Appendix E
Management Indicator Species Selection Process

The Grand Mesa, Uncompahgre, and Gunnison National Forest Management Indicator Species Selection Process

Using the Region 2 Selection Process and Criteria

March 2005

Guiding Principles

The Region 2, Regional Desk Guide, outlines five principles to guide selection of MIS (Hayward et al 2004). These principles were followed during the selection of MIS for the Grand Mesa, Uncompahgre and Gunnison National Forests.

Principle 1 - Choose MIS to reflect major management issues and challenges.

Principle 2 - MIS function to facilitate evaluation.

Principle 3 - Consider MIS chosen on neighboring planning units.

Principle 4 - Consider whether employing MIS is the best approach to evaluate the management problem.

Principle 5 - Choose an adequate but limited number of species.

The approach represents a shift away from the past emphasis on choosing MIS to represent particular habitats toward an emphasis on the effects of management activities or management challenges. Management indicator species have always been defined to assess management effects, but the array of species selected was driven by a desire to have a representative of each major habitat that occurred on the National Forest. With the focus on management issues or activities, not every habitat will be represented by a MIS.

Selection of management issues/activities to track through monitoring might depend on the "footprint" of an activity (how much land was affected) or the magnitude of the alteration of the environment at the site, but in all cases MIS will be chosen to improve understanding of the consequences of management. Species characteristics that influence selection include status as a listed species, size of home range, strength of habitat associations, migratory habits, population stability, abundance, generation time (or speed of response to habitat change), ease of detection, and relationship to effects other than the management effects, among others. These factors were also evaluated in the GMUG's selection process.

MIS Selection Steps

The following seven steps were used for selecting MIS:

Step 1: Assemble Information About the Planning Area and Species-Habitat Relationships.

In 2003, the GMUG initiated two broad ecosystem assessments; one focused on terrestrial ecosystem current conditions and the other on aquatic, riparian and wetland current conditions. Both assessments are being completed using portions of Region 2 Aquatic, Riparian and Wetland protocol (Winters et. al. 2004) and Development of Terrestrial Ecosystem Current Landscape Assessment protocol (Regan et. al. 2004). Draft and partial results of these assessments are summarized here to provide context for establishing monitoring priorities related to MIS in Step 2 in the selection process. Final assessments will be completed in 2005.

Current vegetation and habitat conditions are presented for each of the five Geographic Areas (GA) being used in revision of the GMUG Forest Plan (Howe, in preparation). Figure 1 displays the Geographic Areas being used in the Forest Plan Revision.

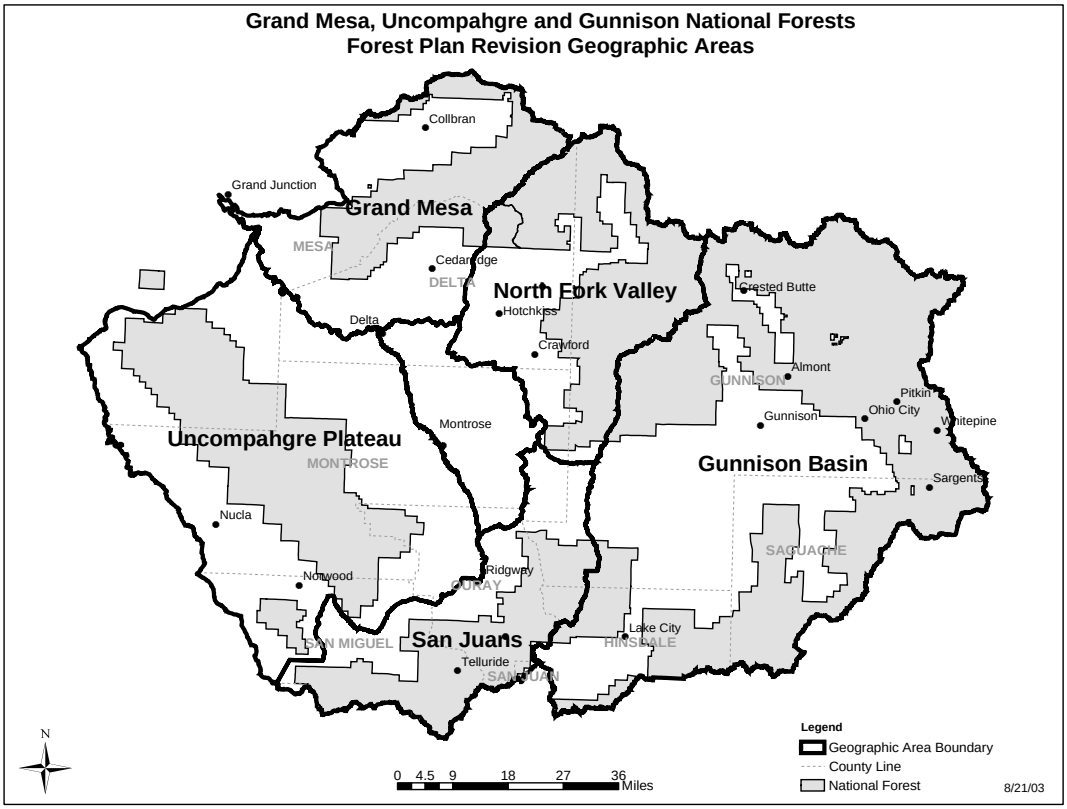

Figure 1. Forest Plan Geographic Areas for the Grand Mesa, Uncompahgre, and Gunnison National Forests.

Terrestrial Current Landscape Condition Assessment

Uncompahgre Plateau GA

Key Findings

- Gambel oak and mixed mountain shrub cover types currently occupy just over a quarter of the NFS lands. Aspen currently dominates a quarter of the NFS lands.
- Conifer forest and woodland cover types (piñon-juniper, ponderosa pine, spruce-fir, Douglas-fir, blue spruce, lodgepole pine) combined make up 38 percent of the current vegetation cover on the Uncompahgre Plateau.
- Most of the spruce-fir, aspen, mixed conifer, ponderosa pine, Gambel oak and mixed mountain shrub cover types within the total Geographic Area occur on NFS lands.
- Most of the piñon-juniper, cottonwood, sagebrush, willow and grass/forb cover types within the total Geographic Area occur off NFS lands on either BLM or private land.
- Current vegetation conditions are a result of the disturbance history on the Uncompahgre Plateau. Large fire(s) in 1879 burned much of the Uncompahgre Plateau Geographic Area. The majority of the forest cover types regenerated following this fire event. This is reflected in the average age of all types (80 to 120 years old), their habitat structural stages (66 percent are in mature size class) and their current seral conditions (the majority of all forest types are in mid seral conditions).
- Reduced extent and frequency of fire resulting from approximately 100 years of fire suppression is reflected in current vegetation conditions, however the impact of fire suppression differs among cover types (e.g. changes are likely more dramatic in ponderosa pine than certain piñon-juniper types). Seventy-one percent of the forest and woodland cover types have dense canopy closures (> 40 % canopy closure). There are relatively few acres of early seral conditions in any cover type on the Uncompahgre Plateau. The potential disparity between expected distributions of cover types and current conditions are most pronounced in cover types that had a history of more frequent fires, such as ponderosa pine, oak-serviceberry and piñon-juniper-oak-serviceberry types.
- When comparing the compositions of current vegetation cover types to Potential Natural Vegetation (PNV) types, it appears that aspen and oak currently occupy more area than would have been expected historically. This is somewhat misleading, however; because aspen and oak are both earlier seral stages to conifer dominated forest types (i.e. spruce-fir-aspen, ponderosa pine-oak), and given time, these deciduous cover types will succeed to conifer cover types.
- Over 80 percent of the spruce-fir, aspen, mixed conifer, and ponderosa pine cover types are within ½ mile of an open road or trail. The vast majority of the transportation related influences are from high clearance roads and foot and/or motorized trails.

Grand Mesa GA

Key Findings

- Aspen and spruce-fir cover types each currently occupy 26 percent of the Grand Mesa Geographic Area. Aspen is also present in 31 percent of the spruce-fir cover type, making aspen the most common tree species on the Geographic Area.
- The large extent of aspen is the result of large-scale fires in the late 1800s (Sudworth 1900) which affected most of the Grand Mesa Geographic Area. As a result, the majority of this geographic area is currently in mid seral conditions.
- Approximately 84 percent of the forest and woodland cover types are in the mature size class.
- There is very little early seral condition in any cover type on the Grand Mesa.
- The composition of current vegetation is very similar to PNV. This characteristic further demonstrates that current vegetation is predominantly mature seral condition.
- Over 80 percent of spruce-fir, aspen, and mixed conifer cover types are within ½ mile of an open road or trail. The vast majority of the transportation related influences are from high clearance roads and foot and/or motorized trails.

North Fork Valley GA

Key Findings

- Aspen is currently the dominant tree species occurring on the North Fork Valley Geographic Area, with stands dominated by aspen occurring on 40 percent of the Geographic Area and stands of aspen mixed with spruce-fir cover types currently occupying 23 percent of the Geographic Area.
- The large extent of aspen is the result of large-scale fires in 1878 to 1879, with less extensive burning occurring in 1883 to 1885 and again in 1890 to 1892 (Sudworth 1900), which affected the northern two-thirds of the North Fork Valley Geographic Area. As a result, the majority of this geographic area is currently in mid seral conditions.
- The majority of the current forest and woodland vegetation conditions – 87 percent - have dense canopy closures (> 40 percent canopy closure).
- When comparing the compositions of current vegetation to PNV, the forest types and bare areas are nearly equal in terms of percent composition.
- Structure and composition in each cover type will continue through successional development. A shift from aspen dominated forests to conifer-dominated forests is occurring as a result of successional changes.
- Over 80 percent of spruce-fir, aspen, and mixed conifer cover types are within ½ mile of an open road or trail. Between 60-80 percent of the piñon-juniper and gambel oak-mixed mountain shrub cover types are within ½ mile of an open road or trail. The vast majority

of the transportation related influences are from high clearance roads and foot and/or motorized trails.

San Juan Mountains GA

Key Findings

- Spruce-fir and aspen cover types currently occupy just over half of the NFS lands in the San Juan Geographic Area.
- Grass/forb types and bare/rock each comprise 19 percent of the San Juan Geographic Area. The majority of these types are in alpine areas (elevations > 11,000 feet), with 56 percent of the grass/forb types and 86 percent of the bare/rock occurring at these elevations.
- The San Juan Geographic Area is dominated by late-mid seral conditions in forest and woodland cover types.
- Approximately 86 percent of the forest and woodland cover types are in late seral condition.
- The lack of recent disturbances (fire, insect and disease mortality, harvest) is also reflected in current forest and woodland vegetation conditions – 85 percent have dense canopy closures (> 40 percent canopy closure).
- When comparing the compositions of current vegetation to PNV, the forest types and bare areas are nearly equal in terms of percent composition. The biggest differences occur in the willow and grass/forb types. Currently the extent of willow is less than would have been common in the past while grass/forb types are more common than would have been expected in the past. These conditions occur in alpine areas and are partly a result of limitations in both the current vegetation and the PNV type data. Additional evaluation is needed to determine if this shift in cover type has a relationship to past management activities, such as livestock grazing.
- Structure and composition in each cover type will continue through successional development. A shift from aspen dominated forests to conifer-dominated forests is occurring as a result of successional changes.
- Over 80 percent of spruce-fir, aspen, and mixed conifer cover types are within ½ mile of an open road or trail. The vast majority of the transportation related influences are from high clearance roads and foot and/or motorized trails.

Gunnison Basin GA

Key Findings

- Lodgepole pine is the most common tree on the Gunnison Basin GA (20%). Lodgepole pine occurs naturally only on the Gunnison Basin GA portion of the GMUG National Forests.
- Aspen is the second most common tree on the Gunnison Basin Geographic Area (14%).

- The large extent of lodgepole pine and aspen is the result of broad-scale fires in the past (Johnston et al 2001). As a result, the majority of this geographic area is currently in mid seral conditions.
- Current vegetation classification shows approximately 46 percent of forest and woodland cover types are in the sapling/pole size class (mostly in the lodgepole pine and aspen cover types), and 53 percent are in mature size class (mostly in the spruce-fir cover type).
- The majority of the current forest and woodland vegetation conditions (87%) - have dense canopy closures (> 40 percent canopy closure).
- Early seral conditions are less common in the GA than would have been expected in the past.
- When comparing the compositions of current vegetation cover types to PNV types, forest vegetation types are approximately equal across the GA. The majority of the GA is in mid seral stages currently dominated by lodgepole pine and aspen, however much of these areas will eventually succeed to spruce-fir and Douglas-fir.
- Structure and composition in each cover type will continue through successional development. A shift from aspen dominated forests to conifer-dominated forests is occurring as a result of successional changes.
- Over 80 percent of spruce-fir, aspen, and lodgepole pine cover types are within ½ mile of an open road or trail. The vast majority of the transportation related influences are from high clearance roads and foot and/or motorized trails.

Aquatic, riparian, and wetland ecosystems condition and trends

A draft cumulative watershed activity assessment was completed for all 6th level watersheds on the GMUG. A total of 223 watersheds was included in the analysis. Six categories of management activities were considered in the Assessment:

- Water uses (e.g. number of diversions and miles of stream affected)
- Transportation (e.g. miles and density of roads and motorized trails)
- Recreation (e.g. presence of developed campgrounds, dispersed camping areas)
- Minerals (e.g. number of mines and streams influenced by mining activities)
- Vegetation manipulation (e.g. acres affected by timber sales, wildlife habitat improvement treatments, etc.)
- Urbanization (e.g. amount of private land in the watershed)

The additive activity assessment grouped watersheds into four activity classes: 1 being least affected by past or current management activities and 4 being most affected.

Of the 223 watersheds, 24% are in class 1 (least) and 20% are in class 4 (most) activity classes. Management activities having the greatest potential to influence aquatic system health were water uses, transportation, and mineral activities. The Grand Mesa is most influenced by water development. Class 4 watersheds in the San Juan Mountain and the Gunnison GA are most

influences by mining and motorized travel. Watersheds on the Uncompahgre Plateau in the highest activity class are most influenced by motorized travel, past timber harvest and recent wildfires. Analysis of grazing related activities were not available for the draft assessment but will be added at a later date. The assessment only provides relative risk at the watershed scale and should not be interpreted as indicating the presence of measurable cumulative effects to aquatic organisms. Limited site/reach scale assessments to identify specific activities affecting aquatic ecosystems conditions and trends have been completed.

Step 2: Establish MIS Monitoring Priorities

This step involves determining the questions that will be answered through designating MIS. Forest biologists identified areas of concern or uncertainty related to management activities and key findings presented in Step 1 in relation to their potential effects on habitat. In addition, the economic and social importance of wildlife resources (i.e. elk and mule deer) on the GMUG and how these species are influenced by forest management activities were also considered. The resulting areas of uncertainty include the following:

- The amount and spatial distribution of dead downed wood and snag habitats as they relate to distribution and abundance of species on the forest.
- The amount and spatial distribution of interior forest habitats and the relationship between these conditions and the distribution and abundance of species on the forest.
- The amount and spatial distribution of late seral forests and the relationship between these conditions and the distribution and abundance of species on the forest.
- Effects of past and current fire suppression on composition and structure of tree and shrub ecosystems and how changes in structure and composition that result from disturbance patterns relate to the distribution and abundance of species on the forest.
- Effects of prescribed fire and mechanical treatments on composition and structure of tree and shrub ecosystems and the consequences for the distribution and abundance of species on the forest.
- Increased risk of insect and disease on forested ecosystems and potential effects of these changes on habitat conditions and trends.
- Potential effects of management activities on aquatic, riparian and wetland habitats. Effects may include but are not limited to, sedimentation from earth disturbing activities, loss of floodplain function due to road fill, loss of movement for aquatic organism due to poorly designed and/or installed stream crossings.
- Potential effects of domestic livestock and wild ungulate grazing on riparian plant communities and resulting impacts on the array of species associated with riparian areas.
- Availability of forage for wildlife following use by livestock.
- Potential influence of roads and trails (use levels and spatial distribution) on wildlife populations.

To focus potential monitoring efforts, the list of areas of uncertainty related to management activities were further refined based upon the relative risk the activity or change posed to species

or habitats and which activities are likely to occur on the Forest in the next planning period. Criteria considered included the potential magnitude and duration of the effect, the amount of area potentially affected, and information (or unresolved debate) in the scientific literature suggesting potential adverse consequences of certain types of management. Other factors considered in this step are whether selection of an MIS will aid in an understanding of management activities and critical environmental conditions that influence species distribution, abundance, and persistence.

The following monitoring priorities were identified as the highest priority management considerations to evaluate as part of the MIS program. To facilitate development of a monitoring strategy, they are presented in the form of a question. All questions relate to meeting Forest Plan direction related to MIS.

1. Are vegetation management activities altering vegetation and habitat conditions in ways that move them toward desired conditions described in the Forest Plan? The absence of fire and other disturbances in forest and shrub ecosystems have resulted in denser vegetation conditions than occurred commonly in the past across large portions of the Forest. This is particularly true in certain cover types with more frequent disturbance regimes (i.e. Ponderosa pine and shrubland communities). When disturbances do occur, either through natural or human causes there is concern that intensities and spatial distributions may be larger than what may have occurred commonly in the past.

2. Is the management of mature to late seral (old growth) forest vegetation sufficient to meet Forest Plan direction for species dependent upon these habitats? Preliminary results of historic range of variation evaluations indicate the current amount of late seral forest cover is less than would have occurred commonly in many areas of the forest. These conditions likely result, in part, from past timber management and fire suppression.

3. Does Forest Plan direction provide for adequate amounts and distribution of habitats isolated from human activities sufficient for species requiring minimal human disturbance? What are the cumulative effects of transportation networks, recreation activities, and other forest management activities on adjacent habitats?

4. Does Forest Plan direction related to the management of roads and trails provide sufficient quantity and quality of habitat for species influenced by the use of transportation networks? Currently over 80 percent of spruce-fir, lodgepole pine, aspen, mixed conifer, and ponderosa pine cover types are within ½ mile of a road or trail.

5. Does Forest Plan direction provide adequate protections to maintain aquatic ecosystem health needed to support aquatic life? Preliminary results indicate that approximately 20% of the 6th level watersheds on the GMUG are in the highest category for cumulative watershed activities which may pose a risk to aquatic organisms from increased sedimentation, changes in channel morphology, blockage of migratory paths (via culverts), etc.

6. Is the amount of domestic and wild ungulate grazing reducing the abundance and structural diversity of plant communities (particularly willow in riparian areas and aspen regeneration) to prevent attainment of Forest Plan direction? The Forest currently permits 290,000 Animal User Months (AUMs) of grazing on the GMUG by cattle and sheep. Elk herds are at or near Colorado Division of Wildlife objectives (2003 population estimate for 11 Data Analysis Units (DAU) on the GMUG is 154,000 animals). These figures include animals that spend part of their time at lower elevations on private and BLM lands. Mule deer numbers are generally below CDOW objectives.

Use of Ecological Indicators versus MIS

The Forest biologists determined that "ecological indicators" for snags and down wood and for riparian plant communities were more appropriate than selection of an MIS to address potential effects of management activities. Standing snags, down woody material and riparian plant communities are extremely important for many, if not most, wildlife species on the Forest. Snag and down woody material are important in all habitat life zones ranging from low elevation piñon-juniper to subalpine forests (e.g. over 40 species of birds and 25 mammals use snags). The current GMUG Forest Plan provides management direction for maintenance of snags and down woody habitats (See Amended Land and Resource Management Plan, 1991: pages III-9b thru III-10). This is consistent with recommendations provided by Hoover and Wills (1984). Selection of an MIS to represent this diversity was determined not to be meaningful or practical. A direct measurement of snags and down woody material is more appropriate to meet our monitoring goals.

Likewise, riparian plant communities occur across all elevational zones and are critical habitats for a wide variety of species. The current GMUG Forest Plan provides management direction for riparian plant communities (See Amended Land and Resource Management Plan, 1991: pages III-173 thru III-188). Current Forest Plan direction requires that riparian ecosystems be maintained in at least an upper mid-seral successional stage (p. III-177). This direction was determined to provide required protection for species dependent upon these ecosystems. Direct measures of riparian plant communities' condition and composition were deemed the best way to evaluate effects from management activities given the goals of our Forest.

A variety of monitoring protocols and/or GIS analysis tools to measure snags, down woody material and riparian plant communities are currently available (i.e. USDA Forest Service - Rangeland Analysis and Management Training, 1996). Any potential updates and/or modifications to this direction will be considered during Forest Plan revision, which is scheduled for completion in 2006.

Step 3: Identify Potential MIS Based on Categories Identified in the Regulations and the Forest Service Manual.

- The 1982 NFMA identifies five appropriate MIS categories. MIS are not limited to species in these categories, and the GMUG process selected candidates primarily for their association with the major activities and/or issues. The following categories from NFMA were all considered federally listed endangered and threatened plant and animal species that occur on the Forest.

- Forest Service sensitive species occurring or suspected on the GMUG.
- Species with special habitat needs that may be influenced significantly by planned management programs.
- Species commonly hunted or fished.
- Non-game species of special interest.
- Species whose population changes may be indicative of the effects of management activities on other species within a selected biological community.

Screening of TES species: The list of threatened, endangered, and sensitive (TES) plant and animal species occurring or suspected on the Forest was reviewed and assessed for advantages and disadvantages as MIS. Detailed rationale for elimination is provided in the analysis file. For plants, a more formal evaluation was conducted (Johnston, 2004). For animals, biologists reviewed the management issues and considered which TES species would be most suitable to evaluate the effects of the management activity/issue. In general the following are the primary reasons why species were eliminated from further consideration.

- Limited habitat on National Forest System Lands.
- Species distribution is primarily off-forest or of limited distribution on Forest.
- Unknown distribution on Forest. No inventories have been conducted for many species.
- Species uncommon or rare on Forest and therefore would be a poor indicator and difficult to monitor.
- Species suspected on Forest, but not confirmed.
- No well established links between management activities and effects to species and/or habitat.
- Based upon Step 2 above, species is not suitable to answer monitoring question(s).

All Federally listed species were eliminated from consideration largely due to being primarily off-forest, rare, or limited suitable habitat on the forest. Ten sensitive animal species were retained for further evaluation for MIS (Table 1).

Table 1. Threatened, endangered and sensitive species potentially suitable as MIS and associated monitoring question(s).

Sensitive Species	**Expected habitat**	**Potential MIS to answer monitoring question(s)**
American marten *Martes americana*	Mature to old mixed conifer, lodgepole and spruce-fir	1, 2, and 3
northern goshawk *Accipiter gentilis*	Mature to old aspen, lodgepole and mixed conifer/aspen stands	1, 2, and 3
Gunnison sage-grouse *Centrocercus minimus*(Candidate*)*	Sagebrush	1
white-tailed ptarmigan *Lagopus leucurus*	Alpine, subalpine willow shrub communities during winter	6
Boreal owl *Aegolius funercus*	Mature to late seral mixed spruce fir and lodgepole pine	1, 2, and 3
flammulated owl *Otus flammeolus*	Mature to late seral aspen and aspen/mixed conifer mix	1, 2, and 3
American three-toed woodpecker *Picoides dorsalis*	Mixed conifer, spruce-fir and lodgepole	1, 2, and 3
purple martin *Progne subis*	Mature to late seral aspen	1, 2, and 3
Brewer's sparrow *Spizella breweri*	Mature sagebrush	1
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*	Aquatic habitats - streams	5

Screening of species commonly hunted or fished:

Species that are commonly hunted or fished were evaluated as potential MIS. Species considered were elk, mule deer, bighorn sheep, black bear, wild turkey, blue grouse, rainbow trout, brook trout and brown trout. Some of these species were eliminated from further analysis because they were 1) a habitat generalist; 2) not widely distributed across the forest in their

preferred habitat, or 3) failed to adequately answer the identified management question. Elk and mule deer, while habitat generalists, were brought forward because they are economically important and are at least partially responsive to the monitoring questions. Table 2 lists the species that were brought forward for further analysis.

Table 2. Species commonly hunted and fished; potentially suitable as MIS and associated monitoring question(s).

Game Species	**Expected habitat**	**Potential MIS to answer monitoring question(s)**
Elk *Cervus canadensis*	Generalist: forested areas in summer; lower elevation in winter	1, 2, 3 and 4
Mule Deer *Odocoileus hemionus*	Generalist: forested areas in summer; lower elevation in winter	1, 3,4 and 6
Common trout (brook, brown, rainbow and cutthroat trout) *Salvelinus fontinalis* *Salmo trutta* *Salmo gairdneri* *Oncorhynchus spp.*	Stream and lakes	5 and 6

Screening of species with special habitat needs potentially influenced by management

Other groups of species considered for MIS are those with special habitat needs that may be significantly affected by management activities. It is assumed that their populations are strongly influenced by key ecological characteristics on which the species depends. Monitoring questions developed in Step 2 were used to identify which habitat types could be affected by management activities that are not already covered by TES species or species commonly hunted and fished. A total of 26 species was considered in this screen. Of the 26 species, 6 species were brought forward for further analysis (Table 3). Major factors disqualifying species for further analysis included 1) not having a well understood life history and a narrow range of habitat requirements; 2) little or no habitat on the GMUG; 3) population changes could not be linked to management activities at the appropriate temporal or spatial scales; 4) species habitat or populations could not be effectively or efficiently monitored or, 5) did not adequately address the monitoring question(s).

Table 3. Species with special habitat needs potentially suitable as MIS and associated monitoring question(s).

Species	**Expected habitat**	**Potential MIS to answer monitoring question(s)**
Abert's Squirrel *Sciurus aberti*	Mature to late seral ponderosa pine	1 and 2
Red-napped sapsucker *Sphyrapicus nuchalis*	Aspen and highly dependent upon infected aspen over 10 dbh.	1 and 2
Warbling vireo *Vireo gilvus*	Mature and late seral aspen	1 and 2
Black throated gray warbler *Dendroica nigrescens*	Piñon-juniper and dry oaks woodlands.	1
Plain (Juniper) titmouse *Parus inornatus*	Mature piñon-juniper, gambel oak.	1 and 2
Virginia's warbler *Vermivora virginiae*	Gambel oak	1

Step 4: Sort potential MIS identified in Step 3, grouped by each important monitoring priority.

Step 5: Review preliminary list of MIS by examining MIS on neighboring units and if MIS is the best approach to evaluate the management activity/issue.

Steps 4 and 5 were evaluated jointly. Species from tables 1, 2 and 3 were grouped by dominant ecosystems on which they depend, management issues and associated monitoring question(s). Biologists then screened each of these species using the following criteria.

- Scientific evidence exists confirming that the species is an indicator for other species or ecosystems they represent.
- Species and/or habitat can be monitored effectively and efficiently using established protocols at the appropriate spatial and temporal scales that are commensurate with management objectives.
- Habitat conditions and trends can be modeled or tracked through GIS using established forest databases.

- The species is sensitive to ecological change.
- Lands administered by the GMUG are important to the life history and persistence of the species.
- The species is indigenous.
- The species is a resident or a local migrant (e.g. migrates across elevation zones).
- Adjacent National Forests are using this species as an MIS thus providing opportunities to share information across a larger landscape.

Results of the screening process are presented below. A spreadsheet documenting this process is available in the project file. Of the 18 species evaluated in the final list, 3 species were affirmed on 7 of the 8 criteria and five species met all 8 criteria.

Species	**Number of criteria met**
Abert's squirrel	8/8
American Marten	8/8
Goshawk	7/8
Plain (Juniper) titmouse	8/8
Gunnison sage grouse	7/8
Brewer's sparrow	7/8
Colorado River cutthroat trout	8/8
Common trout (rainbow, brook, brown and cutthroat trouts)	8/8

Two additional species, mule deer and Rocky Mountain elk were also evaluated due to their economic importance on the Forest. These species are habitat generalists and are somewhat tolerant to changes in their environment. However, elk use in an area is influenced by the number and use of roads and trails in that area, which is one of the primary management activity/issues identified on the Forest. Mule deer is also a species of economic interest and one that has undergone decline since the 1980's (CDOW data, 1980 -2003). Projects have and are proposed to improve mule deer habitat on the GMUG.

Results of MIS Selection Process

It is important to recognize that it is not necessary to select a species for each category or management activity/issue. From the steps above, eight species were selected as MIS (Table 4). The management activity/issue, monitoring question to be answered, and cover type and/or ecosystem affected are also presented. . Gunnison sage grouse was not retained as an MIS because of it's limited distribution (Gunnison Basin) and because Brewer's sparrow was determined to also be a good indicator of shrub dominated and sagebrush habitats.

Table 4. Proposed MIS with rationale for selection. Rationale includes monitoring questions MIS is intended to address, cover type(s) represented, and potential challenges posed by the species as an MIS.

Species Selected	Rationale (Management activity/issue represented, monitoring feasibility, etc.)
Rocky Mtn. Elk	**Rationale for selection:** ▪ Indicator for habitat that is relatively free of human disturbance. Presence of elk is directly related to the availability of sizeable tracts of secure habitat. ▪ Empirical studies demonstrate that Elk movements are strongly related to transportation route density and human use. ▪ Species of high public interest and high economic value (hunting, wildlife viewing). ▪ Responsive to management activities/issues such as vegetation management, and road density and use. Monitoring questions 1 thru 4. ▪ Feasibility of modeling habitat (elk security, cover/forage).Feasibility of monitoring population trends (CDOW data). ▪ Species and habitat can be effectively and efficiently monitored using established protocols. ▪ Wide distribution across Forest; making forest-wide and project level analysis feasible. ▪ May serve as indicator for other species requiring solitude (e.g. Canada lynx). **Potential challenges:** ▪ Species is a habitat generalist and population changes may not always be at the appropriate temporal and spatial scales. ▪ Relating habitat changes to population numbers. ▪ Species is hunted and populations are affected by hunting success, management of private property and climatic changes (drought and severe winter).
Mule deer	**Rationale for selection:** ▪ Primarily chosen as an indicator because of its public interest and high economic value. ▪ Also serves as an indicator species for productivity and condition of early successional vegetation on the Forest particularly on winter range. ▪ Responsive to Management questions numbers 1,3,4 and 6. ▪ Species whose population has declined over the past 40 years and forest management seeks to increase. ▪ Species is dependent upon a variety of habitat types. ▪ Species occurs Forest wide. ▪ Feasibility of modeling habitat. ▪ Easy to monitor populations using CDOW data.

Species Selected	Rationale (Management activity/issue represented, monitoring feasibility, etc.)
Mule deer (cont.)	▪ Feasibility of monitoring population trends (CDOW data). ▪ Species and habitat can be effectively and efficiently monitored using established protocols. **Potential challenges:** ▪ Species is a habitat generalist and population changes may not always be at the appropriate temporal and spatial scales. ▪ Species is hunted and populations are affected by hunting success, management of private property, and climatic changes (drought and severe winter). ▪ Determining habitat management effects as they relate to population trends.
Abert's Squirrel	**Rationale for Selection:** ▪ Species is a good indicator for productive ponderosa pine forest with multiple age classes, especially late seral ponderosa pine. ▪ Responsive to monitoring questions numbers 1 and 2. ▪ Populations demonstrated to be responsive to changes in habitat amount and condition. ▪ Species and habitat can be effectively and efficiently monitored using established protocols. ▪ Existing data being kept and standard protocols are available. ▪ Species not migratory. ▪ Well distributed in ponderosa pine habitats on Forest. ▪ Designated as an MIS on the San Juan and Pike San Isabel National Forests. **Potential Challenges:** ▪ On northern edge of their range suggesting that populations could be influenced by climate and other non-habitat factors to a greater extent than other species.
American Marten	**Rationale for Selection:** ▪ American Marten will act as an indicator for late seral old growth dependent species such as the snowshoe hare, boreal owl, lynx, red-backed vole and some cavity and snag dependent species. ▪ Research shows species has a strong habitat association for mature to late seral spruce-fir, lodgepole pine, and mixed conifer forest types. ▪ Responsive to monitoring questions 1 thru 3. ▪ Populations demonstrated to be responsive to change in quality and amount of habitat. ▪ Species and habitat can be effectively and efficiently monitored using established protocols. ▪ Species is a year-round resident. ▪ Well distributed in spruce-fir, lodgepole pine and mixed conifer

Species Selected	Rationale (Management activity/issue represented, monitoring feasibility, etc.)
American Marten (cont.)	forest types. ▪ Sampling regime to link habitat with population could include presence/absence such as hair sampling, mark recapture, track or photo census. ▪ Used as MIS on San Juan and Pike San Isabel National Forests. **Potential Challenges:** ▪ Presence of suitable habitat does not insure occupation of habitat due to species requirements of habitat size and juxtaposition ▪ May be easier to monitor an index to population abundance rather than habitat in some cases.
Goshawk	**Rationale for Selection:** ▪ Species good indicator for aspen and aspen with conifer understory or mixed conifer forest types. ▪ Responsive to monitoring questions number's 1 thru 3. ▪ Indicator for diverse prey assemblage utilized by numerous forest carnivores. ▪ Species and habitat can be effectively and efficiently monitored using established protocols. ▪ Species is not a long distance migrant. ▪ Fairly well distributed in aspen and aspen/conifer stands on Forest. ▪ Habitat and presence/absence information already exists in forest databases. ▪ Utilized as an MIS on the San Juan National Forest. **Potential Challenges:** ▪ Species uses other habitats besides aspen (i.e. spruce-fir, lodgepole and ponderosa pine). ▪ Presence of suitable habitat does not insure occupation of habitat due to species requirements of habitat size and juxtaposition. ▪ May be easier to monitor an index of population abundance rather than habitat in some cases.
Brewer's sparrow	**Rationale for Selection:** ▪ Species good indicator for mature healthy sagebrush habitats, which are in decline in lands on and surrounding the forest. ▪ Responsive to monitoring questions number 1. ▪ Populations demonstrated to be responsive to change in habitat amount and condition. Species and habitat can be effectively and efficiently monitored with established and accepted protocols. ▪ Well distributed and abundant in sagebrush habitats. ▪ Used as an MIS on the White River National Forest. **Potential Challenges:** ▪ Populations have been declining. ▪ Habitat on the Forest is vulnerable to climatic changes (i.e. drought) and potential management activities (i.e. prescribed fire).

Species Selected	Rationale (Management activity/issue represented, monitoring feasibility, etc.)
Brewer's sparrow (cont.)	▪ Linking habitat changes to changes in the presence of the species. ▪ Species migrates (winters in Mexico), which limits detection from mid-May thru July which could confound interpretation of local patterns.
Plain (Juniper) titmouse	**Rationale for Selection:** ▪ Species good indicator for late-seral piñon-juniper, Gambel oak and mixed woodland habitat types. ▪ The presence of the Plain Titmouse is a component of the extent and condition and quality of a healthy piñon-juniper and Gambel oak ecosystems. ▪ Responsive to monitoring questions number's 1 and 2. ▪ Populations demonstrated to be responsive to change in amount and condition of habitat. ▪ Species and habitat can be effectively and efficiently monitored with established and accepted protocols. ▪ Well distributed in habitats on Forest. **Potential Challenges:** ▪ Can be difficult to observe.
Common trout (cutthroat trout, brook trout, rainbow trout, and brown trout)	**Rationale for Selection:** ▪ As a group, common trout is a good indicator of instream habitat conditions and secondarily to ecological status of riparian vegetation as it relates to maintaining channel morphology and cover. ▪ Using 'common trout' as a group minimizes the influence of competition between trout species on population abundance unrelated to Forest Service management (e.g. cutthroat typically decline in the presence of brook trout). ▪ Responsive to monitoring questions number 5 and 6. ▪ Populations demonstrated to be responsive to change in habitat amount and condition. ▪ Species and habitat can be effectively and efficiently monitored using established protocols. ▪ Well distributed in stream and lake habitats. ▪ Elevational migrants only. ▪ Used as an MIS on the Rio Grande National Forest. **Potential Challenges:** ▪ Influence of climate and fishing harvest. ▪ In some cases, brook, rainbow and brown trout may have to be reduced to expand populations of Colorado River cutthroat trout.

Step 6 - Prepare MIS Report Documenting Selection

The following discussion provides a summary why the species was selected, known habitat associations, management influences, and potential responses to change resulting from management activities.

Rocky Mountain Elk:

The GMUG supports the largest populations of elk occupying National Forest lands in Region 2. The Forest actively manages habitat for elk in cooperation with the state and the species represents an important economic resource in western Colorado.

Elk were selected to answer monitoring questions 1, 2, 3 and 4. Elk were primarily selected as an economically important species that the Forest actively manages in cooperation with the state. Movement, condition, and abundance of elk are influences by management actions carried out by the Forest Service. Elk were also selected as an indicator to represent potential response of species that require areas of habitat relatively undisturbed by humans.

Elk use of an area declines as road densities or other human related disturbances increase. Elk require a wide range of habitats from early successional stage forage to dense stands of mature timber for hiding and thermal cover. Elk are generalist feeders being both grazers and browsers. Grasses, shrubs, and aspen are important winter forage components. In some areas of Colorado 77-90% of the summer diet is composed of grasses and browse constitutes 56% of the winter diet (Boyd 1970). Forest wide habitat for Rocky Mountain elk includes most habitat types for a total of 3,103,088 acres of potentially suitable elk habitat. The GMUG National Forest contains at least a portion of 11 elk Data Analysis Units (DAUs). Population estimates for these DAU's (DAU 51 estimates were not available) in 2003 totaled 154,290 animals.

Several Forests within the Region have selected elk as an MIS, largely due to public interest in the species (e.g. viewing, hunting) and the amount of research conducted on Forest Service management activities in relation to elk population management. In addition, Forests emphasize habitat improvement projects for elk such as prescribed burns, and road closures. Elk habitat management on the Forests can directly affect elk distributions and hunter success, and carries significant economic importance to surrounding communities.

A dominant concern for both State and Forest Service biologists is the lack of elk security habitat on National Forests, primarily where high road densities have led to changes in elk distribution and/or herd composition. Elk commonly retreat to secure areas, defined as areas of cover away from roads, during periods of stress (Hillis et.al.,1991). Stress on elk often begins prior to summer archery hunting seasons and continues through fall hunting seasons, though general dispersed recreation may also cause stress (Dave Freddy, personal communication). This can cause a shift in elk use away from the National Forest and other public lands, where high road densities may occur, to private lands where access is limited or controlled. The shift from public to private lands during and following hunting seasons constrains efforts to achieve desired hunter harvest. These constraints on harvest, limits the manager's abilities to meet harvest objectives. It is for this reason that elk are often selected as MIS, as assumptions are made that other species must similarly need secure habitats where human disturbance is minimized and adequate cover is provided.

Road densities and cover attributes are often manipulated in response to timber management and other activities on the Forests. Examples of high road density associated with poor hunter success, low bull: cow ratios, and reduced elk presence have been shown in several studies (Jellison 1997). Road density was selected as an indicator of overall elk security due to its association with habitat condition and elk use of an area.

Mule Deer:

The GMUG supports one of the largest known populations of mule deer occupying National Forest lands in Region 2. The Forest actively manages habitat for mule deer in cooperation with the state and the species represents an important economic resource in western Colorado.

Mule deer were selected to answer monitoring questions 1, 3, 4 and 6. On the GMUG National Forests mule deer were selected because they are a species of high public interest and economic value.

Mule deer are a medium-sized ruminant of the cervid family found throughout the state of Colorado. They can be found from high alpine tundra, montane zones, foothills and shrublands to the plains and prairies. Though considered a browser, mule deer use grasses and forbs as part of their diet. Mule deer use hundreds of different plants and shrubs for forage. They require high quality forage to survive and reproduce successfully.

Some mule deer are migratory, moving to summer and winter ranges annually. Others are resident, remaining on the same range year round. The GMUG National Forest contains at least a portion of 11 deer DAU's. Data indicates an overall decline in mule deer numbers across DAU's that include the GMUG N.F. since the early1980's. However, from 1993 - 2002 the population appears to be relatively stable.

Several Forests within the Region have selected the Mule Deer as an MIS, largely due to public interest in the species (e.g. viewing, hunting) and the amount of research conducted on Forest Service management activities in relation to mule deer population management. In addition, there is a lot of emphasis placed on habitat improvement projects in Region 2 and more specifically on the GMUG. Deer habitat management on the Forests can directly affect mule deer distributions and hunter success, and carries significant economic importance to surrounding communities.

Abert's Squirrel:

Abert's squirrel were selected to answer monitoring questions 1 and 2. Specific to these questions, Abert's will be an indicator to determine the effects of management activities on ponderosa pine forest types. Abert's squirrel ecology demonstrates that their abundance is highest in productive Ponderosa pine forests that include late-seral forest components and a broad range of organisms that result from natural distrubances of these ecosystems. Therefore, because of the challenges of defining and measuring the wide range of habitat characteristics important to animals that utilize Ponderosa pine, Abert's was selected as an indicator of productive Ponderosa pine with late-seral forest elements.

Abert's squirrel is a large tree squirrel with strong habitat associations with late-seral Ponderosa pine. Some evidence indicates the species was more common in the past than present however, long-term trends in Abert's squirrel populations have not been measured or monitored.

Populations experience decline if severe weather and heavy snow cover persists for extended periods in the ponderosa pine ecosystems. Abert's squirrels rely on the ponderosa pine tree for most of their life requirements (e.g. seeds from cones, inner bark as an energy source, canopy cover, etc.). Good squirrel habitat contains open un-even aged stands with clusters of even aged groups of large trees connected by canopy corridors to provide secure travel routes.

A large proportion of the habitat should contain late seral ponderosa pine. The Abert's squirrel is considered a Management Indicator Species on several other Forests in southern Colorado and is considered a demand game species in Colorado where it is also hunted. Resident Abert's squirrels do not move long distances. Home ranges vary from 2-27 hectares. Patton (1985) noted that home ranges increased two-fold as a result of logging in one study. This has a detrimental effect on the population. Preferred foods are pine seeds and false truffles (hypogenous fungi), which can be high in calories and protein. Forest management activities such as certain types of logging, certain types of grazing, and large, intense fires reduce the amount and quality of habitat, which in turn, reduces the abundance of squirrels (Patton, 1985). Patton also found higher squirrel densities existed on un-logged stands than on logged forests in Arizona. Numbers were greatest where larger trees (30-74 cm dbh) were most abundant, probably because larger trees produced more cones and cover than small trees.

Harvesting of habitat is detrimental because of the altering of the habitat structure. Patton has developed a scoring method to evaluate habitat quality (Patton 1985). Monitoring protocol exist that allow for efficient and cost-effective monitoring.

American Marten:

America Marten was selected to answer monitoring questions 1, 2 and 3. Specifically to these questions, marten will be an indicator of the effects of management activities on late seral spruce-fir, lodgepole, and mixed conifer forest types.

Marten are primarily animals of dense, old forest with a complex structure of understory and downed wood. Late-successional multi-storied stands of spruce-fir forest are preferred, though multistoried lodgepole (usually with invading sub alpine fir) and other forest types with downed wood are also used. High quality Martens habitat is associated with relatively dense forests with canopy cover of at least 30%. A complex arrangement of downed wood (large logs, tangles of smaller material, root wads, downed trees with branches) provides habitat for prey, cover from predators, dens, resting sites, and entry to subnivian habitat (Thompson and Harestad, 1994). Squirrel middens, hollow logs, cavities in snags, and rock piles are used for dens (Ruggiero, 1994). Partially arboreal, marten hunt and rest in trees, in cavities and on mistletoe brooms (Bull, et.al. 1997).

Martens appear to respond negatively to fragmentation (including perforated patterns) at the scale at which logging typically occurs on National Forest Service. Marten populations declined to near zero when 25% to 30% of a watershed was logged (Bissonette, et. al., 1997), a decline that would not be expected until 60% of the mature forest was logged if the animals were responding to habitat loss alone. Where forest is fragmented by regeneration timber harvest, a marten must occupy a larger area to include adequate forest habitat in its home range.

Both habitat based and distribution (presence/absence) monitoring protocols for marten are available for use (Ghormley and Lockman, 2003). Habitat type and structural condition of

habitats are primary factors related to occurrence of the species, which can be effectively and efficiently monitored.

The Northern Goshawk:

Northern goshawk were selected to answer monitoring questions 1, 2 and 3. Goshawk will be an indicator of the effects of management activities on aspen and aspen with mixed conifer forest types. Specifically to these forest types, goshawk is used to evaluate the effects of altering structural conditions required for nest areas, post-fledging areas and foraging areas. Goshawk will also indicate potential affects of management on prey species utilized by goshawk and other forest carnivores.

On the GMUG, over 90% of the documented nest sites occur in aspen or aspen with mixed conifer forests -100 out of 110 nests (LeFevre, 2004). In the Uncompahgre Plateau and portions of the San Juan GA's nest trees most often occur in pure aspen stands while in the Grand Mesa, North Fork and Gunnison GA's nest trees are most often associated with old to mature aspen/mixed conifer stands.

Effects of forest management activities on goshawk include habitat alteration to nesting; post-fledging areas and foraging areas from timber harvest, altered stand condition resulting from past and current fire suppression and human disturbance (Kennedy, 2003). The quality of habitat influences the overall fitness of goshawk, nesting success and productivity, degree of fidelity to breeding area and mate, size of home range and population density of both goshawk and prey species (Reynolds et al. 1994). Forest management activities that alter the structure, function and quality of nesting and post-fledging areas can reduce nesting success (Kennedy, 2003). Goshawk forage in areas with specific structure attributes, including old or mature forest stands with open understories, relatively high canopy closure, large trees and high stem densities (USFWS, 1998). These structural conditions provide optimal habitat for goshawks preferred prey species. Prey utilized by goshawk on the GMUG include ground squirrel, thirteen line ground squirrel, rabbit, red squirrel, chipmunk, blue grouse, and various old forest dependent birds (LeFevre 2004). Since goshawk is believed to be food limited (Reynolds et al. 1992), management activities that alter habitat for their prey, and thus the number of prey species available, should be reflected in the numbers and distribution of goshawks. Thinning and fragmentation of mature forests may also provide better habitat for early successional species such as red-tailed hawks and great-horned owls (Woodbridge and Detrich, 1994). Both species have been documented to prey on goshawk nestlings and occasionally adults and have displaced goshawks from historic nest sites (LeFevre, 2004 and Jackson pers. com.).

Both habitat condition and species distribution (presence/absence) monitoring protocols for goshawk are available and accepted.

Brewer's Sparrow:

Brewer's sparrow was selected to answer monitoring question number 1. Specifically to this question, Brewer's will be an indicator of the effects of management activities on sagebrush shrubland habitats.

This species is a sagebrush obligate, and has experienced population declines as the sagebrush cover type throughout its range has decreased. Most other species associated with sagebrush

(such as sage sparrow and sage grouse) have experienced population declines, which are believed to be largely due to loss of sagebrush by human and natural causes.

Brewer's sparrows are tightly associated with sagebrush shrublands that have abundant, scattered shrubs and short grass; they prefer areas dominated by shrubs compared to areas dominated by grass (Paige and Ritter 1999). They will thrive best where sagebrush is maintained in tall, clumped, and vigorous stands (Paige and Ritter 1999). Brewer's sparrows are more likely to occur on sites with high shrub cover and large patch size, and generally stands that are greater than 5 acres. They will breed in high densities where they occur, usually being the most abundant bird species in that immediate habitat area. However, population densities have been observed to decline on plots on which coverage of sagebrush has been reduced, either through experimental manipulation or by wildfire (Rotenberry et al. 1999). Breeding territories average between 1.5 and 3.0 acres (0.63 to 1.25 ha), contracting as densities increase (Paige and Ritter 1999). Brewer's sparrows prefer to build an open cup nest placed in large, live sagebrush.

The migratory Brewer's sparrow nests only once each season with annual fluctuations in nesting schedules due to weather; clutch size is typically 3-5 eggs. Analysis of breeding bird surveys (BBS) provides context for analysis at finer scales but is more appropriate for examination of trends for larger scale areas such as forest-wide or state-wide trends. Monitoring information from the NA Breeding Bird Surveys indicates population and trends are down over the years.

Species distribution monitoring protocols are available through the North American Breeding Bird surveys, Monitoring Colorado Birds program and from Ralph, et. al. (1995). Habitat monitoring protocols are available and accepted.

Plain (Juniper) Titmouse:

Plain (Juniper) titmouse was selected to answer monitoring questions 1 and 2. Specifically to these questions, titmouse will be an indicator of the effects of management activities on Gambel oak and piñon-juniper woodland habitats.

The Plain titmouse is a resident of deciduous or mixed woodlands, favoring oak and piñon-juniper (Enrlich et al. 1988). The titmouse usually nests in natural cavities or old woodpecker holes, but is capable of excavating its own cavity in rotten wood. The species feeds primarily on insects, seeds and occasional fruits. As a cavity nester, large older trees are an important habitat feature. The mechanical removal of piñon-juniper and wildfires has a very negative effect on titmouse habitat and populations. The encroachment of piñon-juniper into meadows, sagebrush stands and other openings has positive influence on titmouse habitat. The most significant management activity in the Southwest that altered or destroyed titmouse habitat was the plowing and chaining of piñon-juniper woodlands to create forage for livestock grazing. The titmouse is a year-round resident in most of the mild winter areas of piñon-juniper woodlands in Southwest Colorado. Monitoring information from the NA Breeding Bird Surveys indicate population and trends are slightly down over the years.

Species distribution monitoring protocols are available through the North American Breeding Bird surveys, Monitoring Colorado Birds program and from Ralph, et. al. (1995). Habitat monitoring protocols are available and accepted.

Common trout (Cutthroat, Brook, Brown, and Rainbow):

Selection of common trout as an MIS addresses monitoring for water quality, aquatic habitat, and riparian vegetative conditions. Particularly, as it relates to inchannel habitat and presence of mid to late seral riparian vegetation, sediment loads, dissolved oxygen, and a macro-invertebrate prey base.

Nonnative salmonids (i.e. brook, brown and rainbow trouts) have been widely introduced since 1900. These nonnative fish have a dramatic affect on native salmonids like Colorado River cutthroat trout when they exist in sympatry (occurring in the same area). In many areas of the interior west, Colorado River cutthroat trout have been effectively replaced by nonnative salmonds -primarily brook trout (Young, 1996). Rainbow and nonnative subspecies of cutthroat trout readily hybridize with Colorado River cutthrout trout and can produce fertile offspring. Many scientists believe this biotic interaction with nonnative salmonids is one of the primary reasons for decline of Colorado River cutthrout trout (Young 1996).

Because these biotic interactions with nonnative fish have such a dramatice influence on distrubution and abundance of Colorado River cutthroat trout, the Forest chose to lump common trout as a group for purposes of MIS. Furthermore, the array of trout provide a mechanism for addressing managenment issues Forest-wide because, as a group, the taxa occur throughout much of the Forest. Protocols to monitoring habitat conditions and trends have been developed and are in use on the GMUG. Population estimates and population trend data are available from CDOW.

Step 7 - Conduct a Review of the MIS Selection Process and Report

Proposed MIS were discussed with Ted Schenck and reviewed by Greg Hayward, Region 2 Wildlife Ecology Program Leader, and comments/suggestions were incorporated as appropriate.

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