CHAPTER 5

MONITORING AND EVALUATION

Monitoring and evaluation provide information to determine whether programs and projects are meeting Forest Plan direction, and whether the cost anticipated to implement the Forest Plan coincides with actual costs. Monitoring and evaluation is required by NFMA implementing regulations *(36 CFR 219.12(k))* to determine whether requirements of the regulations and Forest Plan are being met.

This Chapter establishes Monitoring Questions that are to be answered over the course of Forest Plan implementation. Monitoring questions address whether the desired conditions, goals and objectives of the Forest Plan are being met and whether Forest Plan standards are effective. Monitoring Questions are part of the Forest Plan and are stated in terms that will direct what will be monitored, but are not so specific as to address how monitoring will be accomplished.

Monitoring Questions will be further refined during Forest Plan implementation into Monitoring Elements and Task Sheets, which are more detailed, specific and measurable than the Monitoring Questions themselves. Monitoring Elements and Task Sheets may be modified and prioritized to guide monitoring activities over the course of Forest Plan implementation. The Monitoring Summary Table and sample Task Sheet (Appendix G) demonstrate the relationships between Forest Plan Goals, Objectives, Standards and Monitoring Questions, and indicate the nature of Monitoring Elements and monitoring details that are to be further developed during Forest Plan implementation. The Monitoring Summary Table and sample Task Sheet are presented here only for information and may be modified as needed to address changes in needs, priorities, availability of personnel and funding.

The concept of adaptive management is foundational for planning and Forest Plan implementation in a dynamic environment. Regulations require that Forest Plans be revised periodically *(36 CFR 219.10(g)).* However, Forest Plans may need to be more dynamic to account for changed resource conditions (such as large storms or insect outbreaks), new information or findings of science, or new regulations or policies. An effective monitoring and evaluation program is essential for determining when these needs may exist and facilitating quick resolution of a need for change.

The Monitoring Questions were developed to address three types of monitoring:

- Implementation monitoring – addressing whether the Forest Plan is being carried out
- Effectiveness monitoring – dealing with whether desired conditions are resulting
- Validation monitoring – to determine if information used in developing the Forest Plan has changed

MONITORING AND EVALUATION

Monitoring and evaluation provide information that can be used to keep Forest Plans current. Key results and findings will be used to determine if changes are needed in goals, objectives, standards, the monitoring questions themselves or research needs.

MONITORING QUESTIONS

Monitoring and evaluation are distinct activities. The monitoring phase generally includes the collection of data and information, either by observation, direct measurement or compiling data from appropriate sources. Evaluation is the analysis of this data and information, and is used to assess if the Forest Plan is being implemented correctly and whether it needs to be changed. Forest Plan Monitoring and Evaluations will be reported annually in the Forest Monitoring and Evaluation Report.

Monitoring and evaluation may lead to adjustments of programs, projects, or activities or to changes or amendment to the Forest Plan itself. Alternatively, they may be used to recommend changes in laws, regulations, and policies that affect both the Forest Plan and project implementation (FSM 1922.7).

Forest Plan amendments and revisions should be responsive to changes that affect the Forest Plan, and may be needed at any time if a Forest Plan becomes out of date in some way. Within an adaptive management framework, the need to amend or revise the Forest Plan may result from:

- Recommendations of an interdisciplinary team, based on evaluation and monitoring results
- Changes in agency policy and regulations
- Planning errors found during Forest Plan implementation
- Changes in physical, biological, social, or economic conditions

The evaluation of findings under the following Monitoring Questions will lead forest managers to these determinations.

MONITORING QUESTIONS

1. Are rare ecological communities being protected, maintained, and restored?

A Forest Plan goal, along with related objectives and standards, are designed to maintain and restore rare communities. To monitor accomplishment of these provisions and the effects that overall Forest Plan implementation will have on rare communities, trends in the number of occurrences, locations and conditions, and effects of maintenance and restoration activities will be tracked.

2. Are landscape- and stand-level composition, structure, and function of major forest communities within desirable ranges of variability?

Success in maintaining and restoring composition, structure, and function of forest ecosystems within desired ranges of variability is reflected by both changes in forest condition and by levels of management and other effects that are shaping these communities. Monitoring will include tracking the abundance of major forest cover and/or community types and levels of management activities conducted to maintain and restore desired conditions. Trends in occurrence and habitats of Management Indicator Species will be monitored to help indicate effects of national forest management within selected communities.

Table 5- 1. Species Selected as Management Indicators of Composition, Structure, and Function of Forest Communities

Indicator	Reasons for Selection
Hooded Warbler (*Wilsonia citrina*)	Selected to help indicate the effects of management on species associated with mature mesic deciduous forest. The species is closely associated with bottomlands and moist deciduous forests with fairly dense understories. It is relatively effectively monitored.
Red-cockaded Woodpecker (*Picoides borealis)*	Federally-listed T&E species is highly responsive to habitat changes induced through active forest management. It is effectively monitored. It serves as an indicator of the effectiveness of management in maintaining mature pine forests in open conditions.
Field Sparrow (*Spizella pusila*)	Selected to help indicate the effects of management on species associated with woodlands, savannas, and grasslands. It is associated with frequently burned open habitats, as well as habitats with scattered saplings or shrubs in tall weedy or herbaceous cover. It serves as indicator of the effectiveness of management efforts to restore and maintain these communities. It is effectively monitored.

3. Are key successional stage habitats being provided?

Forest goals, objectives, and standards have been established for maintaining a balance between the early, mid-, and late-successional habitat conditions. Some wildlife species depend on early- successional forests, while others depend on late-successional forests. Trends in successional conditions and abundance of key successional habitats, such as high-elevation early-successional habitat, mature forest interiors, old growth, and permanent wildlife openings, will be monitored. Trends in occurrence of Management Indicator Species selected to help indicate effects of management on successional habitats will be monitored.

Table 5- 2. Species Selected as Management Indicators of Successional Habitats

Indicator	Reasons for Selection
Prairie Warbler (*Dendroica discolor*)	Selected to help indicate the effects of management on species associated with early successional forest. The species is closely associated with this habitat. It is relatively effectively monitored.
Chestnut-sided Warbler (*Dendroica pensylvanica*)	Selected to help indicate the effects of management on species associated with high elevation early successional forest. It is effectively monitored. It serves as an indicator of the effectiveness of management in maintaining this habitat.
Acadian Flycatcher (*Empidonax virescens*)	Selected to help indicate the effects of management on species associated with mature riparian forest. It is closely associated with mature deciduous forest along streams and bottomland hardwoods. It serves as indicator of the effects of management on this community. It is effectively monitored.

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MONITORING QUESTIONS

Indicator	Reasons for Selection
Ovenbird (*Seiurus aurocapillus*) – Chattahoochee NF; Wood Thrush (*Hylocichla mustelina*) – Oconee NF	Ovenbird is selected to help indicate effects to species associated with forest interior in the mountains. It is strongly associated with mature forest interior and is common enough to effectively monitor. Wood Thrush is selected to help indicate effects to species associated with forest interior in the Piedmont. It is closely associated with forest interior and is common enough to effectively monitor.
Scarlet Tanager (*Piranga olivacea*)	Selected to help indicate the effects of management on species associated with mature upland oak communities. It is closely associated with this community and is effectively monitored.
Swainson's Warbler (*Limnothlypis swainsonii*) – Oconee NF	Selected to help indicate the effects of management on species associated with canebrakes, tangles, and thick shrubby understories, and open bottomland hardwoods and mixed forests. It is correlated with forested riparian areas with fairly closed canopy and dense undergrowth. It is relatively easily monitored.
Pine Warbler (*Dendrioca pinus*)	Selected to help indicate the effects of management on species associated with pine and pine-oak forests. It is closely associated with forests with some pine component and is an indicator of the effects of management in restoring and maintaining pine forests. It is effectively monitored.

4. How well are key terrestrial habitat attributes being provided?

Special habitat attributes such as hard and soft mast, den trees, snags, and downed wood are necessary elements for certain species. A variety of Forest Plan goals, objectives, and standards provide for the protection, restoration, and maintenance of these elements. Trends in the abundance and condition of key terrestrial habitat attributes and associated Management Indicator Species will be monitored.

Table 5- 3. Species Selected as Management Indicators of Key Terrestrial Habitat Attributes

Indicator	Reasons for Selection
Pileated Woodpecker (*Dryocopus Pileatus*)	Selected to help indicate the effects of management on maintaining the desired condition relative to the abundance of snags. This species requires large snags for nesting and feeding. The occurrence of this species is correlated with forested habitats containing abundant large dead trees and fallen logs, habitat components also used by a variety of other species.

5. What is the status and trend of aquatic habitat conditions in relationship to aquatic communities?

The Forest Plan provides for protection and restoration of riparian ecosystems, wetlands, and aquatic systems and for assuring that aquatic habitat conditions are suitable to maintain native aquatic communities. Conditions and trends in the overall health of streams will be monitored as well as water quality parameters and physical conditions of the aquatic habitats.

6. What are status and trends of forest health threats on the forest?

Measures designed to control or mitigate negative effects of insects, diseases, native and nonnative invasive species, air pollution, and high fuel levels are important aspects of this Forest Plan. Trends in occurrence and effects will be monitored.

7. What are the status and trends of federally-listed species and species with viability concerns on the forest?

Contribution to conservation and recovery of federally-listed threatened and endangered species is an important goal of this Forest Plan. Trends in occurrence or abundance of these species will be monitored, along with levels of management activities implemented for the purpose of achieving recovery. Some threatened and endangered species have been selected as Management Indicator Species because of their critical dependence on national forest management for recovery.

Table 5- 4. Monitoring for Threatened and Endangered Species

INDICATOR	REASONS FOR SELECTION
Red-cockaded Woodpecker (*Picoides borealis*)	Trends in populations of this species will be used to help indicate effectiveness of management activities designed specifically to meet recovery objectives for this species. (See also Monitoring Question 2.)
Smooth coneflower *(Echinacea laevigata)*	Trends in populations of this species will be used to help indicate effectiveness of management activities designed specifically to meet recovery objectives for this species.

Maintaining habitat capable of supporting viable populations of native and desired non-native species is also an important goal of the Forest Plan. Many objectives and standards are designed to meet this goal. Monitoring will focus on selected plant and animal communities and species as determined by priorities set through periodic reviews.

8. What are the trends for demand species and their use?

The Forests provide large public ownership with opportunities for hunting, fishing, wildlife viewing, and collection of special forest products. Monitoring of some game species populations and/or harvest levels are done in coordination with the Georgia Department of Natural Resources. Some of these species are selected as Management Indicator Species where effects of national forest management are important to meeting public demand. Some species that are collected as special forest products will be monitored through management of the permitting process.

Table 5- 5. Demand Species Selected as Management Indicators

Indicator	Reasons for Selection
Black Bear, White-Tailed Deer	Selected to help indicate the effects of management in meeting public demand for these species. These are commonly hunted species and monitoring will be in conjunction with Georgia Wildlife Resources Division

MONITORING QUESTIONS

9. Are high quality, nature-based recreation experiences being provided, and what are the trends?

The Forests offer a unique combination of nature based dispersed recreation, including undeveloped settings, built environments reinforcing natural character, and wildland settings that complement enjoyment of special places. The Forest Plan attempts to provide for safe, natural, well-designed, accessible, and well-maintained recreational opportunities for all visitors. Monitoring will include structured surveys to check visitor experiences as well as tracking changes in facilities, trails, visitor safety, and accessibility.

10. What are the status and trends of recreation use impacts on the environment?

This Forest Plan is committed to providing recreational opportunities that are compatible with stewardship of forest resources. Site condition surveys will be used to monitor the effects of recreation use across a variety of settings.

11. What is the status and trend of wilderness character?

Wilderness character is comprised of both human and biophysical elements. Monitoring the human elements requires monitoring trends in the human experiences, i.e. solitude, crowding, etc., as well as trends in the use patterns and visitor impacts. User surveys and trailhead data will allow for tracking trends among visitors. Monitoring physical elements is important for tracking changes to the natural systems due to natural and human influences within and outside the wilderness. Although there are many components to the physical element, air quality is viewed as a basic indicator of wilderness health. Additionally, changes that are occurring in wilderness due to the fire regime, especially in fire dependent communities, will be monitored.

12. What are the status and trends of Wild and Scenic River conditions?

The two main elements in determining the eligibility and suitability of a river for inclusion in the National Wild and Scenic Rivers System are a free-flowing condition and the presence of Outstandingly Remarkable Values. Rivers determined to be eligible (or eligible and suitable) that have not yet been designated by Congress must have those elements protected until a further designation is assigned. Monitoring changes to these elements will help us evaluate our management of these rivers on our forests.

13. Are the scenery and recreation settings changing, and why?

Scenery and recreational settings are managed by establishing management direction for Scenic Integrity Objectives (SIO) and Recreation Opportunity Spectrum (ROS) classes. Management of scenery and settings are essential in the management of recreational experiences and the quality of the environment. Changes in scenic quality of the forest and the recreation settings will be monitored.

14. Are heritage sites being protected?

Compliance with the National Historic Preservation Act is essential during implementation of this Forest Plan. The requirement that sites eligible for the National Register of Historic Places be identified and protected before ground disturbing activities occur must be met. Monitoring will be done to assess how well sites are being identified for protection and whether site protection measures are effective in preventing site loss.

15. Are watersheds maintained (and where necessary restored) to provide resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support intended beneficial uses?

This Forest Plan provides for management of watersheds to provide resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support intended beneficial water uses. Numerous best management practices are established as standards for practices to be carrying out during implementation of the Forest Plan. Monitoring will review implementation and effectiveness of Forest Plan Standards in protecting soil and water resources.

16. What are the conditions and trends of riparian area, wetland and floodplain functions and values?

Riparian ecosystems restoration and management is important to maintain aquatic resources and values. Desired conditions, including the composition and structure of vegetation, equipment limitations, maintaining ground cover and stable stream-banks are established in the Forest Plan. Floodplains and wetlands are to be protected. Riparian management practices and standards, ground cover, stream-bank stability, wetland and floodplain status will be monitored.

17. How do actual outputs and services compare with projected? *[36 CFR 219.12(k)1]*

The 1982 NFMA implementing regulations require that outputs and services will be monitored and compared to those projected in the Forest Plan. Trends in forest products, mineral leasing and surface rights, access and road conditions, Forest Plan implementation costs, and special uses will be tracked and compared to projections made at the time the Forest Plan was developed.

18. Are silvicultural requirements of the Forest Plan being met?

The 1982 NFMA implementing regulations also require monitoring of specific silvicultural requirements. Silvicultural practices, regeneration establishment, harvest methods, harvest unit size, and land suitability for timber production will be monitored and evaluated to determine if and when changes may be needed.

19. Are Forest Plan objectives and standards being applied and accomplishing their intended purpose?

Periodic review of objectives and standards established in the Forest Plan is called for to assure that desired condition are being achieved and that these requirements will stay current given Forest Plan modifications, changed conditions and new information that accumulate over time. Implementation and effectiveness of objectives and standards will be tracked and periodically evaluated.

RESEARCH NEEDS

RESEARCH NEEDS

The Forest Service Research Branch is the largest forestry research organization in the world and a national and international leader in forest conservation. Agency research contributes to the advancement of science and the conservation of many of our Nation's most valuable natural resources, both on private lands and the National Forests. Research needs identified during planning, monitoring and evaluation are to be included in formulating overall research programs and plans for Forest Service Research to support or improve management of the National Forests.

Research and monitoring are related activities that help to meet information needs for adaptive management of national forests. Research involves rigorous study under controlled conditions, following the scientific method. Forest Service research activities include study planning, design, quality control, peer review and relatively rigid publication standards. Monitoring is generally conducted under less controlled conditions and results are often more general in contrast with research.

Research needs for management of the National Forests are to be identified during planning and periodically reviewed during monitoring and evaluation of implemented Forest Plans *(36 CFR 219.28)*. Research needs identified while monitoring the implementation of the Forest Plan will be reported in Annual Monitoring and Evaluation Reports. At its inception; however, the plan can identify areas of concern that can be the subject of "research needs."

There is a need for more information on the appropriate buffer corridor for a physiographic area or zone given the goals and objectives of managing riparian area ecosystems. We need to know more about how we can best determine the effectiveness of riparian corridor buffers to meet the intent of management. Research is extant relative to sediment and nutrient loading/temperature but other functions and values in the riparian area are not as well studied. One example is large woody debris recruitment. Another is the amount and characteristics of large woody debris as habitat both within streams and on their banks. Recreation impacts on water quality and riparian areas, specifically OHVs and equestrian use, are topics for which more information is needed. Responses of riparian-associated species to catastrophic natural effects as well as periodic events like moderate to severe drought also need to be better understood.

Forest management actions have also been studied for years and will be the subject of monitoring and evaluation under this plan. Specifically; however, the effects of tree cutting and the use of prescribed burning on some Threatened and Endangered species habitat use and their distribution and abundance could bear further research. For example, can management create habitat niches that will be successfully occupied, expanding the population and distribution of T&E species? Effects of prescribed burning, particularly growing season burns, on invertebrate diversity and abundance should be researched.

It could be helpful to more fully understand the market dynamics of wood products that have a very large procurement area of several hundreds of miles or even international markets. It may be that very carefully targeted sale strategies could generate large revenues from low intensity harvest.

Threatened and endangered species research is needed to fully understand their ecological relationships. For plants, information on soil nutrient status, moisture regimes, light regimes, genetics, pollinating species, vectors for seed dispersal, germination and

growth conditions, and so on would all help to design practices to conserve the species and expand their population and area occupied.

The correlation of modern human recreational use of the forest to pre-historic use would be an interesting light on how humans relate to the land and how technology may have changed that. It could also provide some ability to predict the locations, nature, and extent of recreational impacts on cultural resources generally or even of specific eras.

Specific case studies are needed for the feasibility of operational use of remote sensing to reduce costs while maintaining or increasing quality of resource data. For example, a remote sensing application to determine the extent of privet, a nonnative invasive species, could provide rapid assessment of the problem and prioritized response.

Models of the forest capability to provide various types of recreation to specified quality standards are needed to position the national forest on the recreation setting continuum and to know how much recreation opportunity can be provided in total.

Localized air quality data is needed. Initially this may be more of an inventory need but once localized data is available it may lead to research on how and why it changes. Of particular interest would be research to fill in any data gaps on how the Forest Service affects air quality under various environmental conditions. (SAMAB Rpt. 3, Pg. 63)

The latest genetic knowledge needs to be used to continue to work to restore American chestnut to the Southern Appalachians. If seedlings were to be available, guidance for out-planting; site selection, site preparation, and so on will be needed.

Research is needed for biological control agents of pests of all kinds. The public prefers these to pesticides of all kinds. Research is also needed to ensure that biological controls do not themselves become pests. In particular, public acceptance or rejection of genetically engineered organisms in order to achieve disease resistance needs to be studied. For example, is there a public consensus that restoration of chestnut is more important than purity of its genetic makeup?

Research of several types is needed to help develop a consensus answer of just what “restored” conditions would be for any community or process being restored. Field tools and techniques are needed to select restoration community types, their structure, their composition, and to plan for them to be sustained on the landscape. When reference sites are used, research help may be needed to select them, or to compile data across reference sites in a comparable way.

For future cycles of revision, it appears that existing tools need to be extended to be full ecological succession models capable of forecasting long-term consequences of action or inaction. Better understanding is needed about the development of old growth and how long it is likely to maintain itself. Growth and yield projections need to include natural catastrophic events and accelerated mortality with age.

Research is needed on practical low-cost remote automatic monitoring systems that can give near-continuous feedback for critical needs. Public acceptance or rejection of such technology needs to be investigated.

A refined ability to project demands for goods and services such as (water, utilities, roads and public facilities) in Georgia is needed to stay ahead of urban pressures. In particular, the Forest Service may find itself struggling not to become a city park; that is, to find a recreational niche appropriate to the Forest Service mission and one that can be maintained in the face of mounting pressures.

RESEARCH NEEDS

Research help may be needed to validate and refine a GIS-based rare communities model by collecting data at rare community locations in order to improve the predictive capability of the model.

Research help may be needed to localized fire/fuels models used in fire behavior programs. Specifically, the conditions under which green fuels become available needs to be better understood. Predicted fire behavior of lightening ignitions in different fuel and weather conditions and without active suppression needs to be better understood.

The operational old growth definitions need to be validated with a robust set of data to examine the range of variability compared to old growth parameters. Old growth community definitions need refined based on such analysis.

Research is needed on self-policing, self-reporting systems (e.g., incentive-based reporting) as a monitoring tool such as web-based voluntary data submission. Why will people submit data we may need? How can we design systems to reliably obtain data? How do we validate who is reporting and who is not, and adjust results accordingly?

A GIS-based, semi-automated riparian area delineation model is needed that will accurately map and quantify riparian area size, shape, and extent. From this basis, a predictor of characteristics is needed to serve as a management tool to meet resource needs.

A localized sediment production model is needed that will assess public and private land conditions and produce results to base prioritization of effort and expenditure to get the greatest return for the investment.

Research is needed to develop and test forest health models that produce a dynamic hazard rating and reflect change through time as an aid to making better decisions before crises occur.

Research help may be needed to develop a model that relates FIA, CISC, GIS, TNC (NatureServe) plant association and other vegetation data into inter-active systems.

Research help may be needed to refine estimates of particulate matter concentrations down-wind of prescribed burns in order to comply with EPA air quality constraints. (SAMAB Rpt. 3, Pg. 64)

Quantitative estimates of neo-tropical migratory breeding bird population response to management actions are needed to refine and improve habitat objective amounts and distributions.

There is a need to better understand the natural dynamics of amphibian populations and behavior in response to the drying up of intermittent and perennial streams in drought years, partial or complete canopy removal whether by natural events or managed change, changes in water nutrient status, changes in leaf litter depth following burning, and changes in large down woody material volume and condition both within and outside the riparian area.