Appendix E

Plant and Animal Diversity and Management Indicators

Plant and Animal Diversity

This section summarizes the analyses that were conducted to ensure the conservation of the wide variety of terrestrial and aquatic species integral to maintaining ecological, social, and economic sustainability on the Wayne National Forest. It also demonstrates how the results of the analyses were incorporated into the development of the alternatives. This section outlines the:

- Legal requirements, policy, and public participation that are relevant to addressing and analyzing plant and animal diversity
- Methodology and scientific accuracy of the species viability evaluation process
- Identification of management indicator species to address legal requirements, policy, and public issues relevant to addressing and analyzing plant and animal diversity.

Legal and Policy Framework

The legal and policy framework for the development of alternatives, other than NEPA, is provided primarily by these regulations:

- **36 CFR 219.19 (1982):** "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area."[1]
- **Department of Agriculture Regulation 9500-4:** "Manage habitats for existing native and desired non-native plants, fish, and wildlife species in order to maintain at least viable populations of such species."
- **36 CFR 219.19 (1982):** "For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained habitat

[1] The 2005 Planning Regulations, 36 CFR 219.14(e) (January 5, 2005) allow the use of the 1982 planning regulations for this Plan since it was initiated prior to the transition period defined at 36 CFR 219.12(b).

must be provided to support at least a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area."

- **36 CFR 219.26 (1982):** "…provide for diversity of plant and animal communities and tree species consistent with the overall multiple use objectives of the planning area."
- **36 CFR 219.6 (2):** "Ensure that the Forest Service understands the needs, concerns, and values of the public."

We considered the public's interest in and need for plant and animal diversity, which included:

- The public's comments on their needs, concerns, and values for plant and animal resources (see Draft EIS, Appendix A for a summary of the public involvement process)
- Review of annual Forest Plan monitoring reports, and development of the Analysis of the Management Situation
- Discussions with researchers with the Forest Service's Northeast Forest Experiment Station who are responsible for conducting research on the role of fire in southeastern Ohio's oak ecosystem
- Coordination with State & Private Forestry on future insect and disease threats to forest communities on NFS lands
- Compilation and review of scientific literature pertaining to conservation of biodiversity, and plant and animal species of viability or conservation concern
- Discussions with recognized taxonomic experts (i.e., persons recognized by their peers as having expertise in one or more species gained through research, education, study, or experience) on viability concerns for native and desired non-native species found within the WNF
- Coordination with other public planning efforts which included The Nature Conservancy's Western Allegheny Plateau broad scale assessment and the Ohio Department of Transportation's Nelsonville Bypass Project
- Coordination with other state and federal agencies with an interest in or responsibility for plants and animals and their habitats.

Integrating Biological Diversity into the Revised Forest Plan

Regulations and policy require the Forest Service to be concerned with all species of plants and animals on NFS lands. This section will demonstrate how we used the best available scientific information to identify species and habitats that are considered rare or declining, and how we

incorporated conservation measures into the development of the alternatives to conserve and restore these habitats and species.

Analyses Completed to Support the Development of Alternatives

Broad Scale Assessment of the Western Allegheny Plateau Ecoregion

We used The Nature Conservancy's (TNC) broad scale assessment of the Western Allegheny Plateau ecoregion to identify ecologically significant landscapes for the WNF. These ecologically significant landscapes (i.e., matrix forming landscapes, ecological drainage units, and aquatic ecological systems) received special attention during alternative development.

The Nature Conservancy, in association with numerous ecological experts, conducted a broad scale assessment of the Western Allegheny Plateau, an ecoregion which aligns itself closely with the Southern Unglaciated Allegheny Plateau (TNC, 2003). The purpose of the assessment, in part, was to characterize the biological diversity of the area and highlight areas on the landscape critical to biodiversity conservation.

As a coarse-filter strategy for conserving terrestrial biodiversity, TNC utilized the concept of matrix-forming landscapes in their broad scale assessment. Matrix-forming landscapes are made up of all forest types, and form extensive cover on the scale of thousands to millions of acres. These matrix-forming landscapes are often influenced by disturbances or ecological processes such as ice storms, insect outbreaks, and fire. Within the matrix-forming landscapes, smaller patch-forming communities occur and are characterized by a mosaic of successional forest stages resulting from disturbance processes (TNC, 2003). Through this coarse-filter strategy, matrix-forming landscapes would play an important role in the conservation of most species, including wide ranging fauna such as predators, forest interior birds, and rare species.

Potential matrix-forming landscapes were evaluated as to their size or "resistance" (i.e., 15,000-20,000 acre minimum), condition or "resilience" (i.e., low road density, large regions of core interior habitat, large patches of more mature forest), and landscape context or "persistence" (i.e., continuous forest cover, presence of wide-ranging species). Three of the 18 matrix-forming landscapes identified in the Western Allegheny Plateau ecoregion were located on the WNF, one on the Marietta Unit and two on the Ironton Ranger District.

The Wayne has a relatively homogeneous landscape. However, landform and aspect have the most influence on forest communities (USDA Forest Service, 1999), and because of that a mix of three forest systems can be found within the three matrix-forming landscapes: Central Appalachian Cove Forest System, Allegheny-Cumberland Dry Oak Forest and

Woodland System, and Cumberland Dry Circumneutral Forest and Woodland System (TNC, 2003).

As a coarse-filter strategy for conserving aquatic biodiversity, TNC utilized the concept of ecological drainage units and aquatic ecological systems. Ecological drainage units are thought to contain aquatic systems with similar patterns of physiography, drainage density, hydrologic characteristics, connectivity and zoogeography. Aquatic ecological systems are defined as dynamic spatial assemblages of aquatic ecological communities that occur together in an aquatic landscape with similar geomorphologic patterns, ecological processes (e.g., hydrologic and nutrient regimes, access to floodplains), and environmental gradients (e.g., temperature, chemical, and habitat volume). They form a robust, cohesive and distinguishable unit on a hydrography map that can be used to partition and classify environmental patterns. Aquatic ecological systems are intended to characterize the potential aquatic communities and species occurring in different stream types.

Two priority ecological drainage units identified in TNC's broad scale assessment encompass parts of the WNF. The Marietta Unit is within the Glaciated Ohio Tributaries ecological drainage unit and the Ironton Ranger District is within the Southern Allegheny Plateau ecological drainage unit. These ecological drainage units represent a historically diverse aquatic fauna, which have been impacted by dam construction, resource extraction, agriculture, industrial effluents, and non-native species introductions. This has resulted in a decline in native fishes and an increase in non-native fishes.

Two aquatic ecological systems occur on the Marietta Unit. These can both be described as having low to moderate elevation and acidic sedimentary bedrock. The aquatic ecological systems differ in size and dominant landforms within the watersheds. The larger downstream system is dominated by sideslopes with large amounts of coves, gently sloping flats and slope bottoms. The two smaller systems which drain into the larger aquatic ecological system have very high amounts of summit/upper slope and sideslope/coves with some gentle slopes. These collectively represent the Little Muskingum watershed, an ecoregionally significant watershed (TNC, 2003).

Two ecologically significant watersheds occur on the Ironton Ranger District, Symmes Creek and Pine Creek watersheds. These are located in two aquatic ecological systems, both of which have low elevations with acidic sedimentary bedrock. The downstream system is larger and dominated by sideslopes and gently sloping flats with larger amounts of slope bottoms and some upper slopes, flat summits, coves, and patchy surficial sediments. The smaller aquatic ecological system has large amounts of sideslope/cove/summits with substantial gentle slopes, and

more dry flats on fine grained sediments than any other aquatic ecological system in the Southern Allegheny Plateau ecological drainage unit.

Species Viability Evaluations

Our evaluation of plant and animal species viability is our best judgment at this time. Due to the complexities of ecosystems and inevitable gaps in information, viability evaluations are not an exact science. However, we used the best available scientific information and requested input about species of viability concern from recognized taxonomic experts. These experts are considered to have knowledge and expertise of the species and biological communities within the WNF and Ohio, and the Southern Unglaciated Allegheny Plateau Ecoregion. They are affiliated with the Ohio Division of Wildlife, Ohio Division of Natural Areas and Preserves, U. S. Fish and Wildlife Service, Ohio EPA, The Nature Conservancy, Cleveland Museum of Natural History, Museum of Biological Diversity at The Ohio State University, the Ohio Historical Society, universities, and other natural resource agencies and heritage programs in neighboring states, as well as individuals not affiliated with any particular institution. The following describes our species viability evaluation process.

Step 1

We used taxonomic experts to develop a list of plant and animal species of viability and conservation concern for the WNF.

Species of viability concern included federally listed species and Regional Forester sensitive species.

The U.S. Fish and Wildlife Service lists nine endangered (E) or threatened (T) species as occurring within or adjacent to the Forest. These include the Indiana bat (E), bald eagle (T), American burying beetle (E), fanshell (E), pink mucket pearly mussel (E), running buffalo clover (E), northern monkshood (T), Virginia spiraea (T), and small whorled pogonia (T).

Twenty-nine species were recognized by the Forest Service as Regional Forester sensitive species for the WNF when we started this process. These species were identified through the Region 9 Regional Forester's Sensitive Species designation process (FSM 2672, R9 Supplement No. 2600-2000-1). During that process, many species were evaluated, including those identified by Forest Service biologists and taxonomic experts and other interested people. Risk evaluations used to identify species and to maintain the Regional Forester sensitive species list are on file at the Supervisor's Office in Nelsonville, Ohio. Regional Forester sensitive species are documented in the Biological Evaluation (Appendix F).

Other species were identified for which there was a viability or conservation concern now or in the future with continued implementation

of the Forest Plan (Alternative A). This list of species was derived from various sources:

- Conservation targets identified by The Nature Conservancy in their broad scale assessment of the Western Allegheny Plateau
- Species ranked as S1 (critically imperiled) or S2 (imperiled) in Ohio
- WNF management indicator species with declining population trends
- Avian species of concern on the Audubon Watch List and Partners in Flight Watch List
- Plant species on the Committee on International Trade of Endangered Species (CITES) list.

These data sources produced a list of 118 plant and animal species of viability or conservation concern with documented occurrences within the Forest proclamation boundary (i.e., planning area) within the last 25 years.

Step 2

We took the list of 118 plants and animals of viability or conservation concern and grouped them by broad habitat categories. For each species, we made a determination as to what broad habitat it required (e.g., early successional hardwood forest, mature hardwood forest, etc.) or what broad aquatic habitat type it required (e.g., riverine-riffle, riverine-pools, wetland, etc.). We also considered management needs that would reduce or eliminate threats to viability when grouping species. For example, the taxonomic experts identified some plant species which are threatened by fire suppression because they are fire-adapted (e.g., juniper sedge), and therefore they would benefit from management that prescribes low intensity ground fires. In some cases, there was not enough known about a species to be able to place it into a certain habitat category or management need grouping.

For purposes of this species viability evaluation process, one or more species were chosen to serve as focal species for the remaining species in each of the habitat or management needs groups. Focal species were selected because they were believed to be indicative of the status of a larger functioning group of species, could be reflective of the status of a key habitat type, or because they encompass the habitat requirements of many other species due to their large area requirements or use of multiple habitats (COS, 1999). This list of focal species, in addition to all known federally listed species known to occur in the planning area and any species that could not be grouped with others because of a lack of information, were reviewed by the taxonomic experts.

Based on comments by the taxonomic experts, a list of 60 species was developed and carried through the remainder of the process (Table E - 1). This process, described below, included an exhaustive review of information to enable us to learn as much as we could about the needs of these species.

Table E - 1. Plant and animal species carried through the species viability evaluation process

Mammals	**Fishes**	**Plants**
Indiana bat	Eastern sand darter	Dwarf iris
River otter	Ohio lamprey	Featherbells
Birds	Ohio muskellunge	Juniper sedge
Bald eagle	Slenderhead darter	Kral's sedge
Cerulean warbler	Western lake chubsucker	Lined sedge
Field sparrow	**Mussels**	Marshes St. John's wort
Henslow's sparrow	Little spectaclecase mussel	Pale straw sedge
Louisiana waterthrush	Round pigtoe	Pigeon grape
Prairie warbler	Salamander mussel	Pinxter flower
Prothonotary warbler	**Insects**	Rock skullcap
Red-headed woodpecker	American burying beetle	Small-flowered alumroot
Ruffed grouse	Green-faced clubtail	Smooth beardtongue
Yellow-breasted chat	Grizzled skipper	Sparse-lobed grape fern
Wood thrush	Gilded river cruiser	Striped gentian
Worm-eating warbler	Olympia marble	Tall nut rush
Amphibians	Rapids clubtail	Thyme-leaved pinweed
Blanchard's cricket frog	Wabash river cruiser	Umbrella magnolia
Four-toed salamander	**Plants**	Yellow crownbeard
Hellbender	American ginseng	Yellow-fringed orchid
Mud salamander	Bicknell's panic grass	Yellow gentian
Reptiles	Blue scorpionweed	
Box turtle	Butterfly pea	
Timber rattlesnake	Carolina thistle	

Step 3

We conducted a thorough review of the scientific literature to compile information about the 60 species for three geographic areas:

- Their range
- The Southern Unglaciated Allegheny Plateau Ecoregion
- The planning area

For each species, a Species Data Collection Form was used to organize the information into five subject areas:

- Historical and current occurrence information
- Historical and current population information
- Life history
- Habitat, food, and population trends
- Identification and description of potential threats to viability for two time periods, 10 years and 100 years into the future

The literature review focused on peer-reviewed research and gray literature (e.g., natural resource agency reports).

When the Species Data Collection Forms were completed for each of the 60 species, one-day meetings were held with the taxonomic experts for the purpose of discussing each species. To facilitate the participation of the most taxonomic experts, six one-day meetings were held to discuss Open Area Plants; Woodland Plants; Sedges, Rushes and Grasses; Amphibians and Reptiles; Aquatic Species; and Insects. Follow-up meetings or telephone conversations were held with experts who could not participate during the one-day meetings. The topics covered at each meeting consisted of the following discussion points:

- Identification of missing or inaccurate information in the Species Data Collection Forms
- Validation of the threats to viability identified in the Species Data Collection Forms
- Discussion of the role of the WNF in maintaining viability of the species in its range
- Discussion of management methodologies or tools that help mitigate or eliminate threats to viability
- Identification of monitoring methodologies
- General discussion of potential effects to population viability from Forest Service management activities
- Identification of any further species groupings
- Discussion of whether viability of the species in the planning area is tied to landscape-level forest management or to site-specific management needs
- Discussion of whether viability of the species in the planning area is truly at-risk

After meeting with the taxonomic experts, six species were eliminated from the process. We found that three species thought to occur within the planning area did not occur within the WNF proclamation boundary: gilded river cruiser, Olympia marble, and Wabash river cruiser. Population trends were stable or increasing for three other species and taxonomic experts did not consider their viability or conservation to be at risk in the planning area now or in the future: river otter, box turtle, and field sparrow. The habitat and management needs for these six species were considered to be covered by one or more of the 54 remaining species, and therefore removal of these six species from the species viability evaluation process did not affect habitat or management need representation of any other plant or animal species.

Step 4

Based on the information collected through the literature review phase and from information generated from discussions with taxonomic experts, we developed **conservation approaches** and determined **viability outcomes** for each of the 54 remaining focal species. The conservation approaches and viability outcomes are incorporated into the Species Data Collection forms for each of the 60 species.

The development of **conservation approaches** focused on the primary threats to loss of viability in the planning area for each species. These were proactive measures to improve habitat conditions or measures that could be employed to mitigate or eliminate both short-term and long-term risks to viability in the planning area.

After reviewing the scientific literature and information from the taxonomic experts, we identified two groups of species we labeled landscape-level focal species and site-specific focal species. Eleven plant and animal species were identified as landscape-level focal species because threats to their viability could best be addressed by conservation approaches that incorporated landscape-level vegetation management (Table E - 2). These eleven focal species were believed to represent the habitat needs of other species in five broad habitat categories. Based on the habitat needs of these eleven focal species, we confirmed that a diversity of habitats must be provided to maintain viable populations of plants and animals on the WNF.

Table E - 2. Landscape-level focal species and associated broad habitat categories

Focal species	Habitat Category
Henslow's Sparrow	Grassland
Prairie Warbler Yellow-breasted Chat	Early successional forest
Ruffed Grouse	Mosaic of hardwood successional habitats (early-, mid-, and late-successional forest)
American Burying Beetle Indiana Bat	Open to semi-open mature hardwood forest
Cerulean Warbler Worm-eating Warbler Wood thrush Louisiana Waterthrush Rock Skullcap	Mature interior forest

Viability or conservation concerns for the remaining 43 plants and animals are only partially addressed through landscape-level forest vegetation management for various reasons:

- They tend to occur in localized areas of the WNF, and in most cases potential for expansion of their range on the Forest is limited because they are associated with a specific habitat feature
- Threats to viability or conservation are related more to management of Forest visitors rather than habitat

Threats to viability of these 43 species can be addressed through conservation approaches such as development of Forest-wide goals, objectives and standards and guidelines and management area standards and guidelines that supplement landscape-level forest vegetation management direction (Table E - 3).

Table E - 3. Conservation approaches for site-specific focal species.

Conservation Approach	Species
Promote restoration or improvement of riparian area structure and function	Louisiana waterthrush, prothonotary warbler, bald eagle, hellbender, four-toed salamander, Blanchard's cricket frog, mud salamander, Ohio muskellunge, Ohio lamprey, western lake chubsucker, slenderhead darter, eastern sand darter, round pigtoe, little spectaclecase, salamander mussel, rapids clubtail, green-faced clubtail, pigeon grape, large marshes St. John's wort, pale straw sedge
Maintain herbaceous vegetation or open sunlight conditions (mowing)	Blanchard's cricket frog, grizzled skipper, yellow gentian, thyme-leaved pinweed, smooth beardtongue, featherbells
Maintain open to filtered sunlight conditions (prescribed fire)	Striped gentian, pinxter flower, dwarf iris, blue scorpionweed, yellow gentian, yellow-fringed orchid, yellow crownbeard, thyme-leaved pinweed, Carolina thistle, butterfly pea, tall nut rush, Bicknell's panic grass, juniper sedge, Kral's sedge, red-headed woodpecker
Maintain open to filtered sunlight conditions (uneven-age or even-aged timber harvest methods)	Timber rattlesnake, red-headed woodpecker
Maintain filtered sunlight conditions (uneven-aged timber harvest methods)	Grizzled skipper, striped gentian, dwarf iris, yellow gentian, yellow-fringed orchid, pigeon grape, Bicknell's panic grass, juniper sedge, Kral's sedge
Maintain closed-canopy forest	Four-toed salamander, umbrella magnolia, sparse-lobed grape fern, lined sedge
Manage non-native invasive plant species	All plant species, wood thrush, worm-eating warbler, Louisiana waterthrush
Manage recreation activities	American ginseng, small-flowered alumroot, pinxter flower, Ohio muskellunge
Education and awareness	Timber rattlesnake

The **viability outcome** is a judgment and should be thought of as an index of the capability of the environment to support population abundance and distribution, but not as an actual prediction of population occurrence, size, density or other demographic characteristics. A scale of five viability outcome levels was developed for use by Region 9 National Forests for summarizing the existing conditions in the planning area, and for summarizing the knowledge of the species distribution, population trend, life history needs and threats (T. Schenck, pers. comm.).

The viability outcomes represent points along a gradient ranging from broadly distributed with a high likelihood of persistence to poorly distributed with a high likelihood of extirpation. It is important to note that the concept of ecological conditions, distribution, and quality must be based on the knowledge of the species distributional range and life history. For example, some species may have received a viability outcome level of D or E. Some plants, reptiles, amphibians, fishes, mussels, and insects naturally occur in a localized or patchy distribution, and thus would never occur in the conditions described in outcome levels A, B, or C.

We used the following viability outcome scales for each focal species to:

- Summarize existing conditions on NFS lands in the planning area
- Summarize existing conditions on all lands within the planning area.

Viability outcomes for NFS lands in the planning area:

Outcome A – Suitable ecological conditions are broadly distributed and of high abundance across the historical range of the species within the planning area. The combination of distribution and abundance of ecological conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the species.

Outcome B – Suitable ecological conditions are either broadly distributed or of high abundance across the historical range of the species in the planning area, but there are gaps where suitable ecological conditions are absent or only present in low abundance. However, the disjunct areas of suitable ecological conditions are typically large enough and close enough to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the planning area.

Outcome C – Suitable ecological conditions are distributed frequently as patches and/or exist at low abundance. Gaps where suitable ecological conditions are either absent, or present in low abundance, are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from historical within the planning area may have resulted from the isolation.

Outcome D – Suitable ecological conditions are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these ecological conditions may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which there is not the historical condition within the planning area, reduction in overall species range from historical condition within the planning area may have resulted from this isolation.

Outcome E – Suitable ecological conditions are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of re-colonization of such patches. There has likely been a reduction in overall species range from historical within the planning area, except for

some rare, local endemics that may have persisted in this condition since the historical record.

Viability outcomes for all lands within the planning area (i.e., cumulative effects analysis area):

Outcome A – The combination of environmental and population conditions provides opportunity for the species to be broadly distributed and of high abundance across its historical range within the cumulative effects analysis area. There is potential for continuous or nearly continuous intraspecific interactions at high population size.

Outcome B – The combination of environmental and population conditions provide opportunity for the species to be broadly distributed and/or of high abundance across its historical range within the cumulative effects analysis area, but there are gaps where populations are potentially absent or present only in low density as a result of environmental or population conditions. However, the disjunct areas of higher potential population density are typically large enough and close enough to other subpopulations to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the cumulative effects analysis area.

Outcome C – The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by patchiness and/or areas of low abundance. Gaps where the likelihood of population occurrence is low or zero are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition may have resulted from this isolation.

Outcome D – The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by areas with high potential for population isolation and/or very low potential abundance. While some of these subpopulations may be self-sustaining, gaps where the likelihood of population occurrence is low or zero are large enough that there is limited opportunity for interactions among them. For species for which there is not the historical condition within the planning area, reduction in overall species range from historical has likely resulted from this isolation.

Outcome E – The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

Step 5

The results of the species viability evaluations were made available to the public to ensure information on species of viability and conservation concern was available to those who wanted to participate in the Forest Plan revision process. A general summary of the species viability evaluation process and results was posted on the WNF web site in September 2003, along with the Species Data Collection Forms for each of the 60 species (including those species eliminated from the process), and has remained on the web site throughout the Forest Plan revision process. Hard copies and CDs were available to the public upon request. A presentation about the species viability evaluation process and results was presented to participants at the three collaborative public workshops held in October and November 2003.

Step 6

We used the results of the species viability evaluation process to develop management area prescriptions, alternatives, and to aid in the selection of management indicator species. The details on how we used this information is provided in the next section.

Use of the Western Allegheny Plateau Ecoregion Assessment and Species Viability Evaluations to Develop Alternatives

The scientific literature recognizes the coarse filter and fine filter approaches as strategies for incorporating conservation of biological diversity into land management planning (Haufler, 1999). Haufler (1999) defines the coarse filter and fine filter approaches as follows:

- **Coarse Filter** – Strategy for setting biodiversity planning goals based on providing an appropriate mix of ecological communities across a planning landscape, rather than focusing on the needs of specific species.
- **Fine Filter** – Strategy for setting biodiversity planning goals based on the needs of individual species or guilds of species, thus providing for the needs of those species or guilds.

Coarse Filter Approach

Terrestrial and Semi-Aquatic Biodiversity

We developed the **Historic Forest and Historic Forest with OHVs Management Areas** after review of TNC's broad scale assessment of the Western Allegheny Plateau ecoregion (TNC, 2003), the fire/oak ecosystem research results from the Northeast Forest Experiment Station (Sutherland and Hutchinson, 2003) and other researchers (e.g., Yaussy, 2000; Spectich, 2004), and the Species Data Collection Forms for the 60 species.

Fire played a role in the maintenance of the oak ecosystem. Fire suppression, in part, has led to the increase of shade tolerant forest species in the understory and mid-canopy layer of these mixed oak communities and the concern for the potential decline in oak-hickory on the landscape in the future. The species viability evaluations demonstrated that certain fire-adapted plant species maintain healthy populations with fire as a periodic disturbance (e.g., juniper sedge, yellow gentian, Carolina thistle) and that there are animal species on the WNF that are dependant on the oak and hickory species for food and shelter (e.g., ruffed grouse, Indiana bat). The Historic Forest and Historic Forest with OHVs prescriptions incorporate the use of fire as a natural disturbance on the landscape to maintain fire-adapted communities.

We used TNC's findings about matrix-forming landscapes to spatially locate these two management areas on the ground. Two of the three matrix-forming landscapes, both found on the Ironton Ranger District, occurred in areas large enough to accommodate natural disturbance regimes and area sensitive species (>15,000 contiguous acres). Both areas had a mixture of all ecological land types found on the Athens Unit and Ironton Ranger District (USDA Forest Service,1999) and exhibited condition factors (e.g., large regions of core interior habitat, large patches of more mature forest, composition dominated by native non-weedy species, confirmed evidence of forest breeding species) to provide the best opportunity for restoration to mature and overly mature age classes, which are currently under-represented in all forest landscapes in Ohio (TNC, 2003). These matrix-forming landscapes would play an important role in the conservation of most species, including wide ranging fauna such as predators, forest interior birds, and rare species.

The third matrix-forming landscape identified by TNC in their broad scale assessment, was located on the Marietta Unit in an area with a sparse and relatively scattered NFS land ownership pattern. We considered this matrix-forming landscape, but we believed the scattered NFS land pattern would not accommodate the use of prescribed fire on a landscape basis. Instead, we identified an area on the Athens Unit, which had been identified as a potential matrix-forming landscape during the preliminary

stages of the Western Allegheny Plateau broad scale assessment. It had areas of contiguous NFS land ownership patterns which would enable the Forest Service to use prescribed fire on a landscape basis, and had a representation of the ecological land types found on the Athens Unit and Ironton Ranger District.

In total, we identified three areas on the Wayne to place the historic Forest and Historic Forest with OHVs Management Areas. The number and location of these management areas were varied by alternative.

The species viability evaluations were used, in part, to formulate the vegetation management prescriptions for **nine management areas** (Table E - 4). One coarse-filter approach to conserving biodiversity incorporates active management of ecosystems to maintain a mix of stand structures across the landscape, from early successional forest to older growth (Oliver, 1992 and 1994 in Haufler, 1999). In discussions with taxonomic experts, we discovered that threats to the eleven landscape-level focal species could be best addressed by providing five broad categories of terrestrial habitat across the landscape. Our assumption was that by managing for a representation of habitats needed by the landscape-level focal species, most terrestrial and semi-aquatic plant and animal species on the WNF would be associated with one or more of these habitats during their life cycle.

Table E - 4. Management areas developed to provide habitat for focal species.

Focal Species	Broad Category of Habitat	Management Area*
Henslow's Sparrow	Extensive grassland	Grassland and Forest Mosaic
Prairie Warbler Yellow-breasted Chat	Early successional forest; area sensitive	Forest and Shrubland Mosaic; Forest and Shrubland with OHVs; Grassland and Forest Mosaic
Ruffed Grouse	Mosaic of early, mid, and late successional hardwood forest; oak (mast)	Forest and Shrubland Mosaic and Forest and Shrubland with OHVs
Cerulean Warbler Worm-eating Warbler Wood Thrush Louisiana Waterthrush	Mature hardwoods; generally extensive tracts; forest interior; variable canopy structure	Diverse Continuous Forest and Diverse Continuous Forest with OHVs
Rock Skullcap Louisiana Waterthrush	Closed-canopy mature hardwood forest	Future Old Forest and Future Old Forest with Mineral Activity
American burying beetle Indiana bat	Open to semi-open mature hardwoods	Historic Forest and Historic Forest with OHVs

*Refer to the Revised Forest Plan for management area descriptions

The allocation of these nine management areas was varied in amount and spatially among the alternatives. As a proactive conservation measure, we used known occurrence data for all plants and animals carried through the species viability evaluations process to help locate placement of specific management areas on-the-ground, as well as corridors for dispersal and species interactions across the landscape. We also ensured through

vegetation management prescriptions and spatial allocation that the broad categories of habitat were well-distributed across the planning area.

Aquatic and Semi-Aquatic Biodiversity

We used the results of the Western Allegheny Plateau Ecoregion Assessment and the species viability evaluations to develop the **River Corridor Management Area**. Streams have been degraded by a myriad of past land use activities, but TNC (2003) found that the WNF contained ecoregionally significant aquatic ecological systems. The species viability evaluations similarly identified these same systems as having species of viability or conservation concern inhabiting them. The River Corridor Management Area was developed to emphasize the restoration and enhancement of the inherent ecological processes and functions associated with riverine systems.

We used TNC's findings to identify ecoregionally significant Aquatic Ecological Systems, significant watersheds, and the spatial locations of the River Corridor Management Area on the ground. Symmes Creek and the Little Muskingum River were identified by TNC as ecologically significant. Corridors along Symmes Creek and the Little Muskingum River that occurred in the 1988 Forest Plan were maintained, but the spatial extent of the corridors was enlarged to account for biologically important tributaries.

An area along the Ohio River was also designated in the River Corridor Management Area. The Nature Conservancy did not consider the Ohio River under the jurisdiction of the Forest Service in their broad scale assessment; however it was identified as an ecologically significant aquatic ecological system (TNC, 2003). We chose to recognize the Forest Service's obligation to contribute to the restoration of the Ohio River aquatic ecosystem by designating an area on the Marietta Unit as a River Corridor Management Area.

Fine Filter Approach

Conservation of every plant or animal in the planning area cannot rely wholly on a coarse filter approach in the planning process. We also incorporated a fine filter approach in the development of the alternatives and the direction and guidance found in the Revised Forest Plan. The species viability evaluation process identified those species for which there was a viability or conservation concern now or in the future, and we considered all of the species carried through the process during the development of management areas and the Revised Forest Plan.

In addition to locating management areas on-the-ground where these species occurred and would benefit overall from the management prescriptions, we identified three fire-adapted oak barrens communities on the Ironton Ranger District that included plant species of viability and

conservation concern (Bluegrass Ridge, Fradd Hollow, Handley Branch). These three areas were designated as **Special Areas**, along with seven Candidate Areas identified in the 1988 Forest Plan. Special Areas are regionally or locally significant and emphasize the preservation, management, and study of unique natural areas.

The species viability evaluations identified certain species which naturally occur in localized areas of the planning area, and do not likely have the potential for significantly increasing their range in the planning area. **Forest-wide direction and guidance** in the Revised Forest Plan not only ensures that the populations of these species are protected from management activities, but allows for proactive management for species that need various forms of disturbance to maintain population viability within the planning area (Table E - 5).

We recognized that aquatic biodiversity cannot be maintained only by focusing on the mainstem of the larger streams; we must account for the entire drainage network that begins in the headwaters. Therefore, we enhanced Forest-wide aquatic and riparian corridor direction and guidance along all perennial, intermittent, and ephemeral streams to better maintain and improve habitat quality for aquatic and riparian-dependant species (Table E - 5). The values of streamside areas are recognized and the Revised Forest Plan directs and guides us to protect, restore or improve functions such as sediment filtering, recruitment of nutrients and large woody debris into aquatic systems, and flood conveyance, storage and ground water recharge.

Table E - 5. Methods for incorporating conservation approaches for site-specific focal species into the alternatives and Revised Forest Plan (RFP).

Conservation Approach	
Promote restoration or improvement of riparian area structure and function	Established the River Corridor and Timbre Ridge Lake management areas. Developed Forest-wide goals and objectives to promote healthy watersheds, and riparian and aquatic ecosystems that sustain ecological processes and functions, and a variety of plant and animal communities, including viable populations of native and desired non-native species (RFP, Chapter 2, Goals 2.1 and 3.1 and associated objectives). Incorporated Forest-wide standards and guidelines to protect aquatic and riparian resources from management activities (RFP Chapter 2, 2.1-WSH; 3.1-ARR; others found throughout Chapter 2).
Maintain herbaceous vegetation or open sunlight conditions (mowing)	Developed Forest-wide goals and objectives to promote healthy terrestrial ecosystems that sustain a variety of plant and animal communities, including viable populations of native and desired non-native species (RFP, Chapter 2, Forest-wide Goal 4.1; Objectives 4.1a, 4.1f, 4.1g). Incorporated Forest-wide standards and guidelines to protect and enhance habitat (RFP, Chapter 2, Forest-wide standards and guidelines WLF- 3 to WLF-13; TES-35).
Maintain open to filtered sunlight conditions (prescribed fire)	Developed Forest-wide goals and objectives to promote healthy terrestrial ecosystems that sustain a variety of plant and animal communities, including viable populations of native and desired non-native species, and to reintroduce fire into fire-adapted ecosystems to conserve biodiversity and promote ecosystem structure and function closer to the historic range of variability (RFP, Chapter 2, Forest-wide Goals 4.1 and 6.2; Objective 6.2a). Incorporated Forest-wide standards and guidelines to protect and enhance habitat (RFP, Chapter 2, Forest-wide standards and guidelines WLF- 2; FIRE-7, 8, 12, 13, and 14).
Maintain open to filtered sunlight conditions (uneven-age or even-aged timber harvest methods)	Incorporated the use of uneven-aged and even-aged timber harvesting methods into several management area prescriptions (see RFP, Chapter 3). Incorporated Forest-wide standards and guidelines to protect and enhance habitat (RFP, Chapter 2, Forest-wide standards and guidelines TES-36).
Maintain closed-canopy forest	Established FOF and FOFM management areas. Incorporated Forest-wide standards and guidelines to protect and enhance habitat (RFP, Chapter 2, Forest-wide standards and guidelines TES-32, 33, and 34).
Manage non-native invasive plant species	Developed Forest-wide goals and objectives to control non-native invasive plant species (RFP, Chapter 2, Forest-wide Goal 7.2; Objectives 7.2a and 7.2b). Provided guidance on non-native invasive species treatment and prevention of spread (RFP, Chapter 2, Forest-wide standards and guidelines WSH-6 and 7; FH-1-3, 8-26).
Manage recreation activities	Numerous Forest-wide objectives and standards and guidelines promote quality recreation opportunities in an environmentally safe manner (RFP, Chapter 2, Forest-wide goals 11.1 and 11.2). Examples include a Forest-wide standard to protect populations of sensitive species by allowing rock climbing and rappelling only at designated sites (RFP, Chapter 2, REC-13) and a Forest-wide objective to reduce adverse effects to species from illegal OHV trails (FRP, Chapter 2, Objective 11.2e).
Education and awareness	Established a Forest-wide goal to collaborate with partners to promote education and conservation (RFP, Chapter 2, Forest-wide Goal 1.1). Developed a Forest-wide objective to use interpretive and education services and programs to develop public interest and understanding of the Forest's natural environment, and educate the public on the safe and legal use of the Forest (RFP, Chapter 2, Forest-wide Objective 11.1c).

Evaluating Effects of Alternatives

In brief, the 1982 regulations [36 CFR 219.19 (a) (1)] require the Forest Service to select "management indicator species" in order to estimate the

effects of each alternative on wildlife. The following types of species were to be considered:

- Species on state or federal endangered and threatened lists for the planning area;
- Species with special habitat needs that may be influenced significantly by planned management programs;
- Species commonly hunted, fished, or trapped;
- Species of special interest; and
- Species believed to indicate the effects of management activities on other species of major biological communities or on water quality.

As part of the planning process, the Forest Service is directed to "select management indicators that best represent the issues, concerns, and opportunities to support recovery of Federally-listed species, provide continued viability of sensitive species, and enhance management of wildlife and fish for commercial, recreational, scientific, subsistence, or aesthetic values or uses. Management indicators representing overall objectives for wildlife, fish, and plants may include species, groups of species with similar habitat relationships, or habitats that are of high concern (FSM 2621.1)."

The process of making a final selection of management indicators that address the 36 CFR 219.19 requirements took into account the limitations of using single species to represent a wide range of habitats and associated species. The concept of indicator species has been used widely, but has been criticized. Some people consider life history requirements of single species to be so complex and unique that they cannot reliably serve as indicator species and reflect the needs or responses of other species (Thompson et al., 1995). The Committee of Scientists (1999) stated that habitat alone cannot be used to predict wildlife populations, however. The presence of suitable habitat does not ensure that any particular species will be present or will reproduce. They suggested that populations of species must also be assessed and continually monitored, and these species will provide information about the integrity of the larger ecosystem to which they belong.

During the development of the 1988 Forest Plan, biologists worked closely with recognized wildlife and fisheries experts to select twenty management indicator species. Appendix B of the 1988 Forest Plan contains a detailed analysis of the relationship of the 1988 management indicators to other vertebrates native to the Forest, which remains valid today. We reviewed the 1988 Forest Plan and annual Forest Plan monitoring reports to evaluate whether or not there was a need to change

management indicator species during the revision process (refer to the Analysis of the Management Situation).

Management Indicators for the Revised Forest Plan

Table E - 6 provides rationale for the selection of management indicators for the Revised Forest Plan. The overall approach we took was to use a limited number of management indicators species, in combination with three management indicator habitats considered to be of special importance for maintaining viable populations of native and desired non-native species in the planning area. By selecting a limited but appropriate set of management indicator species/habitats, resources for inventory and monitoring activity can be focused where needed. Our approach is consistent with 36 CFR 219.14 (f). We placed emphasis on:

- Selecting those that guided the development of the alternatives for the Revised Forest Plan
- The availability of credible monitoring protocols
- Those that can be effectively and efficiently monitored

Eight bird species, in combination with three forest community types or habitats, were selected as management indicators (Table E - 6). Table E - 7 displays the management indicator species used in the 1988 Forest Plan, and describes the rationale for selecting or not selecting these species.

Management indicator monitoring methods should account for situations where population trends of migratory or resident bird populations may respond not only to habitat management activities conducted on the WNF, but also to winter range conditions outside the Forest, weather or climate conditions, hunting pressure, disease, or cyclical phenomena. Because methodologies to determine population numbers and/or estimate trends vary by species, conclusions that relate management indicator species population trends to habitat conditions are also reached through a variety of methods. These include:

- Population trends can be determined through the use of 100-percent population counts or can be estimated through the use of population sampling designed to estimate actual population numbers. Although rarely used, 100-percent population counts can be feasible for some species, such as for populations in very restricted geographic areas. These are the most intensive and rigorous methods, usually reserved for some federally-listed species or some high risk globally-imperiled species selected as management indicators.
- Population trends can be estimated through the use of population indices. Indices are not estimates of actual population numbers, but are aimed at reflecting population trends or relative abundance for

a species. Properly designed population indices are a well accepted method for assessing populations for many taxa. Examples could include state hunting/fishing information, track counts, and bird point counts. Population indices are commonly used in natural resource management.

- Population trends can be estimated using population occurrence data. This approach would be appropriate for a management indicator where the risk to local or broad extirpations is low to moderate (i.e., the cost of making a management decision that would adversely affect the species is low to moderate) and there is high correlation and understanding for a management indicator and its associated habitat(s) (i.e., there is a high likelihood the conclusions regarding population trends would be correct).
- When population data is not available, population trends may be inferred using species-habitat relationships information. This approach involves inferring population trends from trends in amount and condition of habitat over time, based on known relationships between species and habitat.

Site-specific monitoring or surveying of a proposed project or activity area is not required by the NFMA regulations. At the project-level, habitat analysis will be conducted to determine the effects, including cumulative effects, for each alternative on each management indicator selected for the project. The effects to management indicators for the project are put into perspective by discussing forest-wide management indicator species/habitat conditions and trends.

Table E - 6. Management indicators for the Revised Forest Plan and the rationale for selection.

Management Indicator	Habitat	North American Landbird Conservation Plan Ranking*	Rationale for Selection
Oak-hickory Forest	Forest stands dominated by oak and hickory species	N/A	Oak and hickory are considered keystone species in the central hardwood region. A number of species are dependent upon mast production, highly diverse herb layer, bark characteristics, and other structural characteristics of oak and hickory species.
Native Pine Forest	Forest stands dominated or partially comprised of one or more native pine species	N/A	Native pine forest was selected to supplement monitoring efforts of our management activities. Native pine occurs on only a small percentage of the WNF, but provides habitat for certain species.
Early Successional Forest	Forest stands less than 20 years of age	N/A	Approximately 35% of the terrestrial vertebrate species that are known to occur on the WNF use early successional forest habitat during some part of their life cycle. The herbaceous plants and shrubs provide dense cover that is necessary for predator avoidance and they produce a variety of soft mast that is nutritionally important. It is a habitat component that has declined significantly over time on the WNF and in the eastern U. S., and is recognized as a conservation issue in the North American Landbird Conservation Plan.
Pine Warbler	Mature pine and pine hardwood communities	Stewardship Species	The pine warbler relies upon pine habitat for breeding. Pine and mixed pine-hardwood comprises only a minor component of the WNF, yet there are some species that feed, hide or breed in these forest stands.
Pileated Woodpecker	Mature to overmature hardwood forest with snags and coarse woody debris on the forest floor	None	The pileated woodpecker is a primary cavity excavator that relies on the availability of dead and dying trees. The dead and dying trees in a forest community are important for many other species, including the Indiana bat. Many of the species that rely on dead and dying trees are considered cavity-dependant species, and are secretive in nature and difficult to monitor. The pileated woodpecker is a relatively easy species to monitor because of its size, appearance and vocalizations.
Cerulean Warbler	Mature interior hardwood forest with a heterogeneous canopy	Watch List Species	The needs of the cerulean warbler were considered in the development of the DCF and DCFO Management Areas. It requires large tracts of interior forest. It is a canopy nester that is generally associated with uplands and oak-hickory forest on the WNF with gaps in the canopy and taller trees exposed above the canopy.
Worm-eating Warbler	Mature interior hardwood or pine-hardwood forest o hillsides with a dense understory and coarse woody debris on the forest floor	Watch List Species	The needs of the worm-eating warbler were considered in the development of the DCF and DCFO Management Areas. It requires large tracts of interior forest. It is a ground nester that favors mesic areas and ravines on the WNF, but is dependant upon disturbance to create dense understory conditions.
Louisiana Waterthrush	Mature riparian forest corridors along headwater streams; healthy aquatic habitat	Stewardship Species	The Louisiana waterthrush is sensitive to declining stream quality and loss of riparian forest. It was selected as a management indicator species because the taxonomic experts involved in our species viability evaluations indicated this species could reflect stream quality because it relies on aquatic invertebrates for food, and thus may also be an indicator of riparian forest condition. It is an early ground nester, often initiating nesting in March.

Management Indicator	Habitat	North American Landbird Conservation Plan Ranking*	Rationale for Selection
Ruffed Grouse	Mosaic of early-, mid-, and, late-successional forest	None	The ruffed grouse is of great interest to hunters. The needs of the ruffed grouse were considered in the development of the FSM and FSMO Management Areas. Many species rely on the oak-hickory forest during some aspect of their life cycle, and ruffed grouse in the Appalachian states exemplify this in that its population trends may be correlated to oak mast production. It is a species that not only relies on early successional forest for brood rearing; it needs mid and late successional oak forests located near early successional forest for food and cover during part of the year.
Yellow-breasted Chat	Early successional forest habitat	None	The needs of the yellow-breasted chat were considered in the development of the FSM, FSMO and GFM Management Areas. It is an area-sensitive shrub nesting species, meaning it needs larger tracts of early successional forest habitat to successfully reproduce. Managing for shrub nesting birds often is compatible with actions to conserve American woodcock and other game species.
Henslow's Sparrow	Extensive grasslands	Watch List Species	The needs of the Henslow's sparrow were considered in the development of the GFM Management Area. It is area-sensitive and is considered a grassland obligate species. Grassland habitat did not naturally occur within the WNF, but occurs now as a result of past surface mining activities.

* Rich et al. (2004a)

Table E - 7. Disposition of the 1988 Forest Plan management indicator species.

Management Indicator Species	Habitat Component (as defined in 1988 Forest Plan)	Disposition
Pine warbler	Conifers	Maintained as a management indicator.
Pileated woodpecker	Mature hardwoods	Maintained as a management indicator.
Cerulean warbler	Closed-canopied, mature to overmature hardwoods	Maintained as a management indicator.
Ruffed grouse	Early hardwoods	Maintained as a management indicator.
White-eyed vireo	Late succession	Not maintained as a management indicator. Habitat is tracked by the early successional forest, yellow-breasted chat, and ruffed grouse management indicators.
Common yellowthroat	Middle succession	Not maintained as a management indicator. Habitat is tracked by the early successional forest and yellow-breasted chat management indicators.
Field sparrow	Early succession	Not maintained as a management indicator. Habitat is tracked by the early successional forest and yellow-breasted chat management indicators. The field sparrow is not representative of area sensitive species that require early successional forest habitat.
Eastern bluebird	Park like	Not maintained as a management indicator. Habitat tracked by the Henslow's sparrow management indicator. The bluebird is not representative of area sensitive species that require grassland species.
Wood duck	Beaver ponds/oxbows	Not maintained as a management indicator. Habitat tracked by the Louisiana waterthrush and pileated woodpecker management indicators.
Virginia rail	Marsh	Not maintained as a management indicator. This species is rarely detected in southeast Ohio. Similar habitat is required by Blanchard's cricket frog, which is evaluated in the Biological Evaluation as a species proposed for RFSS designation.
Western chorus frog	Fishless ponds in fields	Not maintained as a management indicator. It has been rarely detected during frog and toad monitoring surveys. Similar habitat is required by Blanchard's cricket frog, which is evaluated in the Biological Evaluation as a species proposed for RFSS designation.
Wood frog	Vernal pools in hardwoods	Not maintained as a management indicator. It calls only briefly in the early spring and has a weak call that is difficult to hear. Similar habitat is required by the four-toed salamander, which is evaluated in the Biological Evaluation as a species proposed for RFSS designation.
Bluegill	Artificial impoundment	Not maintained as a management indicator species. The Ohio EPA considers this species moderately tolerant of pollution. Its population trends are artificially manipulated by the Ohio Division of Wildlife to provide recreational fishing opportunities for the public.
Southern redbelly dace	Small stream/intermittent stream	Not maintained as a management indicator. Fish community indices are used rather than single species to assess impacts to aquatic habitat quality. Its habitat is tracked by the Louisiana waterthrush, a species that relies on quality aquatic habitat for its prey. A Forest-wide, long-term aquatic monitoring program is identified as part of the monitoring plan in Chapter 4 of the Proposed Revised Forest Plan. Such a monitoring program would follow standardized protocols to monitor changes to the physical habitat and to biological communities across the WNF.
Redfin shiner	Medium stream with sand/gravel pools	Not maintained as a management indicator. Same as southern redbelly dace.
Blackside darter	Medium stream with silt pools	Not maintained as a management indicator. Same as southern redbelly dace.
Rainbow darter	Medium stream with riffles	Not maintained as a management indicator. Same as southern redbelly dace.
Golden redhorse	Large stream with pools	Not maintained as a management indicator. Same as southern redbelly dace.
Sand shiner	Large stream with sand pools	Not maintained as a management indicator. Same as southern redbelly dace.
Banded darter	Large stream with riffles	Not maintained as a management indicator. Same as southern redbelly dace.