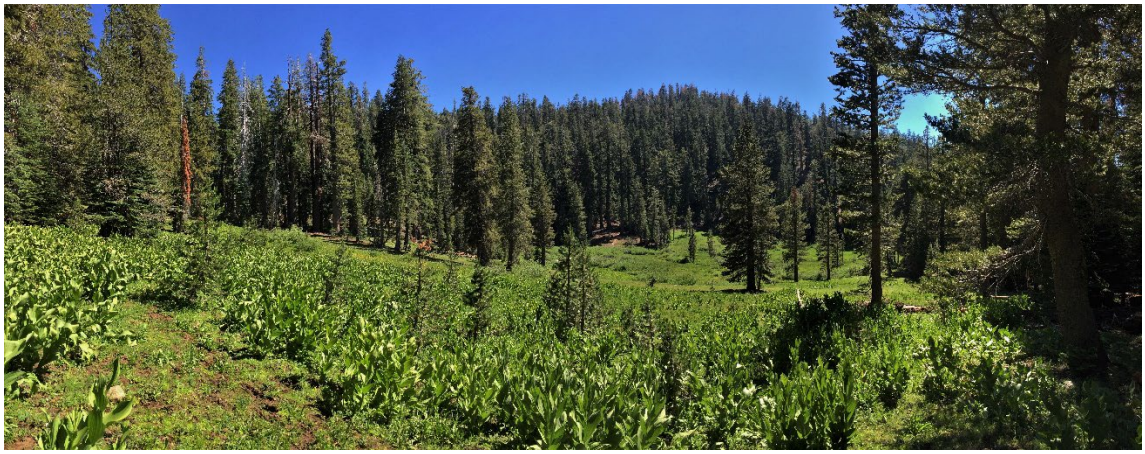
United States Department of Agriculture

Sierra and Sequoia National Forests Monitoring Guide

Version 1.0



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Introduction

A plan monitoring program is included in land management plans as a requirement of the 2012 Planning Rule (FSH 1909.12.31). Monitoring information derived from the plan monitoring program enables the Responsible Official to determine if a change may be needed in plan components or other plan content that guide the management of resources in the plan area (36 CFR 219.12). The plan monitoring program includes monitoring questions and indicators based on one or more desired conditions, objectives, or other plan components. Additional information to support the plan monitoring program (e.g., data collection methods, data storage, monitoring reporting) may be described in a separate monitoring guide (FSH 1909.12.31). This document is the first version of the monitoring guide for the Sierra and Sequoia National Forests' plan monitoring programs and provides the framework for implementing and reporting the monitoring results and evaluating adaptive management strategies. Refer to Chapter 4 of each of the 2022 Sierra and Sequoia National Forest Land Management Plans for the plan monitoring programs. Currently, the plan monitoring programs are identical except for one question (AR02) that applies only to the Sierra National Forest. This guide may be updated in the future.

Monitoring results are evaluated and used to identify if a change to the plan, management activities, or the monitoring program, or a new assessment, may be warranted. According to the planning rule, this information is made available to the public every two years in a written biennial monitoring evaluation report (BMER). The BMER provides new information gathered through the plan monitoring program and relevant information from the regional broader-scale monitoring strategy (36 CFR 219.12(d)(1)). Information from the regional broader-scale monitoring strategy will be provided to the Forests every five years for incorporation into the Forests' biennial monitoring reports. The monitoring evaluation report may be postponed for one year in case of exigencies but notice of the postponement must be provided to the public prior to the date the report is due for that year (36 CFR 219.16(c)(6)). Some monitoring questions in the plan monitoring program may not be evaluated biennially because of resource constraints, frequency of data collection, or availability of updated datasets. Monitoring is dependent upon funding, personnel, and other considerations. Monitoring may be performed by the Forest Service, other agencies, partners, or other interested parties (FSH 1909.12.31.2).

Organization of the Guide

This guide is organized by the eight monitoring topics required under the 2012 Planning Rule (36 CFR 219.12(a)(5). These include:

(i) The status of select watershed conditions.
(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
(iii) The status of focal species to assess the ecological conditions required under § 219.9.
(iv) The status of a select set of the ecological conditions required under § 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.
(v) The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
(vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.

(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.

(viii) 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)). (36 CFR 219.12(a)).

Each of the eight required monitoring topics has one or more relevant questions. Each monitoring question is organized into five main sections:

- Staff responsible for data collection, evaluation, and reporting: This section lists the staff positions on each of the Forests responsible for collecting, evaluating, and /or reporting the results.
- Introduction: This section describes the purpose of the question (e.g., uncertainty, assumption) and the relevant plan components.
- Methods: This section describes the methods, data sources, and protocols used to evaluate the indicators and timeline for data collection and reporting.
- Evaluation of Results: This section describes how the results are evaluated relevant to the plan component and management question and how the results are reported in the biennial monitoring evaluation report.
- Adaptive Management Questions: This section describes the adaptive management questions the specialist would answer during the evaluation of results to determine if changes are needed to the monitoring program, plan components, and/or management actions. This section may also describe thresholds or alerts (if they have been identified) that may indicate the need to adaptively manage.

The end of this guide includes a section that describes the estimated Forest capacity needed to answer the monitoring questions as well as the staff on each Forest and the Regional Office that contributed to the development of the guide.

Sierra and Sequoia National Forests Plan Monitoring Program Summary

Rows in the table below represent monitoring questions in the Sequoia and Sierra plan monitoring programs. The questions are organized by the eight required monitoring topics (36 CFR 219.12(a)(5)). For each monitoring question, the table lists the applicable plan component code(s), indicators, data sources for the indicators, the frequency with which data would be reported, and the responsible staff areas. Reporting would occur every two years in a written biennial monitoring evaluation report (BMER) however not all indicators are evaluated and reported every two years. Where there are multiple indicators with differing data sources, those indicators and data sources have matching numbers across columns. Data sources may change over time as new scientific information and technologies become available. Acronyms are defined at the bottom of the table.

Summary of Sierra and Sequoia National Forests Plan Monitoring Programs

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(i)	WS01 – To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?	WTR-FW-DC-03	Watershed Condition Framework Classification	WCATT	Every six years or sooner based on data availability	Hydrologists
(ii, iv)	TE01 – To what extent are the old forest areas approaching the natural range of variation (i.e., NRV)?	TERR-OLD-DC-02	Proportion of area with large trees Number of large trees and snags per acre by forest type	CWHR, LANDFIRE, and possibly F[3] and eDaRT FIA and possibly F[3]	Every six years	Data collection and evaluation: R5 IM Ecologist, R5 EP GIS Analyst, or Forest GIS. Data evaluation and reporting: Province Ecologist or Associate.

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(ii)	TE02 – What is the status and trend of ponderosa, Jeffrey, and sugar pine in select locations?	TERR-MONT-DC-03 TERR-MONT-DC-01	Pine relative density; basal area; average diameter at breast height; regeneration density; and health Acres of treated forest, by treatment type and ecological zone	FIA and possibly F[3], ADS, and eDaRT FACTs	Every six years	Same as TE01 Data collection: Forest Vegetation Management Staff and Fuels Planner. Data evaluation and reporting: Province Ecologist or Associate.
(ii, iv)	AE01 – What is the trend in the condition of selected meadows and other riparian areas?	WTR-RCA-MEAD-DC-05 MA-RCA-DC-05 MA-RCA-DC-06	Meadow and riparian vegetation condition Greenness or wetness indices Stream physical condition Acres of riparian areas restored	1. Field data using Region 5 Rooted Frequency and Greenline monitoring protocols. 2. Aerial Imagery (e.g., NAIP) 3. Stream Condition Inventory Technical Guide and/or Proper Functioning Condition protocol 4. NRM (WIT)	1 & 3 Every six years 2 & 4 Every two years	1. Data collection: Region 5 Range Crew, data evaluation and reporting: Forest Range staff 2-4 Hydrologist
(ii, iii)	FS01 – What is the status and trend of black oak trees?	TERR-OAK-DC 01	Density of large trees Regeneration Incidence of insects, disease, and mortality	FIA FIA FIA and possibly field data	1 & 2 Every six years 3. Periodic (when detected)	1 – 2 Province Ecologist or Assistant 3. Province Ecologist or Assistant, Forest Health Protection, and Forest Veg staff

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(ii, iv)	AR01 – Do stream temperatures support persistence of native at-risk aquatic species in select reaches?	SPEC-FW-DC-02	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.)	Field data using Stream Condition Inventory Technical Guide	Sierra NF - Every two years Sequoia NF – every six years or sooner based on data availability	Biologist
(ii, iv)	AR02 - To what extent is suitable habitat for terrestrial at-risk plant species being maintained or improved?	SPEC-FW-DC 01 SPEC-FW-DC 02 SPEC-PLANT-STD 01 TERR-SH-DC 01	Extent of suitable habitat Proportion of suitable habitat disturbed Proportion of suitable habitat improved	Local Forest data for suitable habitat, NRM (FACTS, WIT, INFRA), BAER reports and soil burn severity, NRIS	Every 2-6 years depending on data availability and disturbanc e frequency	Data collection and evaluation: Botanists, R5 IM Ecologist, R5 EP GIS Analyst, or Forest GIS. Data evaluation and reporting: Botanist.

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(ii, iv)	AR03 - 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?	SPEC-CSO-DC 01 SPEC-CSO-DC 02 SPEC-CSO-STD 02 SPEC-CSO-STD 03	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	CWHR, F³, FACTs, RAVG, ADS, eDaRT	1-2 Every six years unless there has been a major disturbance 3 Every two years	Data collection and evaluation: R5 IM Ecologist, R5 EP GIS Analyst, or Forest GIS. Data evaluation and reporting: Biologist.
(ii, iv)	AR04 (Sierra NF only) - To what extent is management meeting the thresholds in SPEC-YT-GDL-03 and are the number of Yosemite toad occupied breeding and rearing areas being maintained or increasing?	SPEC-YT-DC-01 SPEC-YT-DC-02 SPEC-YT-GDL-03	Population status Habitat condition Utilization Percent alteration (disturbance)	Field data using Forest-level protocol	1-2 Every six years 3-4 every two years	Biologist and Range (SNF only)
(v)	VU01 – What are the trends in visitor use and satisfaction?	REC-FW-DC-03	Visitor use and satisfaction Visitor recreational activity by type Visitor demographics	NVUM	Every six years or sooner based on data availability	Public Services

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(v)	VU02 – What percentage of the inventoried motorized and non-motorized trail system is maintained to standard?	REC-FW-DC-13 REC-FW-OBJ-01	Miles of trail maintained to standard Inventoried motorized and nonmotorized trail system miles	NRM (Infra Trail)	Every two years	Public Services
(vi)	CC01 – How is the rate and distribution of drought-related tree mortality changing?	TERR-FW-DC-02	Tree mortality by ecosystem type Spatial extent of tree mortality by ecosystem type and severity class	eVeg, ADS, eDART ADS and eDaRT	Every four years	Data collection and evaluation: R5 IM Ecologist, R5 EP GIS Analyst, and/or Forest GIS, and Forest Health Protection (ADS). Data evaluation and reporting: Province Ecologist or Associate.
(vi)	CC02 – How are fire regimes changing compared to the desired conditions and the natural range of variation?	FIRE-FW-DC-04	Fire return interval departure Number and acres of fire by ecological zone Fire severity by ecological zone	FRID FRAP RAVG or MTBS, possibly eDaRT	Every 4 years 2-3 Every two years	Data collection and evaluation: R5 IM Ecologist, R5 EP GIS Analyst, or Forest GIS. Data evaluation and reporting: Province Ecologist or Associate.

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(vii)	PC01 – To what extent are partnerships helping the Forest accomplish objectives?	VIPS-FW-DC-01 WTR-FW-GOAL-02 REC-FW-GOAL-04	Workforce Partnership Agreements Volunteer Agreements Accomplishments	Budget reports/Regional Budget Monitoring Tool RACA report VSReports database and Forest files NRM (e.g., FACTs, WIT, Infra) and Forest tracking	Every two years	Forest Environmental Coordinator and Strategic Communication Officer
(vii)	PC02 – What management actions are contributing to the achievement of desired conditions relating to fire regimes?	FIRE-FW-GOAL-01	Acres of fires 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	FRAP FRAP FACTs FACTs	Every two years	Province Ecologist (or Associate) Forest Fuels Planner with support from Vegetation Management Staff
(vii)	PC03 – What are the economic contributions of forest-based uses and ecological services to the local communities?	LOC-FW-DC-03	Local economic conditions Forest contributions	Headwaters Economic (Economic Profile System) Various national databases	Every two years	Forest Environmental Coordinator

Monitoring Requirement	Monitoring Code/ Question	Plan Component	Indicators	Current Data Source(s)[1]	Reporting Cycle	Staff collecting, evaluating, reporting data
(iv, viii)	PR 01 – How does soil disturbance differ from pre- and post-activity for timber management?	WTR-FW-DC-04	Soil compaction Erosion Displacement	Field data using Sierra National Forest 10-point protocol	Every six years	Soil Scientist and/or hydrologist

[1] Data source acronym definitions (and hyperlinks where available):

- ADS: Aerial Detection Surveys
- CWHR: California Wildlife Habitat Relationships
- eDaRT: Ecosystem Disturbance and Recovery Tracker system
- eVeg: Existing Vegetation Data
- FACTs/EDW: Forest Service Activity Tracking System Enterprise Data Warehouse
- FIA: Forest Inventory Analysis
- FRAP: CalFire California Fire and Resource Assessment Program
- FRID: Fire Return Interval Departure
- MTBS: Monitoring Trends in Burn Severity
- NAIP: National Agriculture Imagery Program
- NRM: Natural Resources Manager
- NVUM: National Visitor Use Monitoring
- RACA: Reimbursable and Advanced Collections Agreements
- RAVG: Rapid Assessment of Vegetation Condition After Wildfire
- WCATT: Watershed Classification and Assessment Tracking Tool

(i) The status of select watershed conditions.

WS01: To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?

Staff Responsible for Data Collection, Evaluation, Reporting

Hydrologists

Introduction

This question was designed to address the uncertainty surrounding the degree to which management activities performed or permitted by the forest, fire and/or tree mortality, or activities that visitors engage in, affect trends in watershed condition overtime. This question is tied to the following desired condition: **WTR-FW-DC03.** Watersheds are fully functioning or trending toward 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, instream 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, and maintenance of riparian and aquatic communities. Watersheds sustain long-term soil productivity.

Monitoring Code/Question	Indicators	Data Source	Reporting Cycle	Plan Component
WS01 – To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?	Watershed Condition Framework Classification	Watershed Classification and Assessment Tracking Tool (WCATT)	Every six years (3rd BMER cycle) or sooner based on data availability	WTR-FW-DC-03

Methods

Data will be collected using the methodology described as part of the Watershed Condition Framework (USDA Forest Service 2011) in the Watershed Condition Classification Technical Guide (USDA Forest Service 2011). The Guide consists of 12 indicators related to watershed processes. The indicators and their attributes are evaluated as surrogate variables that represent the underlying ecological functions and processes that affect soil and hydrologic function. The approach mainly uses professional judgment relying on existing information, maps, and GIS coverage. The result is a rapid, coarse filter office assessment, based on existing data that may have been collected in the field over the past five years. Each watershed receives one of the following aggregate ratings:

1. Class 1 = Functioning Properly (Good)
2. Class 2 = Functioning at Risk (Fair)
3. Class 3 = Impaired Function (Poor)

The hydrologist will evaluate the status and trend in priority HUC12 watersheds every 5 years and conservation HUC10 watersheds every 10 years. Some non-priority watersheds may be evaluated if there is a major change that warrants evaluation, focusing on the following criteria:

- Watersheds where improvement activities have been implemented.
- Watersheds that have experienced large fires since the previous year.

Data are recorded in the Watershed Classification and Assessment Tracking Tool (WCATT), a web-based Natural Resource Manager (NRM) application. A description of the data recording tool and briefing paper are on the USDA Forest Service NRM website.

The Watershed Condition Framework, Technical Guide, and all relevant information can be accessed at this website: https://www.fs.usda.gov/naturalresources/watershed/condition_framework.shtml.

Data for the status and trends of watershed conditions would be reported in every six years (every 3rd biennial monitoring evaluation report) or sooner based on data availability.

Evaluation of Results

The hydrologist will complete the classification process using the WCATT application and will query the database for results to include in the monitoring report. Data from the ratings will be evaluated and interpreted relative to the desired condition. WCATT uses a weighted system to calculate the change in a watershed rating; some variables are weighted more heavily than others. Therefore, some major events may not trigger a substantial change in a watershed rating if they are not weighted heavily. Although the rating may be accurate, there will be a need for professional judgement in interpreting and describing the ratings. The hydrologist would answer the following questions when evaluating the ratings of the priority watersheds to interpret the details that may not be reflected in the coarse rating:

- Is the priority watershed fully functioning or trending toward fully functioning?
- Are any of the priority watersheds trending negatively?
- Have there been recent management actions that have improved (or are anticipated to improve) priority watershed conditions?
- Have there been recent disturbances that have negatively affected priority watershed conditions?

For each reporting cycle, monitoring results would be described primarily in a narrative format though graphs with trend lines can be used if informative. The narrative will describe the changes (or lack of changes) in priority watershed functioning over time and the reason for the observed changes (including the answers to the above four questions).

Adaptive Management Questions

Based on the evaluation of results, the hydrologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The hydrologist would answer the following four questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in watershed condition? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?

- Are additional or different indicators needed?
- Should data be collected with a different frequency?
- Is there a new methodology, tool, or new science that should be incorporated?

The hydrologist will make recommendations to amend the monitoring question in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If conditions in some priority watersheds are not trending toward proper functioning condition or trending away from proper functioning condition, are additional management actions needed to facilitate improvement?

   The hydrologist will identify which of the influential factors are leading to the deficiencies and whether they can be influenced by Forest management actions. Where management actions can shift priority watershed indicators towards a positive direction, such as, but not limited to, reduction of fuels, repairing of roads, reducing grazing intensity, a recommendation for change will be made in the biennial monitoring report. The results from changed management actions will be reported in the next relevant reporting cycle.

3. Is there a need to change priority watersheds?

4. Is there a need to change a plan component to facilitate improved watershed conditions?

(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems

TE01: To what extent are the old forest areas approaching the natural range of variation (i.e., NRV)?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection and Evaluation – Region 5 Information Management Ecologist, Region 5 Ecosystem Planning GIS Analyst, or Forest GIS analysts
Data Evaluation and Reporting – Province Ecologist or Associate

Introduction

This question was designed to address the condition and trend of old forests, which provide a variety of ecosystem services including wildlife habitat, carbon sequestration, and biodiversity. There is uncertainty in the status of old forests due to interacting stressors associated with uncharacteristic wildfires, insect outbreaks, pathogens, and climate change. This question is tied to the following Desired Condition: **TERR-OLD-DC-02**. The landscape contains a mosaic of vegetation types and structures that provide foraging and breeding habitat, movement, and connectivity for a variety of old forest-associated species. Areas of moderate (40 to 60%) to high (greater than 60%) canopy cover comprised primarily of large trees provide habitat connectivity for old-forest-associated species in key habitat corridors such as canyon bottoms and drainages. It should be noted that large trees are defined in the Land Management Plans as ≥ 30 inches diameter-at-breast height.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
TE01 - To what extent are the old forest areas approaching the natural range of variation (i.e., NRV)?	1. Proportion of area with large trees 2. Number of large trees and snags per acre by forest type	1. CWHR, LANDFIRE, and possibly F3 and eDaRT 2. FIA and possibly F[3]	Every six years (3rd BMER cycle)	TERR-OLD-DC-02

Methods

The approaches described below will be evaluated for assessing the proportion of the forested landscape with large trees (indicator 1). Each of the approaches have pros and cons associated with them and the most appropriate approach will be determined based on data availability and data integrity at the time that monitoring commences. Some of these approaches are rapidly developing their technologies.

1. California Wildlife habitat Relationship (CWHR) data as reported in the FS Region 5 Existing Vegetation dataset (FS R5 geospatial data) will be extracted for all forested vegetation types in the montane and upper montane zones on the Sierra and Sequoia National Forests, and the proportion of this area containing CWHR classes 5 and 6 will be estimated; or
2. LANDFIRE data (https://www.landfire.gov/) will be extracted for forest vegetation types in the montane and upper montane zones on the Sierra and Sequoia National Forests, and the

proportion of this area containing late successional classes ('s-classes') D (late seral, open canopy) and E (late seral, closed canopy) will be estimated; or

3. F^3 data from the Region 5 MARS lab in Information Management Department could be used to help identify old forest areas with large trees. F^3 is a relatively new and evolving modeling framework developed by the Region 5 MARS to integrate Forest Inventory and Analysis (FIA) plot data, Forest Vegetation Simulator (FVS), and FastEmap (Field and SatelliTe for Ecosystem MAPping) to simulate spatiotemporal forest change under natural succession and vegetation management (Huang et al. 2018).
4. LiDAR-derived products or similar datasets could also be helpful, although coverage may not be available for the entire forest or during the time of interest; and

Events that may correlate with changes in the proportion of area with large trees over time could be evaluated using the following sources:

a. Ecosystem Disturbance and Recovery Tracker (eDaRT), to account for most recent changes that may not be evident in the above sources. The Ecosystem Disturbance and Recovery Tracker (eDaRT) is a satellite-based remote sensing and processing system that detects forest stand- and landscape-level changes (Koltunov et al. 2020). eDaRT products provide information on vegetation disturbance events derived from Landsat satellite imagery at the 98 ft (30 m) scale. The onset of these events is attributed to a two-week time period, and each event has a relative severity that corresponds to % canopy cover loss. per 30 m pixel.
b. Rapid Assessment of Vegetation Condition after Wildfire (RAVG), or the Monitoring Trends in Burn Severity (MTBS) program to account for most recent changes that may be due to high severity wildfire (see question CC02).
c. Aerial Detection Survey data from the Forest Health Protection Department to account for most recent changes that may due to drought-related tree mortality (see CC01).

Data for the number of large trees and snags per acre by forest type (indicator 2) will be obtained from Forest Inventory and Analysis (FIA) data summaries. It is possible that F^3 data could provide estimates of large trees, specifically those metrics corresponding to live trees per acre for all trees ≥30" DBH and <40" DBH, and for all trees >40" DBH. F^3 produces data for total cubic foot volume/acre for live trees ≥ 30" diameter-at-breast height (DBH) for Douglas fir, incense cedar, Jeffrey pine, ponderosa pine, red fir, sugar pine, and white fir. These data have a higher accuracy than data for trees per acre but volume does not tie back to metrics used in the Land Management Plans; the Plans refer to trees per acre. Regardless, data for volume may be used as needed to supplement our understanding of trends. Additionally, F^3 data include total basal area per acre (ft^2/acre) for all live trees ≥ 10" DBH. This metric may also be useful in explaining trends. For snags, it is possible that densities could be estimated using eDaRT to account for vegetation loss due to disturbance over recent years.

Data for CWHR data are updated every 10 to 15 years by the R5 Remote Sensing Lab. FIA data are completely updated every 10 years (10% of plots are resampled annually in CA) by the USFS Forest Inventory and Analysis program. F^3 data would be updated more frequently.

Quick review of the LANDFIRE data summaries (see the Vegetation Condition Assessment supplemental report) appears to provide a relatively reliable estimate of the proportion of old forests across the landscape (i.e., S-classes D and E).

Results would be reported every six years (every 3rd biennial monitoring evaluation report) because of the long interval between CWHR and FIA data updates. Results will be available for reporting earlier than every 3rd biennial monitoring evaluation report if data refreshes occur more frequently based on new analysis tools such as F^3 data.

Evaluation of Results

Indicator 1. The proportion of the montane and upper montane forest landscape in CWHR classes 5 and 6 will be estimated (status) and compared to previous estimates (trend). CWHR classes 5 and 6 (or LANDFIRE s-classes D and E) can be mapped to display the spatial distribution of older forests (or similarly done with LANDFIRE data). The proportion of CWHR classes could also be graphed over time to display trends.

Note: Development is underway for a CWHR classification to be integrated into F^3, and these data may be able to quantify this indicator more accurately over time.

Indicator 2. FIA/F^3: The density of large trees and snags will be summarized. Tree and snag densities could be displayed as follows:

1. Trees: ≥20", ≥30", ≥40" diameters – for comparison with desired conditions (Table 7 in Sierra NF and Sequoia NF Plans)
2. Snags: ≥20", ≥30" diameters – for comparison with Tables 3 and 6 in Sierra NF and Sequoia NF Plans (possibly)
3. All structures could be graphed over time to display trends

Data can also be displayed for volume/acre for live trees if F^3 analyses are conducted and this metric is a valuable metric to display.

Success will be observed if:

Indicator 1. CWHR classes 5 and 6 or analogous forest structural classes based on F^3 data comprise ≥40% of the montane and upper montane forest landscapes on the forest or display an increasing trend in the proportion of these classes over time.

Indicator 2. Large tree and snag densities meet the desired conditions displayed in Table 7 (large trees) and Table 3 and 6 (snags) of the Sierra and Sequoia National Forests Land Management Plans.

Adaptive Management Questions

Based on the evaluation of results, the ecologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The ecologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in old forest areas? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?

- Are additional or different indicators needed?
- Should data be collected with a different frequency?
- Is there a new methodology, tool, or new science that should be incorporated?

The ecologist would make recommendations to amend the monitoring question in the biennial monitoring evaluation report and describe the results of changes in the next relevant reporting cycle.

2. If monitoring results indicate that the proportion of the landscape with large trees and/or the density of large trees (trees/acre) is consistently trending away from the natural range of variation and desired conditions, can we target forest management treatments in these areas, where feasible, to improve growing conditions and stand resilience?

3. Is there a need to conduct an assessment to re-evaluate the status of the large trees on the landscape and management actions that would alleviate the impacts of stressors to large trees?

4. Is there a need for a change in the plan components related to the pace and scale of treatments (objectives) or the standards and guidelines pertaining to large tree retention or resilience (for example, diameter limits or burn prescriptions for conifers in old forests)?

TE02: What is the status and trend of ponderosa, Jeffrey, and sugar pine in select locations?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection and Evaluation – Region 5 Information Management Ecologist, Region 5 Ecosystem Planning GIS Analyst, or Forest GIS analysts (indicator 1) and Forest Vegetation and Fuels Program Managers (indicator 2)
Data Evaluation and Reporting – Province Ecologist or Associate (both indicators)

Introduction

This question is designed to evaluate if management actions associated with the Plans have been successful in promoting and protecting pine species from threats like climate change, bark beetles, blister rust, and uncharacteristically severe wildfires. There is uncertainty as to whether management action, including the pace and scale of restoration, is successful in achieving the desired conditions for pine species. This question is tied to the following two plan components:

- **TERR-MONT-DC-03. (Desired Condition)** At the landscape scale, white pines (such as sugar pine and western white pine) are healthy and vigorous with a low incidence of white pine blister rust. Individual trees and the stands they occur in are resilient to moisture stress, drought, and bark beetles. White pine blister rust-resistant trees are regenerating, and populations are sustained.
- **TERR-MONT-DC-01. (Desired Condition)** At the landscape scale, the Sierra Nevada montane landscape is a heterogeneous mosaic of open and closed canopy forest patches, meadows and riparian areas. These ecosystem types occur in a complex mosaic of different densities, sizes, and species mixed across large landscapes that vary with topography, soils, and snow accumulation. The composition, structure, and function of vegetation make these ecosystems resilient to fire, drought, insects, pathogens, and climate change. The mix of seral stage patches, and open versus closed canopied areas, varies by forest type as shown in table 1 and figure 4. Large and old trees are common in later seral stages throughout the landscape and in varying densities (see “Old Forest Habitats” section).

Monitoring Code/Question	Indicators	Data Source	Reporting Cycle	Plan Component
TE02 - What is the status and trend of ponderosa, Jeffrey, and sugar pine in select locations?	1. Pine relative density; basal area; average diameter at breast height; regeneration density; and health 2. Acres of treated forest, by treatment type and ecological zone	1. FIA (possibly F^3, ADS, and eDaRT) 2. FACTs	Every six years (3rd BMER cycle)	TERR-MONT-DC-03 TERR-MONT-DC-01

Methods

Indicator 1. The MARS Ecologist (or R5 GIS Analyst) will conduct an initial evaluation of Forest Inventory Analysis Indicator (FIA) data for the first indicator – pine relative density; basal area; average diameter at breast height; regeneration density; and health. The Province Ecologist (or Associate) would use the

data and evaluation provided to complete the evaluation and report. FIA data are updated every 10 years by the USFS Forest Inventory and Analysis program. Ten percent of plots are re-sampled each year in California. Status and trend data for this indicator would be collected and evaluated when FIA data are updated. Health data (host, agent, % affected) would come from Aerial Detection Survey (ADS), with supplemental spatial extent and severity for health issues as reported in the Region 5 Remote Sensing Lab eDaRT product.

The F^3 modeling framework may be used (instead of using FIA alone) to gather and synthesize data for the first indicator. If F^3 is used, the trends for this indicator may be evaluated more frequently. Because F^3 models forest metrics across both space and time, analyses that supplement FIA with F^3 would provide a more complete picture for these indicators. Furthermore, the precise locations of change would be known with F^3, therefore enabling adaptive management action (FIA plot locations cannot be published, thus summaries based on them can only indicate change at the forest scale). However, regeneration information currently is only available from plot-based FIA data.

Multiple datasets are required to determine if desired conditions have been met at spatial and temporal resolutions required for management action. FIA would provide trends in tree density, diameter-at-breast-height (DBH), and regeneration by species. F^3 would use proxies for species-specific tree density information to assist in extrapolation and interpretation of FIA-data at the forest-wide scale. Specific relevant F^3 metrics include:

- total cubic foot volume/acre for ponderosa pine, Jeffrey pine, and sugar pine for live trees:
  - ≥ 0" DBH and <10" DBH
  - ≥ 10" DBH and <20" DBH
  - ≥ 20" DBH and <30" DBH
- total basal area per acre (ft^2/acre) for all live trees ≥10" DBH
- quadratic mean diameter for all live trees (conifer and hardwood species); Trees >11” DBH and with < 10% canopy cover have lower DBH set to 0. For trees >11” dbh and ≥ 10% canopy cover the lower DBH is based on calculated the largest tress that make up 75% of the BA.

Indicator 2. Treatment acres would come from the annual accomplishments reported in the Forest Service Activity Tracking Systems (FACTS) database as accessed through our corporate Enterprise Data Warehouse (EDW). The Forest Vegetation Program Manager and Fuels Program Manager enter the data annually as part of typical duties. Data entered are quantitative and spatially explicit. The forest staff would provide these data to the province ecologist or associate annually or biennially. Treatment acres will focus on the montane and upper montane ecological zones where ponderosa pine, sugar pine, and Jeffrey pine primarily occur.

Monitoring results would be evaluated and **reported every six years (every third biennial monitoring evaluation report)**. Results will be available for reporting earlier than every 3rd biennial monitoring evaluation report if data refreshes occur more frequently based on new analysis tools such as F^3 data.

Evaluation of Results

Indicator 1. The relative tree density, basal area, average diameter, regeneration density, and health of ponderosa, sugar, and Jeffrey pines will be estimated (status) and compared to previous estimates (trend). These stand variables will be graphed over time to display trends. Success will be observed if

stand variables show an increase in the relative abundance, diameter, and health of pines or meet desired conditions for pines within ponderosa pine, dry and moist mixed conifer, and Jeffrey pine forest types as described in the Land Management Plans for the Sierra and Sequoia National Forests. Post-drought baseline conditions will be carefully considered to ensure proper interpretation of trends.

Indicator 2. Acres and type of treatment (e.g., mechanical, prescribed fire, hand) will be tallied for the montane and upper montane zones (e.g., yellow pine, mixed conifer, and potentially other forest types). Success will be observed if the acres of treated forest in the montane and upper montane zones increase from baseline conditions recorded prior to the completion of the Land Management Plans for the Sierra and Sequoia National Forests. Baseline could be the trend of treatments over the last decade before the plans were approved. The amount of treatment would vary year to year; ultimately, the goal is for treatments to be conducted on more acres overall than in the past.

Adaptive Management Questions

Based on the evaluation of results, the ecologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The ecologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in ponderosa, Jeffrey, and sugar pines? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The ecologist would make recommendations to amend the monitoring question in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If monitoring results indicate that the relative or absolute density (trees/acre, basal area, regeneration/acre, volume/acre), average diameter, or health of ponderosa, Jeffrey, and sugar pines is consistently trending away from the natural range of variation and desired conditions, can we apply forest management treatments, where feasible, in these areas to improve growing conditions and resilience of the target species?

3. Is there a need to conduct an assessment to re-evaluate the status of ponderosa, Jeffrey, and sugar pines on the landscape and management actions that would alleviate the impacts of stressors to these tree species?

4. Is there a need for a change in the plan components related to the pace and scale of treatments (objectives) or the standards and guidelines pertaining to pine retention or resilience (for example, diameter limits or burn prescriptions for conifers)?

AE01: What is the trend in the condition of selected meadows and other riparian areas?

Staff Responsible for Data Collection, Evaluation, Reporting

Data collection (indicator 1) – Regional rangeland crew
Data evaluation and reporting (indicator 1) – Forest Range staff
Data collection, evaluation, reporting (indicator 2) – Hydrologist
Data collection, evaluation, reporting (indicators 3 & 4) – Hydrologist

Introduction

There is uncertainty as to whether meadows and other riparian areas are meeting or moving toward desired conditions as described in the Land Management Plans. The condition of meadows and other riparian areas are influenced by a variety of factors, including, but not limited to, management actions (e.g., road and trail development, stream diversions, grazing), changes in fire regimes, invasive species, encroaching non-riparian vegetation, and drought and other consequences of changing climate conditions. This question uses four indicators to evaluate the trend in key characteristics of meadow/riparian area condition. Some indicators are used to evaluate trends in meadows that experience management action and other indicators are used to evaluate conditions in unmanaged meadows that may be influenced by changing climate conditions. The fourth indicator tracks the work the Forests are doing to actively improve riparian habitat conditions. This question is tied to the following desired conditions:

- **WTR-RCA-MEAD-DC-05**. Meadows have substantive ground cover and a rich and diverse species composition, especially of grasses and forbs. Meadows have high plant functional diversity with multiple successional functional types represented. Perennial streams in meadows contain a diversity of age classes of shrubs along the streambank, where the potential exists for these plants.
- **WTR-RCA-DC-05.** Riparian areas provide a range of substrates to sustain habitat for a variety of aquatic and terrestrial fauna within the natural capacity of the system.
- **WTR-RCA-DC-06.** Soil structure and function is sustained to infiltrate and disperse water properly, withstand erosive forces, sustain favorable conditions of stream flow, and cycle nutrients. Associated water tables support riparian vegetation and restrict non-riparian vegetation.

Monitoring Code/Question	Indicators	Data Source	Reporting Cycle	Plan Components
AE01 – What is the trend in the condition of selected meadows and other riparian areas?	1. Meadow and riparian vegetation condition 2. Meadow greenness or wetness indices 3. Stream physical condition 4. Acres of riparian areas restored	1. Field data using Region 5 Rooted Frequency and Greenline monitoring protocols. 2. Aerial imagery (e.g., NAIP) 3. Field data using Stream Condition Inventory Technical Guide and/or Proper Functioning Condition protocols. 4. NRM (WIT)	1 & 3 Every six years (3rd BMER cycle) 2 & 4 Every two years (BMER)	WTR-RCA-MEAD-DC-05 WTR-RCA-DC-05 WTR-RCA-DC-06

Methods

- Indicator 1 (meadow and riparian vegetation condition): The intent of this indicator is to understand the trends in meadow and riparian vegetation condition. Data for indicator 1 are collected using two protocols and a dichotomous key to meadow hydrogeomorphic types/classification:
    - Protocols:
        - USDA Forest Service Region 5 protocol entitled *Field Methods for Condition Assessment in Meadows Using Plant Rooted Frequency and Soil Measurements* (Weixelman, Zamudio, and Lorenzana 2014 – with updates in 2020, unpublished).
        - Greenline monitoring as described in Winward (2000).
    - Dichotomous Key:
        - Meadow Hydrogeomorphic Types for the Sierra Nevada and Southern Cascade Ranges in California (Weixelman et al. 2011)

  Together, the data collected using these two monitoring protocols, along with meadow classification, form the assessment of the status and trend in meadow and riparian vegetation condition that overlap open, vacant, and closed range allotments. The rooted frequency protocol identifies plant species, frequency of species occurrence, vegetation community types, and functional groups. The greenline monitoring protocol evaluates and records the different community types of vegetation that line the stream's edge within the riparian type meadow systems. Data for both protocols are collected annually by the Region 5 rangeland monitoring team. Individual meadows are monitored on a five-year cycle. **Results will be reported every six years (every 3rd biennial monitoring evaluation report cycle) unless data are available at earlier intervals**. The Sierra NF currently has 79 rooted frequency plots and three greenline plots. The Sequoia currently has 51 rooted frequency plots and four greenline plots.

  Permanent plots are established on key range sites to provide long-term monitoring of condition and trend. Plots were established to determine how well Region 5 (Pacific Southwest Region) standards and guidelines are leading toward desired conditions. These methods were selected to evaluate condition (also termed ecological status) of range types in key areas. Sites were selected to best represent trend and do not necessarily reflect the overall condition of an area.

Sites were often selected to be in a mesic meadow type where trend will most likely be detected over time. Key areas were selected so that when the range types on these sites are at desired condition, or trending towards desired condition at a satisfactory rate, surrounding types will likely be trending the same.

The transects are generally not located in the hydric (wetter) types that are more likely to be at good ecological condition, but rather in the mesic sites that are more likely to be in lower ecological condition. These are sites that are sensitive to changes in management practices and are intended to be representative of the meadow type (wet, mesic, or dry) where they are located. Sites were selected in meadow areas that were homogeneous in landform, hydrologic characteristics, and vegetation.

Because rooted frequency is simple to obtain, objective, and relatively stable from season to season and year to year on perennial meadow systems, frequency sampling is advantageous for monitoring changes in species composition.

Additional information that is collected during rooted frequency monitoring is ground cover, root depth, soil texture, depth to soil mottles, depth to saturation, and dominant vascular species by cover. Rooting depth of fine and very fine roots (<2mm diameter), essentially the "sod depth", provides an effective measure of plant vigor, soil stability, and ability of a plant community for stabilizing streambanks. Bare ground is soil that is not protected by plants (including lichens and moss), litter, standing dead vegetation, gravel, or rocks. Areas with higher percentages of bare soil are at greater risk of runoff and erosion. Keeping soil covered physically protects if from erosive forces that disrupt aggregation while also building organic matter.

Greenline measures the percent of each plant community type along a reach of streambank and can provide an indication of ecological condition. Well-developed greenline vegetation stabilizes channel banks and buffers water forces. Thus, an evaluation of community type can provide a good indication of the general health of the streambank vegetation.

- Indicator 2 (wetness/greenness indices): The intent of this indicator is to measure the trend in meadow function and condition. Long term changes are indicative of changing climate, a change in water retention, and/or encroachment by upland species like conifers or shrubs.

  Data will be collected using fine-scale aerial imagery. Currently, National Agriculture Imagery Program - NAIP Hub Site (arcgis.com) (NAIP) is the preferred data collection platform because it is a long term record and is readily accessibility to Sierra and Sequoia National Forest staff. Other fine-scale imagery platforms that resolve meadow vegetation and erosion features (e.g., Sentinel-2) may be used as well or in the future. During the development of this guide, we evaluated using LandSat satellite data and determined that the data does not meet fine-scale imagery monitoring needs without refinement into a processed product to meet the objectives. This may be something to pursue with the USFS Geospatial Technology and Applications Center (GTAC) or the Region 5 Remote Sensing Lab Ecologists.

  The Forests would evaluate data for a minimum of two larger (e.g., > 100 acres), multi-component meadows (e.g., distinct zones of de/watering, aggradation, degradation, infrastructure) and 5-10 smaller and/or less complex meadows.

Using aerial imagery for each meadow, the hydrologist will evaluate the magnitude of conifer encroachment (e.g., affected acreage, density), erosion features (i.e., incipient incisions, head cuts), and herbaceous vegetation NDVI (normalized difference vegetation index). NDVI is a common index used in remote sensing. Values range from -1 to +1. When you have high NDVI values, you have healthier vegetation. When you have low NDVI, you have less or no vegetation. Collectively, these three metrics address the meadow wetness and greenness indicator.

Aerial imagery data would be collected and evaluated for the same meadows at two-year intervals. **The evaluation would be reported every two years (every biennial monitoring evaluation report)**.

- Indicator 3 (stream physical condition): the intent of this indicator is to evaluate stream physical condition in areas where management action has occurred. Data for indicator 3 are collected as part of a project before and after management has occurred. Therefore, data for this indicator would be collected on an irregular schedule and at a variety of project locations. Based on the current project workload associated with the Forests, we anticipate that data would be available for evaluation and **reporting every six years (every third biennial monitoring evaluation report)** unless data are collected and available sooner.

  Data may be collected using either the Stream Condition Inventory or Proper Functioning Condition protocol. Both protocols evaluate channel and soil stability and hydrologic function in support of WTR-RCA-DC-06.

  Stream Condition Inventory (SCI) (Frazier et al. 2005) is a statistically valid quantitative method of obtaining biological, chemical, and physical properties of a stream channel in various riparian systems (e.g., meadows, creeks). This method should be considered when wanting to establish baseline conditions (pre-project) and to track any changes to the system once the project is complete. SCI creates and allows for repeatable surveys to track these changes over time. Examples for applicability include, but are not limited to, meadow restoration, timber related projects, and grazing impacts. Data are collected downstream of project activity at established survey sites, typically in perennial streams. Surveys are completed every 5 years or after a major event.

  Proper Functioning Condition (PFC) is a qualitative analysis of lentic and lotic systems. It requires knowledge of hydrology, botany, and soils to complete the survey (USDI 2015, 2020). The survey is based on ocular assessments and professional judgment of an Interdisciplinary Team. This is considered a “rapid” assessment. Surveys are typically associated with range allotments/grazing as a management action. Data are collected near project activity such as key use areas within allotments. Surveys can be conducted in both stream (lotic) and/or meadow (lentic) systems. Surveys are completed every two years.

  Determination of protocol applicability will largely depend on meadow hydrogeomorphic type (e.g., riparian vs. subsurface), data resolution, and available staffing. SCI, for example, would best be used for riparian meadows or stream systems near vegetation management activities where a greater degree of quantification is desired or needed.

Future monitoring could use the American Rivers Scorecard approach if there is a desire to supplement (or replace) the above-collected data by regularly tracking the same meadow and stream. However, unlike SCI and PFC that collect data at any stream subject to management action, data for American Rivers Scorecard are collected only in meadows. American Rivers Scorecard is a qualitative rapid meadow assessment consisting of six ranked parameters and other observations. It assesses bank height and stability, gully formation, vegetation cover, percentage of bare ground, and upland shrub and/or conifer encroachment.

- Indicator 4 (acres of riparian areas restored): The intent of this indicator is to track progress towards improving the condition of riparian areas. The source of data for this monitoring item would be annual accomplishment reporting documentation for acres of riparian habitat restored. The hydrologist will collect these data and provide a quantitative and qualitative description of the restoration actions. **These data will be reported every two years (every biennial monitoring evaluation report cycle).**

Evaluation of Results

Indicator 1. Data will be synthesized by the Region and raw data and a report will go to the Forests. The data/report will be reviewed and synthesized by the Forest or District rangeland management specialist. Data results will be compared to the desired condition to determine if the meadows meet, move toward, or depart from desired condition. Specific data given to Forests include the location and ecological condition rating of each meadow.

The Forest rangeland management specialist will compare indicator results with desired targets which include plant species, frequency of species occurrence, vegetation community types, and functional groups. The greenline monitoring protocol evaluates and records the different community types of vegetation that line the stream's edge within the meadow systems.

The current year's data will be measured against the desired condition of each type of meadow vegetation and greenline community type. Results will include:

1. Location and ecological rating of each meadow
2. Comparison of a meadow's current Ratliff rating to the first year of monitoring Ratliff score to give long-term condition and trend.

The Ratliff score gives a rating of Excellent, Good, Fair, or Poor based on the number of competitor and intermediate species). Competitor = typically occupy sites with low to moderate amounts of disturbance and are generally more competitive in later successional stands. These species are associated with lower amount of bare soil and deeper root length densities allowing for access to deeper soil moisture providing greater soil stability. Generally native perennial grasses and perennial grasslike species. Intermediate = species live in areas of moderate intensity disturbance and can adapt to moderate to high levels of stress imposed by the environment. In wetlands and meadow areas, this often means adapting to changing water table levels and disturbance. Species that have adapted this strategy generally have slower growth rates, long lived leaves, high rates of nutrient retention and low phenotypic plasticity. These species are low statured rhizomatous herbaceous dicots, tall herbaceous

dicots, species that are able to fix nitrogen, perennial spikerush plants, most geophytes and perennial non-native grasses (USDA Forest Service 2017).

The monitoring report will include a discussion of what the trend is showing between the last reading and the first. Rooting depth and saturation levels will be analyzed to determine if there is a change. Depending on the results a more expansive look may be required to determine what is causing any downward trends such as current management, drought, etc.

Indicator 2. The hydrologist will evaluate changes in aerial imagery from one time period to the next to identify:

- acres of meadow and/or meadow perimeter changing because of encroaching conifers,
- acres of meadow experiencing incision degradation (erosion features), and
- shift in meadow NDVI (e.g., histogram).

Currently, NAIP imagery may be captured at different times of years which can influence the NDVI value observed. For example, a meadow may have a lower NDVI value in the fall than in the spring. Therefore, when interpreting the results for NDVI across multiple years, the hydrologist will take into consideration the influence of the time of image acquisition.

Additionally, the evaluation of changes in NDVI over time may be influenced by radiation to and from the atmosphere. This is generally corrected by performing an atmospheric correction. The hydrologist should be aware of the potential NDVI data interpretation limitations without an atmospheric correction.

Affirmative results would include those that indicate stable or increasing meadow perimeters, stable or increasing acres of wet meadows free from erosion features, and meadows with stable or increasing NVDI values.

Indicator 3. The data for stream condition would be evaluated to determine if the Forests are maintaining or achieving the desired conditions for this question, specifically WTR-RCA-DC-06. Stream Condition Inventory indicators have multiple components to track changes. Key indicators to watch for are 1) shifts in benthic macroinvertebrate populations showing a degradation of water quality, and 2) changes in Rosgen channel type to a more unstable form (e.g., G channel type). Pre- and post-management action data would be compared for the key indicators.

Data collected using the Proper Functioning Condition for physical and biological indicators would be evaluated in the PFC checklist. The specialists completing the checklist would work point by point through the checklist to create an overall rating for the condition of the system. The system would be classified as either: 1) functioning, 2) functioning at risk with a downward or upward trend, or 3) non-functioning condition. Data would be compared before and after management action.

Success would be observed if stream condition is sustained or improved following management activity.

Indicator 4. Results will be evaluated for progress towards achieving Land Management Plan objectives for riparian habitat restoration, trends in the pace and scale of restoration, and trends in the types of restoration occurring (e.g., prescribed fire, tree removal/thinning, road decommission, culvert

installation). Success will be observed if there is a stable or increasing trend in restoration of riparian areas.

Adaptive Management Questions

Based on the evaluation of results, the specialists may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicators providing information necessary to understand the trend in the condition of meadows and other riparian areas? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The specialists would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. Do monitoring results demonstrate intended progress towards maintaining or achieving the desired conditions for meadow and riparian vegetation condition? If not, would adjustments to management improve the trend in meadow and other riparian area vegetation condition? Potential adaptive management actions could include rerouting trails, locate OHV access away from meadows, upsize road crossings, or make changes through a modification to the grazing permit through the permit administration process. If the monitoring data show a need to change allotment management, the NEPA analysis will be used to make changes to and/or update an allotment management plan which would be incorporated into the grazing permit.

3. In meadows experiencing increasing conifer encroachment, can we remove/reduce conifers and/or reintroduce fire to stabilize or reverse this trend, ensuring management action is consistent with other plan components can be achieved for related resources (e.g., riparian habitat, fire)?

4. Meadow restoration to repair incisions and increase the water table may be recommended in meadows that are experiencing increasing incision degradation and showing drying conditions in vegetation over time.

5. Are there additional plan components and/or Best Management Practices needed to improve/protect stream physical condition during management actions? Is restoration needed in streams demonstrating continued degradation?

6. Is there a need to adjust the pace and scale of restoration to improve trends?

(iii) The status of focal species to assess the ecological conditions required under § 219.9.

FS01: What is the status and trend of black oak trees?

Staff Responsible for Data Collection, Evaluation, Reporting

Data collection, evaluation, and reporting (all indicators) - Province Ecologist or Associate
Data collection and evaluation (indicator 3) – Forest Health Protection (FHP) staff and/or Forest Vegetation Staff

Introduction

This question is designed to evaluate if management actions associated with the Land Management Plans have been successful in promoting and protecting black oak trees from various stressors. There is uncertainty as to whether management action, including the pace and scale of the action, is successful in achieving the desired conditions for oak species. Oak communities provide valuable habitat for a variety of species and have value for traditional cultural uses. This question is tied to the following plan desired condition (**TERR-BLCK-DC 01):** Oak trees, snags, and down logs provide habitat for a variety of wildlife species. Oak snags and live trees with dead limbs, hollow boles, and cavities provide shelter, and resting and nesting habitat. Acorns are plentiful, provide food for wildlife, and are available for traditional cultural uses.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
FS01 – What is the status and trend of black oak trees?	1. Density of large trees 2. Regeneration 3. Incidence of insects, disease, and mortality	1. FIA 2. FIA 3. FIA and possible field data from FHP	1 -2 Every six years (3rd BMER cycle) 3. Periodically when issues arise	TERR-BLCK-DC 01

Methods

Data for all indicators would come from the Forest Inventory and Analysis (FIA) data. FIA data are updated every 10 years by the USFS Forest Inventory and Analysis program. Ten percent of plots are re-sampled each year in California. Status and trend data for this indicator would be collected and evaluated when FIA data are updated and **reported every six years (every third biennial monitoring and evaluation report cycle).**

For indicator 3, since FIA data are not frequently updated, Forest staff would also report recently discovered incidences of elevated mortality or possible insect and disease outbreaks to the Province Ecologist (or Associate) and Forest Health Protection staff for follow up evaluation.

Evaluation of Results

Indicator 1. Black oak large tree density will be graphed over time to display trends. Success will be observed if black oak large tree density increases or remains stable over time.

Indicator 2. Black oak regeneration density will be graphed over time to display trends. Success will be observed if black oak regeneration density increases or meets desired conditions for TERR-BLCK-DC 01 and other forest plan desired conditions (e.g., TERR-POND-DCs 01 and 02).

Indicator 3. Acres of black oak mortality and mortality agents (insects, diseases) will be graphed over time to display trends. New invasive mortality agents (e.g., goldspotted oak borer) will be mapped to display geographic patterns of occurrence and possible range expansion. Success will be observed if the acres of black oak mortality and mortality agents are decreasing or remain stable over time, there are no occurrences of new invasive mortality agents, such as goldspotted oak borer, or these occurrences are very limited in number and spatial extent.

Adaptive Management Questions

Based on the evaluation of results, the ecologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The ecologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in black oak? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The ecologist would make recommendations to amend the monitoring question in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. Do monitoring results demonstrate intended progress towards maintaining or achieving the desired conditions for this monitoring question? If not, are additional management actions (e.g., wood grinding treatments designed to contain or limit the spread of goldspotted oak borer, or removal of conifer ladder fuels to reduce fire-related mortality in mature oaks) needed to facilitate improvement?

3. Is there a need to conduct an assessment to re-evaluate the status of black oak on the landscape and management actions that would alleviate the impacts of stressors to black oak trees and regeneration?

4. Is there a need for a change in the plan components related to the pace and scale of treatments (objectives) or the standards and guidelines pertaining to oak retention or resilience (for example, diameter limits or burn prescriptions for hardwoods)?

(iv) The status of a select set of the ecological conditions required under § 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.

AR01: Do stream temperatures support persistence of native at-risk aquatic species in select reaches?

Staff Responsible for Data Collection, Evaluation, Reporting

Aquatic Biologists

Introduction

This question was designed to address whether select stream temperatures can support habitat for at-risk species and their prey. Secondarily, the question attempts to discern if management action is correlated with changes in stream temperatures or if changes are unrelated to management activities. The question is tied to the following desired condition **SPEC-FW-DC-02:** Ecological conditions for at-risk species support self-sustaining populations within the inherent capabilities of the plan area, including minimizing impacts from threats (such as disease and other site-specific threats). Ecological conditions provide habitat conditions that contribute to the survival, recovery, and delisting of species under the Endangered Species Act; preclude the need for listing new species; and improve conditions for species of conservation concern.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
AR01 – 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.)	Field data using Stream Condition Inventory Technical Guide	Sierra NF - Every two years (BMER) Sequoia NF – every six years (3rd BMER cycle) or sooner based on data availability	SPEC-FW-DC-02

Methods

Data would be collected in select reaches of streams that are known to support, or can support, at-risk aquatic species and are subject to management actions. Data collection methods for this indicator are different for each Forest and are described separately below. For both Forests, data are collected as part project implementation and/or because of US Fish and Wildlife (USFWS) Biological Opinions associated with projects or other ongoing management activities.

Sierra National Forest

Stream temperature data collection methods follow the guidance provided on page 18 of the Pacific Southwest Region Stream Condition Inventory Technical Guide version 5.0 (Frazier et al. 2005).

Temperature data (and other stream condition metrics) are collected in perennial stream reaches that overlap or are downstream from timber and/or fuels management projects. Some data are collected in streams that overlap range allotments because these streams are occupied by Lahontan cutthroat trout, a federally threatened species. Because much of the data are collected as part of project activities, the number and location of monitoring sites would change over time. Typically, the Forest deploys one temperature logger per project. However, more loggers may be needed depending on the complexity of the project and the stream channel. Determination is up to the hydrologist or aquatics biologist. Temperature loggers are deployed in early May and collected at the end of October. Data are not currently collected in the winter. Temperature loggers collect hourly data.

Within a stream, temperature loggers are deployed in a riffle or run. For each project, data are collected annually in stream reaches with potential be affected by the management actions. Annual monitoring begins two years before management action, occurs during the management activity, and continues up to five years following completion of the management activity. Results from stream temperature monitoring on the Sierra National Forest would be reported **every two years (every biennial monitoring evaluation report)** or perhaps longer intervals based on data collection frequency.

Currently there are 24 temperature loggers deployed in 21 streams on the High Sierra Ranger District and five loggers deployed in five streams on the Bass Lake Ranger District.

Sequoia National Forest

Stream temperature data are collected in streams that overlap the Little Kern range allotment because these streams are occupied by and within critical habitat of Little Kern golden trout (*Oncorhychus mykiss whitei*), a federally threatened species. Consistent with the Long-Term Monitoring Plan of Critical Stream Habitat for Little Kern Golden Trout (referred to in Biological Opinion 1-1-96-I-622 and associated with livestock grazing), temperature loggers are deployed to record temperature data at eight sites, every five years. Temperature loggers are typically deployed in June and collected at the end of October. Temperature loggers usually collect hourly data and are deployed in a stream riffle or run. Results from stream temperature monitoring on the Sequoia National Forest would be reported **every six years (every third biennial monitoring evaluation report cycle) unless the data are available earlier.**

Temperature data (and other stream condition metrics) may be collected in perennial stream reaches that overlap or are downstream from future timber and/or fuels management projects, if warranted.

Evaluation of Results

Sierra National Forest

Temperature data are evaluated for native trout assemblages and Lahontan cutthroat trout thermal tolerances. Thermograph data are displayed by minimum, average, and maximum temperatures per day and per month. Data would be evaluated to determine if temperatures are appropriate for native aquatic/riparian species which should not exceed expected summer temperature range (<21º C) for the zoogeographic province (Moyle 2002). For Lahontan cutthroat trout, optimal fluvial habitat is characterized by clear, cold water with an average maximum summer temperature of <22° C and a relatively stable summer temperature regime averaging about 13° C (Recovery Plan for Lahontan Cutthroat Trout, US Fish and Wildlife Service 1994). Data are reported annually to the USFWS as part of

a monitoring plan under a Biological Opinion from 1994-1995 for two range allotments (Dinkey and Mugler) on the Sierra NF that have stream reaches occupied by Lahontan cutthroat trout.

Sequoia National Forest

Stream temperature data are used to determine if temperatures are within acceptable ranges for the Little Kern golden trout. Water temperatures that exceed 30°C is considered lethal for most trout species (Beitinger, Bennett, and McCauley 2000). During the spawning season, eggs hatch in water with temperatures between 12 and 16°C (USFWS). Data are reported every 5 years to USFWS, consistent with Biological Opinion 1-1-96-I-622.

Adaptive Management Questions

Based on the evaluation of results, the biologists may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand is stream temperatures in select reaches are consistent with supporting native at-risk aquatic species? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The biologists would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If stream temperatures in select reaches indicate that thresholds have been exceeded for a species or a native species assemblage, can management action be used to reverse trends? Below are some adaptive management questions the specialists would consider.
    - Is the source naturally occurring (i.e. drought) or created by management actions (i.e. removal of stream shade cover)?
    - Is the source from a project or a separate action unrelated to the project (e.g., road blow out, stream diversion upstream)?
    - Are activities on adjacent land ownerships playing a role? If so, can the Forest work with adjacent land managers?
    - Can in-channel restoration action be used to create stream features (e.g., sinuosity, pool scouring) conducive to cooler temperatures?
    - Can management action like planting riparian vegetation improve the amount and quality of streamside shading?
    - Do we need to change stream buffers when conducting vegetation management activities?

AR02: To what extent is suitable habitat for at-risk plant and lichen species being maintained or improved?

Staff Responsible for Data Collection, Evaluation, Reporting

Data collection: Botanists, Forest GIS staff, and/or Region 5 Ecosystem Planning GIS Analyst
Data evaluation and reporting: Botanists

Introduction

This question is designed to address the extent to which suitable habitat for at-risk plant and lichen species is being maintained or improved in the plan area. From rocky outcrops to mixed conifer forests, the Sierra and Sequoia National Forests support diverse ecological conditions and processes that provide suitable habitat for at-risk plant and lichen species. Threats facing suitable habitat include, but are not limited to, climate change, drought, wildfire, wildfire suppression, grazing, intensive recreation, invasive species, and vegetation management and fuels reduction treatments. Monitoring the trend in the extent and condition of suitable habitat and the threats that may be influencing these trends will enable the Forests to adapt the plans and/or management as needed to protect suitable habitat.

This question is tied to the following desired conditions: **SPEC-FW-DC 01** Persistent populations of native, and desirable nonnative, plant and animal species are supported by healthy ecosystems, essential ecological processes, and land stewardship activities, and reflect the diversity, quantity, quality, and capability of natural habitats on the national forest. These ecosystems are also resilient to uncharacteristic fire, climate change, and other stressors, and this resilience supports the long-term sustainability of plant and animal communities, **SPEC-FW-DC 02** Ecological conditions for at-risk species support self-sustaining populations within the inherent capabilities of the plan area, including minimizing impacts from threats (such as disease and other site-specific threats). Ecological conditions provide habitat conditions that contribute to the survival, recovery, and delisting of species under the Endangered Species Act; preclude the need for listing new species; and improve conditions for species of conservation concern, and **TERR-SH-DC 01**: The integrity of special habitats is maintained or improved from current conditions. Composition, diversity, and structure of unique plant assemblages are maintained in all areas, including those with multiple-use activities.?

This question will also help the Forests maintain a current and accurate understanding of suitable habitat which is applicable to **SPEC-PLANT-STD 03**, which states: Use information that is current, accurate, and precise enough to avoid or mitigate impacts on at-risk plants and lichens when designing projects. If such information cannot be obtained, assume occupancy of the project area by one or more at-risk species within suitable habitat and apply resource protection measures to avoid or mitigate impacts throughout the project area.

In order to promote beneficial effects of fire and other disturbances on some at-risk plants and lichens, this standard does not apply to the following activities:

a. The fire itself when conducting a prescribed under-burn.
b. Temporary or light disturbance created by use of hand tools, such as construction of fireline with hand tools or hand piling or scattering of residual woody material. Only scatter residual woody materials when neutral or beneficial to at-risk plants and lichens.

Monitoring Code/Question	Indicators	Data Source	Reporting Cycle	Plan Components
AR02 – To what extent is suitable habitat for at-risk plant and lichen species being maintained or improved?	1. Extent of suitable habitat 2. Proportion of suitable habitat disturbed 3. Proportion of suitable habitat improved	Local Forest data for suitable habitat, NRM (FACTS, WIT, INFRA), BAER reports and soil burn severity, NRIS	Every 2-6 years depending on data availability and disturbance frequency	SPEC-FW-DC 01 SPEC-FW-DC 02 SPEC-PLANT-STD 01 TERR-SH-DC 01

Methods

This question evaluates the change over time in *broadly defined ecological conditions (suitable habitats)* for at-risk plant and lichen species. At this time, this question does not evaluate the change in individual plant occurrences, occupied habitat, or microsite habitat characteristics. However, these types of fine-scale data (quantitative and qualitative), where they are available, can be integrated with the results from this question to supplement the interpretations. Likewise, results from project-level surveys, partner monitoring, or other relevant data can also supplement this evaluation.

Suitable habitats and associated at-risk species are currently described in the Sierra and Sequoia Final Environmental Impact Statement Appendix D (table D-42). Some examples of broadly defined suitable habitats include rock outcrop, meadow, upper montane, and fens. Multiple species may be associated with the same broadly defined suitable habitats. Some species may be associated with more than one suitable habitat.

To the extent it is feasible and meaningful, this monitoring would utilize the help of partners. Our partners may evaluate trends in these broadly defined suitable habitats. Alternatively, our partners may track trends in more fine-scale data that can be used to supplement this evaluation.

- Indicator 1 (extent of suitable habitat): Data would come from the Forest existing vegetation layer (eVeg), most recently updated in 2016 for the Forests. The botanists may also wish to review/verify the suitable habitats using recent aerial imagery, F3 data as part of the regional resource kits, or another analogous data source. California Wildlife Habitat Relationships data (CWHR) are used less frequently by botanists due to the extremely coarse nature of the information, but botanists do use it when appropriate. As aforementioned, these spatial data could be supplemented with qualifiers (where available) applied by botanists to reflect the fine-grained presence of at-risk plant populations.

  It should be noted that the ability to monitor changes in the extent of suitable habitat over time is contingent upon the vegetation data (eVeg or an analogous vegetation layer) being refreshed in a timely manner. The existing 2016 Calveg Zone versions of the Eveg data can be found here:

  - T:\FS\Reference\GeoTool\agency\DatabaseConnection\r05_rsl_default_as_myself.sde\S_R05_RSL.VegetationByZone\S_R05_RSL.EVEG_SouSierra_95_16_v2

- T:\FS\Reference\GeoTool\agency\DatabaseConnection\r05_rsl_default_as_myself.sde\S_R05_RSL.VegetationByZone\S_R05_RSL.EVEG_SouSierra_95_16_v2

A good breakdown of all the attributes in the Existing Vegetation data can be found here:

- https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5365219

Information Management MARS groups library contains SDE vector vegetation data for the 2016 vegetation conditions at these locations:

- T:\FS\Reference\GeoTool\agency\DatabaseConnection\r05_rsl_default_as_myself.sde\S_R05_RSL.VegetationByForestCurrent\S_R05_RSL.ExistingVegetation_SNF16_1
- T:\FS\Reference\GeoTool\agency\DatabaseConnection\r05_rsl_default_as_myself.sde\S_R05_RSL.VegetationByForestCurrent\S_R05_RSL.ExistingVegetation_SQF16_1

- Indicator 2 (proportion of suitable habitat negatively disturbed): This indicator would measure the extent of a negative disturbance in a suitable habitat type that has been adversely affected during the monitoring period. These can be measured as percent affected, acres or miles affected, and/or qualitatively where quantitative data do not exist. Not every suitable habitat needs to be evaluated during a monitoring period; only those habitats affected by a negative disturbance would be measured. Disturbance types and known data sources may include but are not limited to:
  - Known invasive species infestations (% infested or acres of infestation) within suitable habitats, data source: Natural Resource Information System (NRIS),
  - Acres of high soil burn severity (SBS) within suitable habitats not adapted to high severity fire, data source: soil burn severity data from Burned Area Emergency Response (BAER) team,
  - Drought-related tree mortality, data source: USFS Forest Health Protection Aerial Detection Surveys (and/or potentially eDaRT for canopy cover loss),
  - Fire suppression activities, data source: spatial data provided to Forest by Resource Advisor (READ/REAF) and BAER teams, and/or
  - Miles of trails built in suitable habitat, data source: NRM Infrastructure Administrative Sites, Recreation Facilities, and Roads (INFRA) database.

  The Land Management Plans include plan components to protect at-risk plant and lichen species and their habitat during implementation of the Plan; therefore, minimizing disturbance or working with the IDT to plan beneficial disturbance (e.g., for a plant that benefits from prescribed fire). Each project would incorporate these plan components and may include additional, project-specific design features. Therefore, the assumption for this monitoring indicator is that ground disturbance from management, guided by these plan components and project-level design features, would not constitute negative disturbance. However, if there is a need to evaluate the extent of ground disturbance from management actions, the evaluation could use data from FACTs for mechanical operations and prescribed fire as well as other local knowledge.

- Indicator 3 (proportion of suitable habitat improved): This indicator would measure the extent of management actions or natural beneficial disturbance events that improve the condition of existing suitable habitat. These can be measured as percent improved, acres or miles improved, and/or qualitatively where quantitative data do not exist. Types of actions that may improve habitat condition and known data sources may include but are not limited to:
    - Meadow, stream, riparian area restoration, data source: NRM Watershed Improvement Tracking (WIT),
    - Reforestation, data source: NRM FACTS,
    - Acres of invasive species treated, data source: NRM FACTS,
    - Low to moderate severity wildfire, data source: soil burn severity data from BAER team disturbance that improved habitat,
    - Native plant material dispersal (e.g., seed sowing), data source: local Forest-level data,
    - Select forest management activities to intentionally improve habitat for native species (e.g., herbicide spraying of invasive weeds that are encroaching on habitat of at-risk plants), data source: FACTS, supplemented by local Forest project records.

Evaluation of Results

For all three indicators, the evaluation would focus on broad categories of suitable habitat that have changed in some way since the last reporting cycle. The evaluation for each indicator could also be supplemented by Forest-specific fine-grained information about occupied suitable habitat where available. For example, the monitoring can be supplemented to provide an evaluation of changes to the extent of occupied habitat (e.g., newly identified occupied sites or expansion of known occurrences), disturbance to occupied habitat, and restoration of occupied habitat where these data are readily available.

- Indicator 1 (extent of suitable habitat): The intent of this indicator is to quantitatively measure the extent of the broadly defined suitable habitat types on the Forests and track changes over time. The first monitoring period would describe the baseline extent of suitable habitat types on the Forests. For example, 500 acres of meadows, 100 acres of fens, 250 acres of foothill mixed chaparral. Suitable habitats are defined at a coarse level, not taking into consideration all the micro-habitat conditions that may be needed by individual species. Therefore, these baseline data would not be interpreted to mean that all the suitable habitat is occupied by at-risk species. Where the data are available, the proportion of acres of each broad type occupied by at-risk species and the proportion that has been surveyed since the last reporting period could be described to supplement the data for this indicator.

  Future monitoring periods would use updates to the eVeg (or analogous) spatial vegetation information to identify a quantitative change in suitable habitats as compared to the baseline extent as well as over monitoring periods. The magnitude of change of suitable habitat would be evaluated as percent decrease or percent increase over time and as compared to the baseline amount. These data can be shown graphically. Where a major loss has occurred, these data may also be shown spatially. These losses or changes would be used to target monitoring and/or survey efforts for at-risk species where conditions are most likely to be “very suitable” within the broad habitat categories (see adaptive management questions below).

The evaluation would describe the factors associated with loss where it is known. Percent increase could occur when habitat has been restored to meet the definition of suitable habitat or where surveys have identified new areas of suitable habitat. The evaluation would characterize the factors associated with the increase where they are known.

Success would be observed if the extent of suitable habitat remains the same or increases over time. Where data are available for trends in micro-habitat conditions, occurrences of populations, or other fine-scale information, these data can be used to evaluate success of rare plants sustained on the landscape.

- Indicator 2 (proportion of suitable habitat negatively disturbed): The intent of this indicator is to measure the extent of damaging or negative disturbances to the condition of suitable habitat over time The evaluation would look at the acres, miles, and/or percent of suitable habitat affected by a specific disturbance type and the percent increase or decrease over time. Any qualitative information regarding the nature of the various disturbances would be described. Where data are available and where the context is helpful, the evaluation would include a discussion of the frequency of a disturbance and implications.

  Success would be observed if the amount of suitable habitat damaged or negatively disturbed decreases over time. As with indicator 1, where finer-scale data (qualitative or quantitative) are available for disturbances in micro-habitats and/or in known occupied habitat, these data can be used to supplement the evaluation of success of rare plants sustained on the landscape.

- Indicator 3 (proportion of suitable habitat improved): The intent of this indicator is to measure the extent and type of actions that have improved the condition of suitable habitat within the monitoring period (two years). Data would be evaluated by the type of improvement action and the proportion, acres, and/or miles of each suitable habitat type that experienced an improved condition. Any qualitative information regarding the nature of the various disturbances would be described.

  Success would be observed if the condition of suitable habitat remains the same or improves over time. Where fine-scale data (quantitative or qualitative) are available for improvements made within micro-habitats, known occupied habitat, or other fine-scale information, these data can be used to evaluate success of rare plants sustained on the landscape.

Adaptive Management Questions

Based on the evaluation of results, the botanists may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The botanists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in suitable habitat for at-risk plant species? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
   - Are additional or different indicators needed?
   - Should data be collected with a different frequency?
   - Is there a new methodology, tool, or new science that should be incorporated?

The botanists would make recommendations to amend the monitoring question in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If the extent of a suitable habitat type is decreasing or the condition is increasingly negatively disturbed, can management action help reverse the decreasing trend?
    - Can management action be used to restore meadows or areas that were historically meadow habitat?
    - Is there a need to increase invasive species control and eradication efforts?
    - Is a management action (or the timing of a management action) correlated with the decreasing trend and can that be stopped/adjusted?

3. If the extent of a suitable habitat type is continuing to decrease or the condition is increasingly negatively disturbed, and the factors associated with the adverse effects are unknown, is there a need to conduct on-the-ground targeted monitoring of on-site conditions, especially in areas of very suitable habitat or where there are known populations, to further define adaptive management options?
4. If the extent or condition of a suitable habitat type is decreasing, is there a need to change or add a plan component(s)?

AR03: 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?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection and Evaluation – Region 5 Information Management Ecologist, Region 5 Ecosystem Planning GIS Analyst, Forest Health Protection Aerial Detection Survey staff member, and/or Forest GIS staff (data collection and evaluation shared with TE01)
Data Evaluation and Reporting – Wildlife Biologists

Introduction

This question is designed to evaluate the trend in nesting and roosting habitat within California spotted owl Protected Activity Centers (PACs) and territories as influenced by widespread disturbance events and management action. Habitat within the range of the California spotted owl is increasingly affected by large-scale disturbance events like high severity wildfires and widespread drought-related tree mortality. Under the Sierra and Sequoia Land Management Plans, management action in PACs and territories is intended to promote resilience to these disturbances while also protecting important habitat features like large diameter trees.

There is greater flexibility for management in PACs and territories under the new Plans than under previous direction from the early 2000s. Therefore, there is a need to evaluate if greater flexibility in management action under the Plans is successful in maintaining nesting and roosting habitat within PACs and territories. This new direction for management action (and restrictions) in PACs and territories is consistent with *Conservation Strategy for the California Spotted Owl in the Sierra Nevada version 1.0* (April 2019).

This question is tied to the following desired conditions for high-quality habitat in PACs and territories:

SPEC-CSO-DC 01: Protected activity centers provide high-quality nesting and roosting habitat that contributes to successful reproduction of California spotted owls. Protected activity centers encompass habitat that is essential for nesting and roosting, as defined by the following characteristics: The habitat has a high canopy cover (including large clumps of more than 70 percent canopy cover), with multiple layers of tree canopy, and many large trees, very large trees, and snags (including some greater than 45 inches in diameter). Basal area and tree density tend toward the upper end of the range of desired conditions for the relevant forest vegetation type. Large tree density, snag density, and coarse woody debris align with the old-forest desired conditions for the relevant forest vegetation type.

SPEC-CSO-DC 02: At least 40 percent (for xeric vegetation type and site conditions) or at least 60 percent (for mesic vegetation type and site conditions) of each California spotted owl territory consists of the highest quality nesting and roosting habitat (see definition above) in large enough patches to provide interior stand conditions, generally 1 to 2 tree heights from an edge. The remainder of the territory consists of a diversity of many different structure and canopy classes (aligned with desired conditions for terrestrial vegetation type). For areas where multiple territories comprise over 75 percent of a watershed (typically a HUC 8 unit and greater than 10,000 acres in size) at

least 30 to 50 percent (depending on the vegetation type and site conditions), of the watershed consists of the highest quality nesting and roosting habitat and the remainder of the territory consists of a diversity of many different structure and canopy classes (aligned with desired conditions for terrestrial vegetation type).

This question will also provide valuable information for whether the Forests are achieving the following standards:

SPEC-CSO-STD 02: In California spotted owl protected activity centers, all management activities must maintain or improve habitat quality in the highest quality nesting and roosting habitat. Where necessary to increase long-term resilience, vegetation treatments that may reduce near-term habitat quality may be authorized in up to 100 acres outside of the highest quality nesting and roosting habitat. Throughout protected activity centers all vegetation treatments must:

- Retain the largest/oldest trees, known nest trees, and other large trees and snags with cavities, deformities, broken tops, or other habitat features of value to old-forest species;
- Retain connected areas of moderate (at least 40 percent) and high (at least 60 percent) canopy cover between the known nest site (if nest site is not known, use the most recent known roost site) and areas in the remainder of the protected activity center;
- Avoid mechanical treatments within a 10-acre area surrounding the most recent known nest;
- Avoid creating new landings, new temporary roads, or canopy gaps larger than 0.25 acre;
- Increase the quadratic mean diameter of trees at the protected activity center scale; and
- Maintain the average canopy cover of the protected activity center above 50 percent.

Exceptions:
In community buffers, this standard may be modified as necessary to meet safety objectives.

This standard may be modified as specified in SPEC-CSO-GDL 02 when constructing a fuelbreak where avoiding overlap with a protected activity center is not feasible.

SPEC-CSO-STD 03: In California spotted owl territories that do not currently meet the territory desired condition (SPEC-CSO-DC-02), retain habitat quality in the highest quality nesting habitat wherever it exists throughout the territory. If this desired condition has been met, vegetation treatments to improve resilience and increase heterogeneity should maintain highest quality nesting and roosting habitat as identified in SPEC-CSO-DC-02.

In territories where survey data indicate pair occupancy and DC-02 is not met, if retaining habitat quality in the highest quality nesting habitat is insufficient to achieve the desired condition, also retain habitat quality in the best available nesting and roosting habitat to the level described in the DC-02. Prioritize retention of best available nesting and roosting habitat in CWHR class 4D ahead of 4M.

Exception: Does not apply in community buffers.

Monitoring Code/Question	Indicators	Data Source	Reporting Cycle	Plan Components
AR03 – 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?	1. Proportion of PACs and territories with CWHR 4M/D and 5M/D, 6 and large snags 2. Proportion of PACs and territories affected by disturbance (e.g., wildland fire, tree mortality) 3. Treatment acres in PACs and territories	CWHR, F³, FACTs, RAVG, ADS, eDaRT	1-2 Every six years unless there has been a major disturbance 3 Every two years	SPEC-CSO-DC 01 SPEC-CSO-DC 02 SPEC-CSO-STD 02 SPEC-CSO-STD 03

Methods

As described in the Land Management Plan, highest quality habitat includes California Wildlife Habitat Relationship (CWHR) 6, 5M, and 5D. Best available habitat includes CWHR 4M and 4D with large remnant trees.

CWHR data would be used for these analyses. Multiple other data sources exist that could be used to evaluate this indicator (e.g., F³, LANDFIRE, LiDAR, eDaRT, Regional Resource Kits; see TE01, indicator 1). Some sources of data are more rapidly updated than others. If CWHR data are not used for this analysis due to an extraordinary delay in data refresh, another analogous data source will be selected based on the best ability to estimate late successional forest with large trees and snags like the categories used by CWHR.

Lastly, it takes time for trees to grow. Therefore, data may not readily show change in CWHR size and density classes even at a six-year time frame.

Indicator 1. Proportion of PACs and territories with CWHR 4M/D and 5M/D and 6 and large snags

Data and evaluation for this indicator are very similar to the methods described for question TE01 (trend in old forest).

For the proportion of PACs and territories with CWHR 4M/D and 5M/D and 6, data from California Wildlife habitat Relationship (CWHR) would be extracted for all Protected Activity Centers and spotted owl territories on the Sierra and Sequoia National Forests. Specifically, data will be extracted for CWHR classes 4M & D (combined), 5M & D (combined), and 6 because these are the size and density classes that represent large diameter trees and very large diameter trees. Data for 5M & D can be evaluated collectively with data for size class 6.

Data for the density of large snags can be obtained from Forest Inventory and Analysis (FIA) data summaries and/or from F³. Density of snags could also be estimated using eDaRT to account for vegetation loss due to disturbance over recent years. F³ currently displays snag data in the following

diameter classes: 20-29.9", 30-39.9", and >=40". Data for snags in the following diameter classes would be ideal for this evaluation but are not currently produced by F[3]: 40-44.9", and >=45".

In the future, or if additional information is needed, F[3] data may be used to identify total basal area per acre (ft^2/acre) as well as relative stand density index. These metrics are also closely aligned with the desired conditions SPEC-CSO-DC 01 and SPEC-CSO-DC 02.

Indicator 2. Proportion of PACs and territories affected by disturbance (e.g., wildland fire, tree mortality)

Data for disturbance events that have occurred in territories could be evaluated using the following sources:

- Ecosystem Disturbance and Recovery Tracker (eDaRT), to account for most recent changes that may not be evident in the above sources. The Ecosystem Disturbance and Recovery Tracker (eDaRT) is a satellite-based remote sensing and processing system that detects forest stand- and landscape-level changes (Koltunov et al. 2020). eDaRT products provide information on vegetation disturbance events derived from Landsat satellite imagery at the 98 ft (30 m) scale. The onset of these events is attributed to a two-week time period, and each event has a relative severity that corresponds to % canopy cover loss. per 30 m pixel.
- Rapid Assessment of Vegetation Condition after Wildfire (RAVG), or the Monitoring Trends in Burn Severity (MTBS) program to account for most recent changes that may be due to wildland fire (see question CC02).
- Aerial Detection Survey data from the Forest Health Protection Department to account for most recent changes that may be due to drought-related tree mortality (see question CC01).

Indicator 3. Treatment acres in PACs and territories. Data for acres of treatments in PACs and territories are entered annually in the Natural Resource Manager Forest Service Activity Tracking System (FACTs) database and can be accessed from the Enterprise Data Warehouse. For the monitoring reports, the database can be queried, and a summary can be extracted of **completed** treatments in PACs and territories. Treatments evaluated include mechanical treatments and prescribed fire treatments. Mechanical treatment data includes the use of mechanical equipment (e.g., mastication, commercial and non-commercial mechanical thinning). Prescribed fire would include any management activity that puts fire on the landscape regardless of ecological benefits (e.g., underburning, jackpot burning, pile burning).

Data for mechanical treatments associated with fire suppression activities in PACs are maintained by fire incident (resource advisor data) and provided to the Forests.

Evaluation of Results

It could be advantageous to evaluate the results in the context of the trends identified in TE01 which looks at how late seral conditions trend across each Forest as a whole. Comparing the trend in PACs and territories with those (at least qualitatively) produced for TE01 can be very useful to see how habitat in PACs and territories is changing compared to the rest of the Forest.

Indicator 1. Proportion of PACs and territories with CWHR 4M/D and 5M/D and 6 and large snags. This indicator is intended to evaluate the extent to which habitat in PACs and territories is trending towards (or away from) desired conditions (SPEC-CSO-DC 01 and SPEC-CSO-DC 02).

PAC evaluation

For the PAC evaluation, the acres (and proportion) of CWHR size and density classes 4M & D, 5M/D and 6 would be summed for PACs on the Forest. The trend in habitat should be evaluated at the level of the individual PAC but can be summed for multiple PACs where appropriate (e.g., if certain PACs were not treated or have not experienced negative disturbance events). Data for CWHR 4M and 4D can be combined. Data for 5M, 5D, and 6 can also be combined.

Data would be evaluated as the percent change from a baseline proportion when the Record of Design for the Plan was signed and change across monitoring periods. Below is an example of a table that could be produced to illustrate change in CWHR habitat in PACs. If desired, data can be first evaluated collectively for all PACs and subsequently broken out by individual PAC if needed to explore any unusual trends. Data can also be displayed graphically as a trend over time.

		Current Monitoring Period	Current Monitoring Period	% change from previous monitoring period	% change from baseline
PAC ID	Total Acres	Acres 4M/4D (% of PAC)	Acres 5M, 5D, 6 (% of PAC)		

Success for PAC habitat would be observed if the trend in habitat condition is moving towards SPEC-CSO-DC 01 in that PACs have habitat with many large trees (≥ 30 inches DBH) and very large trees (≥ 36 inches DBH). In terms of CWHR, success would be achieved if there is a stable or increasing trend in CWHR 5M/D, 6. A stable or increasing trend in CWHR 4M/D can be an indication that habitat is trending towards supporting large and very large trees.

If desired, the biologist can compare basal area and tree density in the major vegetation types within the PACs with the desired conditions described for those vegetation types in the LMPs. This analysis could be conducted using F^3 data produced by Information Management staff. Success would be achieved if basal area and tree density are at the upper range of the desired conditions for the major vegetation types or if large tree density is aligned with the densities described for old forest desired conditions. This evaluation helps us understand if the stand structure is trending towards resilient conditions (i.e., NRV and DCs).

If there is a declining trend in CWHR 4M/D, 5M/D, 6, the biologist would further evaluate factors as described in indicators 2 (disturbance) and 3 (treatment) that may be correlated with this trend.

Territory Evaluation

For the territory evaluation, the acres (and proportion) of CWHR size and density classes 4M/D, 5M/D and 6 would be summed for each territory on the Forest. As with PACs, the trend in habitat should be evaluated at the level of the individual territory but can be summed for multiple territories where appropriate (e.g., if certain territories were not treated or have not experienced negative disturbance

events). Data would be inclusive of the entire territory, including the associated PAC. Data for CWHR 4M and 4D can be combined. Data for 5M, 5D, and 6 can also be combined.

Data would be displayed as the acres (and proportion) of CWHR 5M/D, 6 in dry forest types and moist forest types. Dry and moist mixed conifer types are defined below and in Appendix H of the Land Management Plan.

- Dry mixed conifer: mixed conifer forests located on ridges or on south- or west-facing aspects.
- Moist mixed conifer: mixed conifer forests in canyon/drainage bottoms or on north- or east-facing aspects.

Application for California Spotted Owl Territories

At least one of the following criteria must be met for a California spotted owl Territory to be classified as Moist Mixed Conifer; otherwise, it will be considered Dry Mixed Conifer.

- >=51% of the 800 acre Territory is Moist Mixed Conifer; OR
- >=51% Forested acres of the Territory is Moist Mixed Conifer; OR
- >=51% of the 800 acre Territory is Moist Conifer and/or Red Fir; OR
- >=51% of Forested acres of the Territory is Moist Mixed Conifer and/or Red Fir

Where there is a majority of moist vegetation types (moist mixed conifer), at least 60% of the territory must be retained as highest quality nesting and roosting habitat. Where the majority of the territory is xeric (dry mixed conifer and other dry vegetation types), the minimum is 40%. Data would be evaluated as the percent change from a baseline proportion when the Record of Design for the Plan was signed and change across monitoring periods. As with PACs, data can be displayed in a table by individual territory, and graphically as a trend over time by individual territory and/or by all territories collectively.

Success for territory habitat would be observed if at least 40 percent (for dry mixed conifer and other xeric vegetation types) or at least 60 percent (for moist mixed conifer and other mesic vegetation types) of the habitat in California spotted owl territories consist of CWHR 5M/D, and 6, or if there is a positive trend towards achieving SPEC-CSO-DC 02.

If there is a declining trend in CWHR 4M/D, 5M/D, 6, the biologist would further evaluate factors as described in indicators 2 (disturbance) and 3 (treatment) that may be correlated with this trend.

Large Snag Density Evaluation

Data for large snag density would be displayed either by PAC and associated territory **outside** of a PAC (as shown in table below) or as a mean and median range of overall snag densities among all PACs and all territories. The depth of analysis (lumping and splitting) will depend on the activities and disturbances that have been occurring in PACs and territories. Large snags would be defined as 20-29.9", 30-39.9", and >=40". Data for snags in the following diameter classes would be ideal for this evaluation (perhaps these could be requested of F[3]): 40-44.9” and >=45".

PAC ID	Snags ≥20" Density	Snags ≥30" Density	Snags ≥ 40" Density	Snags ≥20" Density in Territory (outside of PAC)	Snags ≥30" Density in Territory (outside of PAC)	Snags ≥ 40" Density in Territory (outside of PAC)

Success will be observed if the density of snags greater than 20 inches in diameter are at the upper range of those desired ranges described in the table associated with WHMA-GDL-02. The table includes the desired range of snags greater than 20 inches diameter per 10 acres for the various major vegetation types.

PAC and Territory Retirement

For this indicator (and indicator 2), the biologist should track the number of PACs and associated territories that have been retired during the monitoring period and since the Record of Decision for the Plan was signed (baseline). The biologist would describe the reason for retirement (lack of pair occupancy or disturbance).

Note: The ability to evaluate this indicator is influenced by the frequency with which vegetation data are refreshed as well as the time it takes for trees to grow.

Indicator 2. Proportion of PACs and territories affected by disturbance (e.g., wildland fire, tree mortality). This indicator is intended to evaluate how much of the habitat in PACs and territories has experienced the adverse (and beneficial) consequences of disturbance events.

Negative Effects of Disturbance

High severity wildfire is considered a negative disturbance on spotted owl nesting and roosting habitat. According to the LMP, when a territory associated with a PAC experiences more than 75 percent basal area mortality over more than 50 percent of the territory, the PAC and territory may be retired following adequate surveys that determine the absence of CSO pair occupancy. PAC (and associated) territory retirement may also occur if a disturbance has affected a PAC and there is not sufficient nesting and roosting habitat within a 1.5-mile to re-map the PAC.

The monitoring will track and report the number of territories and associated PACs that have experienced high severity wildfire, defined as ≥ 75 percent basal area mortality in more than 50 percent of the territory. To the extent data are available and recently refreshed, track the CWHR types affected by high severity fire within the territory. The trend in the number of affected PACs and territories would be compared across monitoring periods and compared to the baseline number of affected territories during the first monitoring period (i.e., the first two years following the signature of the Record of Decision). Success would be achieved if the Forest observes a decrease in the number of territories affected by high severity wildfire.

Data can be displayed in a table for each monitoring period and as a graph for trends across monitoring periods (and compared to baseline). Data can be displayed spatially if there is a desire to show the location within the Forest affected by the disturbance.

Data for the effects of drought-related tree mortality would be evaluated similarly to the effects of high severity wildfire. The monitoring will track and report the proportion of territories and PACs that have experienced drought-related tree mortality in more than 50 percent of the territory. Trends will be compared across monitoring periods and with the first monitoring period. Success would be achieved if the Forest observes a decrease in the number of territories affected by drought-related tree mortality.

The monitoring associated with the negative effects of disturbance would also track the number of territories (and associated PACs) that have been retired because of the disturbance. Success would be observed if the number of territories retired have decreased over time.

Potential Beneficial Effects of Disturbance

Low and moderate severity wildfire can have beneficial effects on spotted owl nesting and roosting habitat by increasing heterogeneity and improving habitat for prey at elevations where woodrats are primary prey species. Data will be evaluated for the acres (or count) of territories and PACs that have experienced low and moderate severity wildfire (≤ 50% basal area loss). Success would be observed if territories and PACs are experiencing low to moderate severity wildfire effects.

Indicator 3. Treatment acres in PACs and territories. This indicator is designed to evaluate implementation of SPEC-CSO-STD 02 and SPEC-CSO-STD 03. Data will be evaluated for the acres of mechanical treatment in each PAC and territory.

For each PAC and territory (exclusive and inclusive of the PAC acreage), data will be tracked for type of completed treatment, acres treated, and CWHR density class (4M/D, 5M/D, 6) treated. To the extent feasible, the monitoring should track post treatment CWHR type (or an analogous metric) to evaluate whether a treatment is meeting the intent of STD 02 and STD 03 to retain the highest quality nesting and roosting habitat. In territories, identify the acres of treatments in dry and moist mixed conifer habitat in addition to the above metrics. If desired, data for change in basal area or tree density may be helpful to identify if treatments are moving forest structure to more resilient conditions.

Success would be observed if treatments in PACs did not reduce habitat quality (e.g., no change in CWHR density class) and avoided 10 acres surrounding a nest. If near-term habitat quality changed following a treatment, meaning the CWHR density class was reduced (e.g., 4D to 4M), success would be observed if treatments occurred in fewer than 100 acres of the PAC, outside of the highest quality nesting and roosting habitat, and met all the remaining criteria from STD 02 (see Introduction above). Note: PACs treated within community buffers or to create a fuel break may deviate from the STD02. These instances should be recorded.

For territories that do not meet SPEC-CSO-DC 02, meaning there is not at least 40 percent (for xeric vegetation type and site conditions) or at least 60 percent (for mesic vegetation type and site conditions) of each California spotted owl territory consisting of the highest quality nesting and roosting habitat, success would be observed if treatments retain habitat quality in the highest quality nesting and roosting habitat wherever it exists throughout the territory. In other words, treatments do not reduce 5M or 5D anywhere in a territory.

For territories that exceed SPEC-CSO-DC 02, meaning that there is greater than 40 percent (for xeric vegetation type and site conditions) or greater than 60 percent (for mesic vegetation type and site conditions) of each California spotted owl territory in the highest quality nesting and roosting habitat

CWHR types (5M and 5D), success would be observed if treatments retained at least 40 percent (for xeric vegetation type and site conditions) or at least 60 percent (for mesic vegetation type and site conditions) in CWHR 5M and 5D throughout the territory.

There are times when PACs and territories may be affected by fire suppression actions, especially the use of mechanical equipment to remove trees, bulldozers to create fire line, and fire to create black line (intentionally burned area to stop progressing wildfire by removing all combustible fuels). Typically, a resource advisor assigned to the fire would prevent adverse impacts to spotted owl PACs from suppression activities, but some impacts may be unavoidable. Data will be tracked for the acres or linear miles of activities of fire suppression activities conducted within PACs and territories, the extent to which the actions complied with STD02 and STD03, and any remedial actions that occurred in the affected areas.

Adaptive Management Questions

Based on the evaluation of results, the wildlife biologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The biologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in nesting and roosting habitat in PACs and territories? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The biologist will make recommendations to amend the monitoring question in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.
2. If the highest quality nesting and roosting habitat (5M/D, 6) is declining in PACs and/or territories, how does that trend compare to the overall trend at the landscape scale (i.e., TE01)? If consistent, address these adaptative management questions here as well as those associated with TE01. If inconsistent, seek to identify what might be driving the decline specifically in PACs and territories.
3. If the proportion of the highest quality nesting and roosting habitat (5M/D, 6) is declining in PACs and territories because of disturbance, can management action help stop or reverse the declining trend? For example, do the results suggest that there are PACs and territories where we should prioritize forest resilience treatments?
4. If mechanical and prescribed fire activities in PACs and territories are consistent with the LMP but the amount of CWHR 5M/D, 6 is still declining, is there a need to change plan components to relax (or further restrict) constraints on PAC and territory management?

AR04: To what extent is management meeting the thresholds in SPEC-YT-GDL-03 and are the number of occupied Yosemite toad breeding and rearing areas being maintained or increasing?

Staff Responsible for Data Collection, Evaluation, Reporting

Sierra National Forest Only – Biologist and Range

Introduction

This question applies only to the Sierra National Forest. This question is designed to evaluate the extent to which management is supporting the persistence of the Yosemite toad in range allotments. This question evaluates: (1) implementation of a plan guideline and (2) the trend in the number of Yosemite toad occupied breeding areas that overlap range allotments. There are three guidelines in the Sierra National Forest LMP intended to facilitate maintaining or achieving the desired conditions for the species. This question directly monitors implementation of a guideline **SPEC-YT-GDL-03** which states: "to help monitor if there is sufficient breeding and rearing habitat to support the survival and recovery of local Yosemite toad populations, grazing utilization should be restricted using Yosemite toad probability of occupancy or reproduction and rangeland habitat indicators (see Table 9)". Table 9 is provided below. This question also addresses the extent to which the Forest is achieving or maintaining the desired conditions in select grazed breeding meadows. It addresses components of the desired condition **SPEC-YT-DC-01** which states "Yosemite toad numbers and occupancy are increasing on the Forest, with sufficient reproduction and recruitment" and **SPEC-YT-DC-02** which states "Yosemite toad breeding, rearing, and upland habitat is sufficient to contribute to species survival and recovery".

Table 9 from Sierra NF LMP SPEC-YT-GDL-03. Rangeland habitat indicators for grazing management based on Yosemite toad probability of occupancy or reproduction and proper functioning condition status of meadow habitat

Meadow Functional Status[10]	Known Occupied Meadows and/or Highly Suitable Breeding and Rearing Habitats (Utilization)	Known Occupied Meadows and/or Highly Suitable Breeding and Rearing Habitats (Disturbance)	Moderately and Low Suitable Breeding and Rearing Habitats (Utilization)
Properly functioning	Utilize no more than 35% of herbaceous vegetation.	Alter breeding habitat no more than 20%.	Utilize no more than 40% of herbaceous vegetation.
Functional at-risk with upward, static (stable), or unapparent Trend	Utilize no more than 25% of herbaceous vegetation.	Alter breeding habitat no more than 15%.	Utilize no more than 30% of herbaceous vegetation.
Non-functional – stable (static)	Incidental Grazing. Utilize no more than 10% of herbaceous vegetation.	Alter breeding habitat no more than 10%	Utilize no more than 30% of herbaceous vegetation.
Functional at-risk with trending downward, Non-functional – not stable (static)	Incidental Grazing. Utilize no more than 10% of herbaceous vegetation.	Alter breeding habitat no more than 10%	Incidental Grazing. Utilize no more than 10% of herbaceous vegetation.

[10] Meadow functional status assessment procedures vary based on meadow /riparian type and the question being asked. The words proper functioning condition or properly functioning condition do not imply or refer to the Proper Functioning Condition Protocol developed by the Bureau of Land Management for Lotic and Lentic systems.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
AR04 - To what extent is management meeting the thresholds in SPEC-YT-GDL-03 and are the number of occupied Yosemite toad breeding and rearing areas being maintained or increasing?	1. Population status 2. Habitat condition 3. Utilization 4. Percent alteration (disturbance)	Field data using Forest-level protocol	1-2 Every six years (third BMER cycle) 3-4 Every two years (BMER)	SPEC-YT-DC-01 SPEC-YT-DC-02 SPEC-YT-GDL-03

Methods

Data for the four indicators will be collected as follows:

- Population status
  - Rationale: to directly evaluate the desired condition (maintenance of Yosemite toad populations) indicated by breeding presence in meadows experiencing grazing.
  - Metrics: number and percentage of occupied breeding areas per selected meadow per allotment.
  - Protocol: Visual Encounter Surveys (VES) are used to collect data on the number of occupied breeding areas within the meadows. Breeding areas will be defined in the Sierra National Forest Yosemite Toad Population Status and Habitat Condition Protocol prepared by Barnes and Brown in preparation).
- Habitat condition
  - Rationale: to evaluate desired conditions (breeding habitat quality) and to provide context for observed trends in population status (e.g., amount of water in breeding areas).
  - Metric: percent surface water within individual breeding areas.
  - Protocol: Ocular estimation is used to estimate the dimensions of each breeding area and percent of each breeding area with water. Methods will be described in the Sierra National Forest Yosemite Toad Population Status and Habitat Condition Protocol (Barnes and Brown in preparation).
- Utilization
  - Rationale: to provide information on the amount of livestock grazing to evaluate implementation of the thresholds in SPEC-YT-GDL-03.
  - Metric: percent utilization
  - Protocol: Data are collected according to Utilization Studies and Residual Measurements, Interagency Technical Reference, Cooperative Extension Service, U.S. Department of Agriculture, Forest Service, Natural Resource Conservation Service, Grazing Land Technology Institute, U.S. Department of the Interior, Bureau of Land Management, 1996; *Revised in 1997, 1999*. Utilization data are collected to determine how much forage has been utilized/consumed by livestock to ensure that enough of the plant leaves/herbaceous tissue remains in order to store carbohydrates prior to

overwintering for their root system to maintain/sustain them and produce growth the following year not depleting the reserves or diminishing plant health and vigor.

- Percent alteration (disturbance)
    - Rationale: to provide information on the degree to which livestock presence directly alters Yosemite toad breeding habitat and to evaluate implementation of the thresholds in SPEC-YT-GDL-03.
    - Metric: percent of hoof punches that break sod layer (≥ 13 mm deep, Table 8 in SPEC-YT-GDL-03) in breeding areas and percent of breeding areas with signs of cattle during that season.
    - The protocol to collect these data will be described in the Sierra National Forest Yosemite Toad Population Status and Habitat Condition Protocol (Barnes and Brown in preparation). The methodology that will be described is a modified version of the following two protocols:
        - Burton, T.A., S.J. Smith, and E.R. Cowley. 2011. Riparian area management: Multiple indicator monitoring (MIM) of stream channels and streamside vegetation. Technical Reference 1737-23. BLM/OC/ST-10/003+1737. U.S. Bureau of Land Management, National Operations Center, Denver, CO. 155 pp.,
        - Weixelman, D.A., D.J. Cooper. 2009. Assessing Proper Functioning Condition for Fen Areas in the Sierra Nevada and Southern Cascade Ranges in California, a User Guide. Gen. Tech. Rep. R5-TP-028. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA. 42 pp.

Data for the four indicators will be collected in selected meadows that are occupied by Yosemite toads located in grazing allotments. Meadows are visited early in the season to establish toad occupancy, mid-season to determine if cattle should be moved based on the amount of utilization and disturbance, and at the end of season to capture final information for grazing utilization and disturbance. Data for implementing the thresholds in guideline SPEC-YT-GDL-03 (utilization and disturbance) will be **reported every 2 years (every biennial monitoring evaluation report);** an evaluation of monitoring results for the desired conditions (population status and habitat condition) and will **be reported every six years (every third biennial monitoring evaluation report cycle).** This longer time interval reflects the long-term processes behind Yosemite toad population and meadow condition trends (e.g., Yosemite toad generation time, meadow recovery and degradation), and natural variability in environmental conditions that affect Yosemite toad breeding (e.g., annual precipitation).

The meadows selected for monitoring will be distributed across grazing allotments with occupied Yosemite toad breeding habitat. The meadows are not selected probabilistically. Instead, meadows selected for monitoring serve as sentinel sites; they are assumed to represent conditions (e.g., utilization, breeding occupancy) in other meadows of the same allotment. Thus, the selected meadows will (1) have both grazing and occupied breeding areas and (2) be reasonable indicators of conditions in other meadows within the allotment that have both grazing and occupied breeding areas. The Forest currently monitors 22 meadows annually; meadows may be redistributed as needed to ensure coverage of allotments with meadows that have grazing and occupied breeding habitat. If staffing increases, there may an opportunity to conduct monitoring in additional (> 22) meadows.

Evaluation of Results

Monitoring data will be evaluated to identify the extent the Forest is implementing SPEC-YT-GDL-03 as designed and the extent the number of occupied Yosemite toad breeding and rearing areas are being maintained or increasing (consistent with desired conditions SPEC-YT-DC-01 and SPEC-YT-DC-02). The evaluation cannot identify a cause for observed trends in the number of occupied breeding and rearing areas; that evaluation is outside the scope of this monitoring question. This evaluation will answer the following questions:

- To what extent is rangeland management implementation meeting the utilization and disturbance thresholds as described in SPEC-YT-GDL-03?
    - We will evaluate the percentage of monitored meadows where thresholds were met and the percentage where thresholds were exceeded.
    - We will evaluate how often cattle were moved from occupied meadows mid-season as a mitigating action to avoid or stop exceeding a threshold.
- To what extent are the number of occupied breeding and rearing areas being maintained or increasing?
    - We will compare the number and percentage of occupied breeding areas in monitored meadows across years to examine the trends in meeting/achieving the desired conditions associated with this monitoring question.
- To what extent is the condition of breeding habitat being maintained?
    - To the extent possible, we will quantify annual and seasonal patterns in the percent of surface water in breeding areas (indicator 2) in monitored meadows. We recognize that 2-3 surveys per summer will provide only a coarse measure of seasonal desiccation patterns, and that the amount and retention of water results from many factors and is challenging to measure at sufficient resolutions for the Yosemite toad.

We will evaluate the results of these questions in the context of snowpack in the prior winter as it relates to available water in breeding habitats.

Adaptive Management Questions

Based on the evaluation of results, the specialists may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand if management is complying with thresholds and if desired conditions (numbers of breeding areas, surface water habitat) is being maintained or increasing? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    Any recommendation to amend the monitoring question and/or indicators would be coordinated with the Regional Monitoring Coordinator.

2. Where the Forest is exceeding utilization and/or disturbance thresholds in SPEC-YT-GDL-03, can mitigating actions like those described in guideline SPEC-YT-GDL-01 (deferred seasonal grazing, meadow fencing, and modifying grazing period) or other mitigating actions be used to ensure implementation meets the thresholds?
3. Is there an opportunity to amend the Land Management Plan to increase the thresholds while still achieving the desired conditions for Yosemite toads? This adaptive management option would require, at a minimum, the following actions:
    - evaluation of data for trends in occupied Yosemite toad breeding and rearing areas in the meadow(s) where thresholds are being exceeded,
    - determination that other mitigating actions are not feasible or effective, and
    - revised monitoring approach that may include additional monitoring effort (e.g., larger sample size, more frequent data collection, additional indicators, triggers for adaptive management) and/or new questions and indicators.
4. If the trend in Yosemite toad occupied breeding and rearing habitats is declining, the specialists will evaluate if management actions, permitted activities, climate information, and other available data to determine if management action can be used to stop and/or reverse the trend. Questions evaluated by the specialists will include, but not be limited to, the following:
    - Have utilization and disturbance thresholds been implemented as described in SPEC-YT-GDL-03 or have they been exceeded?
    - What other management or permitted activities are occurring in the meadows where a decline is being observed?
    - What have been the climatic trends (e.g., drought) over the monitoring period?
    - Has there been a declining trend in the condition of monitored meadows (meadow condition categories in SPEC-YT-GDL-03) over the monitoring period such that meadows appear to be less resilient over time?
    - Do data from bio-regional monitoring for the Yosemite toad provide relevant information about broader-scale trends in populations and habitat? These data will be made available to the Forest as part of the broader-scale monitoring strategy results every five years.

(v) The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.

VU01: What are the trends in visitor use and satisfaction?

Staff Responsible for Data Collection, Evaluation, Reporting

Public Services/Recreation staff

Introduction

Long term changes in visitor use patterns and satisfaction metrics can indicate the need for greater access to specific recreational activities or the need to improve the quality of services and opportunities available to the visiting public. This question is tied back to the following Desired Condition: **REC-FW-DC-03**. Recreation opportunities provide a high level of visitor satisfaction, while minimizing user conflicts. The range of recreation opportunities contribute to social and economic sustainability of local communities.

Monitoring Code/ Question	Indicators	Data Source	Data Reporting Cycle	Plan Component
VU01 – What are the trends in visitor use and satisfaction?	1. Visitor use and satisfaction 2. Visitor recreational activity by type 3. Visitor demographics	NVUM	Every six years (3rd BMER cycle)	REC-FW-DC-03

Methods

The National Visitor Use Monitoring (NVUM) program is responsible for collecting data regarding demographics, activities, frequency and the percent overall satisfaction of recreation visitors. Surveys are conducted every five years. The most recent survey for the Sierra and Sequoia National Forests is scheduled for 2021. The data is processed at the Washington Office and the soonest results will be available is early 2022. Because data are collected every five years and results are made available every six years, results from this monitoring questions will be **evaluated and reported every six years (every 3rd biennial monitoring evaluation report cycle)**.

The NVUM protocol has 14 metrics that are assessed in developed facilities, access, services, and safety. Metrics are based on a scale of categorical data from 1-5 (i.e., dissatisfied to very satisfied). The metrics are designed to show change over time in visitor satisfaction. Reports and data for NVUM can be found here: https://www.fs.usda.gov/about-agency/nvum.

Evaluation of Results

Visitor satisfaction information helps managers decide where to invest in resources or to allocate resources more efficiently. For indicator 1, the specialist will calculate the percent change in visitor use and satisfaction since the last report. It is possible that the Forests may want to evaluate the percent change in visitor use and satisfaction over a broader time, for a longer trend, and may look back at previous NVUM reports for these data. For indicators 2 and 3, data will come directly from the NVUM report that describes changes in recreational activity by type over time and demographics of visitors. The evaluation of NVUM results will include a narrative to help interpret the patterns being observed.

When interpreting NVUM results, forest staff should consider any circumstances that may have affected visitor use such as forest fires, floods, closures that may have created an unusual recreation use pattern for the year sampled.

Adaptive Management Questions

Based on the evaluation of results, the public services or recreation staff may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand visitor use and satisfaction? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?

   If changes are needed or new tools become available, the specialists could make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If monitoring results indicate a decline in visitor satisfaction, can management action be used to improve the visitation experience?

   The Forest will review NVUM satisfaction results as they relate to type of use (e.g., satisfaction at day use, overnight, etc.). The Forest staff will also engage internally with recreation staff and externally with concessionaires and/or partners to identify opportunities for improvement. These engagements and details from NVUM can help the Forest identify which sites are most popular with visitors as well as identifying areas that may need attention/improvements. Specific management action would depend on the findings of the NVUM report and the engagements. Potential opportunities could include adding additional overnight camping capacity, improving day use facilities, upgrading restrooms, provide additional parking, and/or creating better signage.

3. How can demographic data be used to maintain/improve the user experience and ensure diverse groups are using public lands?
   - Demographic data can be used to identify where we need to better provide for a valuable user experience at the specific site types. For example, data from NVUM can tell the Forest where there may be a need to improve access to sites for persons with disabilities. NVUM data may also indicate where they may be a need to improve multi-lingual or photographic signs at sites where there is a high visitation by non-English speaking groups.
   - The recreation staff can work with public affairs staff to improve messaging on the social media pages to reach a diverse group of potential visitors.

VU02: What percentage of the inventoried motorized and non-motorized trail system is maintained to standard?

Staff Responsible for Data Collection, Evaluation, Reporting

Public Services/Recreation/Trails staff

Introduction

This question is tied to the following desired condition and objective:

- **REC-FW-DC-13. (Desired Condition)** A sustainable system of trails provides access to destinations, provides for opportunities that connect to a larger trail system, provides linkages from local communities to the national forest, and is planned, designed and managed to be compatible with other resources.
- **REC-FW-OBJ-01. (Objective)** Within 15 years of plan approval, maintain to standard 25 percent of the national forest's designated trail systems.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
VU02 – What percentage of the inventoried motorized and non-motorized trail system is maintained to standard?	1. Miles of trail maintained to standard 2. Inventoried motorized and nonmotorized trail system miles	NRM (Infra Trail)	Every two years (BMER)	REC-FW-DC-13 REC-FW-OBJ-01

Methods

Monitoring data for indicator 1 would come from the NRM Infra Trail database. Infra Trail is part of the Forest Service's Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/. The Forests enter annual trail maintenance accomplishments into the database annually at the end of the fiscal year. Forest staff also pull NRM Infra Trail Reports to evaluate end of year trail maintenance accomplishments.

The three accomplishments metrics annually entered in NRM Infra Trail reporting database are miles maintained, miles improved, and miles meeting standard. They are defined as follows:

- Miles maintained (indicator 1) is the miles of National Forest System trail on which at least one maintenance task is performed to standard during the fiscal year. This measure includes annual maintenance and deferred maintenance (repair, replace, decommission). These data can be found in the NRM Trail module under the reports tab.
- Miles improved is the miles of National Forest System trail improved or constructed to standard. This measure includes trail alteration, expansion, or new construction.
- Miles meeting standard is the total National Forest System trail miles that meet Trail National Quality Standards consistent with the maintenance cycle identified for the trail. Trail-specific maintenance cycles are identified on Trail Management Objectives (TMOs) and in NRM Infra Trails.

Although miles maintained to standard is consistent with the monitoring question and relevant plan components, trails staff may consider adding the miles meeting standard indicator because these data provide a more thorough and comprehensive measurement of an entire trail. See the Adaptive Management Questions section below.

Indicator 2 is intended to demonstrate the extent to which the Forest enters and maintains data for trails. System trails have signed Trail Management Objectives and meets trail data quality standards. Data for indicator 2 are published in the Enterprise Data Warehouse.

Trail maintenance inventory occurs during every field season. Data would be **evaluated and reported every two years (every biennial monitoring evaluation report).**

Evaluation of Results

For indicator 1, the Forests should confirm all data are entered annually in NRM Infra Trails. Once data are entered, reports can be pulled from the database that describe annual accomplishments. Evaluate the percent of trails maintained to the desired target (25% percent of the designated trail system to standard within 15 years of plan approval). Analyze trends in miles of trails maintained by calculating percent change in miles maintained to standard. After two reporting cycles (four years), if trends indicate that the forest is not on a trajectory to achieve targets to standard, implement adaptive management (see below). Note: Miles Meeting Standard can provide a better snapshot of the overall condition of the trail system than Miles Maintained to Standard (see definitions above).

For indicator 2, the Forests should verify that motorized and non-motorized trails are published to the Enterprise Data Warehouse and current. Compare number of signed Trail Management Objectives to draft or missing Trail Maintenance Objectives. Use QA/QC reports in NRM to identify needs to improve data. Complete assigned TRACS surveys and report accomplishments in NRM. Complete accomplishment reporting prior the end of the fiscal year to track progress on the trail system goals. Compare MVUM last revisions with current trail system status and new decisions which may have changed motorized access.

***Adaptive Management** Questions*

Based on the evaluation of results, the trails specialist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in trail conditions and access? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Would “Miles Meeting Standard” or “Percent Meeting Standard” be a better indicator than “Miles Maintained to Standard”?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?
    - Is there a need to evaluate the nexus of trail conditions with other trends such as wildfire, increased recreation use, and budget trends?

The specialists would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If targets described in the plans are unattainable, a plan of action may be needed to change the trajectory toward meeting targets within 10 years of plan approval. The following investments may contribute to increased performance for trail programs:
    - Hosting Training and participation in the CA Trails and Greenways Conference.
    - Improve and invest in data collection and management.
    - Build and expand partnerships including the use of conservation corps.
    - Assessment of trail and bridge conditions for maintenance scheduling.
    - Trail planning to identify sustainable trail systems that address community priorities.

(vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.

CC01: How is the rate and distribution of drought-related tree mortality changing?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection and Evaluation – Region 5 Information Management Ecologist, Region 5 Ecosystem Planning GIS Analyst, Forest Health Protection Staff (ADS), and/or Forest GIS analyst
Data Evaluation and Reporting – Province Ecologist or Associate

Introduction

California has experienced major, prolonged droughts, insect outbreaks, and extensive tree mortality in recent years. The forested landscape has also been experiencing more subtle, underlying effects from changing climate conditions. There is uncertainty about how forest management can influence forest resilience to the drastic and more subtle effects of climate change. This question is tied to the following Desired Condition: **TERR-FW-DC-02.** Vegetation structure and composition provide ecosystem resilience to climate change and other stressors including altered fire regimes, drought, and flooding in riparian systems. This question does not address tree mortality (fire severity) associated with recent uncharacteristically large and severe wildfires, which is addressed by question CC02 (see below).

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
CC01 – How is the rate and distribution of drought-related tree mortality changing?	1. Tree mortality by ecosystem type 2. Spatial extent of tree mortality by ecosystem type and severity class	1. eVeg, ADS, eDART 2. ADS and eDaRT	Every four years (2nd BMER cycle)	TERR-FW-DC-02

Methods

Data for indicator 1 (tree mortality by ecosystem type) would come from Aerial Detection Survey (ADS), Existing Vegetation Data (EVeg), and the Region 5 Remote Sensing Lab eDaRT product. Ecosystem types to be evaluated include ponderosa pine, Jeffrey pine, mixed conifer, red fir, hardwood, lodgepole pine, and subalpine. ADS products include % area affected by tree mortality and estimates of trees per acre that have died. ADS consists mostly of airborne, based on ocular estimates, which can be supplemented with eDaRT to give a more complete picture of forest health. Therefore, the combination of using ADS and eDaRT allows us to evaluate acres affected and canopy cover loss due to recently dead trees. The tools may be able (though may be less likely) to answer the number of recently dead trees.

Data for indicator 2 (spatial extent of mortality) would be collected using both ADS and eDaRT. A combination of aerial detection and satellite-based techniques, along with the limitations of each, will provide the most complete landscape-level assessment.

Historical reference conditions for tree mortality are found in the Region 5 Ecology Natural Range of Variation assessments for the Sierra Nevada (Sierra Nevada NRV documents).

Although tree mortality events can be immediate and extensive, they can also occur more slowly over time, revealing patterns that are valuable for managers to understand. To capture both immediate and more slowly evolving trends, data for these indicators would be collected, evaluated, and **reported every four years (every second biennial monitoring evaluation report cycle).** However, if trends are staying somewhat regular and static, a longer interval for evaluation (every six years) may be more appropriate and will be evaluated as the data are collected and interpreted.

Evaluation of Results

The number of dead trees, severity in terms of cover loss, and total acres of tree mortality by ecosystem type will be graphed over time to display trends. The spatial extent of tree mortality will be mapped to display spatial patterns by ecosystem type and severity class over time. Post-drought baseline conditions will be carefully considered to ensure proper interpretation of trends.

Success will be observed if the number and acres of dead trees, and cover loss, declines or remains stable over time for most ecosystem types, accounting for changes in mortality rates associated with drought. Success will also be observed if the spatial extent of tree mortality declines or remains stable over time for most ecosystem types, accounting for the effects of drought on spatial extent.

Adaptive Management Questions

Based on the evaluation of results, the ecologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The ecologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in the rate and distribution of tree mortality? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The ecologist would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If there is an increasing trend in tree mortality, can adjustments to management actions facilitate an improvement? Based on the trends observed, the ecologist may recommend management actions such as prescribed fire and/or tree thinning in specific areas or ecosystem types to improve resilience. The ecologist will explore if there is a need to:
    - increase the pace and/or scale of treatments,
    - identify a specific treatment type or combination of treatments that can be used to improve resilience, and/or
    - address management action needs with adjacent landowners?

3. Is there a need to conduct an on-site assessment to identify specific causal agents of mortality? Is there a new or specific pathogen or causal agent that requires a unique management approach?

CC02: How are fire regimes changing compared to the desired conditions and the natural range of variation?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection and Evaluation – Region 5 Ecosystem Planning GIS Analyst or Forest GIS analyst
Data Evaluation and Reporting – Province Ecologist or Associate

Introduction

This question was designed to address the pattern and trend in fire regimes, which is an essential ecological process in terrestrial and riparian ecosystems. Changes in fire regimes, including departure in fire frequency, severity, or extent, is an important indicator of terrestrial ecosystem function and integrity. For example, currently some forest ecosystems are burning too infrequently and severely compared to the natural range of variation (NRV), resulting in the loss of forest ecosystem resilience and health. There is uncertainty regarding the degree and extent of negative impacts of changing fire regimes on terrestrial and aquatic ecosystems due to the interaction of additional stressors (e.g., climate change, invasive species, insect outbreaks) with fire. The identification of landscapes with increased fire regime departure from NRV could be targeted for ecological restoration treatments to improve ecosystem resilience to stressors or focused field-based monitoring to identify the impact of interactive stressors. This question is tied to the following Desired Condition: **FIRE-FW-DC-04.** Wildland fires burn with a range of intensity, severity and frequency that allow ecosystems to function in a healthy and sustainable manner. Wildland fire is understood as a necessary process, integral to the sustainability of fire-adapted ecosystems and is used as an effective restoration tool (see TERR-FW-DC related to fire). The landscape is strategically compartmentalized by treated areas and natural features, which facilitates use of prescribed fire and wildfire to meet resource objectives for protecting values and resources.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
CC02 – How are fire regimes changing compared to the desired conditions and the natural range of variation?	1. Fire return interval departure 2. Number and acres of fire by ecological zone 3. Fire severity by ecological zone	1. FRID 2. FRAP 3. RAVG or MTBS, possibly eDaRT	1. Every 4 years (2nd BMER cycle) 2-3 Every two years (BMER)	FIRE-FW-DC-04

Methods

Fire Return Interval Department (FRID) data are available from the USFS Region 5 MARS Lab in the Information Management Department and R5 Ecology Program. Data are updated annually. Methods for developing FRID data are outlined in Safford and van de Water (2014). There are six fire return interval condition classes. Mean CC_FRI ranges from -3 (currently burning much less frequent than historical reference condition) to 3 (currently burning much more frequently than historical reference). The larger the number, the greater the departure. Values of 1 or -1 indicate current conditions have a relatively low departure from the natural fire return interval. Data for this indicator will be **evaluated and reported every four years (every second biennial monitoring evaluation report cycle).**

Data for the number and acres of wildfire by ecological zone are obtained from the CalFire California Fire and Resource Assessment Program (FRAP) Statewide Fire Perimeter Database which is updated annually.

Data for fire severity are obtained from Rapid Assessment of Vegetation Condition after Wildfire (RAVG), or the Monitoring Trends in Burn Severity (MTBS) program. Region 5 vegetation burn severity calibrated to the Composite Burn Index (CBI) will be used if available and evaluated by ecological zone. RAVG or MTBS fire severity data could be used to evaluate broad ecological categories using fires generally >1000 acres in size. RAVG and MTBS data are updated annually (with an initial time lag of approximately two years for availability of MTBS data). The R5 Fire and Aviation Program previously supplemented RAVG data with an R5 burn severity database, to include smaller fires and fires on non-NFS lands. Data from that program may be available if resources are allocated for it. Alternatively, the eDaRT system has a burn severity index under development that may serve the same purpose. Data for indicators 2 and 3 will be **evaluated and reported every two years (every biennial monitoring evaluation report cycle).**

Evaluation of Results

Indicator 1. The proportion of the Sierra and Sequoia National Forests in each fire regime condition class (6 total) will be estimated (status) and compared to previous estimates (trend). Increasing levels of fire return interval departure indicates a declining trend in fire regime integrity. Data could be mapped and/or displayed in a table. The desired target includes greater proportions of the Sierra and Sequoia National Forests in fire regime condition classes 1 and -1 (and to a lesser extent, CC 2) and lesser proportions in condition classes 3, -2, and -3.

Indicator 2: The total number and area (in acres) burned in wildfires will be displayed by ecological zone. Data could be displayed in the monitoring report as a table or a graphic.

Indicator 3: The proportion of each fire severity class (unchanged, low, moderate, high) will be estimated for each fire and summary statistics will be calculated for all fires combined by ecological zone (status). Trends in high severity proportion could potentially be calculated for the forest but may be more appropriate at a provincial or regional scale (BSMS). Data could be displayed in a simple tabular or graphical display (for an example see Fig.1 in Meyer 2015; NRV values are optional). The desired target in the montane and upper montane forest zones are a greater proportion of wildfires burning within NRV and desired conditions, which in general, amounts to lower proportions of high severity fire and greater proportions of other fire severity classes (i.e., unchanged, low, moderate). Fire severity patterns within wildfires categorized by a non-full suppression fire management strategy (“other” category as recorded in FRAP database and/or ICS 209 and validated by local forest specialist input) will be evaluated separately, when feasible, to determine if these fires meet desired conditions.

Adaptive Management Questions

Based on the evaluation of results, the ecologist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The ecologist would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in the rate and distribution of tree mortality? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?

- Are additional or different indicators needed?
- Should data be collected with a different frequency?
- Is there a new methodology, tool, or new science that should be incorporated?

The ecologist would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If there is an increasing trend in wildfires that do not meet the desired conditions, can adjustments to management actions to facilitate an improvement? Based on the trends observed, the ecologist may recommend management actions such as prescribed fire and/or mechanical thinning in specific ecological zones or other areas to facilitate opportunities for the safe and effective re-establishment of natural fire regimes across the landscape. Some questions may include:
    - Is there a need to increase the pace and/or scale of treatments?
    - Is there a specific treatment type or combination of treatments that can be used to improve trends in fire regimes?
    - Is there an opportunity to work with adjacent landowners, regulatory agencies, local public figures, the public, and/or partners to improve acceptance and use of prescribed fire to help in improving overall fire regime trends?

3. Is there a need to increase emphasis on restoration of montane forests with a consistent pattern of fire return interval departure?

(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.

PC01: To what extent are partnerships helping the Forest accomplish objectives?

Staff Responsible for Data Collection, Evaluation, Reporting

Data collection, evaluation, reporting (all indicators) – Strategic Communication Officer (Sierra) and Forest Environmental Coordinator (Sequoia)
Data collection indicator 4 – Forest specialists from various disciplines would provide data on accomplishments (USFS and partner) to above positions for evaluation and reporting.

Introduction

This monitoring question is intended to evaluate the trend in the Forest's capacity to conduct work towards achieving plan objectives and how that capacity is supplemented by partnerships. There is uncertainty about how the Forest capacity will change over time and how those changes influence the ability of the Forests to conduct work. There is also uncertainty about how much the Forest will engage in partnerships to help achieve Plan objectives. This question is tied to the following plan components:

- **[Sierra] VIPS-FW-DC-01**. **(Desired Condition)** The Sierra National Forest has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.
- **[Sequoia] VIPS-FW-DC-01**. **(Desired Condition)** The Sequoia National Forest has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.
- **WTR-FW-GOAL-02. (Goal)** Take a landscape- or watershed-scale approach to restoring aquatic and riparian ecosystems, integrating with recreation, range management, fuels, and vegetation management to efficiently use limited resources, including partnerships, and to effectively address climate change.
- **REC-FW-GOAL-03. (Goal)** Promote effective communication with neighboring communities, urban populations, youth, and underserved communities to help foster partnerships, inspire volunteers, educate the public, and support stewardship that contributes to funding, implementation of projects, and long-term maintenance of facilities.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Components
PC01 – To what extent are partnerships helping the Forest accomplish objectives?	1. Workforce 2. Partnership Agreements 3. Volunteer Agreements 4. Accomplishments	1. Budget reports/Regional Budget Monitoring Tool 2. RACA report 3. VSReports (National volunteer database) and Forest files 4. NRM (e.g., FACTs, WIT, Infra) and Forest tracking	Every two years (BMER)	VIPS-FW-DC-01 WTR-FW-GOAL-02 REC-FW-GOAL-03

Methods

Indicator 1 is intended to represent the trend in the number of **employees (workforce) on the Forest.** Data for indicator 1 (workforce) can be prepared via a request for a custom report from Human Resources Management at the following link: http://fsweb.wo.fs.fed.us/hrm/data-reports/index.php. This is the preferred data source. Alternatively, data could also come from budget staffing reports and a regional budget monitoring tool used to track budget changes over a fiscal year. The data for staffing reports could come from zone budget staff contacts. The number of employees would be divided into fire and non-fire employees as well as permanent and other than permanent positions.

- Full time fire employees (FTE non-fire)
- Full time non-fire employees (FTE Fire)
- Other than full time fire employees
- Other than full time non-fire employees

The Zone budget system used in Region 5 can make tracking Forest-level budget expenditures difficult. Therefore, the indicator currently does not measure Forest budgets and expenditures. In the future, if there is a relatively easy way to evaluate budget expenditures for each Forest, monitoring data could be gathered for salary and non-salary Forest Service budget expenditures and used in combination with workforce data to monitor changes in Forest capacity and budget.

Indicator 2 is intended to represent the trend in partnership agreements the Forests engages in to accomplish work. For the purposes of this monitoring program, partnership agreements do not include volunteer agreements; partnership agreements have funding exchanged. Data for indicator 2 would come from the Reimbursable and Advanced Collections Agreements (RACA) reports. The Forests maintain an annual report containing data for this indicator. Metrics measured for this indicator include:

- Total dollars provided to partners in agreements,
- Total dollars provided by partners to USFS in agreements,
- Partnership dollars by resource area (e.g., recreation, vegetation, fire/fuels, heritage) and
- Partnership dollars by project type (implementation or planning).

Indicator 3 is intended to represent the trend in volunteer agreements the Forests engages in to accomplish work. Data for indicator 3 would come from the VSReport volunteer database and/or Forest volunteer files. The VSReports application is the official database for outcomes and accomplishments for USDA Forest Service volunteer and service partnerships across all deputy areas. The Forests maintain an annual report containing data for this indicator. Metrics measured for this indicator 3 include:

- Volunteer hours (including by resource area like recreation, heritage, vegetation, facilities)
- Number of volunteers
- Number of volunteer groups
- Dollar value of volunteer work
- Comparable full-time employees (FTEs)

Indicator 4 (accomplishments) is intended to show accomplishments completed on the ground by the Forest Service, partners, and volunteers. Data would come from Natural Resource Manager (NRM) databases (e.g., WIT, FACTs, Infra Trails) and Forest-level tracking. Data could also come from grant and/or volunteer accomplishment reports.

Data for each of all indicators would be **evaluated and reported every two years (every biennial monitoring evaluation report).**

Evaluation of Results

Changes in the metrics for all indicators (e.g., percent change in full time non-fire employees) would be compared against a baseline and previous reporting cycles.

There is no desired condition for the number of staff the Forest employs. Success for indicator 1 will be observed if the Forest capacity is able to support the partnerships and volunteer agreements assisting in accomplishing Forest and if the workforce, along with partners and volunteers, can support a stable or increasing trend in accomplishments. Success for indicators 2, 3, and 4 will be observed if there is a stable or increasing trend in: (1) partnerships and volunteer agreements and (2) acres/miles of projects conducted with those valuable resources.

Covariates to consider when evaluating factors that influence trends in the indicators include the available forest staffing to support volunteers and partners, staff to write up volunteer reports, relevant local information (e.g., pandemic, recession, new local volunteer or partner organizations, etc.) that may influence the trends.

Adaptive Management Questions

Based on the evaluation of results, the Strategic Communication Officer and/or Forest Environmental Coordinator may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. They would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend in Forest capacity and partnerships? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The Strategic Communication Officer and/or Forest Environmental Coordinator would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If the Forest may not be achieving a network of dependable partners and volunteers, do the data indicate that the Forest lacks the capacity (staff) to support the work of partners (e.g., writing proposals, writing master stewardship agreements, administering contracts/grants of partners, having NEPA-ready projects)? If so, follow up questions could include the following:

- Are there opportunities at the Zone-level to help improve efficiencies?
- Can the Forest engage Enterprise or others to conduct third party NEPA?
- Can the Forest prioritize the work differently?

PC02: What management actions are contributing to the achievement of desired conditions relating to fire regimes?

Staff Responsible for Data Collection, Evaluation, Reporting

Data evaluation and reporting all indicators – Fuels Planner

Data collection and evaluation indicators 1 and 2 – Region 5 Ecosystem Planning GIS analyst

Data evaluation indicators 1 and 2 – Forest Province Ecologist (or Associate)

Data collection and evaluation indicator 4 – Forest Vegetation Program Manager would provide data on accomplishments to Fuels Planner for reporting.

Introduction

The Plans are testing whether management actions will contribute to moving the landscape trend toward the natural range of variability (NRV) for fire regimes. There is uncertainty whether our management actions, even with the changes in the forest plans, can contribute to fire regime desired conditions. This question addresses whether we are managing wildfires for objectives other than full suppression (e.g., natural resource benefit), thereby restoring fire on the landscape in an ecologically beneficial way. This question also evaluates the trend in our management action to prepare the landscape to receive fire and burn in an ecologically beneficial way. This question is tied to the desired condition **FIRE-FW-DC-02** which states the following: fire management activities reduce fuel build up, help maintain and protect habitat for a variety of species, reduce smoke from larger fires, provide added protection for communities and utility infrastructure, and restore fire on the landscape. These actions are also an integral part of achieving sustainable recreation, particularly by maintaining scenic attractiveness, integrity, and character.

Monitoring Code/ Question	**Indicators**	**Data Source**	**Reporting Cycle**	**Plan Component**
PC02 – What management actions are contributing to the achievement of desired conditions relating to fire regimes?	1. Acres of fires managed for resource objectives by ecological zone 2. Acres of fire by objective within each strategic fire management zone 3. Acres of prescribed fire 4. Acres of mechanical treatment	1-2 FRAP 3-4 NRM (FACTs)	Every two years (BMER)	FIRE-FW-DC-02

Methods

Data for indicators 1 and 2 are obtained from the CalFire California Fire and Resource Assessment Program (FRAP) Statewide Fire Perimeter Database which is updated annually. If FRAP data are insufficient for describing fire objective, these data may be found in the Forest's NIMS ICS-209 forms, via a conversation with Forest fire staff, and/or a review of the WFDSS database. Data accuracy (fire objective coding/classification) will also be verified by the ecologist through conversations with the Forest Fuels Planners.

Data for indicator 3 (acres of prescribed fire) and indicator 4 (acres of mechanical treatment) are entered annually in the Natural Resource Manager Forest Service Activity Tracking System (FACTs) database. For the monitoring reports, the database can be queried, and a summary can be extracted. Mechanical treatment data includes the use of mechanical equipment (e.g., mastication, commercial and non-commercial mechanical thinning).

Data will be **evaluated and reported every two years (every biennial monitoring evaluation report cycle).**

Evaluation of Results

For indicators 1 and 2, data will be evaluated to identify if there is an increasing trend in fire managed for objectives other than full suppression on the Forest, in the different ecological zones, and in the various fire management zones. The goal is to identify an increasing trend in the fires that are managed for resource objectives, especially in the montane and upper montane zones. Data will be used to identify the total area (in acres and possibly percentages) on the Forest burned in wildfires by fire management type, ecological zone, and strategic fire management zone. For example, data could be presented as follows: *in 2025, 50 acres of wildfire on the Sierra National Forest burned with full suppression objectives and 10 acres burned with other than full suppression objectives. All acres managed for other than full suppression burned in the Wildfire Restoration Zone.* These data would be compared against previous years to identify a potential trend for fire managed for other than full suppression. Trends can be evaluated for the Forest and for each strategic fire management zone and ecological zone. Success will be observed if trends show an increase in fires managed for resource benefit.

Data for indicators 3 (prescribed fire) and 4 (mechanical treatments) will be evaluated for each Forest as a whole and for each strategic fire management zone. Data would be compared against previous years to identify a potential trend. Success will be observed if there is an increasing trend in the pace and scale of restoration in the various strategic fire management zones. Data would be evaluated to determine (spatially) where prescribed fire footprints overlap previously mechanically treated areas (live forests) to determine if we are using prescribed fire following mechanical treatments in live stands.

Treatments are used to improve forest structure, reduce fuel loads, and increase resilience towards natural disturbances like fire. Therefore, the spatial overlap for all indicators should be evaluated to identify if fires managed for resource objectives are occurring in areas previously treated.

Adaptive Management Questions

Based on the evaluation of results, the fuels planner, ecologist, and/or the vegetation program manager may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. They would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand the trend towards achieving the desired conditions for fire regimes? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?

- Should data be collected with a different frequency?
- Is there a new methodology, tool, or new science that should be incorporated?

The fuels planner, ecologist, and/or vegetation program manager would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If the acres of fire managed for objectives other than full suppression (indicators 1 and 2) decreases over time (or are not being managed at all), what is the reason (e.g., climate conditions, political pressures, excessive fuel conditions, budget, other) and how can the Forest respond?

    - Can we focus management actions to decrease fuel loads and continuity, increase fuel breaks in specific areas, and/or implement concepts like Potential Operational Delineations (PODs) so we can improve our chances of safely managing wildfires for resource objectives?
    - Can we work with the public and/or public officers to increase education and acceptance of circumstances when we may manage wildfire for resource objectives?
    - Can we engage with regulators, local land managers, and/or local fire agencies (e.g., CalFire) to discuss opportunities to manage wildfire for natural resource objectives?

3. Should the fire management zones be adjusted? The fuels planner could use FSim - Wildfire Risk Simulation Software to evaluate if the fire management zones should be adjusted due to changes in risk conditions.
4. If the pace and scale of restoration treatments are trending negatively (as indicated by decreasing acres of mechanical treatment and/or acres of prescribed fire), what actions can we take to increase the pace and scale of restoration?

    The fuels planner and vegetation program manager may recommend ways to increase the pace and scale of restoration. If public/political concerns are delaying project approval, can we work with our concerned public to enhance awareness and understand concerns? If capacity is a concern, can the Forest hire more staff, work with partners to supplement Forest staff capacity, solicit more contractors, and/or identify potential ways to increase the number of processing facilities? If fuel loading conditions are preventing the use of prescribed fire, can we strategically place mechanical treatments where we want to introduce fire?

5. Is there a need to modify the forest plan to allow for increased mechanical treatment in conjunction with prescribed fire and/or increased intensity of a single treatment?

PC03: What are the economic contributions of forest-based uses and ecological services to the local communities?

Staff Responsible for Data Collection, Evaluation, Reporting

Data Collection, evaluation, and reporting – Forest Environmental Coordinators

Introduction

Forests provide economic contributions to communities through activities such as recreation visitation, grazing, timber as well as through the employment of forest service staff. Forests also provide ecological services to communities such as water supply. Monitoring changes in these contributions can provide insight as to how forest management may be supporting economic and social conditions in these communities. This question is tied to the desired condition **LOC-FW-DC-03** which states the following: National forest uses such as recreation, forest products, grazing, power generation and water production are provided in an ecologically sustainable way that also contributes to economic and social sustainability in local communities.

Monitoring Code/ Question	Indicators	Data Source(s)	Reporting Cycle	Plan Component
PC03 – What are the economic contributions of forest-based uses and ecological services to the local communities?	1. Local economic conditions 2. Forest contributions	1. Headwaters Economic (Economic Profile System) 2. Various national and forest databases	Every two years (BMER)	LOC-FW-DC-03

Methods

Data for local economic conditions (indicator 1) will be downloaded from various relevant websites. Currently, the website with the best available data include: Headwater Economic - Economic Profile System available at: https://headwaterseconomics.org/apps/economic-profile-system/.

Data are provided for the following metrics:

a. Local demographics – age distribution, immigration/emigration rates, housing ownership and valuation, per capita income, unemployment rate, poverty rate, etc.
b. Local economy – industry-level employment and earnings

Headwater provides reports on their website describing the trends in the above metrics. Headwaters does not draw the link between local economic conditions and forest contributions (outputs); that connection can be inferred from the data collected for both indicators. The Region 8 broader-scale monitoring strategy reports that are produced every five years are a great example of a narrative that evaluates trends in these metrics and the story-telling aspect of those reports should be reviewed when producing the monitoring report narrative for this indicator.

Data for indicator 2 (Forest contributions) would come from existing national databases.

The list below of Forest use and resource metrics are those currently identified to contribute to the economy surrounding the Sierra and Sequoia National Forests, as they support and sustain local

business activities. Other uses and resource metrics like mineral extraction and/or waters supply can be evaluated in the future if the use becomes a greater portion of the local economy or data are updated more regularly, respectively.

- Recreation:
    - Metric: Total annual Forests visits, trip spending
    - Data source: Natural Resource Manager National Visitor Use Monitoring (NVUM).
- Forest timber products:
    - Metric: forest product volume sold by various categories
    - Data source: NRM Timber Information Manager (TIM) database. Various Forest Products Reports are available from the TIM database information, including the Periodic Timber Sale Accomplishment Reports (PTSAR) and the Forest Products Cut and Sold Report. The PTSAR report provides quarterly updates for forest product volume sold by various categories, including the regular program funded with appropriations, the Salvage Sale Fund, personal use permits and small commercial sales. Data can be used to evaluate the amount of wood cut and sold for personal and commercial uses, including the volume that went to processing facilities. Cut and Sold reports show total volumes and values of all convertible forest products sold and harvested from the National Forest System lands and National Grasslands agency-wide, and by organizational unit. Data from the two reports should be evaluated to identify the trend in forest products that have contributed to local economic conditions. Data may be used to estimate the number of full-time employees (FTE) supported by the products (Lippke and Mason 2005) but should only be calculated for products sold through contracts and agreements and not data for personal fuelwood permits.
- Rangeland Management economic conditions:
    - Metric: grazing volumes
    - Data source: NRM Rangeland Management
- Forest employment and labor income in local communities, and partnership/volunteer agreements (see PC01).

Data will be evaluated and reported every two years (every biennial monitoring report cycle). Some data sources may not be evaluated and reported at a biennial interval because they are available at longer intervals than every two years. For example, NVUM data are available every five years.

Evaluation of Results

Data should be examined to determine if there are discernable and meaningful changes in the identified values, suggesting a potential change in forest- generated economic contributions to communities. Given the importance of recreation to local economies around the Sierra and Sequoia National Forests, for example, this would be done by looking at trends in the estimates of visitation and spending. The best measure of community conditions and trends would be data collected at a community level; however, community level data are often difficult to obtain, therefore more aggregated data may be the best available (e.g., county, regional, state level data). However, caution should be used in applying aggregated data, such as county level data, to represent forest community conditions and the resulting

Sustained negative trends in these values could suggest changes in local conditions that may be related to Forest Service management actions. However, it is important to remember that economic data is driven by many different external factors so one should not immediately associate any measurable economic effects to forest management. Instead, for further clarity, these data should be used as a basis for conversations with local community stakeholders and county governments to better understand what may be driving any changes. Contacting local stakeholders to review these trends will help build relationships to ensure a common understanding and interpretation of the results.

Adaptive Management Questions

Based on the evaluation of results, the specialist may recommend changes to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need for such change:

1. Is the monitoring question and/or indicator providing information necessary to understand the status of local economies and the Forest contributions to those economies? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?

    The Forest environmental coordinator would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. What are the positive and/or negative trends suggested by the monitoring results?
    - What changes might be needed to correct the negative trends?
    - What takeaways might we draw from the positive trends?
    - Who should we reach out to for further insight?
        - If the data show a decrease in use or outputs, this is a good opportunity to engage local stakeholders/companies to discern why the trend is occurring and how to remedy. What are the actionable things we can do? Engaging in this way can help improve Forest contributions, build/strengthen relationships, and ensure our partners/stakeholders have clear and accurate perceptions of the work we do.

(viii) 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)). (36 CFR 219.12(a)).

PR01: How does soil disturbance differ from pre- and post-activity for timber management?

Staff Responsible for Data Collection, Evaluation, Reporting

Soil scientist, watershed staff, and/or hydrologist

Introduction

This question was designed to address to what extent does ground-based treatment activities (e.g., timber) affect soil productivity and whether there is a trend over time for soil productivity in the plan area (specifically where fuel and timber management take place – Jeffrey pine/lodgepole, mixed conifer and limited thinning of pinyon stands). This question is tied to the following desired condition **WTR-FW-DC-04** which states: Soil and vegetation functions in upland and riparian areas are sustained and resilient. Healthy soils provide the base for resilient landscapes and 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.

Monitoring Code/ Question	Indicators	Data Source	Reporting Cycle	Plan Component
PR 01 – How does soil disturbance differ from pre- and post-activity for timber management?	1. Soil compaction 2. Erosion 3. Displacement	Field data	Every six years (3rd BMER cycle)	WTR-FW-DC-04

Methods

Data for the indicators will be measured using the Sierra National Forest quick 10 point transect form, a shorter version of the national 30 point Forest Service Soil Disturbance Monitoring Protocol transect (Page-Dumroese et al. 2009 – WO-GTR-82a and WO-GTR-82b). The shorter version adequately measures the same metrics but requires less intensive field effort. The quick transect form assesses the severity class (0 through 3) of 7 visual indicators: (1) wheel tracks or depressions, (2) penetration & resistance, (3) soil physical condition, (4) forest floor, (5) mineral soil, (6) erosion, and (7) burning. If time availability/staffing allows the 30+ point Forest Soil Disturbance Monitoring Protocol transects (WO-GTR-82a and WO-GTR-82b) could also be used, these transects are statically valid but take longer to fully complete. This monitoring would occur in areas that are treated using ground-based mechanical equipment (e.g., mastication, whole tree timber harvesting, tethered logging). Highest priority areas for data collection are where soil conditions may have been detrimentally affected by past management, and where proposed activities have the greatest potential to cause detrimental effects to soil functions. Examples of high priority areas include the following:

- timber operations utilizing new techniques/equipment, or
- timber operations implemented on steep slopes (> 35%), or

- areas where multiple ground-based management projects involving heavy equipment have occurred in the past, or
- areas where proposed activities could result in a large reduction in soil cover and increased soil erosion risk.

Both Forests conduct timber management activities in landscapes burned by wildfires. The soil in these areas is already disturbed but there is uncertainty about whether timber management activities lead to substantial or permanent impairments to the productivity of the land. Depending on staffing, safety, and feasibility, the Forest may evaluate the change in the level of disturbance before and after timber management activities in post-fire treatment units. In these cases, monitoring would prioritize steeply sloped areas, areas in high soil burn severity, and/or areas that have burned multiple times in the past.

For each Forest, monitoring would be conducted on a minimum of one treatment unit within one broader project area. Additional treatment units would provide a larger sample size from which to evaluate results; more treatments units may be monitored if Forest staffing (or partner assistance) can support the work. Transect(s) are typically placed in treatment units with sensitive soils, steep slopes, and/or high erosion hazard probability. The number of transects established within a treatment unit would be dependent on staffing, soil sensitivity, and the type of project. More complex projects may have more transects. A minimum of one pre- and post-treatment transect pair would be evaluated for a given treatment unit. When the pair of pre- and post-treatment transects can't be compared (e.g., pre-treatment transect didn't end up overlapping with a treatment unit, pre-treatment transect burned up) post-treatment data should be collected either from the same subdrainage or in a comparable treatment unit with similar soils, slopes, and erosion hazard probability.

The frequency of monitoring is dependent on staff capacity and the timeline of project implementation. Timber contracts may last one year or up to four (or five) years. Once the contract is awarded, the treatment schedule for a specific unit depends on access, limited operating periods, weather, project size, safety, among other factors. Therefore, the pre- and post-transect data would be collected at a maximum of every five-year intervals on a given project and **reported every six years (every third biennial monitoring report cycle) unless data are available sooner.** If treatments occur more rapidly, data will be collected and reported at more frequent intervals.

Pre-implementation data would be collected either during the project planning phase or just prior to contract implementation. Post-implementation data would be collected one to three years after timber harvest. If capacity can support it, post-treatment data should also be collected after post-harvest fuels treatments where the Forest treats the fuels that remained on the unit after tree harvest.

Evaluation of Results

After completing an assessment, each indicator will be assigned one of the following condition classes: Good (Meets Desired Condition); Fair (Partially Meets Desired Condition); or Poor (Does Not Meet Desired Condition). These definitions come from the Region 5 Soil Management direction. A description of the 3 classes is provided below:

1. GOOD - Nearly all the area meets the desired condition for the indicator. Negligible changes have occurred.

2. FAIR - Changes in indicator condition both in degree and extent can no longer be considered negligible. Degree of indicator change may be slight in large parts of the area or great in minor portions of the area. As a general rule, the indicator desired condition may be unmet in 5 - 15% of the area. This percentage range is given to help describe a Fair condition but does not represent absolute limits or standards.
3. POOR - The degree and extent of indicator change is significant compared to the desired condition

Data will be evaluated within the context of soil type. For example, some soils benefit from compaction. Data that indicate a fair or poor condition may lead to a detrimental impact in soil productivity and indicate that the desired condition of the land management plan is not being met.

The following information will be summarized in the BMER:

1. Total number of units surveyed, project name, project action
2. Results of both pre- and post-management monitoring
3. Rating for soil characteristics: for soil compaction, displacement and erosion

Adaptive Management Questions

Based on the evaluation of results, the specialist may recommend changes, if needed, to the monitoring program, plan components, and/or management actions. The specialists would answer the following questions to identify if there is a need to adaptively manage:

1. Is the monitoring question and/or indicator providing information necessary to understand if timber management actions are effective in protecting soil productivity? If not, what modifications can be made to improve the utility of the monitoring question and/or indicator?
    - Are additional or different indicators needed?
    - Should data be collected with a different intensity or frequency?
    - Is there a new methodology, tool, or new science that should be incorporated?
    - Should the 30+ point transect be used instead of the rapid 10 point transect?

    The soil scientist or hydrologist would make recommendations to amend the monitoring question and/or indicators (or other monitoring methods) in the biennial monitoring evaluation report and report on the results of changes in the next relevant reporting cycle.

2. If the soil condition class is declining following treatments, can management action be used to reverse the trend?
    - Can on-site mitigation measures be used such as subsoil skid trails and landings? These might alleviate compaction, provide additional ground cover for nutrient cycling and erosion control or repair and stabilize actively eroding sites.
    - Should additional water control treatments on skid trails and water control feature outlets (i.e. adding slash to skid trails & water control feature outlets) be considered to minimize/reduce erosion?

3. If erosion, displacement, and/or compaction are showing a degrading trend, is there a need to change soil-related plan components?

Forest Capacity to Support the Sierra and Sequoia Monitoring Program

Tables 1 and 2 below provide information that can be used for program of work planning. Table 1 describes the monitoring program shared by both Forests. Table 2 describes the monitoring for question AR02 which is only being monitored by the Sierra National Forest. For each monitoring question and indicator, the tables describe the estimated days needed by Forest specialists every two, four, or six years (based on reporting frequency). These estimated days reflect time above and beyond typical duties. For many of these indicators, data are collected as part of typical duties.

The Forest Environmental Coordinator typically shepherds the monitoring reporting process, and this time commitment is reflected in the days estimated for this position in the table below. These estimated days may decrease overtime as the reporting becomes more systematic. The tasks typically managed by the environmental coordinator include:

- organizing and bringing forward the annual program of work needs based on the information contained in the guide, including data collection and reporting,
- organizing specialists' duties and timelines,
- collating individual specialist brief write ups into a biennial monitoring evaluation report with one voice, and
- presenting the results and recommendations to Forest leadership.

The table does not provide details about the estimated days of GIS staff to support the monitoring. Staff with GIS technical skills will be needed to help answer some of the monitoring questions.

The table also does not display the time that Regional Office staff (Remote Sensing Lab, Regional GIS Analysts, Regional Range staff and field teams) and the Regional Ecology Program are providing. These staff are providing support to answer approximately half of the monitoring questions, including: AE01, TE01, TE02, FS02, CC01, CC02, PC02.

Table 1. Sierra and Sequoia National Forests monitoring program (excluding AR04) reporting schedule and estimated staff days to support the production of the monitoring report. Estimated days for the primary specialist are those that are *beyond work that would regularly occur* on the forest. Estimate is the number days needed for the reporting cycle associated with that indicator (i.e., every two years, every six years).

Question	Indicator	Estimated days for annual field data collection	Estimated Days per two year Reporting Frequency	Estimated Days per six year Reporting Frequency	Primary Specialist(s) Needed
WS01	1			4	Hydrology (will need GIS support)
AE01	1			4	Range
AE01	2		2		Hydrology
AE01	3			2	Hydrology/fisheries
AE01	4		1		Hydrology
AR01	1		3		(Sierra only) Biologists
AR01	1			2	(Sequoia only) Biologists
AR02	All		5		Botanists (will need GIS support)
AR03	All		4	7	Wildlife Biologists (will need RO IM or GIS support)
AR04[1] (Sierra only)	1, 2, 4	50			Aquatics Tech (GS-5)
AR04[1] (Sierra only)	1, 2, 4	55			Aquatics Tech (GS-7)
AR04[1] (Sierra only)	1, 2, 4	5	5	5[2]	Aquatics Biologist (GS-11)
AR04[1] (Sierra only)	3, 4	25			Range Tech (GS-7)
AR04[1] (Sierra only)	3, 4	10	5	3[2]	Rangeland Management Specialist (GS-11)
VU01	All			2	Recreation/Public Services
VU02	1-2		2		Trails/Public Services
PC01	1		1		Strategic Comm Officer (Sierra)/ Env Coord (Sequoia)
PC01	2		2		Strategic Comm Officer (Sierra)/ Env Coord (Sequoia)
PC01	3		2		Strategic Comm Officer (Sierra)/ Env Coord (Sequoia)
PC01	4		2		Strategic Comm Officer (Sierra)/ Env Coord (Sequoia)
PC01	4		1		Forest specialists and/or GIS staff
PC02	1-4		3		Fuels Planner
PC02	4		2		Vegetation Program Manager
PC03	1		2		Environmental Coordinator
PC03	2		2		Environmental Coordinator

Question	Indicator	Estimated days for annual field data collection	Estimated Days per two year Reporting Frequency	Estimated Days per six year Reporting Frequency	Primary Specialist(s) Needed
PR01	All			10	Hydrologist/Soil Scientist
All			13		Environmental Coordinator

[1] This estimate assumes monitoring 22 meadows. If different meadows are selected, estimated capacity may decrease/increase depending on access/travel time. This capacity estimate assumes that separate range and aquatics crews will collect field data. However, data for all indicators can be collected in the future by a trained interdisciplinary crew of 2 or 4 staff.

[2] Days for a more complete evaluation of trends in all indicators that would occur every six years.

Staff Contributors

Monitoring Question	Indicator	Staff Contributing to the Monitoring Guide
WS01 – To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?	Watershed Condition Framework Classification	Josh Courter, Hydrologist Sierra NF Andy Stone, Hydrologist Sequoia NF
TE01 – To what extent are the old forest areas approaching the natural range of variation (i.e., NRV)?	Proportion of area with large trees Number of large trees and snags per acre by forest type	Marc Meyer, Province Ecologist Michele Slaton, Ecologist R5 Remote Sensing Lab
TE02 – 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	Marc Meyer, Province Ecologist Michele Slaton, Ecologist R5 Remote Sensing Lab
AE01 – What is the trend in the condition of selected meadows and other riparian areas?	Meadow and riparian vegetation condition Meadow greenness or wetness indices Stream physical condition Acres of riparian areas restored	Steve Anderson, Range Sequoia NF Stephanie Barnes, Biologist Sierra NF Josh Courter, Hydrologist Sierra NF Aimee Cox, Range Sierra NF Sam Prentice, Hydrologist Sierra National Forest Brenda Olson and Leigh Sevy, Regional Range Michele Slaton, Ecologist R5 Remote Sensing Lab Andy Stone, Hydrologist Sequoia NF
FS01 – What is the status and trend of black oak trees?	Density of large trees Regeneration Incidence of insects, disease, and mortality	Marc Meyer, Province Ecologist Michele Slaton, Ecologist R5 Remote Sensing Lab
AR01 – 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.)	Stephanie Barnes, Biologist Sierra NF Josh Courter, Hydrologist Sierra NF Anae Otto, Biologist Sierra NF Chris Sanders, Biologist Sequoia NF
AR02 – To what extent is suitable habitat for terrestrial at-risk plant species being maintained or improved?	Extent (acres) of suitable habitat Proportion of suitable habitat disturbed Proportion of suitable habitat improved	Julie Kierstead, Botanist Forest Service Contractor Joanna Clines, Botanist Sierra NF Anna Bonnette, Botanist Sequoia NF Katie Ludwig, Botanist Sierra NF

Monitoring Question	Indicator	Staff Contributing to the Monitoring Guide
AR03 - 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	Gretchen Jehle, Wildlife Planner, R5
AR04 - To what extent is management meeting the thresholds in SPEC-YT-GDL-03 and are the number of Yosemite toad occupied breeding and rearing areas being maintained or increasing?	Population status Habitat condition Utilization Percent alteration (disturbance)	Stephanie Barnes, Biologist Sierra NF Cathy Brown, Biologist and Yosemite Toad expert Stanislaus NF and UC Davis Aimee Cox, Range Sierra NF Brenda Olson, Assistant Range Program Manager, R5
VU01 – What are the trends in visitor use and satisfaction?	Visitor use and satisfaction Visitor recreational activity by type Visitor demographics	Pen Leak, Assistant Recreation Officer Sierra NF Elaine Locke, Developed Recreation Manager Sierra NF Heather Swarts, Grants Management Assistant Sequoia NF
VU02 – What percentage of the inventoried motorized and non-motorized trail system is maintained to standard?	Miles of trail maintained to standard Inventoried motorized and nonmotorized trail system miles	Pen Leak, Assistant Recreation Officer Sierra NF Elaine Locke, Developed Recreation Manager Sierra NF Heather Swarts, Grants Management Assistant Sequoia NF Garrett Villanueva, Trails Program Manager, Region 5
CC01 – 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	Marc Meyer, Province Ecologist Michele Slaton, Ecologist R5 Remote Sensing Lab
CC02 – 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	Marc Meyer, Province Ecologist Michele Slaton, Ecologist R5 Remote Sensing Lab
PC01 – To what extent are partnerships helping the Forest accomplish objectives?	Workforce Partnership Agreements Volunteer Agreements Accomplishments	Keith Fox, Environmental Coordinator, Sequoia NF Judi Tapia, Environmental Coordinator Sierra NF
PC02 – What management actions are contributing to the achievement of desired conditions relating to fire regimes?	Acres of fires 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	Matthew Avery, Forester, Sierra NF Steven Caracciolo, Forester, Sequoia NF Daniel Tune, Marc Meyer, Province Ecologist

Monitoring Question	Indicator	Staff Contributing to the Monitoring Guide
PC03 – What are the economic contributions of forest-based uses and ecological services to the local communities?	Local economic conditions Forest contributions	Kawa Ng, Lead Economist EMC/WO Stefan Anderes, Economist EMC/WO Joshua Meeks, Economist EMC/WO Erin Barton, Socioeconomic lead and planning specialist, Santa Fe NF Kate Marcille, Economist, WO/EMC
PR 01 – How does soil disturbance differ from pre- and post-activity for timber management?	Soil compaction Erosion Displacement	Andy Stone, Hydrologist Sequoia NF Kellen Takenaka, Soil Scientist Sierra NF

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