Find Your Science: A Research Prospectus for Sequoia and Kings Canyon National Parks

January 2018

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Photos on cover:

Top left: The park collaborates with university scientists and the U.S. Geological Survey to study the health of giant sequoias during and after extreme drought conditions. Photo by Lincoln Else/lincolnelse.com.

Top Right: U.S. Geological Survey biologists track changes in forest structure and function in the parks. Photo by Nate Stephenson/USGS.

Bottom right: National Park Service scientists collect lake water samples to measure water quality. Photo by Linda Mutch/NPS.

Bottom left: As part of a program to monitor wet meadows and fens, National Park Service biologists examine a soil profile to determine wetland type. Photo by Linda Mutch/NPS.

Introduction

Sequoia & Kings Canyon National Parks (SEKI) have a long history of supporting scientific research that is important to park stewardship and the advancement of science. The parks would like to continue this tradition. While the parks welcome a wide range of scientific proposals, this Research Prospectus is intended to encourage scientists to pursue scientific studies that are priorities for the parks.

SEKI's natural and cultural resources face many threats, including climatic change, changing fire regimes, air pollution, invasive non-native species, land use change and habitat fragmentation, and human use. Science is the key to understanding park resources, their interconnections, and vulnerabilities. Scientific findings help guide decisions and enrich park education programs. We welcome researchers to "Find Your Science" and help SEKI meet the challenges of the 21st Century.

Doing Science in the Parks

Prior approval in the form of a permit is required to conduct scientific research or collecting in SEKI. For information about research permits, ongoing programs and studies, the Science Learning Center, or the Science Symposium, please go to: https://www.nps.gov/seki/learn/scienceresearch.htm

A Climate-Smart Resource Stewardship Strategy (RSS)

In October 2017, SEKI published a Climate-Smart Resource Stewardship Strategy (RSS). The purpose of the RSS is to: (1) strategically guide investments in funding, planning, and implementing resource stewardship activities; (2) track and evaluate resource stewardship progress; and (3) integrate climate change adaptation and novel ways of thinking about resource stewardship under changing conditions. The RSS is a compilation of the following interconnected parts:

- SEKI's guiding principles for resource stewardship;
- Goals, indicators, and targets for each of 12 priority resources;
- Assessments of current condition and trends, vulnerability, and plausible future scenarios for each priority resource;
- Management approach for each priority resource, including a menu of prioritized activities.

It is recommended that scientists interested in conducting research in SEKI become familiar with the full RSS as it provides important context for the science activities excerpted here. Learn more about the RSS and watch the "Find Your Science" video at: go.nps.gov/sekiRSS.

Science Priorities

The scientific priorities described below are excerpted from the RSS and are organized under the parks' 12 priority resources. While all the listed activities are important, they were sorted within each priority resource into higher (H), medium (M), and lower (L) priority categories. Approximately one-third of the activities for each priority resource were sorted into each category. While park staff attempted to be comprehensive in identifying priority science activities, we welcome conversations about potential gaps and emerging issues that were not called out in the RSS.

Do you have questions or comments? Please contact Dr. Christy Brigham, Chief of Resource Management and Science, Christy_Brigham@nps.gov, 559-565-3120.

Cultural Resources

Archeological Resources, Cultural Landscapes, Ethnographic Resources, Historic Structures, Museum Collections and Archives

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
CR01	H	Research/ Study	Identify high probability areas for presence of cultural resources. Overlay with vulnerability to erosion, fire, vandalism, etc. to inform management prioritization.	Not started
CR06	M	Research/ Study	Complete SEKI Ethnographic Overview & Assessment regarding beliefs, traditions and other cultural values of American Indians who have ancestral ties to the parks.	Initiated
CR07	H	Document -ation	Document ethno-biotic resources (e.g. plants and animals that are resources for food, fiber, and medicine) based on Ethnographic Overview and interviews with tribal elders.	Not started
CR09	L	Research/ Study	Assess vulnerability of ethno-biotic resources and determine strategy to manage as both natural and cultural resources.	Not started
CR10	H	Document -ation	Conduct surveys, evaluations, and eligibility determinations for all cultural resources, focusing on compliance needs and areas of highest probability, value, and vulnerability.	Ongoing
CR12	H	Document -ation	Review identified cultural landscapes and complete inventory, eligibility, and nominations to ensure they are properly documented and protected.	Not started
CR13	M	Document -ation	Complete evaluation of the Grant Grove Cultural Landscape for National Register listing eligibility and submit to SHPO for concurrence.	
CR14	M	Document -ation	Prioritize and prepare Consensus Determinations of Eligibility (DOEs) for cultural landscapes. Prioritize landscapes that have onsite evaluations (i.e., Dillonwood)	Ongoing
CR17	L	Document -ation	Survey and document Mt Whitney region historic trails for listing in National Register of Historic Places to document national significance and establish clear legal requirements.	Not started
CR19	M	Research/ Study	Investigate educational opportunities and recommend methods to conserve cultural resources by reducing impacts such as illegal collecting, etc.	Not started
CR22	H	Research/ Study	Collaborate with American Indians to incorporate Traditional Ecological Knowledge (TEK) into climate change adaptation activities.	Not started
CR23	L	Direct manage -ment	Reintroduce traditional ecological knowledge and cultural practices (such as Native American burning, thinning, and non-native plant removal), into ethnographic landscapes where appropriate.	Not started
CR28	L	Document -ation	Conduct condition surveys for museum collections, including photographic negatives and correct deficiencies to ensure long-term preservation of collections.	Ongoing
CR32	M	Research/ Study	Assist researchers from inside and outside the parks to make archival and museum collections available for research and to deepen our understanding of the parks and their place in history.	Ongoing
CR33	L	Research/ Study	Research and publish material of historical interest using available channels to build public understanding and research interest in park collections.	Not started

Landscape Integrity and Biodiversity

Habitat Intactness and Connectivity, Biodiversity, Soil

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
LI01	M	Research/ Study	Compare and integrate vulnerability assessment products to describe and map vulnerability to climate change and other stressors at parkwide and larger regional scales.	Not started
LI02	L	Research/ Study	Create landform maps that integrate geology, soils, and topography to help understand vulnerability and manage watersheds, ecosystems, cultural resources, and natural hazards.	Not started
LI03	M	Research/ Study	Identify and map species with rare habitats and determine conservation needs so these species are not lost due to changing conditions.	Not started
LI04	M	Research/ Study	Understand the landscape genetics and distribution of species that are highly valued and/or vulnerable.	Not started
LI06	M	Inventory	Map elevation corridors and intact foothill habitats inside and outside of the parks to avoid development in critical migration corridors, target restoration, and allow species to migrate in response to climate change.	Not started
LI07	M	Research/ Study	Conduct visitor capacity study to inform facility and resource management/protection decision making, as described in the parks' strategic plan.	Initiated
LI08	M	Planning/ Compliance	Assess climate change vulnerability caused or exacerbated by existing and planned facilities and mitigate risk to sensitive areas.	Not started
LI11	L	Planning/ Compliance	Develop better methods for cumulative impact assessment and review of significant actions proposed by adjacent landowners/agencies.	Not started
LI12	H	Inventory	Conduct a parkwide Disturbed Lands Inventory and prioritization strategy to guide future restoration projects.	Not started
LI17	H	Monitoring	Monitor and track fire return interval, severity, gap creation, and regeneration/succession across the landscape.	Partially ongoing
LI18	M	Research/ Study	Evaluate effectiveness of different fire treatments to maintain ecosystem services by reducing impacts of drought and other stressors.	Partially ongoing
LI20	H	Research/ Study	Assess and prioritize invasive nonnative plants for management using a systematic, transparent assessment system.	Initiated
LI21	M	Research/ Study	Determine how to classify plant and animal species as climate migrants versus invasive species and develop monitoring and management frameworks for response to changes in distribution.	Not started
LI26	M	Monitoring	Continue to monitor landscape-scale biodiversity proxies (e.g., birds) as one tool for understanding and responding to changes in diversity across the parks.	Ongoing
LI27	M	Research/ Study	Research more effective techniques to monitor species richness (soundscape monitoring, eDNA, remote cameras/sensors).	Ongoing
LI28	H	Monitoring	Detect landscape-scale changes in vegetation types through remotely sensed imagery and applications.	Not started
LI29	H	Research/ Study	Resurvey sites (e.g. Natural Resource Inventory plots) to detect changes in species distribution and abundance.	Ongoing
LI30	M	Monitoring	Update SEKI's 2001 vegetation map to facilitate vegetation change analysis and identify areas of concern for potential management action.	Not started
LI31	M	Inventory	Complete SEKI soil survey/map to improve predictive modeling and inform management actions that may impact soils.	Ongoing

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
LI32	L	Inventory	Facilitate collection and curation of plant and animal specimens in repositories with data available on relevant internet sites that are positioned to make information accessible for biodiversity study.	Ongoing
LI35	L	Monitoring	Establish landscape monitoring partnerships to understand species adapting to changing conditions versus those in danger of being lost from the ecoregion.	Not started
LI38	M	Partnership	Collaboratively create a publically accessible clearinghouse for Southern Sierra Nevada datasets to build landscape-scale understanding of values, vulnerability, and change.	Not started

Air Resources

Air Quality, Dark Skies, Natural Soundscapes

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
AR01	H	Monitoring	Measure ozone along an elevation gradient to assist in health advisories and to understand ecological effects.	Ongoing
AR02	H	Monitoring	Measure fine particulates (PM2.5) as part of the IMPROVE network to determine trends in visibility.	Ongoing
AR03	M	Monitoring	Measure fine particulates (PM2.5) as part of an interagency effort to monitor smoke dispersion.	Ongoing
AR04	H	Monitoring	Measure wet and dry deposition to detect trends in nitrogen, sulfur, and acidic deposition.	Ongoing
AR05	H	Monitoring	Measure wet deposition to detect trends in mercury deposition.	Ongoing
AR06	H	Research/ Study	Measure atmospherically deposited contaminants of emerging concern (e.g., flame retardant, new classes of pesticides/herbicides) in prioritized locations.	Not started
AR07	H	Research/ Study	Map threats and evaluate risk from airborne pesticides to inform field sampling locations and identify which pesticides to analyze.	Not started
AR08	H	Research/ Study	Determine the ecosystem components most at risk from toxic air contaminants, including higher trophic levels or sensitive species.	Not started
AR09	M	Research/ Study	Research how pesticide pollutants (current and historic use) come into the parks and how they interact with ecosystems.	Initiated
AR10	M	Research/ Study	Understand dynamics of airborne nutrient pollutants (e.g., sources, transport, effects), including receptors (e.g., soil, vegetation, water), risks, and management options to reduce ecological impacts.	Not started
AR11	L	Research/ Study	Determine extent of phosphorus deposition and its contribution to eutrophication of aquatic and/or terrestrial systems	Not started
AR12	L	Research/ Study	Research ammonia gas contribution to nitrogen deposition and ozone formation.	Not started
AR13	L	Research/ Study	Continue long-term Tokopah watershed research to understand effects of atmospheric deposition and climate change on lake and watershed dynamics.	Ongoing
AR14	L	Research/ Study	Develop lichen biomonitoring program as indicator of air pollution impact on terrestrial ecosystems.	Not started
AR15	L	Research/ Study	Determine Critical Loads of nitrogen for oak woodland beyond what is currently understood via lichens.	Not started

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
AR16	M	Research/ Study	Evaluate knowledge and information gaps to determine Critical Loads of nutrient deposition for alpine terrestrial ecosystems.	Not started
AR18	L	Research/ Study	Determine how climate change will affect ozone levels across elevations.	Not started
AR19	L	Research/ Study	Research how airborne industrial and metal pollutants enter the parks, how they interact with ecosystems, and management actions to reduce impacts.	Not started
AR20	M	Partnership	Improve forecasts of fine particulates (PM2.5) during fires to better inform people about health effects.	Ongoing
AR21	M	Other	Develop PM2.5 management action points that help define when people should be moved due to smoke.	Not started
AR23	H	Outreach	Continue to publish reports about impacts of pesticides and fertilizers transported into the parks to inform lawmakers and regulators.	Ongoing
AR27	M	Research/ Study	Measure and monitor natural sounds in areas before and after large events (e.g., burned and unburned, pre and post restoration, pre and post flooding) in selected areas to measure change in biological activity and diversity.	Initiated
AR28	L	Monitoring	Monitor sounds in front-country and Wilderness. Develop acceptable levels of sound intrusion to enable management response.	Ongoing
AR29	L	Data manage - ment	Develop and maintain an online SEKI sound library as a source of baseline data and educational resource.	Not started

Water Resources

Water Quality, Hydrology

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
WR01	H	Planning/ Compliance	Evaluate potential resource impacts from the withdrawal of surface and groundwater for human use in the parks.	Not started
WR09	M	Monitoring	Continue and expand monitoring of precipitation and snowpack to understand broader hydrologic changes in park ecosystems.	Ongoing
WR10	H	Monitoring	Continue and potentially expand monitoring of streamflow (volume and timing) to detect hydrologic changes from climate change.	Ongoing
WR11	M	Monitoring	Report on existing river water quality information to document whether or not water quality goals are achieved and to enable potential management action if they are not.	Not started
WR12	M	Monitoring	Develop and implement water quality and stream/riparian habitat monitoring for river or streams focusing on youth and other volunteers.	Not started
WR13	M	Monitoring	Detect changes in stream morphology caused by hydrological events outside of historic ranges and by heavy recreational use that may degrade riverbanks.	Not started
WR14	H	Monitoring	Monitor water temperature continuously (i.e., install sensors) in rivers and streams to understand effects of climate change and identify potential refugia.	Ongoing
WR15	M	Planning/ Compliance	Determine quantitative targets or assessment points for water quality measures to enable evaluation of resource condition and facilitate management response.	Not started

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
WR16	H	Monitoring	Monitor contaminants (after prioritizing where and how) to assess impact to water resources and associated native species or ecosystems.	Initiated
WR17	H	Monitoring	Continue monitoring status and trends of water chemistry in high-elevation lakes (Sierra Network I&M lake monitoring protocol) as one measure of high elevation ecosystem health.	Ongoing
WR18	H	Research/ Study	Incorporate nitrogen assessment points into lake condition reporting as triggers for management response activities.	Initiated
WR19	H	Monitoring	Monitor lake temperature profiles continuously (i.e, install sensors) as an addition to I&M lake monitoring to understand effects of climate change on lake ecosystems.	Not started
WR20	L	Monitoring	Monitor lake water levels and timing of ice-on/off as an addition to I&M lake monitoring to understand effects of climate change on lake ecosystems.	Not started
WR21	M	Research/ Study	Assess vulnerability of high-elevation lakes to algal blooms, detect effects if they are occurring, and understand system dynamics to identify possible solutions.	Not started
WR22	L	Research/ Study	Support research and development of more accurate snow cover products that estimate snow cover across the landscape.	Ongoing
WR23	L	Research/ Study	Conduct high resolution temperature and precipitation studies; use results to identify climate change refugia.	Not started
WR24	L	Other	Develop an extreme hydrologic events assessment program to further inform park management and visitors of hydrologic conditions.	Not started
WR25	L	Research/ Study	Expand research partnerships that complement and build on existing water quality research and monitoring to create a comprehensive monitoring program.	Ongoing

Aquatic Ecosystems and Species

High Elevation and Low Elevation Aquatic Ecosystems and Species

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
AQ03	H	Direct manage - ment	Conduct active mountain yellow legged frog restoration, including disease resistance treatment, translocations, captive-rearing, immunizations, reintroductions, emergency salvage, temporary predator relocation, monitoring, and research.	Ongoing
AQ04	H	Direct manage - ment	Develop a structured and adaptive implementation blueprint for mountain yellow legged frog restoration and monitoring utilizing expert knowledge.	Not started
AQ05	H	Monitoring	Monitor, research, and protect existing populations of Yosemite toad.	Initiated
AQ06	H	Direct manage - ment	Restore the Yosemite Toad by researching methods, collaborating across agencies, and implementing a restoration plan to improve the status of this threatened species.	Not started
AQ07	M	Monitoring	Maintain protection for Little Kern golden trout, monitor populations, translocate if needed, and assist efforts outside parks.	Ongoing
AQ08	M	Monitoring	Monitor populations of Kern River rainbow trout and translocate if necessary to protect this subspecies.	Initiated
AQ09	L	Research/ Study	Assess feasibility of restoring extirpated aquatic species (e.g., foothills yellow-legged frog and pikeminnow).	Not started

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
AQ10	H	Research/ Study	Identify key breeding habitats for low-elevation aquatic species persistence to inform development of a climate-smart conservation plan.	Initiated
AQ11	M	Monitoring	Develop and implement a monitoring strategy for foothill aquatic and riparian ecosystems.	Not started
AQ12	M	Monitoring	Continue and expand monitoring of lower-elevation aquatic reptiles and amphibians to estimate population sizes and determine trends in abundance, species composition, and breeding habitat.	Ongoing
AQ13	M	Monitoring	Re-establish monitoring of low-to-middle elevation fish assemblages to estimate population sizes and determine trends in abundance and species composition.	Not started
AQ14	M	Monitoring	Develop and use new monitoring techniques (eDNA, acoustic monitoring, etc.) to improve detection of species or communities of conservation interest in aquatic habitats.	Not started
AQ15	L	Research/ Study	Understand historic stream dynamics in the foothills as a baseline to assess whether changes that may occur are caused by climate change, administrative actions, visitor use, etc.	Not started
AQ16	H	Direct manage - ment	Monitor, prevent spread, and eradicate non-native invasive species in lower elevation aquatic habitats (education, monitoring, and testing control measures).	Not started
AQ17	L	Monitoring	Develop volunteer program to detect invasive aquatic animals before they become established.	Not started
AQ20	L	Planning	Apply monitoring and research to develop climate change adaptation strategies, potentially including new types of intervention activities, for conservation of lower-elevation aquatic species and habitats.	Not started

Caves and Karst Systems

Wild Caves, Crystal Cave

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
CV05	M	Monitoring	Analyze cave visitation history in concert with a survey of damaged cave formations and consider management responses to mitigate impacts.	Not started
CV07	L	Inventory	More accurately inventory cave underground extents, formations, and surface area of influence on the cave system to enable more robust assessment of potential impacts from stressors.	Ongoing
CV08	H	Research/ Study	Define natural range of cave biota abundance and rarity to detect and respond to changes over time.	Not started
CV09	H	Inventory	Conduct karst springs survey to understand which caves/watersheds have sustainable water sources.	Initiated
CV10	H	Research/ Study	Analyze caves relative to waterways and infrastructure to identify locations vulnerable to surface and ground sources of contamination.	Ongoing
CV11	M	Monitoring	Analyze exposure of caves to: unregulated visitation and climate change using cave entrance locations, solar aspect, and cold air sheds.	Not started
CV12	M	Inventory	Monitor bat roosts and hibernacula to help managers prevent introduction and spread of White Nose Syndrome (WNS).	Completed
CV13	M	Research/ Study	Monitor environmental change (temperature, humidity, streamflow, sediment) in caves vulnerable to climate change.	Not started

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
CV14	M	Research/ Study	Analyze air quality data to better understand the influence of airborne contaminants on cave environments.	Not started
CV15	M	Research/ Study	Promote research on cave biota to deepen understanding of cave ecosystems and how they change over time.	Initiated
CV16	L	Research/ Study	Increase understanding of groundwater pathways (especially karst) so managers can improve monitoring for threats, such as groundwater extraction or pollution discharge.	Not started
CV17	L	Research/ Study	Conduct acoustic studies near cave entrances to assess wildlife use and human disturbances.	Ongoing
CV18	L	Monitoring	Track cave research from permit to final published reports.	Ongoing
CV20	M	Monitoring	Accurately track Crystal Cave visitation to enable study of visitor impacts.	Ongoing
CV21	M	Research/ Study	Perform food web study of cave invertebrates in Crystal Cave to document and communicate the impact of food introduced by visitors on invertebrate ecology.	Ongoing
CV22	H	Direct manage - ment	Reduce disruption of food webs in Crystal Cave due to visitor use (clean hair and lint and stress no-food on cave tours).	Ongoing
CV24	H	Research/ Study	Improve invertebrate monitoring in Crystal Cave to understand resource condition and respond to changes over time.	Initiated

Wet Meadows and Fens

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
WM01	H	Research/ Study	Map climate change vulnerability for wet meadows and fens.	Initiated
WM02	H	Research/ Study	Determine conservation value of individual meadows.	Not started
WM04	M	Research/ Study	Test methods to retain moisture in wet meadows and fens for climate change adaptation.	Not started
WM06	H	Monitoring	Monitor locations and amount of pack stock grazing in wet meadows and fens.	Ongoing
WM07	H	Monitoring	Monitor wet meadows and fens impacted by visitors or administrative activities as described in Wilderness Stewardship Plan.	Ongoing
WM08	L	Monitoring	Add hydrologic monitoring of wet meadows and fens impacted by visitors or administrative activities.	Not started
WM11	H	Inventory	Complete a disturbed lands inventory and prioritization strategy for wet meadows and fens.	Initiated
WM12	H	Direct manage - ment	Restore priority wet meadows and fens (design, implement, monitor, and evaluate).	Not started
WM13	L	Research/ Study	Identify desirable alternative states and define targets in areas that will not persist as wet meadows and fens in a changing climate.	Not started
WM16	L	Research/ Study	Identify locations where wet meadows and fens don't exist now but might be able to in the future.	Not started
WM17	M	Research/ Study	Define hydrologic indicators and targets for maintaining/restoring wet meadows and fens.	Not started
WM18	H	Monitoring	Continue monitoring of wet meadow and fen soil, vegetation, hydrology, and macroinvertebrates (I&M Wetlands Monitoring).	Ongoing

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
WM19	L	Research/ Study	Test soil carbon flux as a measure of wet meadow and fen structure and function and to quantify carbon sequestration.	Not started
WM20	M	Monitoring	Periodically (~10 yr) remap wet meadows and fens to assess change (area, distribution).	Initiated
WM21	L	Data manage - ment	Scan and curate wet meadow and fen archives to make accessible to managers and researchers.	Initiated
WM25	M	Partnership	Identify opportunities to standardize wet meadow and fen data collection and conduct collaborative regional research.	Not started

Foothill Terrestrial Ecosystems

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
FT01	H	Monitoring	Develop and implement a monitoring plan for terrestrial foothill ecosystems.	Not started
FT02	M	Monitoring	Continue phenological monitoring of California buckeye and blue oak (including citizen scientists).	Ongoing
FT04	M	Inventory	Monitor foothill herpetofauna potentially with citizen science and cross-agency collaboration.	Not started
FT05	M	Partnership	Collaborate with partners to study cross-boundary resource issues and make recommendations to reduce stressors and impacts.	Not started
FT06	H	Research/ Study	Study drought impacts and spatial patterns in oak woodlands (tree mortality, etc.) to inform management actions.	Not started
FT07	L	Research/ Study	Study foothills nutrient and carbon cycling to recommend monitoring measures and thresholds to support biodiversity and ecosystem function.	Not started
FT08	L	Research/ Study	Study foothills hydrology to recommend monitoring indicators and improve understanding of climate-water-vegetation interactions.	Not started
FT09	M	Research/ Study	Describe fire's natural range of variability in the foothills, including methods to measure too-frequent as well as less frequent fire.	Not started
FT12	L	Education	Interpret foothill fire restoration with before-after photo points, including citizen science picture posts.	Not started
FT18	L	Research/ Study	Inventory recreational impacts to popular foothills destinations, determine indicators and management trigger points, and monitor.	Not started
FT21	M	Research/ Study	Research what kind of education or communication is successful at increasing visitor stewardship of foothills areas.	Not started
FT26	H	Monitoring	Monitor, assess impact, and recommend response for park areas vulnerable to feral pigs and trespass cattle.	Not started
FT29	H	Direct manage - ment	Restore and maintain demonstration area(s) of foothill native plant communities, including collaboration with Indian tribes to design and implement it.	Not started
FT31	H	Direct manage - ment	Assist blue oak recruitment in strategic areas of drought-resistant genotypes using direct planting, tree shelters, or nurse sites to mitigate climate/drought induced mortality.	Not started
FT32	L	Research/ Study	Conduct experimental thinning of shade tolerant trees or shrubs that out-compete black oaks and other species.	Not started

Forest Ecosystems

Montane and Subalpine Forests

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
FR01	H	Research/ Study	Map forest vulnerability to moisture stress to help prioritize fire and fuels management and other treatments (Leaf to Landscape project).	Initiated
FR02	L	Research/ Study	Identify suitable habitat for whitebark pine in the future based on climate, soil, etc. to help prioritize management treatments.	Initiated
FR03	H	Research/ Study	Identify metrics to define "resilient forests and landscapes" and revise management prescriptions as needed.	Not started
FR04	M	Research/ Study	Identify areas where conversion of forests to another vegetation type is acceptable due to past conditions, management activities, etc.	Not started
FR09	H	Monitoring	Continue and enhance fire effects monitoring, the parks' most comprehensive, plot-based dataset relating specifically to fire.	Ongoing
FR10	H	Research/ Study	Expand fire return interval departure (FRID) to identify areas burning more frequently than the historic FRI, in addition to areas burning more infrequently.	Not started
FR11	M	Monitoring	Continue to acquire, analyze, ground truth, and evaluate satellite based fire severity data on large fires to provide coarse scale estimate of fire effects and vegetation response.	Ongoing
FR12	H	Monitoring	Install more fire effects plots and revisit existing plots in subalpine forests to capture changing fire regime and fire effects.	Not started
FR13	H	Research/ Study	Improve understanding of historical fire regimes in subalpine forests.	Not started
FR14	L	Monitoring	Analyze fire return interval departure (FRID) in subalpine forests, using improved historic information, to map areas with less or more fire than in the past.	Ongoing
FR15	H	Research/ Study	Determine if prescribed fire etc. designed to restore forests to historic conditions increase resistance to tree mortality during drought.	Initiated
FR16	H	Research/ Study	Test management strategies for increasing forest resilience by reducing tree densities below historic levels using prescribed fire.	Not started
FR17	L	Research/ Study	Design an adaptive management experiment following extreme fire, wind, etc. to test erosion controls and planting genotypes/species suitable for future conditions.	Not started
FR18	M	Planning/ Research/ Study	Create a sugar pine adaptive management plan for identifying and planting genotypes resistant to blister rust.	Not started
FR19	L	Direct manage - ment	Test climate adaptation strategies to provide vegetation cover in Cedar Grove campgrounds that experienced severe drought tree mortality.	Not started
FR20	M	Planning/ Compliance	Identify vulnerable areas, then prevent or minimize epidemic outbreaks of native forest pests that have potential to cause unprecedented forest mortality. Research how other managers responded to native insect infestations and incorporate their lessons learned.	Not started
FR21	M	Monitoring	Quantify effects on resources due to impacts of insects and pathogens (tree cover, carbon storage, native species, wildlife habitat, etc.).	Not started
FR23	L	Inventory	Identify locations and tree species with remnant/subfossil wood in high-elevation or ghost forests. Monitor campsites to minimize loss to fuel wood burning.	Not started
FR25	H	Monitoring	Continue USGS and I&M forest monitoring to assess stressor exposure and forest health, demographics, and structure.	Ongoing

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
FR26	L	Monitoring	Re-measure Natural Resource Inventory (NRI) plots to understand long-term change in forest structure at a parkwide scale.	Not started
FR27	M	Monitoring	Re-measure existing blister rust plots every 10 years to determine status and spread of white pine blister rust.	Initiated
FR28	M	Monitoring	Develop monitoring strategy for western white pine, which is susceptible to blister rust.	Not started
FR29	L	Monitoring	Re-measure 25+ year-old Keifer plots in Rock Creek/Boreal Plateau to detect change in lodgepole and foxtail pine forests.	Not started
FR30	H	Research/ Study	Track status of sugar pine by re-measuring existing plots and analyzing population demographics (birth and death rates).	Ongoing
FR31	L	Research/ Study	Assess sugar pine demographics in fire-restored vs. fire-suppressed sites.	Not started
FR32	L	Research/ Study	Solicit dendrochronology research for high-elevation tree species to better compare current and past conditions.	Ongoing
FR33	M	Research/ Study	Research the interactions of multiple stressors on five-needle pines.	Not started

Giant Sequoia and their Ecosystems

Activity Number	Pr	Activity Type	Short Activity Name	Activity Status
SE01	H	Planning/ Compliance, Monitoring	Complete a Giant Sequoia Monitoring and Management Plan, as called for in SEKI's 2016-2021 Strategic Plan.	Not started
SE03	H	Research/ Study	Map giant sequoia and forest drought vulnerability and monitor across the landscape using remotely sensed data (Leaf to Landscape project).	Initiated
SE04	L	Research/ Study	Obtain fine scale environmental measurements to determine if giant sequoia groves are climate change refugia.	Not started
SE05	M	Research/ Study	Conduct niche modeling including soils information to compare current and potential future distributions of giant sequoia habitat.	Not started
SE06	L	Research/ Study	Identify possible problematic areas of unsustainable soil loss by modeling soil erosion under climate change scenarios.	Not started
SE07	H	Inventory	Improve mapping of giant sequoia groves and trees by correcting the Sequoia Tree Inventory.	Not started
SE12	H	Monitoring	Continue to map fire return interval departure (FRID), fire size, and severity to track changing fire regimes and condition of sequoia groves.	Ongoing
SE13	H	Monitoring	Continue to monitor fire effects in and adjacent to sequoia groves to evaluate program effectiveness and assess conditions following repeated burns over the long term.	Ongoing
SE14	H	Research/ Study	Determine if prescribed fire etc. designed to restore sequoia mixed conifer forests to historic conditions increase resistance to tree mortality during drought.	Initiated
SE15	H	Research/ Study	Test management strategies for increasing giant sequoia mixed conifer forest resilience by reducing tree densities below historic levels using prescribed fire.	Not started
SE16	L	Research/ Study	Design an adaptive management experiment following extreme fire, wind, etc. to test erosion controls and planting genotypes/species suitable for future conditions.	Not started

Activity Number	Pr	Activity Type	Short Activity Name	Activity Status
SE17	L	Research/ Study	Conduct giant sequoia assisted adaptation (plant adapted genotypes) or assisted migration (move seedlings to future suitable habitat) management experiment to test seedling success and social response.	Not started
SE18	L	Research/ Study	Test how best to improve the health of logged/second growth sequoia groves (i.e., Dillonwood or Big Stump), including how to reintroduce fire to these areas.	Not started
SE21	M	Monitoring	Improve and coordinate surveys for early detection of invasive insects and disease.	Not started
SE22	L	Direct manage - ment	Control insects and pathogens that cause or are likely to cause extensive tree mortality within high value areas of sequoia groves.	Not started
SE24	L	Research/ Study	Assess administrative water withdrawals and their effects on giant sequoia groves.	Not started
SE26	M	Research/ Study	Collect giant sequoia seeds for seed banking, genetic analysis, and experimental assisted migration.	Initiated
SE28	L	Research/ Study	Assess genetic diversity of giant sequoia within and across groves to determine variability in climate stress tolerance and adaptive capacity.	Initiated
SE29	M	Monitoring	Continue to support and apply findings from USGS forest demography monitoring.	Ongoing
SE30	H	Research/ Study	Finalize the US Geological Survey report describing a monitoring protocol for giant sequoia demography and evaluate the feasibility of implementing it.	Initiated
SE31	M	Partnership	Continue and improve application of findings from the USFS Forest Health Program (insect and disease outbreaks and tree mortality).	Ongoing
SE32	L	Research/ Study	Develop protocols to monitor biodiversity as an indicator to track condition of giant sequoia groves.	Not started
SE33	L	Research/ Study	Monitor fire scars on giant sequoia Trees of Special Interest to achieve the intent of the Fire and Fuels Management Plan and Trees of Special Interest Policy.	Not started
SE34	L	Research/ Study	Survey stakeholder values about giant sequoia to inform goal-setting, monitoring indicators, and implementation decisions.	Not started
SE35	L	Research/ Study	Develop protocols to monitor social values in giant sequoia groves.	Not started
SE36	H	Research/ Study	Develop long-term monitoring protocol for hydrology and soil indicators within and adjacent to sequoia groves.	Not started
SE37	H	Monitoring	Monitor meteorology in and adjacent to giant sequoia groves to better understand physical conditions over time.	Ongoing
SE38	M	Monitoring	Continue to monitor air quality at Ash Mountain and Kaweah monitoring sites to provide data near sequoia groves.	Ongoing
SE39	L	Data manage - ment	Track current and past research conducted in park sequoia groves to better learn from and communicate this work.	Not started
SE40	M	Data manage - ment	Organize giant sequoia relevant spatial datasets so that they are discoverable, accessible, and well documented.	Not started
SE42	M	Partnership	Collaborate to integrate data across jurisdictions for a landscape-scale understanding of giant sequoia ecology, status, and trends.	Not started

Alpine Terrestrial Ecosystems

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
AL01	H	Monitoring	Enhance early detection efforts for non-native plants, concentrating on vulnerable alpine areas.	Initiated
AL03	L	Monitoring	Continue monitoring the effects of pack stock on alpine upland meadows to ensure adverse impacts are minimized.	Ongoing
AL04	L	Inventory	Assess informal/abandoned trails in the alpine to identify areas especially sensitive and prone to erosion and other impacts of foot traffic.	Not started
AL08	H	Research/ Study	Conduct species and habitat vulnerability review to focus monitoring and management efforts on species and habitats less intrinsically adaptable to climate change.	Not started
AL10	H	Monitoring	Increase alpine weather and snowpack monitoring to characterize and track climate and enable identification of climate change refugia.	Ongoing
AL11	L	Monitoring	Expand monitoring of rock and ice glacial change/melt to determine loss rate.	Not started
AL12	H	Research/ Study	Identify potential climate refugia for alpine organisms to protect them from trails, campsite development, etc. and provide places to move species to aid in future persistence.	Not started
AL13	M	Inventory	Continue to document the distribution and abundance of alpine fauna, especially invertebrates and cryptic amphibians.	Ongoing
AL14	M	Inventory	Continue to document the distribution and abundance of alpine flora, especially bryophytes, lichens, and aquatic plants.	Ongoing
AL15	H	Monitoring	Continue supporting high elevation I&M monitoring of lakes, birds, wetlands, and subalpine forests to detect changes in alpine ecosystem components.	Ongoing
AL16	H	Monitoring	Revisit Natural Resource Inventory (NRI) plots to detect early shifts in distribution of alpine plants and establish 2nd data point for long term monitoring.	Not started
AL17	H	Monitoring	Monitor SEKI Mt. Langley GLORIA sites every 5 years to detect changes in plant species and cover due to climate change or other stressors.	Ongoing
AL18	M	Partnership	Participate in regional GLORIA activities and data analysis to place SEKI into larger regional context regarding shifts in alpine plant communities.	Initiated
AL19	M	Outreach	Develop citizen science program that enables alpine visitors to track observations of plant phenology, weeds, and wildlife.	Not started
AL20	M	Research/ Study	Determine good alpine and subalpine phenological indicators and expand phenological monitoring to include these species.	Not started
AL21	L	Research/ Study	Define targets for measuring the condition of the vegetative structure as an indicator of alpine ecosystem health.	Not started
AL22	L	Research/ Study	Evaluate carbon and nutrient dynamics in alpine terrestrial ecosystems, evaluate if the measures are good indicators of alpine ecosystem function, and establish thresholds of concern (i.e., targets).	Not started
AL23	L	Other	Evaluate the potential for expanding the Yosemite Sky Islands monitoring protocol to the unglaciated alpine plateaus of the Kern River watershed.	Not started
AL24	H	Outreach	Continue to encourage research on snowpack dynamics and consequences for alpine organisms and ecosystems.	Initiated
AL25	M	Research/ Study	Continue to encourage research on potential impacts of climate change on individual species, assemblages, and biotic interactions.	Initiated
AL26	M	Research/ Study	Conduct ecotone studies to document species distribution shifts to understand if species are being lost or are just changing distribution.	Not started

Terrestrial Wildlife of Concern

Species of Conservation Concern, Species of Social Concern

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
WI04	L	Research/ Study	Map and monitor wildlife movement corridors, including using remote cameras and volunteers, to enable the protection of these corridors.	Not started
WI05	M	Research/ Study	Conduct a more comprehensive wildlife vulnerability assessment. For species with higher vulnerability and high social value, project future changes in suitable habitat.	Not started
WI06	H	Research/ Study	Map habitat suitability for California spotted owl and Pacific fisher and apply results to avoid or mitigate impacts to these species.	Not started
WI07	M	Research/ Study	Conduct a Pacific fisher survey to validate/calibrate the habitat suitability model. Update every 5-10 years.	Not started
WI09	H	Monitoring	Continue to monitor and report on birds as a biodiversity indicator (I&M monitoring vital sign).	Ongoing
WI10	M	Research/ Study	Support continued long-term monitoring of California spotted owls, conducted by USFS inside and outside the parks.	Ongoing
WI11	M	Monitoring	Initiate pika monitoring to confirm/reject anecdotal evidence suggesting populations are stable.	Not started
WI12	M	Monitoring	Monitor terrestrial herpetofauna as an indicator of biodiversity.	Not started
WI13	L	Research/ Study	Develop and implement a wildlife monitoring program for mid-level carnivores and common herbivores as an indicator of ecosystem health.	Not started
WI15	M	Research/ Study	Continue to research better techniques to prevent human-bear conflict, including educating people, better trash cans, and better hazing techniques.	Initiated
WI17	H	Data management	Improve the SEKI Bear Incident Management System (BIMS) database and extract information to track conditions over time and analyze potential explanatory variables.	Not started
WI18	H	Research/ Study	Analyze history of bear management in the parks to understand what methods have been successful in the past and why.	Not started

Crosscutting Activities

Activity Number	Pr	Activity Type	Activity Short Name	Activity Status
XC01	H	Partnership	Design and implement Science Learning Center/partnership to increase research benefits and strengthen research and education linkages.	Partially initiated
XC04	M	Other	Research how managers have mitigated effects of extreme events (fire, flood, wind, drought, etc.) on resources.	Not started
XC08	H	Interpret - ation	Provide opportunities for visitors, volunteers, and park staff to interact with scientists working in the parks.	Not started
XC09	H	Outreach	Increase engagement of SEKI resource staff and researchers in local communities through their involvement in curricula, citizen science, teacher trainings, youth camps, and internships.	Partially initiated
XC11	M	Education	Create science-rich outreach and education materials for identified resource priority issues (newsletters, curricula, fact sheets, talking points, website content, social media, video, etc.).	Ongoing