

Chapter 4. Forest Plan Monitoring

Introduction

Monitoring forms the basis for continuous improvement of the forest plan and provides information for adaptive management within the plan area. The forest plan monitoring program enables the responsible official to help determine where and when changes are needed in the forest plan.

The forest plan monitoring program measures management effectiveness and assesses progress toward achieving or maintaining the forest plan desired conditions and objectives through a set of monitoring questions and associated indicators. These are designed to inform management of resources in the plan area, including testing relevant assumptions, tracking relevant changes, and measuring management effectiveness. By using appropriate indicators that can be measured, observed, or described over time, management actions can be evaluated to determine if they are trending conditions toward the anticipated results. Not every plan component will have a corresponding monitoring question or indicator because monitoring in the plan monitoring program is focused on priority management questions and related core information that are achievable within the financial and technical capability of the Sequoia National Forest.

The plan monitoring program is just one piece of the monitoring that occurs within the Forest and region; project and activity monitoring, and resource or species monitoring conducted by other agencies and organizations may inform the plan monitoring program and adaptive management of the plan. To address plan monitoring program questions and associated indicators that can best be answered at a broader geographic scale than one plan area, the regional forester has developed a broader-scale monitoring strategy. The intent of the broader-scale monitoring strategy is to inform decision-making regarding the effectiveness of the forest plan, within the context of an all-lands approach, and realize efficiencies by coordinating similar monitoring across units, integrating agency protocols, and leveraging partner and adjacent landowner monitoring work.

The monitoring program outlined in the following pages considers the 2014 science synthesis,⁴⁵ 2014 bio-regional assessment,⁴⁶ and 2013 forest plan assessment.⁴⁷ Existing national and regional monitoring programs, like the Forest Inventory and Analysis National Program, the National Visitor Use Monitoring Program, the current forest plan monitoring, remote sensing data techniques, and ongoing monitoring with the states contribute to the plan monitoring program data sources. Monitoring is also coordinated with other Forest Service program mission areas (such as Forest Service State and Private Forestry and Research and Development), other Federal and State agencies, Tribes, partners, and the public.

Forest-level monitoring information will be collected every year for many, but not all, monitoring questions. The collected information will be evaluated on a biennial basis. The first evaluation report is anticipated no later than 2 years after the effective date of the forest plan decision. This biennial

⁴⁵ Long, Jonathan W.; Quinn-Davidson, Lenya; Skinner, Carl N., eds. 2014. Science synthesis to support socioecological resilience in the Sierra Nevada and southern Cascade Range. Gen. Tech. Rep. PSW-GTR-247. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 723 p.

⁴⁶ USDA Forest Service. 2014. Final Sierra Nevada Bio-Regional Assessment. Management Bulletin R5-MB-268. Vallejo, CA. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region

⁴⁷ USDA Forest Service. 2013. Final Sequoia National Forest assessment. Management Bulletin R5-MB-267. Vallejo, CA. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region.

evaluation includes information gathered through this plan monitoring program and may include relevant information from the Pacific Southwest Region's broader-scale monitoring strategy. A written report of the evaluation will be made available to the public. The evaluation will identify if changes may be warranted to the plan, plan monitoring program, management activities, or assessment. Where frequency of monitoring is longer than 2 years, evaluation of that information will be made in the next biennial evaluation. For example, a data collection program that takes place once every 5 years, will then be included in every third evaluation report.

The plan monitoring program contains one or more monitoring questions and associated indicators addressing each of the following topics required under the 2012 Planning Rule (36 CFR 219.12(a)(5)):

1. Status of select watershed conditions.
2. Status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
3. Status of focal species to assess the ecological conditions required under the Code of Federal Regulations, specifically 36 CFR 219.9.
4. Status of a select set of ecological conditions required under 36 CFR 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
5. Status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
6. Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple-use opportunities.
8. Effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).

Some monitoring questions and associated indicators may address more than one of these required topics. The entire plan monitoring program must be within the financial and technical capability of the Sequoia National Forest, augmented by broader-scale monitoring by the Pacific Southwest Region and other monitoring with partners. Version 1.0 of the Broader-scale Monitoring Strategy was finalized in 2020 and is available on the Pacific Southwest Region's Planning website and from the Regional Monitoring and Adaptive Management Coordinator.

The plan monitoring program for the Sequoia National Forest is presented below in a set of tables, each related to one of the eight required topics previously listed. Monitoring questions for terrestrial ecosystems and aquatic ecosystems are presented in separate tables. It should be noted that monitoring to inform one of the eight required topics can also be used to inform another topic. For example, information from the at-risk species topic (number 4) could be used in the evaluation of ecological conditions/key characteristics of aquatic ecosystems (number 2). In the tables, each row represents a single monitoring question and associated indicators used to respond to a selected desired condition or objective. The desired conditions are generally complex statements that cannot be fully monitored. Therefore, the monitoring questions and associated indicators focus on some core aspect of the desired condition related to the required monitoring item and that are practicable to be monitored. Details of the plan monitoring program—including monitoring and analysis protocols, data collection schedules, responsible parties, and data management—will be part of a separate monitoring guide.

Monitoring Program

Watershed Conditions

These monitoring questions and their associated indicators are related to water resources and watershed conditions in the forest plan area.

Table 13. Monitoring questions and associated indicators that evaluate watershed conditions

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
WS01	WTR-FW-DC-03	To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?	Watershed Condition Framework classification

Terrestrial Ecosystems

A select set of ecological conditions is monitored for terrestrial ecosystems. The monitoring questions and indicators are selected to measure the effectiveness of the forest plan to maintain or restore ecological conditions for key ecosystem characteristics associated with composition, structure, function, and connectivity.

Table 14. Monitoring questions and associated indicators that evaluate conditions for terrestrial ecosystems

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
TE01	TERR-OLD-DC-02	To what extent are the old-forest areas approaching the natural range of variation?	-- Proportion of area with large trees --Number of large trees and snags per acre by forest type
TE02	TERR-MONT-DC-03 TERR-MONT-DC-01 table 1	What is the status and trend of ponderosa, Jeffrey, and sugar pine in select locations?	-- Pine relative density; basal area; average diameter at breast height; regeneration density; and health -- Acres of treated forest, by treatment type and ecological zone

Aquatic Ecosystems

A select set of ecological conditions are monitored for riparian and aquatic ecosystems. The monitoring questions and indicators are selected to measure the effectiveness of the plan to maintain or restore ecological conditions for key ecosystem characteristics associated with composition, structure, function, and connectivity.

Table 15. Monitoring questions and associated indicators that evaluate ecological conditions for aquatic and riparian ecosystems

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
AE01	WTR-RCA-MEAD-DC-05	What is the trend in the condition of selected meadows and other riparian areas?	-- Meadow and riparian vegetation condition
	WTR-RCA-DC-05		-- Meadow greenness or wetness indices
	WTR-RCA-DC-06		-- Stream physical condition
			-- Acres of riparian areas restored

Focal Species

Focal species are a small subset of species whose status permits inference to the integrity of the larger ecological system to which they belong. Focal species monitoring provides information regarding the effectiveness of the plan in providing the ecological conditions necessary to maintain the diversity of plant and animal communities and the persistence of native species in the plan area. They should act as indicators for the attributes of community composition, structure, connectivity or function, or factors that regulate them.

An effective focal species or assemblage of species will be sensitive to the ecosystem components or habitat attributes of concern. Monitoring questions should relate the species to the ecological condition and reason for its selection; indicators may include affected attributes of the species, such as presence or occupancy, habitat use, reproductive rate, and population trends. If the focal species' sensitivity to habitat changes cannot be directly attributable to a cause-and-effect relationship, then the influence of habitat change on the focal species may not be separable from the influence of other factors on the species, such as climate change, predation, disease, or competition.

Focal species are intended to reduce the cost and effort of ecosystem monitoring and should only be used when direct measurement of resources is not efficient or practical.

Table 16. Monitoring questions and associated indicators that evaluate the status of focal species

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
FS01	TERR-BLCK-DC-01	What is the status and trend of black oak trees?	-- Density of large trees -- Regeneration -- Incidence of insects, diseases, and mortality

Ecological Conditions for At-risk Species

For select at-risk species, a select set of ecological conditions, including habitat, is monitored. The selected ecological conditions are necessary to provide for diversity of plant and animal communities and contribute to the recovery of, conserve, or maintain the viability of at-risk species within the plan area. At-risk species include federally recognized threatened, endangered, proposed, and candidate species plus the species of conservation concern identified for the Sequoia. Only a select set of ecological conditions is monitored for select at-risk species and may include characteristics at both the ecosystem and species-specific levels of terrestrial, riparian, or aquatic ecosystems.

Table 17. Monitoring questions and associated indicators that evaluate ecological conditions for select at-risk species

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
AR01	SPEC-FW-DC-02	Do stream temperatures support persistence of native at-risk aquatic species in select reaches?	Water temperature (maximum summer stream temperature; average daily stream temperatures; maximum daily average stream temperature during summer and fall for fall spawners; maximum and minimum winter stream temperatures).
AR02	SPEC-FW-DC 01 SPEC-FW-DC 02 SPEC-PLANT-STD 03 TERR-SH-DC 01	To what extent is suitable habitat for at-risk plant and lichen species being maintained or improved?	-- Extent of suitable habitat -- Proportion of suitable habitat disturbed -- Proportion of suitable habitat improved
AR03	SPEC-CSO-DC 01 SPEC-CSO-DC 02 SPEC-CSO-STD 02 SPEC-CSO-STD 03	What is the status and trend of highest quality and best available nesting and roosting habitat in California Spotted Owl Protected Activity Centers (PACs) and territories?	-- Proportion of PACs and territories with CWHR 4M/D and 5M/D, 6 and large snags -- Proportion of PACs and territories affected by disturbance (e.g., wildland fire, tree mortality) -- Treatment acres in PACs and territories

Visitor Use, Visitor Satisfaction, and Progress toward Meeting Recreation Objectives

The plan monitoring program includes monitoring questions and associated indicators that address the status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.

Table 18. Monitoring questions and associated indicators that evaluate visitor use, visitor satisfaction, and progress toward meeting recreation objectives

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
VU01	REC-FW-DC-03	What are the trends in visitor use and satisfaction?	-- Visitor use and satisfaction (National Visitor Use Monitoring survey) -- Visitor recreational activity by type -- Visitor demographics
VU02	REC-FW-DC-13 REC-FW-OBJ-01	What percentage of the inventoried motorized and nonmotorized trail system miles meet National Quality Standards ⁴⁸ ?	-- Inventoried motorized and nonmotorized trail system miles -- Miles of trail that meet National Quality Standards.

Climate Change and Other Stressors

The plan monitoring program includes monitoring questions and associated indicators to determine whether there are measurable changes on the plan area resulting from climate change and other stressors. Monitoring of carbon stocks and trends across the Sequoia and other national forests is included in the Region's Broader Scale Monitoring Strategy.

Table 19. Monitoring questions and associated indicators that measure changes on the plan area resulting from climate change and other stressors

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
CC01	TERR-FW-DC-02	How is the rate and distribution of drought-related tree mortality changing?	-- Tree mortality by ecosystem type -- Spatial extent of tree mortality by ecosystem type and severity class
CC02	FIRE-FW-DC-04	How are fire regimes changing compared to the desired conditions and the natural range of variation?	-- Fire return interval departure -- Number and acres of fire by ecological zone -- Fire severity by ecological zone

⁴⁸ FSH 2309.18, Section 15

Progress toward Meeting the Desired Conditions, Objectives, or other Plan Components

Progress toward meeting desired conditions, objectives, or other plan components that do not fall under one of the other eight required items are included in the monitoring program. Specifically, the plan monitoring program must contain one or more questions and associated indicators addressing the plan contributions to communities, social and economic sustainability of communities, multiple use management in the plan area, or progress toward meeting the desired conditions and objectives related to social and economic sustainability.

Table 20. Monitoring questions and associated indicators that evaluate progress toward meeting desired conditions not addressed elsewhere in the monitoring program, particularly those related to social and economic sustainability of communities

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
PC01	VIPS-FW-DC-01 WTR-FW-GOAL-02 REC-FW-GOAL-03	To what extent are partnerships helping the Forest accomplish objectives?	-- Workforce -- Partnership agreements Volunteer agreements -- Accomplishments
PC02	FIRE-FW-DC-02	What management actions are contributing to the achievement of desired conditions relating to fire regimes?	-- Acres of fire managed for resource objectives by ecological zone -- Acres of fire by objective within each strategic fire management zone -- Acres of prescribed fire -- Acres of mechanical treatment
PC03	LOC-FW-DC-03	What are the economic contributions of forest-based uses and ecological services to the local communities?	-- Local economic conditions -- Forest contributions

Productivity of the Land

This monitoring requirement comes from the National Forest Management Act requirement that there be research regarding the effects of timber management systems on the productivity of the land, and that such research is to be based on continuous monitoring and assessment in the field. Monitoring is focused on key ecosystem characteristics related to soils and soil productivity.

Table 21. Monitoring questions and associated indicators that evaluate soils and soil productivity

Code	Selected desired condition and objective or other plan component	Monitoring question	Associated indicators
PR01	WTR-FW-DC-04	How does soil disturbance differ from pre- and post-activity for timber management?	-- Soil compaction -- Erosion -- Displacement