oak

component that contributes to this indicator, desired conditions are designed to maintain the maximum possible amount of the landscape in the optimum mast-producing range. Therefore, over the long term and at the landscape scale, even-aged harvests in these areas are designed to maximize the amount of optimum bear habitat.

Uneven-aged harvesting and intermediate treatments do not reset the stand age; therefore they do not change the amount of optimum bear habitat as measured by this indicator. Such treatments have the potential, however, to change habitat quality in ways not measured by the indicator. Uneven-aged harvests and intermediate treatments, to the extent that they favor mast-producing species, have the potential to increase mast production in the retained trees. However, if uneven-aged harvesting is continued indefinitely, it can cause oaks to be replaced by shade-tolerant species, thereby reducing mast production over the long term. Such a change should be reflected by a change of forest type, which would be measured by this indicator as a reduction in the amount of optimum bear habitat.

Vegetation/Timber Management – Salvage Harvest

Optimum Habitat for Cerulean Warbler - Salvage harvest occurs in stands that have been severely damaged or destroyed by natural disturbances. Salvage harvest is not likely to occur in optimum cerulean warbler habitat, so there is little or no potential for effects on this habitat.

Optimum Habitat for Wild Turkey - Because salvage harvesting removes dead and dying trees in stands that have already been severely damaged or destroyed, it does not appreciably affect optimum mast-producing stands. Therefore, salvage harvesting will have little or no effect on this indicator.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Salvage harvesting is not allowed in suitable West Virginia northern flying squirrel habitat, so it is unlikely to occur in mid-late and late successional spruce forest. If an area of mid-late or late successional spruce forest were to be damaged so extensively that it is no longer considered suitable habitat, salvage harvesting could occur. However, the amount of damage necessary to make the area unsuitable for squirrels also would reset the stand age such that it would no longer be considered mid-late or late successional. Therefore, salvage harvest has little or no potential to change the amount of this indicator.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Because salvage harvesting removes dead and dying trees in stands that have already been severely damaged or destroyed, it does not reset stand age and does not produce new edge habitat. Therefore, salvage harvesting will have little or no effect on this indicator.

Optimum Habitat for Black Bear - Because salvage harvesting removes dead and dying trees in stands that have already been severely damaged or destroyed, it does not appreciably affect optimum mast-producing stands. Therefore, salvage harvesting will have little or no effect on this indicator.

Range Management – Livestock Grazing

Optimum Habitat for Cerulean Warbler - Acreage devoted to range allotments has been declining slowly over several decades, and the revised Forest-wide management direction calls for maintenance of existing grazing capacity. Based on current trends and the revised management direction emphasis, new allotments likely will be limited to newly acquired lands that contain pastures. Therefore, range management is not likely to convert any existing mid-late or late successional mixed mesophytic and cove forest to non-forest habitat. If the decline in range acreage continues, some range land would be replaced by forested habitat, but land reforested at the beginning of the planning horizon would not reach the mid-late successional stage until near the end of the planning horizon.

Optimum Habitat for Wild Turkey - Because range acreage is not expected to increase substantially, and any new allotments probably will occur on land that is already open, range management is not expected to appreciably affect optimum turkey habitat. Maintenance of existing allotments would maintain the contribution of these herbaceous openings to beneficial habitat diversity within optimum habitat. Should range acreage continue to decline, the loss of openings would be reflected by this indicator as a slight decline in the amount of optimum turkey habitat. However, desired conditions and goals for maintained openings, if met, would eventually replace any lost openings.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas – Forest Plan direction prohibits new range allotments in West Virginia northern flying squirrel suitable habitat, therefore it is unlikely that any new range allotments would be developed in mid-late or late successional spruce forest. New range allotments in spruce restoration areas are also unlikely due to conflict with the management emphasis in these areas. Should range acreage continue to decline, reversion of allotments in spruce and northern hardwood ecosystems could cause an increase in spruce and northern hardwood forest. Any new spruce and northern hardwood stands that develop due to reversion of range allotments early in the planning horizon would not reach the mid-late successional stage until near the end of the planning horizon.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Because range acreage is not expected to increase substantially, and any new allotments probably will occur on land that is already open, range management is not expected to substantially increase the edge habitats represented by this indicator. Maintenance of existing range allotments maintains the edge habitat that allotments contribute to this indicator. Should range acreage continue to decline, the loss of openings could reduce the amount of this indicator. However, within MPs in the suitable timber base, desired conditions and goals for maintained openings, if met, would replace any openings and associated edge lost through reversion of range allotments.

Optimum Habitat for Black Bear - New range allotments are unlikely to be developed in optimum black bear habitat, so it is unlikely that range management will cause a decrease in this indicator. If range acreage continues to decline, some current range allotments could revert to oak or pine-oak forest. However, any such areas would not reach optimum mast-producing age

until at least the middle of the planning horizon. Therefore, range management is not expected to substantially affect optimum black bear habitat.

Fire Management – Fire Suppression

Optimum Habitat for Cerulean Warbler - Fire suppression in mid-late and late successional mixed mesophytic and cove forest protects this fire-sensitive community from destruction by wildfires. Therefore, fire suppression prevents the loss of optimum cerulean warbler habitat. Habitat alterations associated with fire suppression activities (i.e., fire lines) are not expected to be extensive enough to cause a measurable decline in the amount of this indicator.

Optimum Habitat for Wild Turkey - Fire suppression in oak and pine-oak communities prevents operation of the natural fire regime in these fire-adapted communities. In the absence of regeneration cutting and associated site preparation, continued fire suppression over the long term can cause oak seedlings and saplings to be out-competed by fire-sensitive species, leading to a long-term decline in mast production. Such an effect would eventually cause a forest type conversion, which would be reflected in this indicator as a decline in the amount of optimum turkey habitat. However, continued suppression of wildfires in areas that have been subject to long-term suppression can prevent unnaturally intense fires from destroying mast-producing optimum habitat. Habitat alterations associated with fire suppression activities are not expected to be extensive enough to cause a measurable decline in the amount of this indicator.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Spruce and northern hardwoods are fire-sensitive communities. Therefore, fire suppression in optimum West Virginia northern flying squirrel habitat and spruce restoration areas prevents wildfires from damaging or destroying these habitats. Habitat alterations associated with fire suppression activities are not expected to be extensive enough to cause a measurable decline in the amount of this indicator.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Fire suppression in edge habitats and early successional regeneration areas allows continued succession of areas that might otherwise be reset to the early successional stage by wildfire. Continued succession reduces quality and quantity of available browse. Eventually, these areas grow out of the early successional stage, resulting in a reduction of the amount of this indicator. Also, by preventing wildfires from killing mature forests, fire suppression prevents the creation of new edge habitats.

Optimum Habitat for Black Bear - Effects of fire suppression on optimum black bear habitat are similar to those described above for optimum wild turkey habitat.

Fire Management – Prescribed Fire Use

Optimum Habitat for Cerulean Warbler - Prescribed fire use in this fire-sensitive community runs the risk of killing the overstory and reducing the amount of optimum cerulean warbler habitat. Low-intensity prescribed fire that does not kill the overstory would eliminate some of the understory and midstory vegetation, thereby reducing the vertical habitat complexity

preferred by cerulean warblers. However, such a change in habitat quality would not be detected by this indicator.

Optimum Habitat for Wild Turkey - The oak and pine-oak forests that make up optimum wild turkey habitat typically are fire-adapted. Prescribed burning in these forests can help perpetuate oak reproduction by controlling competition from fire-sensitive vegetation. Therefore, prescribed fire can help prevent loss of optimum turkey habitat that might otherwise occur due to passive conversion to shade-tolerant forest types.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Essentially all mid-late and late successional spruce forest is included in West Virginia northern flying squirrel suitable habitat. Any vegetation management that is conducted in suitable habitat, including prescribed burning, must be beneficial for the squirrel. Because the spruce ecosystem is not fire-adapted, it is unlikely that any prescribed burning will be conducted in spruce forest. Therefore, there is little or no potential for prescribed burning to affect mid-late and late-successional spruce forest. Prescribed burning in spruce restoration areas also is unlikely because it is not consistent with the management emphasis of these areas.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Because of the potential for killing desirable regeneration, prescribed burning is not likely to be conducted in early successional regeneration areas after the desired regeneration has become established. However, prescribed fire may be used in combination with shelterwood or two-age prescriptions as a way of enhancing the establishment of desired regeneration. Such prescribed burning will not change the amount of this indicator, but by stimulating succulent new growth, it may improve the quality of browse available in some early successional areas. Prescribed burning may also be used to maintain herbaceous openings, which contribute to this edge habitat indicator. Such burning would contribute to maintaining open and edge habitats that otherwise would revert to forest.

Optimum Habitat for Black Bear - The effects of prescribed fire on optimum black bear habitat are similar to those discussed above for optimum wild turkey habitat.

Roads – Construction, Reconstruction, Maintenance, and Decommissioning

Optimum Habitat for Cerulean Warbler - Road construction and reconstruction converts small amounts of cerulean warbler habitat into non-habitat. Roads usually take up a small proportion of the landscape, so the amount of habitat loss at the watershed and Forest-wide scale is not likely to be substantial. Roads can fragment remaining habitat for this forest-interior species, but it is also possible that narrow roads could mimic the canopy gaps that this species seems to prefer. Such changes in habitat quality would not be reflected in this indicator, which measures only the amount of mid-late and late successional mixed mesophytic and cove forest.

Road maintenance perpetuates the changes caused by road construction. Road decommissioning can reverse the fragmentation effects of road construction, and it assimilates the disturbed areas back into the surrounding forest matrix over time.

Optimum Habitat for Wild Turkey - Road construction and reconstruction eliminates small amounts of mast-producing optimum turkey habitat. Roads usually take up a small proportion of the landscape, so the amount of habitat loss at the watershed and Forest-wide scale is not likely to be substantial. In addition, seldom-used roads can serve as beneficial herbaceous openings that enhance optimum turkey habitat, although such a change in habitat quality will not be reflected in this indicator unless the roads are depicted as openings in the stands database. Road maintenance perpetuates the changes created by road construction, whereas road decommissioning would reverse those changes over time.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Due to the restrictions on vegetation management in West Virginia northern flying squirrel suitable habitat, little road construction and reconstruction is likely to occur in mid-late and late successional spruce forest. More road construction is possible in spruce restoration areas. Road construction eliminates small amounts of habitat, but at the watershed and Forest-wide scales, the amount eliminated is not likely to be substantial. Road maintenance perpetuates the changes created by road construction, whereas decommissioning reverses those changes.

Edge Habitats Providing Abundant Browse for White-tailed Deer - Road construction and reconstruction causes a small increase in the openings and associated edge that contributes to this habitat indicator. However, the impact of roads on the amount of this indicator may be too small to measure at the watershed and Forest-wide scales. Road maintenance prevents the loss of edge habitats associated with roads, while road decommissioning removes the edges associated with roads.

Optimum Habitat for Black Bear - Road construction and reconstruction eliminates small amounts of mast-producing optimum black bear habitat. Roads usually take up a small proportion of the landscape, so the amount of habitat loss at the watershed and Forest-wide scale is not likely to be substantial. New roads that are closed to public motorized access generally do not detract from the remote character of optimum black bear habitat, and may actually be beneficial to bears by providing travel ways and soft mast along the edges. New roads that are open to public motorized use reduce optimum bear habitat by the amount of habitat that is made easily accessible by the roads. Road maintenance perpetuates the changes created by road construction, whereas road decommissioning reverses those changes.

Recreation – Developed Recreation

Optimum Habitat for Cerulean Warbler - Developed recreation facilities in mid-late and late successional mixed mesophytic and cove forest reduce optimum cerulean warbler habitat by the amount of land where the forest canopy is removed. Developed recreation sites that do not remove the forest canopy, but reduce vertical habitat complexity by removing understory and midstory vegetation, would have detrimental effects on the quality of cerulean warbler habitat. However, changes in quality will not be reflected in this indicator. At the Forest-wide scale, developed recreation sites are not likely to cover more than a small fraction of the landscape, so substantial effects at the Forest-wide scale are not likely.

Optimum Habitat for Wild Turkey - Developed recreation sites in oak and pine-oak forests of optimum mast-producing age will reduce optimum turkey habitat by the amount of land where the forest canopy is removed. Developed recreation sites that do not remove the forest canopy will likely create human disturbances that are incompatible with turkeys, but such habitat quality effects will not be reflected in this indicator. At the Forest-wide scale, developed recreation sites are not likely to cover more than a small fraction of the landscape, so substantial effects at the Forest-wide scale are not likely.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Developed recreation facilities are prohibited in West Virginia northern flying squirrel suitable habitat, therefore developed recreation will not affect mid-late and late successional spruce forest. Developed recreation sites can occur in spruce restoration areas that are not suitable habitat. Any new recreation sites in spruce restoration areas would cause localized reductions in habitat. However, developed recreation sites are not likely to cover large areas of the landscape, so substantial Forest-wide effects are not anticipated.

Edge Habitats Providing Abundant Browse for White-tailed Deer - New developed recreation facilities that supplant openings or early successional regeneration would reduce the amount of edge habitat providing abundant browse for deer. However, new developed recreation sites may create new edge habitats if they are constructed in forested areas. Because developed recreation sites are not likely to cover large areas of the Forest, substantial Forest-wide effects are unlikely.

Optimum Habitat for Black Bear - New developed recreation facilities are inconsistent with the management emphasis of the remote MPs that make up optimum black bear habitat. Therefore, new developed recreation facilities are not expected to affect optimum black bear habitat.

Recreation – Dispersed Recreation

Dispersed recreation can occur in any of the habitats represented by the habitat indicators for MIS and other species of interest. Dispersed recreation typically does not involve removal of the forest canopy or substantial alteration of habitat structure. Therefore, effects of dispersed recreation on all of the habitat indicators for MIS and other species of interest are expected to be negligible. However, dispersed recreation use can cause human disturbance that is detrimental to turkeys and bears. Such non-habitat related effects will not be reflected in the habitat indicators.

Recreation – Motorized Recreation Use

Habitat-related effects of motorized recreation are covered above under the roads subsection. In addition to habitat effects associated with road construction/reconstruction, maintenance, and decommissioning, motorized recreational use in optimum turkey habitat has the potential to disturb turkeys that attempt to use the roads as brooding habitat. Such disturbance is not reflected in the optimum turkey habitat indicator. Disturbance by motorized use in optimum black bear habitat is not likely to be widespread because motorized use is inconsistent with the

management emphasis of the remote MPs that are included in the optimum bear habitat indicator.

Soil, Water, Riparian, Aquatic – Active Restoration

Active soil, water, riparian, and aquatic restoration tends to focus on localized areas. Such localized activity has little or no potential for appreciable effects on the amount of any of the habitat indicators for MIS and other species of interest. However, revegetation for sediment and erosion control could eventually lead to reforestation of herbaceous openings. Revegetation of these openings would cause minor decreases in the amount of optimum edge habitat for deer browse and herbaceous openings within optimum turkey habitat.

Soil, Water, Riparian, Aquatic – Passive Restoration

The effects of passive soil, water, riparian, and aquatic restoration on habitat indicators for MIS and other species of interest will be similar to the effects discussed above for active restoration.

Wildlife/Fish Habitat Restoration

Optimum Habitat for Cerulean Warbler - Construction of new wildlife openings in mid-late and late successional mixed mesophytic/cove forest would remove small areas of optimum cerulean warbler habitat. However, all MPs that include a desired condition for wildlife openings call for 8 percent or less of the landscape in maintained openings. Thus the effect of new openings on the amount of optimum cerulean warbler habitat is likely to be minor.

Restoration of forested habitat would have little effect on the amount of optimum cerulean warbler habitat. Any open areas that are reforested early in the planning horizon would not reach the mid-late successional stage until near the end of the planning horizon. Restoration that enhances habitat structure in forested areas could improve the quality of cerulean warbler habitat, but such improvement would not be reflected in this indicator.

Optimum Habitat for Wild Turkey - Construction of new wildlife openings would increase the amount of optimum turkey habitat if their construction does not involve removal of optimum mast-producing oak or pine oak stands. The indicator amount would not change if openings are constructed in optimum mast-producing oak or pine-oak stands. Whether or not the indicator measures a change, construction of wildlife openings within the amount specified by the desired conditions in the MPs will improve the quality of turkey habitat. Restoration of forested habitat would cause a decrease in the optimum turkey habitat indicator if it involves reforestation of openings. Any reforested openings dominated by oaks would not reach optimum mast-producing age until at least the middle of the planning horizon.

Restoration or enhancement of habitat structure in forested areas will not change the value of this indicator. Changes associated with such restoration and enhancement could be considered beneficial or detrimental to turkey habitat quality depending on the way they change habitat structure and/or species composition.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas - Construction of new wildlife openings is not likely to occur in mid-late and late successional spruce forests because of the restrictions on vegetation management in West Virginia northern flying squirrel suitable habitat. Therefore, wildlife openings would have little or no effect on optimum habitat as measured by this indicator. New wildlife openings can be constructed in spruce restoration areas that are not suitable habitat; new openings would be measured as a decrease in the amount of the spruce restoration areas indicator. Because desired conditions call for 3 to 8 percent of the MP area in maintained openings, the effects of new openings on spruce restoration areas would be minor.

Restoration of openings to forested areas would have little effect on the optimum habitat or spruce restoration areas indicators. Any openings restored early in the planning horizon would not reach the mid-late successional stage until near the end of the planning horizon. Restoration and enhancement of habitat structure within forested areas could improve habitat quality for West Virginia northern flying squirrel, but such improvement would not be measured by these indicators.

Edge Habitats Providing Abundant Browse for White-tailed Deer - New wildlife openings, if constructed in forests older than 19 years, will increase the amount of edge habitats as measured by this indicator. Restoration of openings to forested habitat would cause no change in edge habitat measured by this indicator for the first 19 years, but in year 20 would be reflected as a reduction in the amount of this indicator. The effects of restoration and enhancement of habitat structure in forests on deer browse would vary depending on the type and degree of alterations, but any such changes will not be measured by this indicator.

Optimum Habitat for Black Bear - New wildlife openings, if constructed in 50 to 150 year-old oak or pine-oak forests in remote MPs, would cause a decline in the optimum bear habitat indicator. The decline is not expected to be substantial because desired conditions call for only 3 to 8 percent openings in MPs 6.1 and 4.1, and no additional openings in the other remote MPs. In addition, such openings could have the beneficial effect of increasing soft mast production, which would not be measured by this indicator.

Restoration of openings to forested habitats would have little effect on this indicator. Any reforested areas would not reach optimum mast-producing age until at least the middle of the planning horizon. Any soft mast associated with the openings probably would be lost or greatly reduced, but this subtle change in habitat quality would not be reflected in the indicator. Effects of habitat structure restoration within forested areas will vary depending on the type and degree of changes to habitat structure, but because any such changes will not change the amount of optimum mast-producing forest, the changes will not be measured by this indicator.

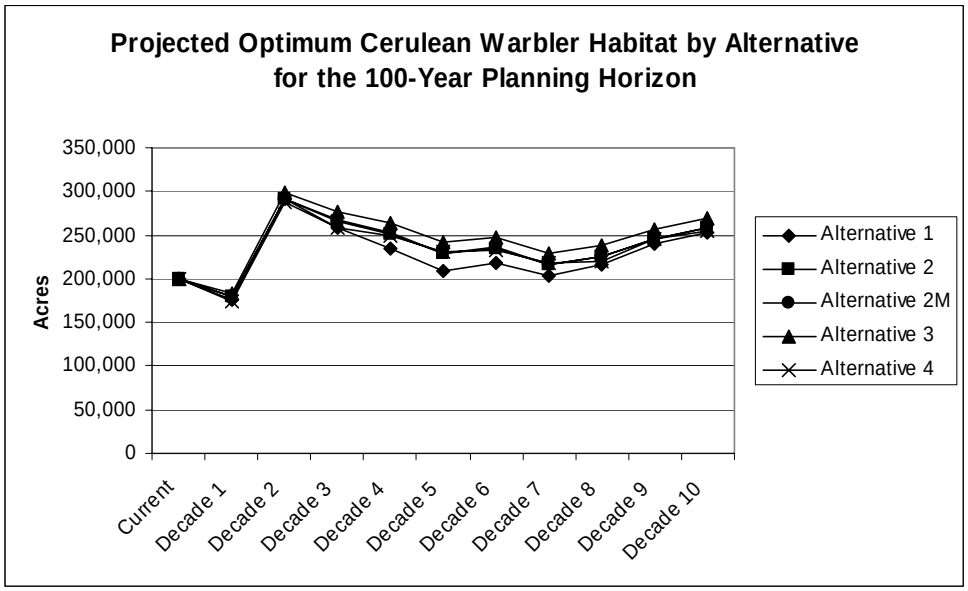
Direct and Indirect Effects by Alternative

Optimum Habitat for Cerulean Warbler

Projected optimum habitat for cerulean warbler during the 100-year planning horizon follows a similar pattern under all alternatives, with minor differences in the amount in certain decades

(Figure MIS-1). In the first decade, optimum cerulean warbler habitat is projected to drop from the current approximately 200,000 acres to around 175,000 to 180,000 acres under all alternatives. This small decline is due to projected timber harvesting in 80+ year-old mixed mesophytic stands. The decline is projected to be short-lived, however, followed by a large increase to about 290,000 to 300,000 acres in the second decade under all alternatives. This increase is due to the large acreage of current mid-successional mixed mesophytic stands reaching 80+ years old in the second decade. Following this increase, a gradual decline is projected through the seventh decade for all alternatives as harvesting to achieve age class diversity removes some mid-late and late successional stands. During this time small differences among alternatives are apparent. The amount is projected to decline the most under Alternative 1 and the least under Alternative 3. The difference among alternatives is projected to be greatest in the fifth decade, when Alternative 1 will provide a little less than 210,000 acres and Alternative 3 will provide a little over 240,000 acres. Alternatives 2, 2M, and 4 are each projected to provide around 230,000 acres in the fifth decade. After the fifth decade, optimum cerulean warbler habitat is projected to decline a little more through the seventh decade, reaching a little over 200,000 acres under Alternative 1, about 230,000 acres under Alternative 3, and 215,000 to 220,000 acres under Alternatives 2, 2M, and 4. The amount is projected to rise gradually under all alternatives in the eighth through tenth decades, with the differences among alternatives becoming smaller and all alternatives finishing between 250,000 and 270,000 acres.

Figure MIS-1.



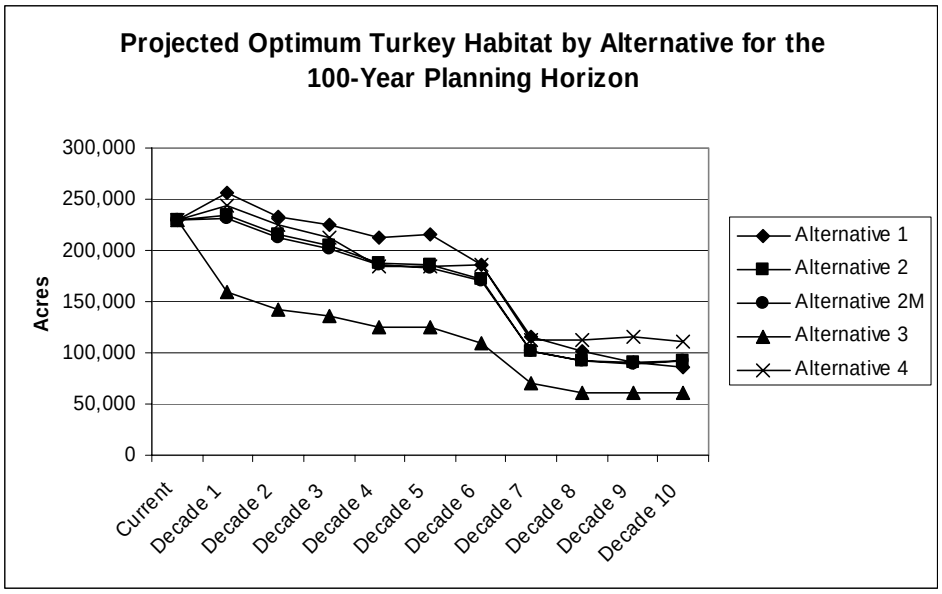
In every decade of the planning horizon, the amount of optimum habitat produced by each alternative exceeds at least 3.5 times the 50,000-acre cerulean warbler habitat objective set by Partners in Flight for the entire mid-Atlantic Ridge and Valley physiographic area (Partners in Flight 2003). This physiographic area covers over 12,000,000 acres in eastern West Virginia, western Virginia, and western Maryland, and the habitat definition used by Partners in Flight was broader than the habitat definition used in this EIS. Therefore, all alternatives should provide

ample habitat for cerulean warblers. However, this may not necessarily translate to an increasing or stable population due to habitat destruction on this species' tropical wintering grounds. (Hamel 2000).

Optimum Habitat for Wild Turkey

Due to aging and harvesting of oak and pine-oak stands that currently are in the optimum mast-producing range, optimum turkey habitat will decline throughout the planning horizon under all alternatives (Figure MIS-2). Because this indicator considers only those optimum mast-producing stands and openings that are in MPs 2.0, 3.0, and 6.1, the decline will be most pronounced under Alternative 3, which allocates large areas to MPs 5.1 and 6.2 that currently are MP 6.1. Through the fifth decade of the planning horizon, the decline would be gradual, as timber harvesting to achieve age class diversity removes some 50- to 150-year-old oak and pine-oak stands. In the fifth decade, Alternative 1 would provide the most optimum turkey habitat, at about 215,000 acres, while Alternative 3 would provide the least, 125,000 acres. Alternatives 2, 2M, and 4 would each produce about 185,000 acres. The projected decline becomes much steeper in the sixth and seventh decades as many stands that are currently in the optimum mast-producing range age beyond 150 years. The projected decline levels off in the eighth through tenth decades as stands harvested in the early decades reach the optimum mast-producing range. Because Alternative 4 has the highest harvest levels in the early decades, it has the highest amount of projected optimum turkey habitat in the eighth through tenth decades. In the tenth decade, Alternative 4 would provide just more than 110,000 acres. Alternative 3 still is projected to have the lowest amount of optimum turkey habitat; it would provide a little over 60,000 acres in the tenth decade. Alternatives 1, 2, and 2M would provide between 85,000 to 90,000 acres.

Figure MIS-2.



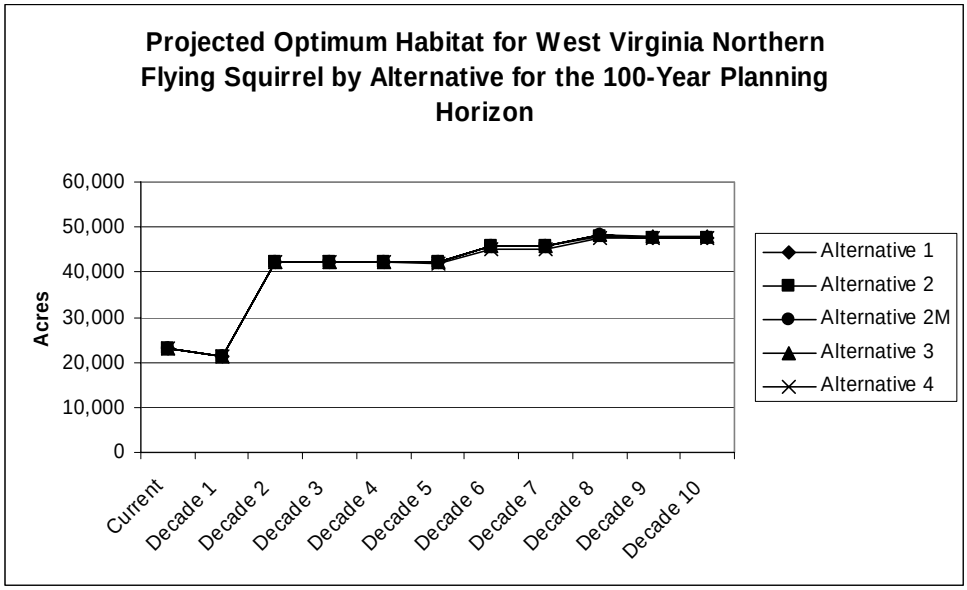
Most of the future decline in optimum turkey habitat is due to the current concentrated age class distribution of the Forest. The current concentration of nearly all oak and pine-oak stands in the

optimum mast-producing age range is not sustainable over the long term under any possible management scenario. Because of the inevitable decline in optimum habitat, the Forest's carrying capacity for turkeys is expected to decline under all alternatives, particularly in the later decades of the planning horizon. The decline would be more pronounced under Alternative 3 than the other alternatives, especially during the first half of the planning horizon.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas

Optimum habitat for West Virginia northern flying squirrel is projected to increase substantially under all alternatives. By the second decade of the planning horizon, optimum habitat would increase from the current 23,000 acres to about 42,000 acres, regardless of alternative (Figure MIS-3). Optimum habitat amounts would show the same increase across alternatives because essentially all spruce forest is considered suitable habitat for the West Virginia northern flying squirrel, and most kinds of vegetation management are restricted in suitable habitat. Therefore, spruce forest will continue to age under all alternatives, and after 20 years the great majority of it will have reached the optimum mid-late and late successional stages. After the first two decades, a continued gradual increase is projected, with the amount reaching about 48,000 acres under all alternatives in the eighth through tenth decades.

Figure MIS-3.

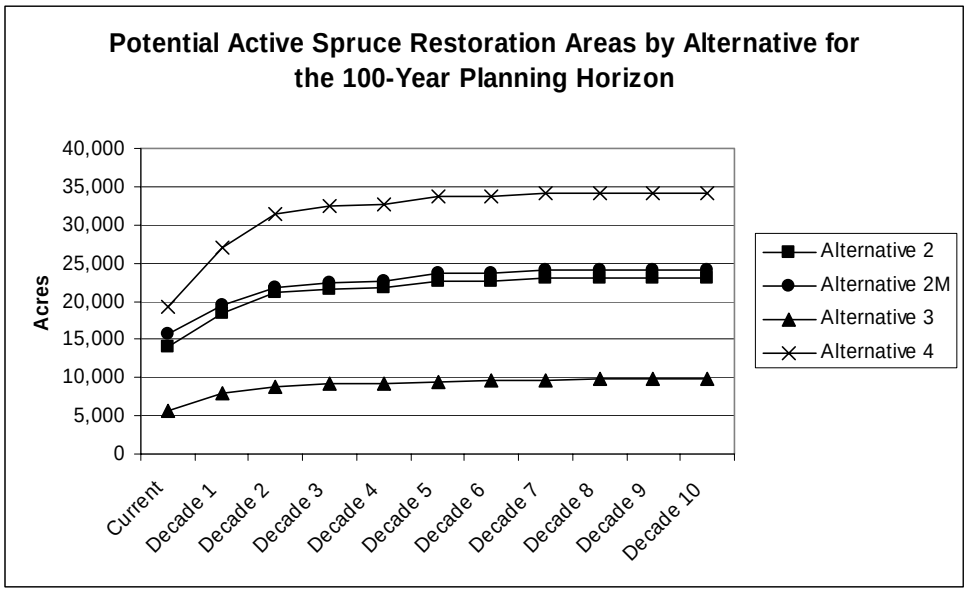


Potential active spruce restoration areas, which are roughly approximated by ≥ 80-year-old northern hardwoods within MP 4.1 that are not currently considered suitable habitat, are projected to increase gradually under the action alternatives in the early decades of the planning horizon (Figure MIS-4). Alternative 1, which does not include MP 4.1, does not provide any potential active spruce restoration areas as measured by this indicator, though it is possible that the Forest could decide on a project-by-project basis to restore spruce in other MPs. Under the

action alternatives, the gradual increase would level off around the fifth decade and the amount would remain stable through the remainder of the planning horizon. Although the pattern is the same, the amounts differ among the action alternatives. Alternative 4 would provide the most potential active spruce restoration area, with the amount leveling off at about 34,000 acres in the fifth through tenth decades. Alternative 3 would provide the least, with a little less than 10,000 acres in the fifth through tenth decades. Alternatives 2 and 2M would be intermediate, with about 23,000 to 24,000 acres in the fifth through tenth decades. Under all action alternatives, the gradual increase in amount in the early decades of the planning horizon is due to aging of northern hardwood stands in the absence of even-aged regeneration harvesting. The differences in amount among alternatives are entirely due to differences in land allocation to MP 4.1.

Other factors being equal, the increase in the amount of optimum habitat under all alternatives should increase the Forest's carrying capacity for West Virginia northern flying squirrel. Under the action alternatives, spruce restoration should increase the carrying capacity further, with the greatest total increase in carrying capacity occurring under Alternative 4 and the smallest total increase occurring under Alternative 3.

Figure MIS-4.



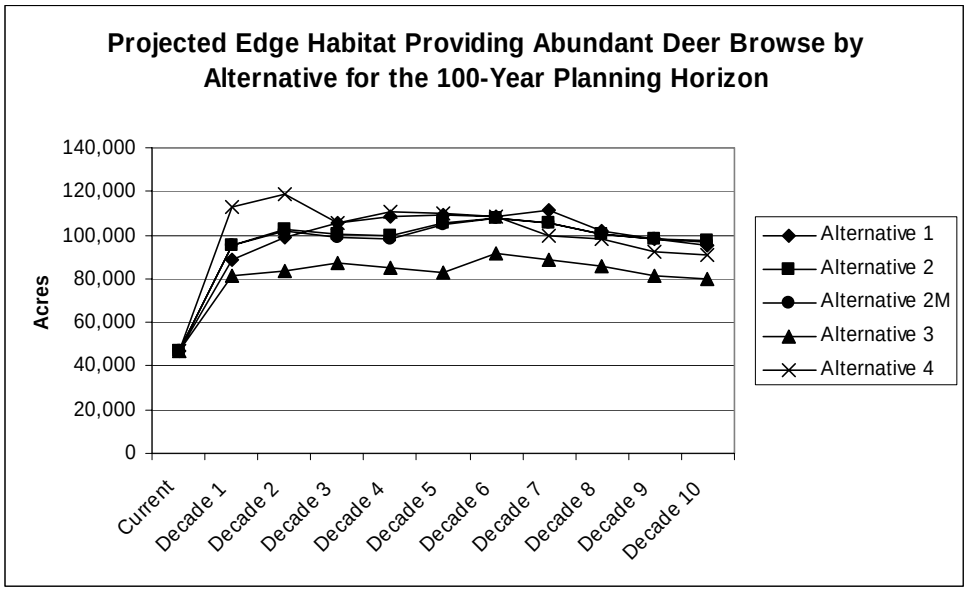
Edge Habitats Providing Abundant Browse for White-tailed Deer

Edge habitats providing abundant browse for white-tailed deer are projected to increase sharply in the first and second decades of the planning horizon as harvesting to achieve age class diversity begins (Figure MIS-5). The increase would be greatest under Alternative 4, with the amount reaching nearly 120,000 acres by the second decade. The increase would be smallest under Alternative 3, with the second-decade amount reaching about 83,000 acres. Amounts under Alternatives 1, 2, and 2M would reach around 100,000 acres in the second decade. In the third decade, the amount under Alternative 4 would decline somewhat such that the amounts

under Alternatives 1, 2, 2M, and 4 would be similar. For the third through seventh decades, the amount under these three alternatives would fluctuate between 100,000 and 110,000 acres. Under Alternative 3, this indicator would fluctuate between about 80,000 and 90,000 acres during the entire planning horizon.

These increases in edge habitat should allow corresponding increases in the Forest's carrying capacity for deer. The increase in carrying capacity would be somewhat smaller under Alternative 3 than under the other alternatives. Hunting regulations and hunting pressure, however, determine the doe harvest, which will determine whether the deer population actually reaches the increased carrying capacity.

Figure MIS-5.



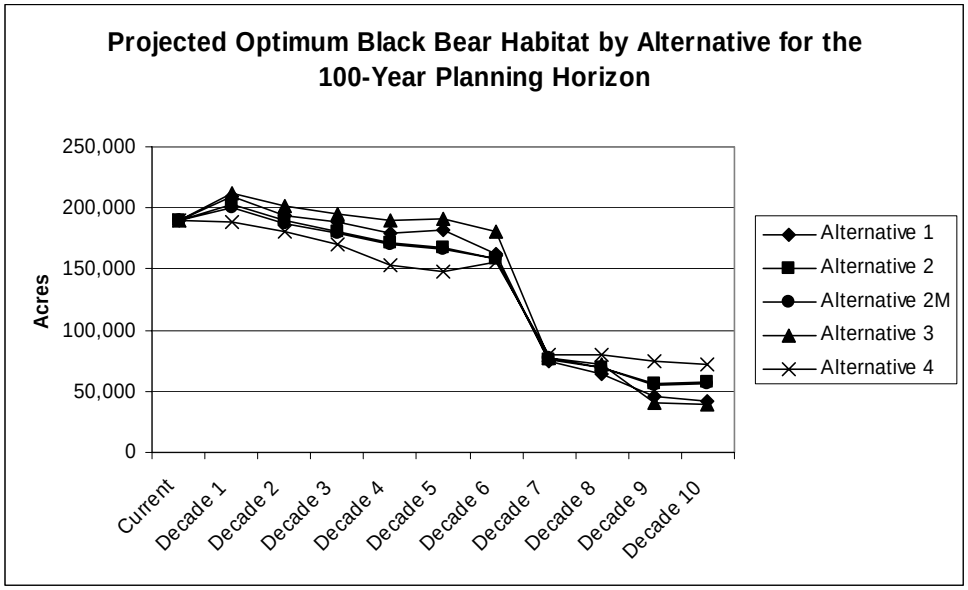
Optimum Habitat for Black Bear

Due to aging and harvesting of oak and pine-oak stands that currently are in the optimum mast-producing age range, optimum habitat for black bear would decline throughout the planning horizon under all alternatives (Figure MIS-6). For the first six decades, the decline would be gradual and would be due primarily to harvesting of stands that are in the optimum mast-producing age range. During this time, Alternative 4 would produce the least optimum bear habitat, primarily because of lower land allocations to remote MPs, but also because of higher harvesting levels. The differences among alternatives would be greatest in the fifth decade, when Alternative 4 would provide just over 140,000 acres of optimum bear habitat, while Alternatives 1 and 3 would provide over 180,000 acres. In the seventh decade, optimum bear habitat would decrease substantially regardless of alternative, with all alternatives producing 70,000 to 75,000 acres. This large decrease is due to aging of oak and pine-oak forest beyond the optimum mast-producing age range. In the remaining decades of the planning horizon, Alternative 4 would provide somewhat more optimum bear habitat than the other alternatives.

This is because the higher level of harvesting early in the planning horizon under Alternative 4 would produce more acreage to mature into the optimum mast-producing age range during the later decades of the planning horizon. Under Alternative 4, optimum bear habitat would level off at 70,000 to 75,000 acres during the eighth through tenth decades. Under Alternatives 1 and 3, optimum bear habitat would decline gradually for the remainder of the planning horizon, reaching about 40,000 acres by the tenth decade. Alternatives 2 and 2M would also produce a gradual decline during these decades, but would not decline as much, producing about 55,000 acres in the tenth decade.

As with optimum turkey habitat, a large decline in optimum bear habitat over the planning horizon is unavoidable because of the current concentrated age class distribution of the Forest. The current high levels of optimum bear habitat are not sustainable under any possible management scenario. The projected declines in optimum bear habitat are expected to cause a decline in the Forest's carrying capacity for bears. Through the first five decades of the planning horizon, the decline would be greatest under Alternative 4, but optimum habitat and presumably carrying capacity would remain fairly high under all alternatives. After the habitat crash in the seventh decade, optimum habitat and presumably carrying capacity would be low under all alternatives, but would remain somewhat higher under Alternative 4 than under the other alternatives.

Figure MIS-6.



Cumulative Effects

The analysis of cumulative effects on habitat for MIS and other species of interest considers the potential effects of activities on all land within the Forest boundary, regardless of ownership. Because almost half of the land within the Forest boundary is not Forest Service land, private activities will account for a large share of the cumulative impacts of all activities. A variety of

private activities have the potential to affect habitat, including timber harvest, oil and gas development, agriculture, mining, residential and commercial development, and passive management that allows stands to grow older.

Timber harvest and passive management have the greatest potential to affect habitat over large areas. The other activities are likely to result in localized temporary or permanent losses or changes to habitat. Based on FIA data, the current trend on private land is toward a slow increase in mature and late successional forested habitat, and a slow decrease in early successional forested habitat. If this trend continues, private lands are likely to make a larger contribution to the total amount of mature and late successional forest communities within the Forest boundary (see Cumulative Effects of the *Ecosystem Diversity* section for further discussion).

Optimum Habitat for Cerulean Warbler

If the trend toward aging forests on private land within the Forest boundary continues, it would add to the projected increase in cerulean warbler habitat on NFS land in the second decade of the planning horizon, and would tend to offset the gradual decline on NFS land during the third through seventh decades. The precise amount of habitat on non-NFS land cannot be predicted, so it is not possible to say with any certainty whether the net cumulative amount of habitat within the Forest boundary would increase or decrease during middle and later decades of the planning horizon. However, under any of the action alternatives, the cumulative amount of optimum cerulean warbler habitat would be somewhat higher than under Alternative 1 because Alternative 1 produces the smallest amount on NFS land. Regardless of the effects of activities on private land, all alternatives will produce large cumulative amounts of cerulean warbler habitat within the Forest boundary because all alternatives will produce in excess of 200,000 acres on NFS land in most decades of the planning horizon.

Optimum Habitat for Wild Turkey

On private land within the Forest boundary, optimum wild turkey habitat could increase during the early decades of the planning horizon as forests continue to grow out of the seedling/sapling and poletimber stages into the sawtimber stage, which roughly corresponds to the optimum mast-producing age range for most oaks. Equating this aging with an increase in optimum turkey habitat assumes that herbaceous openings would be available. In many areas of private land, openings generally are provided by pastures, hay land, gas well sites, and unimproved roads. An increase in optimum turkey habitat on private land would at least partly offset declines in optimum turkey habitat on Forest Service land during the early and middle decades of the planning horizon. However, the potential increase on private land cannot be predicted accurately enough to determine whether the cumulative amount within the Forest boundary will increase or decrease. Alternative 4 provides the greatest chance for a cumulative increase because it is projected to cause the smallest decrease on Forest Service land. Alternative 3, which causes the largest decrease on Forest Service land, provides the smallest chance for a cumulative increase on all lands within the Forest boundary.

Without substantial increases in timber harvesting in the early decades of the planning horizon, private lands are likely to be subject to the same steep decline in optimum mast-producing stands that NFS land are projected to experience in the later decades of the planning horizon. Thus, the cumulative long-term trend within the Forest boundary under all alternatives is likely to be a large decline in optimum turkey habitat, with NFS and private lands contributing measurably to this trend. Although this large decline would occur under all alternatives, Alternative 3 would produce the smallest cumulative amount of optimum turkey habitat in the later decades of the planning horizon, whereas Alternative 4 would produce the most.

Optimum Habitat for West Virginia Northern Flying Squirrel and Spruce Restoration Areas

Because almost all current spruce forest within the Forest boundary is on NFS land, cumulative changes to optimum West Virginia northern flying squirrel habitat will be due almost entirely to those found in the Direct and Indirect Effects section above. Active spruce restoration also is expected to be limited almost entirely to NFS land, so cumulative changes in active spruce restoration areas also will be essentially equivalent to the direct and indirect effects discussed above.

Edge Habitats Providing Abundant Browse for White-tailed Deer

On private land, the trend toward aging of forests, if it continues, would cause a decline in edge habitats. This declining trend will tend to offset the increases that are projected to occur early in the planning horizon on NFS land, but the potential changes on non-NFS land cannot be estimated accurately enough to determine whether the cumulative effect on all land in the Forest boundary will be an increase or a decrease in the amount of edge habitat. Alternative 4, which has the largest increase on Forest Service land early in the planning horizon, would be most likely to show a cumulative increase, whereas Alternative 3, which has the smallest increase on Forest Service land, would be least likely to show a cumulative increase.

Optimum Habitat for Black Bear

On private land, a continuation of the current trend toward increases in sawtimber stands could cause an increase in optimum black bear habitat, assuming the sawtimber size class roughly equates to oaks in the optimum mast-producing age range. However, continuing residential and mineral development could increase motorized access, which might offset habitat gains due to increases in the amount of mast-producing forest. The extent to which these two effects would offset each other is not predictable. Therefore, when combining these effects with the projected gradual decline on Forest Service land in the first six decades of the planning horizon, it is not possible to predict whether the cumulative effect will be an increase or decrease in optimum black bear habitat. However, because Alternatives 1 and 3 are projected to produce the largest amount of optimum black bear habitat on Forest Service land during the first six decades, they are the most likely alternatives to show a cumulative increase, whereas Alternative 4 is the least likely alternative to show a cumulative increase.

During the seventh through tenth decades, private lands are likely to experience the same steep decline in optimum mast-producing stands that is forecast for NFS land, unless a substantial increase in even-aged timber harvesting occurs very early in the planning horizon. Therefore, the cumulative long-term trend within the Forest boundary under all alternatives is likely to be a large decline in optimum bear habitat, with NFS land and private land contributing measurably to this trend. Although this large cumulative decline would occur under all alternatives, Alternative 4 would produce somewhat more bear habitat in the later decades than the other Alternatives.