U.S. Forest Service
Pacific Southwest Region

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Sequoia National Forest Plan Preliminary Draft Monitoring Program

Introduction

The monitoring program is one of three phases in the forest planning cycle, which includes assessment, plan development or revision, and monitoring. The monitoring program is proposed in a national forest's land and resource management plan (forest plan). The monitoring program is implemented during the life of the forest plan, and informs the next forest assessment. Monitoring helps the Forest Service determine if a change to the forest plan may be needed to improve forest management. Each forest plan has its own monitoring program.

Monitoring

Monitoring forms the basis for continuous improvement of the forest plan and provides information for adaptive management of the plan area. The purpose of monitoring in an adaptive management framework is to facilitate learning to support decisions on necessary changes to the forest plan. The forest plan monitoring program enables the responsible official to determine where changes are needed in forest plan components, other plan content, and plan implementation strategies that guide resource management in the plan area. The forest plan monitoring program is laid out as a set of monitoring questions and indicators, and monitoring is conducted during the life of the forest plan.

The regional forester develops a broader-scale monitoring strategy for monitoring questions identified by forest plans in the region that can be answered best at a geographic scale broader than one plan area. The monitoring program outlined below incorporates broader-scale monitoring to address plan monitoring questions where relevant. Existing national and regional monitoring programs, like the Forest Inventory and Analysis Program or the National Visitor Use Monitoring Program, contribute to the plan monitoring program. Monitoring is also coordinated with other Forest Service program mission areas (i.e., State & Private Forestry and Research & Development), other agencies, partners, and the public.

Every two years after the completion of the forest plan, the forest will evaluate monitoring information and produce a monitoring evaluation report. This biennial evaluation begins no later than two years after the effective date of the forest plan decision, and includes information gathered through this plan monitoring program and relevant information from the Region 5 broader scale monitoring strategy. A written report of the evaluation will be made available to the public. Where frequency of monitoring is longer than two years, evaluation of that information will be made at the next biennial evaluation.

The forest plan monitoring program consists of relevant questions and associated indicators. An indicator is something that can be measured, observed, or described and, when observed over time, may show

trends. Monitoring questions and associated indicators are designed to inform the management of resources on the plan area, including by testing relevant assumptions, tracking relevant changes, and measuring management effectiveness.

Monitoring questions and indicators measure forest plan management effectiveness and assess progress toward achieving or maintaining the forest plan desired conditions and objectives; but, every plan component does not have a corresponding monitoring question. Monitoring in the plan is focused on priority management questions and related core information. The plan monitoring program does not include all monitoring conducted by the forest or the region. For example, much resource monitoring will not be included in the plan monitoring program. Project and activity monitoring is not included in the plan monitoring program, although information collected with such monitoring may inform the plan monitoring program and adaptive management of the plan.

The monitoring program contains one or more monitoring questions and associated indicators addressing each of the following topics:

- The status of select watershed conditions.
- The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
- The status of focal species to assess the ecological conditions required under the Code of Federal Regulations, specifically 36 CFR 219.9.
- The status of a select set of the 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.
- The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
- Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
- Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
- The 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 indictors may address more than one of these required topics. The entire monitoring program must be within the financial and technical capability of the forest, augmented by broader-scale monitoring by the Region and other monitoring with partners.

The preliminary draft monitoring program for the Sequoia National Forest is presented below in a set of tables, each related to one of the eight required items listed above. For clarity, monitoring questions for terrestrial ecosystems and aquatic ecosystems are presented in separate tables. In the tables, each row represents a single monitoring question and associated indicators. Rows begin with selected desired conditions and objectives that lead to the monitoring question. Next, the monitoring question and associated indicators are listed. The desired conditions are generally complex statements that cannot be fully monitored. Therefore, the monitoring questions and indicators focus on some core aspect of the desired condition related to the required monitoring item that we are capable of monitoring. Monitoring questions and indicators that address more than one of the eight required items are repeated for each such item. Details of the plan monitoring program, including monitoring and analysis protocols, will be part of a separate monitoring guide.

Watershed Conditions

These monitoring questions and their associated indicators are related to water resources and watershed conditions in the forest plan area. The geographic scale may extend beyond the plan area and may include receiving areas for water that flows off the plan area.

Table 1. Monitoring questions and associated indicators that evaluate watershed conditions.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
WTR-FW-DC-06 Watersheds are fully functioning and resilient; recover from natural and human disturbances at a rate appropriate with the capability of the site; and have a high degree of hydrologic connectivity laterally across the floodplain and valley bottom, and vertically between surface and subsurface flows. Physical (geomorphic, hydrologic) connectivity and associated surface processes, such as runoff, flooding, in-stream flow regime, erosion and sedimentation are maintained and restored. Watersheds provide important ecosystem services such as high quality water, recharge of streams and shallow groundwater, maintenance of riparian communities, and moderation of climate change and atmospheric deposition. Watersheds maintain long term soil productivity.	Is the condition of watersheds improving?	Watershed condition indicators from the Watershed Condition Framework[1].
WTR-FW-DC-02 Water quality is sustained at a level that retains the biological, physical, and chemical integrity of aquatic systems and benefits the survival, growth, reproduction and migration of native aquatic and riparian species.	Do aquatic benthic macroinvertebrate communities indicate stream ecosystem integrity is being maintained? (Same as aquatic ecosystems and focal species below)	Diversity; species composition; other indices of macroinvertebrate response to current conditions (e.g., Rivpacs score [O/E], index of biotic integrity [IBI], Ephemeroptera Plecoptera Trichoptera index [EPT]).

[1]The Watershed Condition Framework (WCF) is a comprehensive approach for classifying watershed condition, proactively implementing integrated restoration in priority watersheds on national forests and grasslands, and tracking and monitoring outcome-based program accomplishments for performance accountability.

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 and key ecosystem characteristics of select terrestrial ecosystems. Key ecosystem characteristics are those associated with ecosystem composition, structure, function, and connectivity.

Table 2. Monitoring questions and associated indicators that evaluate ecological conditions for terrestrial ecosystems.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
TERR-CES-DC-01 Complex early seral habitat created as a result of a disturbance (e.g., stand-replacing fire) contains dense patches of snags as well as habitat elements characteristic of natural succession (e.g., regenerating shrub cover and herbaceous understory) that are important to early seral forest-associated species. Large areas of shrubs are managed in locations where they represent the potential natural vegetation considering fire risks over time to adjacent vegetation and resources. Aspen and oak sprouts are well distributed in areas where they occur.	What is the amount and distribution of complex early seral habitat across large landscapes?	Patch size; patch density; and patch distribution.
TERR-MONT-DC-01, At the landscape scale, montane vegetation occurs in a complex mosaic of different forest densities, sizes, and species mixes across large landscapes that vary with topography, soils and precipitation. The composition, structure, and functions of vegetation make them resilient to fire, drought, insects and pathogens, and climate change. The mix of seral stage patches and open versus closed canopied areas varies by forest type as described in table 3. Interspersed across all seral stages, large and old trees are common in most of the landscape in varying densities (described in the old forest section below). TERR-MONT-DC-02 At the landscape scale, montane vegetation provides ecological connectivity for a wide range of species, including old forest-associated species as well as habitat generalists. At least 30 percent of the landscape provides greater than 40 percent tree or shrub cover for connectivity of wide-ranging forest-associated species that travel on the ground. Between 10 and 40 percent of the landscape has closed canopied, multi-storied forests with greater than 50 percent overstory tree cover for species that travel in the canopies. Most of these multi-storied forests occur on moist sites on lower slope positions and	What are the proportions and spatial distributions of seral stage patches and canopy cover areas for vegetation types across large landscapes?	Percent of seral stage patches by vegetation type at the landscape scale as shown in table 3: acres; and patch size distribution.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
north or east-facing slopes.		
TERR-MONT-DC-06 At the mid-scale, a complex mosaic of groups of trees and shrub and herbaceous plants provide diverse habitat for a wide variety of wildlife species including old forest-associated species. Within forest patches, trees are highly irregular in spacing and size. Individual trees, small clumps and groups of trees are interspersed with grass, herbaceous plants and shrubs in variably sized openings, varying by forest type. A mosaic of moderate to dense shrubs, tree litter, down wood and some bare ground occurs between groups of trees. Vigorous understories of heterogeneous, patchy, and diverse native shrubs, herbs, and grass species support small mammal, bird, insect, and fungal communities, as well as providing pollinator and herbivore forage.	Is heterogeneity increasing within forest patches at the mid-scale?	Variation in tree canopy cover; tree sizes; tree spacing; and shrub and understory cover.
TERR-OLD-DC-03 Between 40 and 80 percent of the forested landscape contains old forest areas. Clumps and patches of old forests components such as old trees, snags, and large downed logs are irregularly distributed across the landscape and interspersed with younger tree stands, shrubs, meadows, other herbaceous vegetation and non-vegetated patches. TERR-OLD-DC-04 The number and density of old trees vary by topographic position and soil moisture. In general, more large and old trees are found in moister sites on lower slopes, bottoms, and north and east aspects, especially where soils are deeper. Large trees, used as a proxy for old trees, are well distributed, but are often clumpy. The densities vary by forest type as described in the forest plan. Trees greater than 40 inches in diameter represent the oldest trees, generally over 150 years old, and comprise a significant proportion of large and old trees. In many areas of high soil productivity, trees grow to large sizes (e.g., around 30 inches in diameter) in fewer than 100 years. On very low and low soil productivity sites, the oldest trees may be smaller in diameter. Sufficient numbers of younger trees are present to provide for recruitment of old trees over time.	Is the proportion of the landscape with large trees and the density of large trees increasing?	Proportion of area with large trees; and number of large trees per acre averaged at the landscape scale.
TERR-BLCK-DC-01 Oak trees in varied ages are present, with wide spacing providing full sunlight around large old oak trees, enhancing their ability to produce abundant acorn crops. Black oak is reproducing successfully. Sufficient numbers of mid-age black oaks have enough canopy space to form full crowns to replace old oaks that eventually die.	Are black oak populations stable or increasing?	Oak spatial extent; basal area; density; regeneration; and tree health (e.g., mortality rates, insects, etc.).

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
TERR-MONT-DC-03 At the landscape scale, ponderosa, Jeffrey and sugar pine are common and dominant or co-dominant on drier sites (ridges, mid and upper slopes, south and west aspects). Large areas of black oak are present both in large patches, and intermixed throughout montane forests where it historically occurred. Sugar pine is reproducing, growing successfully, and is resistant to blister rust and insects. Shrub patches, as well as irregular openings within forests, provide diverse habitat for a wide variety of wildlife and plant species.	Are pines (i.e., ponderosa, Jeffrey, and sugar) increasing?	Pine relative density; basal area; average diameter at breast height; regeneration density; and health.

Table 3. Percent of seral stage patches (>10 acre) by vegetation type at the landscape scale (tens of thousands of acres)**.**

Vegetation Type/Zone	Early Seral[1]	Small Tree[2]	Open Mature Forest[3]	Intermediate Mature Forest[4]	Dense Mature Forest[5]
Black Oak/ Ponderosa pine	10-20%	1-10%	20-40%	40-60%	0-20%
Ponderosa Pine	10-20%	1-10%	60-90%	10-20%	<10%
Dry Mixed Conifer	10-20%	1-10%	60-90%	20-40%	0-20%
Moist Mixed Conifer	10-20%	2-15%	10-40%	30-60%	40-60%

[1]Shrub, grass/herb, tree seedling/sapling.

[2]California Wildlife Habitat Relationships (CWHR) vegetation classification 2 & 3.

[3]CWHR 4, 5, & 6; 10-40% tree cover.

[4]CWHR 4, 5, & 6; 40-60% tree cover.

[5]CWHR 4, 5, & 6; >60% tree cover.

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 and key ecosystem characteristics of select riparian and aquatic ecosystems. Key ecosystem characteristics are those associated with ecosystem composition, structure, function, and connectivity.

Table 4. Monitoring questions and associated indicators that evaluate ecological conditions for aquatic and riparian ecosystems.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
WTR-FW-DC-02 Water quality is sustained at a level that retains the biological, physical, and chemical integrity of aquatic systems and benefits the survival, growth, reproduction and migration of native aquatic and riparian species.	Do aquatic benthic macroinvertebrate communities indicate stream ecosystem integrity is being maintained? (Same as watershed condition above and focal species below)	Diversity; species composition; and other indices of macroinvertebrate response to current conditions (e.g., Rivpacs score [O/E], index of biotic integrity [IBI], Ephemeroptera Plecoptera Trichoptera index [EPT]).
RCA-MEAD-DC-05 Meadows are in mid to late seral condition, with substantive ground cover and a rich and diverse species composition. Meadows have high plant functional diversity and late successional functional types are represented. Perennial streams in meadows contain a diversity of age classes of hardwood shrubs along the stream bank, where the potential exists.	What is the ecological condition of meadows in selected grazed and ungrazed allotments?	Range condition class; species richness; species diversity; and plant functional groups.
RCA-MEAD-DC-05 Meadows are in mid to late seral condition, with substantive ground cover and a rich and diverse species composition. Meadows have high plant functional diversity and late successional functional types are represented. Perennial streams in meadows contain a diversity of age classes of hardwood shrubs along the stream bank, where the potential exists.	What is the status of streambank vegetation in selected grazed and ungrazed meadow perennial streams?	Range greenline monitoring: vegetation community types; presence of woody regeneration; and plant functional groups.
RCA-MEAD-DC-01 Meadows are hydrologically functional. Sites of accelerated erosion, such as gullies and headcuts are stabilized or recovering. Vegetation roots occur throughout the available soil profile. Meadows with perennial and intermittent streams have the following characteristics: (1) stream energy from high flows is dissipated, reducing erosion and improving water quality, (2) streams filter sediment and capture bedload, aiding floodplain development, (3) meadow conditions enhance floodwater retention and groundwater recharge, and (4) root masses stabilize stream banks against cutting action.	Do meadows have well-functioning streams and floodplains?	Undercut banks; down cut streams; headcuts; number and size of deep pools, glides, riffles; and woody vegetation along streams.

Focal Species

Focal species are indicators of ecological integrity, and they provide insight into the integrity of ecological systems on which they depend or that they influence. Monitoring the status of these species provides meaningful information about the effectiveness of the plan in maintaining or restoring the ecological system. Focal species may be selected on the basis of their functional role in ecosystems.

Table 5. Monitoring questions and associated indicators that evaluate the status of focal species.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
Focal species is cheatgrass and red brome for the following ecosystems and desired conditions: TERR-SAGE-DC-01 The sagebrush type has a diversity of age classes, stand structure, cover classes and understory composition. TERR-SAGE-DC-02 Sagebrush ecosystems are resilient to fire, disturbances (e.g., grazing, recreation), invasive species (including cheatgrass) and climate change. TERR-PINY-DC-01 Pinyon-juniper types have a mosaic of trees and open areas that provide wildlife habitat, contribute to functional soils, and are resilient to disturbances such as fire, invasive species and climate change.	Is the abundance of Cheatgrass and red brome (non-native *Bromus* spp.) changing over time?	Spatial extent (acres); and cover (%).
Focal species is benthic macroinvertebrate communities for stream ecosystems and the following desired conditions: WTR-FW-DC-02 Water quality is sustained at a level that retains the biological, physical, and chemical integrity of aquatic systems and benefits the survival, growth, reproduction and migration of native aquatic and riparian species. RCA-RIV-DC-01 Stream ecosystems, riparian corridors and associated stream courses sustain ecosystem structure; are resilient to natural disturbances (e.g., flooding); and climate change; promote the natural movement of water, sediment and woody debris; and provide habitat for native aquatic species.	Do aquatic benthic macroinvertebrate communities indicate stream ecosystem integrity is being maintained?	Diversity; species composition; and other indices of macroinvertebrate response to current conditions (e.g., Rivpacs score [O/E], index of biotic integrity [IBI], Ephemeroptera Plecoptera Trichoptera index [EPT]).

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 forest. 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 6. Monitoring questions and associated indicators that evaluate ecological conditions for select at-risk species.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
TERR-SH-DC-01 The integrity of special habitats is maintained or improved. Composition, diversity and structure are maintained in all areas, including those with multiple use activities (e.g. recreation, grazing, mining, and timber harvest).	Is the integrity of special habitats (e.g. pumice flats, limestone or serpentine soils, fens) for at-risk plants being maintained or improved over time?	Special habitat extent (acres) and health (e.g., species composition, and hydrologic function, grazing utilization).
MA-CAR-DC-02 Streams in critical aquatic refuges (CARs) have vegetation and channel bank characteristics that are properly functioning or functioning at-risk with an upward trend. These ratings are made in relation to the current potential of the stream system. If the current potential is different from historic potential, assess what restoration measures are required to attain historic potential and what ecological thresholds need to be crossed to attain the historic potential.	Do streams in selected grazed and ungrazed meadows and grasslands have vegetation and channel bank conditions within the natural range of variability?	Range greenline monitoring: vegetation community types, and presence of woody regeneration.
SPEC-FW-DC-02 Habitats for at-risk species support self-sustaining populations within the inherent capabilities of the plan area. Ecological conditions provide habitat conditions that contribute to the survival and recovery of listed species, contribute to the delisting of species under the Endangered Species Act, preclude the need for listing new species, improve conditions for species of conservation concern and sustain both common and uncommon native species.	Do stream temperatures support persistence of Little Kern golden trout, California golden trout, Kern River golden trout, and hardhead? (Same as climate change and other stressors below)	Maximum summer stream temperature; average daily stream temperatures; maximum daily average stream temperature during summer and fall for fall spawners; and maximum and minimum winter stream temperatures.
Fisher (*Pekania pennanti*) SPEC-PF-DC-05 Outside of community buffers and focus landscapes, at least 60% of each fisher target hexagon is in California Wildlife Habitat Relationships (CWHR) system classes 5M, 4D, 5D, and 6 in a heterogeneous pattern. Canopy cover greater than 60% occurs in patches, especially in more mesic sites, such as in canyons and swales	What is distribution of fisher target habitat in the fisher target hexagons?	Acreage and distribution of California Wildlife Habitat Relationships classes 5M, 4D, 5D, 6

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
and on north and east slopes, and may be separated by more open stands especially on drier slopes and ridges, with up to 25% of the hexagon in open canopy cover (less than 40%) and the balance in moderate canopy cover (40-60%). Dense stands are also punctuated at fine resolution with gaps of 0.03-2.0 acres (median of 0.1 acres).		
Fisher (*Pekania pennanti*) SPEC-PF-DC-04 Black oaks are well-distributed within mixed-conifer and conifer-hardwood stands throughout the fisher's range. The majority of trees are in good condition and the number of large oaks is increasing.	Are black oaks stable or increasing? (Same as terrestrial ecosystems above)	Oak spatial extent; canopy cover; density; regeneration; and tree health (e.g., mortality rates, insects, etc.)
California spotted owl (*Strix occidentalis occidentalis*) SPEC-CSO-DC-02 California spotted owl protected activity centers encompass the best available 300 acres of habitat in as compact a unit as possible. Best available habitat includes: two or more tree canopy layers; trees in the dominant and co-dominant crown classes averaging 24 inches diameter or greater; at least 60 percent tree canopy cover, including hardwoods; and in descending order of priority, California Wildlife Habitat Relationships (CWHR) classes 6, 5D, 5M, 4D, and 4M and other stands with at least 50 percent canopy cover, including hardwoods. Protected activity centers also contain some very large snags greater than 45 inches diameter and snag and down woody material levels that are higher than average. Where possible, heterogeneity is incorporated as described in the terrestrial vegetation desired conditions appropriate for the protected activity center location (e.g. red fir, mixed conifer, blue oak woodland). In general, the moist mixed conifer desired conditions are most applicable.	What are the ecological conditions in protected activity centers (PACs)?	Diameter of crown trees; canopy cover; and California Wildlife Habitat Relationships class.

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

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
Visitor Use REC-FW-DC-04 Visitors connect with nature, culture, and history through a full range of inclusive and sustainable outdoor recreation opportunities.	Do visitors engage in selected activities that focus on natural and cultural resources?	Percentage of visitors participating in viewing natural features, hiking or walking, viewing wildlife, visiting historic sites, nature study, and backpacking.
Visitor Satisfaction REC-FW-DC-03 Recreation opportunities on land, water and in the air provide a high level of visitor satisfaction and safety. Recreation opportunities are ecologically, socially, and economically sustainable. Agency resources focus on supporting the forest's recreation distinctive roles and contributions.	What level of satisfaction do visitors express for developed facilities, access, services, and perception of safety?	Percent meets expectations (PME) measure for developed facilities, access, services, and perception of safety.
Recreation Objective REC-FW-DC-02 Recreation settings are capable of adapting to changing conditions and support social, ecological, and economic sustainability on the forest and in surrounding communities.	How much money is spent in a year by non-local visitors within the local area on lodging, restaurant meals, groceries, gas and oil, and activities?	Total spending by non-local visitors (whose home is at least 50 miles from the forest) within the local area (within 50 miles of the forest) on lodging, restaurant meals, groceries, gas and oil, and activities.
Recreation Objective REC-FW-OBJ-03 Within 10 years of plan approval, improve 15 miles of trails to standard through forest restoration projects.	How many trail miles meet National Trail Quality Standards?	Miles of trail meeting National Trail Quality Standards.
Recreation Objective SCEN-FW-DC-01 A variety of ecologically sound, resilient and visually appealing forest landscapes sustain scenic character, supporting the forest's distinctive roles and contributions in ways that contribute to visitors' sense of place and connection with nature.	What level of satisfaction do visitors express for scenery associated with day-use developed sites, overnight developed sites, undeveloped areas, and wilderness?	Percent meets expectations (PME) measure for scenery associated with day-use developed sites, overnight developed sites, undeveloped areas, and wilderness.

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.

Table 8. Monitoring questions and associated indicators that measure changes on the plan area resulting from climate change and other stressors.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
TERR-ALPN-DC-03 Subalpine woodlands and alpine ecosystems are resilient to insects, diseases, fire, wind and climate change. High-elevation white pines (e.g., whitebark pine and foxtail pine) are healthy and vigorous, with a low incidence of white pine blister rust, and resilient to moisture stress and drought. White pine blister rust-resistant trees are regenerating and populations of high elevation white pines have the potential to expand above the tree line. TERR-RFIR-DC-01 At the landscape scale, the red fir forest type is part of a heterogeneous mosaic of tree species and vegetation structure (tree density, size, age and shrub cover), with patches of Jeffrey pine, meadows and montane chaparral. It is dominated by red fir trees, with varying amounts of white fir, Jeffrey pine, western white pine, sugar pine, lodgepole pine and mountain hemlock.	Are high-elevation white pines and red fir being sustained or increasing across the landscape with climate change?	Extent by forest type (acres); tree mortality (%); incidence of insects and pathogens (e.g., white pine blister rust) (%);tree regeneration (no./acre); and extent of tree mortality (acres).
RCA-RIV-DC-01 Stream ecosystems, riparian corridors and associated stream courses sustain ecosystem structure; are resilient to natural disturbances (e.g., flooding); and climate change; promote the natural movement of water, sediment and woody debris; and provide habitat for native aquatic species.	Do stream temperatures support persistence of Little Kern golden trout, golden rout, Kern River golden trout, and hardhead? (Same as at-risk species above)	Maximum summer stream temperature; average daily stream temperatures; maximum daily average stream temperature during summer and fall for fall spawners; and maximum and minimum winter stream temperatures.
FIRE-FW-DC-03 Wildland fires burn with a range of intensity, severity and frequency that allows ecosystems to function in a healthy and sustainable manner. Wildland fire is a necessary process integral to the sustainability of the forest's fire-adapted ecosystems.	Are wildfires managed for resource objectives meeting the desired range of conditions within forested landscapes?	Fire severity; proportion high fire severity; fire severity index; and mean and maximum high severity patch size.
FIRE-FW-DC-03 Wildland fires burn with a range of intensity, severity and frequency that allows ecosystems to function in a healthy and sustainable manner. Wildland fire is a necessary process integral to the sustainability of the forest's fire-adapted ecosystems.	Are natural fire regimes within terrestrial ecosystems becoming less departed from the desired conditions and the natural range of variation?	Fire return interval departure.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
TERR-MONT-DC-05 At the landscape scale, fires burn with low, moderate or mixed severity with patches of very high severity (greater than 90 percent basal area mortality) minimal, rarely greater than 200 acres in size. The proportion of areas burned at very high severity within a fire is generally less than 10-15 percent. Due to existing high levels of fuels and weather variability, greater proportions of areas burned at high severity, up to 40 percent with some patches of high severity up to 1,000 acres, may be unavoidable during large landscape prescribed fires or wildland fire managed primarily to meet resource objectives. TERR-UPPR-DC-02 At the landscape scale, fire is a key ecological process restoring and maintaining patchy fuel loads, and increasing heterogeneity and understory plant vigor. Fires occur irregularly, generally every 15 to 40 years. Fires in this vegetation type burn with low, moderate or mixed severity with patches of very high severity (greater than 90 percent basal area mortality) minimal, rarely greater than 300 acres in size. The proportion of areas burned at high severity within a fire is generally less than 10-15 percent. Due to existing high levels of fuels and weather variability, greater proportions of areas burned at high severity, up to 50 percent with some patches of high severity up to 1,000 acres, may be unavoidable during large landscape prescribed fires or wildland fire managed primarily to meet resource objectives.		
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Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
heterogeneity and understory plant vigor. Fires occur irregularly, generally every 15 to 40 years. Fires in this vegetation type burn with low, moderate or mixed severity with patches of very high severity (greater than 90 percent basal area mortality) minimal, rarely greater than 300 acres in size. The proportion of areas burned at high severity within a fire is generally less than 10-15 percent. Due to existing high levels of fuels and weather variability, greater proportions of areas burned at high severity, up to 50 percent with some patches of high severity up to 1,000 acres, may be unavoidable during large landscape prescribed fires or wildland fire managed primarily to meet resource objectives.		

Desired Conditions, Including Social, Cultural, and Economic Sustainability

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 9. 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.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
LOC-FW-DC-03 Forest uses such as recreation, forest products, mining and grazing are provided in an ecologically sustainable way that also contributes to economic and social sustainability in local communities.	What are the economic conditions in local communities that could affect the impact of forest contributions to local economies?	Economic health: unemployment (%); household earnings; per-capita income; and source of income (%). Economic diversity: employment diversity index; employment projections by occupation (% change); number of local businesses, employees, and average salaries in forest related sectors. Local fiscal conditions: forest land use receipts; timber yield tax revenue ($); transient lodging tax revenue ($); visitor spending contribution to county sales tax; and PILT and FFR/SRS payments to counties ($).
LOC-FW-DC-03 Forest uses such as recreation, forest products, mining and grazing are provided in an ecologically sustainable way that also contributes to economic and social sustainability in local communities.	What economic contributions are forest-based recreation, forest products, mining and grazing making to local communities?	Conditions in forest based sectors: forest-related sector employment (jobs); forest-related sector wages (annual salary); employment and earnings from travel and tourism (by county) Forest contributions: units of commodities provided; value of contributions of commodities to local economies; contributions of USDA FS employees; ratio of annual local contracted value to annual total contracted value.

Productivity of the Land

This monitoring requirement comes from the NFMA 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 10. Monitoring questions and associated indicators that evaluate soils and soil productivity.

Selected Desired Condition and Objective or Other Plan Component	Monitoring Question	Associated Indicators
WTR-FW-DC-07 Soil and vegetation functions in upland and riparian areas are sustained and resilient. Healthy soils provide the base for resilient landscapes, provide nutritive forage for browsing and grazing animals, and support timber production. Healthy upland and riparian areas support healthy fish and wildlife populations, enhance recreation opportunities, and maintain water quality. TERR-FW-DC-08 The landscape sustainably provides a variety of benefits that improve peoples' economic, social and physical wellbeing, such as: clean water; forest products; livestock forage; carbon sequestration and storage stability; energy generation; recreational opportunities; landscapes with scenic character and scenic integrity; cultural uses; and biodiversity in the forest. Vegetation provides sustainable amounts of forest products, such as: wood fiber; biomass; forage; firewood; edible and medicinal plants; boughs, bark, berries and cones for commercial, tribal, personal, educational and scientific uses. These products are provided while sustaining soil and water quality and productivity. Vegetation conditions support the long-term sustainability of these benefits to people by reducing the risk of undesirable fire effects, disease and mortality, which interrupt and eliminate forest benefits.	Is soil quality being maintained such that productivity of the land is not substantially or permanently impaired?	Soil stability; surface organic matter; soil organic matter, soil strength, soil structure; macro-porosity