Chapter 6. Monitoring and Evaluation

Grassland monitoring near Chino Valley

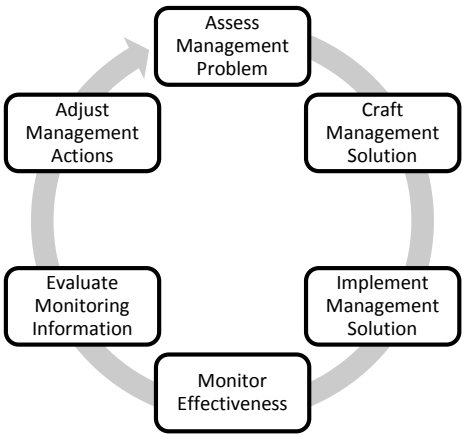
Introduction

Monitoring and evaluation are separate and sequential activities required by National Forest Management Act regulations to determine how well the plan is working. Monitoring involves collecting data by observation or measurement. Evaluation involves analyzing and interpreting monitoring data.

The general purpose of monitoring is to detect changes or trends in a resource. Detection of a change or trend may trigger a management action, or it may generate a new line of inquiry. Monitoring data is most useful when the same methods are used to collect data at the same locations over time. It is important to note that cause and effect relationships usually cannot be demonstrated with monitoring data, but monitoring data might suggest a cause and effect relationship that can then be investigated with a research study.

Monitoring and evaluation activities provide ongoing feedback about management effectiveness and are essential elements of an adaptive management cycle that includes problem identification, solution, and implementation (figure 4). Monitoring and evaluation activities keep direction found in the plan up-to-date and relevant by being responsive to changing conditions and issues, including public desires, and to new information, such as research results or outcomes from management activities.

Figure 4. Elements of an "Adaptive" Management Cycle



Monitoring Strategy

A strategy for plan monitoring and evaluation has been designed to answer these three basic questions:

1. **Did we do what we said we were going to do?** The answers to this question should tell us how well the direction in the plan is being implemented. Collected information is compared to objectives, standards, guidelines, and management area direction.
2. **Did it work how we said it would?** The answers to this question should tell us whether the application of standards and guidelines is achieving objectives, and whether objectives are achieving or moving toward desired conditions.
3. **Is our understanding and science correct?** The answers to this question should tell us whether the assumptions and predicted effects used to formulate the desired conditions and objectives are valid.

The following guiding principles are key elements of the Prescott NF's monitoring strategy and serve as a framework for implementing an effective monitoring and evaluation program:

- Monitoring efforts are efficient, practical and affordable; take into consideration the best available science; and do not duplicate the collection of data already underway for other purposes.
- Monitoring tasks are scaled to the desired condition, objective, or management area direction to be monitored. Data that is collected for other purposes, but can also answer monitoring questions herein, are identified, compiled, and evaluated as part of the monitoring report.
- Monitoring considers effects of management on Forest Service lands and resources as well as adjacent lands and communities. Monitoring results from adjacent non-Forest

Service lands are reviewed to identify how threats and resources may be crossing boundaries, and how pressures and management of surrounding lands may impact resources or activity on National Forest System lands.

- Opportunities to complete monitoring and evaluation activities through partnerships and citizen collaboration are examined on a regular and ongoing basis.
- Monitoring is not performed on every single activity, nor does it need to meet the statistical rigor of formal research.
- A monitoring action plan is prepared initially and updated regularly. The monitoring action plan identifies and schedules various site-specific, on-the-ground monitoring activities. It also describes the methods, locations, responsible persons, and estimated costs. Budgetary constraints may affect the level of monitoring that can be done in a particular fiscal year. If budget levels limit the Prescott NF's ability to perform all monitoring tasks, then those items specifically required by law are given the highest priority (e.g., items in table 5 under theme 1).
- A monitoring and evaluation report is prepared using an interdisciplinary approach that summarizes the results of completed monitoring and evaluates the data for indicators of trends or effects.
- The forest supervisor evaluates the monitoring information displayed in the evaluation reports through a management review and determines if any changes are needed in management actions or the plan itself.
- The public is given timely, accurate information about plan implementation and effectiveness. This is accomplished through the release of a forestwide monitoring and evaluation report.

The specific monitoring questions and performance measures that should be used to evaluate movement toward plan desired conditions under this monitoring strategy are displayed below in table 5 and arranged according to six monitoring themes:

1. Legally Required Monitoring
2. Conserving Biological Diversity
3. Retaining Ecosystem Resilience
4. Maintaining Watershed, Soil, and Air Quality
5. Sustaining Recreational and Social Benefits
6. Maintaining Infrastructure Capacity

In some cases, the monitoring questions and performance measures directly assess accomplishment of desired conditions. In other cases, they gauge objectives or standards and guidelines associated with the desired conditions.

For each monitoring question/performance measure listed in table 5, additional monitoring descriptors are included to provide context for the type of information to gather during monitoring and how often to gather it. These descriptors are defined here:

- **Frequency of Monitoring:** Describes how often information is gathered or measured such as annually, every 2 to 4 years, or every 10 years.
- **Data Precision and Accuracy:** Precision refers to how close the repeated measurements of the same quantity are to each other. Accuracy is a measure of how close a measurement is to the actual value of the variable being measured.

Two categories of reliability are appropriate at the plan scale:

- **Class A:** Methods generally are well accepted for modeling or quantitative measurement. Results have a high degree of repeatability, accuracy, and precision.
- **Class B:** Methods or measurements are based on project records, personal communications, ocular estimates, pace transects, informal visitor surveys, and similar types of assessments. The degree of repeatability, accuracy, and precision are not as high as class A methods, but they still provide valuable qualitative information.

~~Evaluation and Reporting of Monitoring Information~~

~~Provisions of the 1982 Planning Rule were followed in developing this plan, including the direction that information gathered through plan monitoring is to be evaluated and reported on an annual basis. However, the 2012 Planning Rule includes a requirement that monitoring strategies developed under the provisions of a prior planning regulation are to be modified to meet the 2012 Planning Rule's new monitoring requirements on or before May 9, 2016 (36 CFR 219.12(c)(1)).~~

~~Transitioning to the new monitoring requirements at 36 CFR 219.12(a)(5) may result in changes to elements of this plan monitoring program (table 5) such as the frequency of monitoring or how often evaluation reports are published. New monitoring questions and indicators may be added. Changes to this plan monitoring program will be made only after notice to the public of the proposed modification, and an opportunity for public comment (see 36 CFR 219.7(f) and 219.13(c)).~~

Commented [PNF1]: Removed. This is specific to the 1982 Rule provisions and the transition to the 2012 Planning Rule.

Table 1. Monitoring Questions

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
Theme 1 – Legally Required Monitoring ~~(from the 1982 Planning Rule, Section 219)~~				
~~Comparison between estimated and actual plan objectives (Section 219.12(k)(1))~~ Progress toward meeting the desired conditions and objectives in the plan. (Section 219.12(a)(5)(vii))	Are we achieving plan objectives within the estimated ranges?	Proportion of objectives accomplished	Annually	A
~~Plan objectives, standards, and guidelines (Section 219.12(k)(2))~~ The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land. (Section 219.12(a)(5) (viii))	Are the effects of forest management resulting in significant changes to the productivity of the land?	Changes in watershed condition class (6th level hydrologic units)	Annually	A
~~Comparison of actual and estimated costs of activities estimated in plan objectives (Section 219.12(k)(3))~~	~~How close are projected costs with actual costs?~~	~~Dollars~~	~~Every 10 years~~	~~A~~
~~Lands not suited for timber production (Section 219.12(k)5(ii))~~	~~Have areas classified as unsuited for timber production become suitable?~~	~~Amount of unsuited versus suitable acres~~	~~Every 10 years~~	~~A~~
~~Maximum size of openings from even-aged management (Section 219.12(k)5(iii))~~	~~What percentage of openings created from even-aged management are 40 acres or less?~~	~~Percentage of harvest units~~	~~Every 4 years~~	~~A~~
~~Destructive insects and disease[1] (Section 219.12(k)5(iv))~~	~~To what extent are undesirable outbreaks of insects and pathogens occurring within the plan area?~~	~~Acres of infestation and tree mortality~~	~~Annually~~	~~A~~

Commented [PNF2]: Removed. This question is specific to the 1982 Rule provisions.

Commented [PNF3]: Removed. This question is specific to the 1982 Rule provisions.

Commented [PNF4]: Removed. This question is specific to the 1982 Rule provisions.

Commented [PNF5]: Moved to Theme 3 – Retaining Ecosystem Resilience

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
~~Population trends of the management indicator species[2] (MIS) in relation to habitat changes (Section 219.19(a)(6))~~ Status of focal species[1] to assess ecological conditions due to management actions (Section 219.12(a)(5)(iii)).	~~As a proxy for population, what are the trends in habitat for MIS within the plan area?~~ What is the habitat occupancy of focal species in response to management actions within the plan area?	~~MIS habitat attributes; MIS occurrence and distribution~~ Focal species habitat attributes; focal species occurrence and distribution	~~Annually~~ Every 1-5 years, depending on species	A

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
Theme 2 – Conserving Biological Diversity				
Vegetation diversity (Obj-1, Obj-2, Obj-3, Obj-4, Obj-5, Obj-6, DC-Veg-1)	What are the current condition and trend of key characteristics for vegetation identified in the desired conditions for the plan area? How effective are management actions at maintaining or making progress toward desired conditions for the key characteristics of vegetation within the plan area?	Vegetation size class, percent canopy cover, and composition; carbon stored in vegetation; acres of treatment by treatment type	Every 4 years	A
Species diversity (Obj-1, Obj-2, Obj-3, Obj-4, Obj-5, Obj-6, Obj-25, Obj-26, Obj-27, Obj-28, DC-Ecosystem Resilience-1,DC-Wildlife-1 to 2)	To what extent are management activities providing ecological conditions to maintain habitat for ~~viable~~ populations of terrestrial native and desired nonnative species?	Habitat acres treated; miles of fence modified; number of water developments improved; species surveys (e.g., fish, reptiles and amphibians, breeding birds, bats)	Every 2-4 years, depending on species	A

[1] The transition to the new monitoring requirements at 36 CFR 219.12(a)(5) resulted in some changes to this plan monitoring program. The Management Indicator Species (MIS) used to compare and evaluate the plan alternatives were replaced and supplemented with four focal species: northern goshawk, western scrub-jay, western meadowlark, and aquatic macroinvertebrates.

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
Aquatic species (Obj-24, DC-Aquatic-1, DC-Aquatic-3)	Are management actions maintaining or making progress toward desired habitat conditions for native fish, amphibian, and aquatic reptile species?	Aquatic habitat quality; stream miles improved	Every 2-4 years, depending on species	A
Species Conservation (DC-Ecosystem Resilience-1)	Have ~~conservation~~ recovery actions ~~or conservation strategies~~ for federally listed species ~~and~~ or conservation strategies for regionally sensitive species[2] been implemented?	Number of plans or actions initiated	Every 2-4 years, depending on species	A
	What are the habitat trends for federally listed species on the Prescott NF?	Habitat attributes		
Theme 3 – Retaining Ecosystem Resilience				
Nonnative invasive plant species (Obj-6, DC-Ecosystem Resilience-1,DC-Veg-1)	What are the status and trend of areas infested by invasive plant species?	Acres of invasive species surveyed; acres of infestation treated	Annually	A
Destructive insects and disease (DC-Ecosystem Resilience-1)	To what extent are undesirable outbreaks of insects and pathogens occurring within the plan area?	Acres of infestation and tree mortality	Annually	A
Fire (Obj-1, Obj-2, Obj-3, Obj-4, Obj-5, DC-Airshed-1, DC-Ecosystem Resilience-1,)	Are management actions moving fire regimes toward desired conditions?	Acres treated by fire severity level and frequency	Annually	A
	To what extent is wildland fire used to maintain desired fuel levels and vegetation characteristics? To what extent is unwanted wildfire on the landscape suppressed?	Acres of fire managed for multiple objectives; acres of unwanted fire suppressed; postfire fuel loadings		

Commented [PNF6]: Moved from Theme 1 – Legally Required Monitoring

[2] Under current direction, the Prescott NF has chosen to consider regionally sensitive species to be species of conservation

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
	To what extent is prescribed fire used to maintain desired fuel levels, mirror natural processes, and/or restore desired vegetation characteristics?	Acres of prescribed fire by fuel type; postfire fuel loadings; vegetation species structure and density		
	Has the risk for active crown fire been sufficiently reduced in fire-adapted ecosystems where crown fires were not frequent occurrences historically?	Predicted fire behavior by fuel type/loading		
	To what extent are extreme weather patterns (e.g., precipitation and air temperature) affecting fire season length and severity?	Monthly/daily energy release component (ERC) estimates by fuel type		
Ecosystem resilience (DC-Ecosystem Resilience-1)	What management actions, measures, or decisions is the Forest Service taking to enhance ecosystem resilience or adaptation in response to changing environmental conditions?	Project level design features or mitigations	Every 2 years	A

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
	What interacting stressors [3] are impacting the plan area? How are these stressors trending, and how are these trends affecting the plan area?	Project level identification of measurable changes resulting from climate change Monthly energy release component (ERC) estimates by fuel type Acres of unwanted wildfire Acres of infestation and tree mortality Acres of invasive species surveyed Visitor use trends	Annually	A
Theme 4 – Maintaining Watershed, Soil, and Air Quality				
High priority watersheds (Obj-18)	Are management actions being implemented to improve watershed conditions?	Number of projects implemented	Annually	A
Watershed features (Obj-19, Obj-23)	Are management actions being implemented to improve conditions of at-risk riparian areas, seeps, and springs?	Number of projects implemented	Annually	A
Watershed Conditions (Obj-20, Obj-21, Obj-22, Obj-31)	Are management actions being implemented to reduce negative impacts to watershed conditions?	Miles of repaired or improved roads, routes, or trails	Annually	A
		Number of improved drainage crossings, stream channels, and floodplains.	Annually	A
Airshed conditions (DC-Airshed-1)	Are management activities contributing or responding to air	Particulate matter ($PM_{2.5}$) recorded at smoke sensitive sites	Annually	A

[3] Interacting stressors may include fire, insects, invasive species, loss of spatial connectivity, disruption of natural disturbance regimes, geologic hazards, water withdrawals and diversions, and changes in social, economic, and cultural conditions, among others.

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
	quality effects on human health or human enjoyment? Are air quality related values (e.g., visibility) of the Sycamore Canyon and Pine Mountain Wilderness areas being maintained?	Visibility using Interagency Monitoring of Protected Visual Environments (IMPROVE) program	Annually	A
Theme 5 – Sustaining Recreational and Social Benefits				
Diverse recreation opportunities (Obj-8, Obj-10, Obj-13, Obj-14, Obj-16, DC-Rec-1, DC-Rec-Trails-2)	How many new recreation opportunities have been added to the system? How many recreation sites or locations have been improved, relocated, or decommissioned in response to known resource damage?	Number of facilities or dispersed sites	Every 2 years	A
	Does the number of recreation opportunities limit overcrowding, reduce user conflicts, and minimize resource damage? Does the range of recreation opportunities consider population demographic characteristics and desires of the local communities?	Visitor use trends, recreation impact assessments, user satisfaction surveys (e.g., National Visitor Use Monitoring)	Every 4-6 years	A
	To what extent are visitor information opportunities/ education activities being provided to the public?	Number and type of visitor information and education activities	Annually	B

Action, Effect, or Resource to be Measured	Monitoring Question	Performance Measure	Monitoring Frequency	Data Reliability
Wild and scenic rivers (DC-Wild & Scenic-1)	Has there been adequate protection of outstandingly remarkable values (ORVs) of wild and scenic river segments that are eligible or designated?	Changes to ORVs	Every 4-6 years	B
Wilderness areas (DC-Wilderness-1)	Has there been adequate protection of wilderness characteristics of areas that are existing wilderness or recommended for wilderness designation?	Changes to wilderness character	Every 4-6 years	B
Land adjustment (DC-Open Space-1, DC-Lands-1, Obj-29, Obj-31)	To what extent is the Prescott NF land adjustment program supporting or enhancing plan desired conditions (e.g., open space, scenery values, historic access)?	Area of land adjustment that meets community open space needs and provides for natural resource values	Every 4-6 years	B
Theme 6 – Maintaining Infrastructure Capacity				
Roads, trails, and facilities (Obj-9, Obj-11, Obj-12, Obj-15, Obj-17) (DC-Rec-Trails-2, DC-Transportation & Facilities-1)	How many miles of the designated roads and trails are maintained to standard?	Miles of roads and trails	Annually	A
	How many developed and designated recreation sites are being maintained?	Percentage of sites maintained	Annually	A
	What proportion of trailheads and wilderness boundaries are adequately signed or marked?	Percentage of total trailheads; miles of wilderness boundary	Annually	A

[1] ~~This item also meets the monitoring intent of theme 3, "Retaining Ecosystem Resilience."~~
[2] ~~The list of 10 MIS found in the 1987 plan was reviewed and, based on recommendations from forest specialists, modified. The following three MIS were used to compare and evaluate the plan alternatives: pronghorn antelope, northern goshawk, and aquatic macroinvertebrates~~