USDA FOREST SERVICE

USDA Forest Service Region 5 Ecology Program Highlights

2012/2013 R5 ECOLOGY PROGRAM

INSIDE

R5 Ecology Program, 2012/2013

The Pacific Southwest Region (Region 5) Ecology Program is one of only two such programs in the USDA Forest Service. The Region 5 Ecology Program currently staffs ecologists in five geographic zones, each serving three to four National Forests. The Ecology Program serves multiple critical roles in the Pacific Southwest Region, including science application to resource management; inventory and monitoring of conditions and trends in vegetation, fire, and fuels; science support to Forest planning; climate change interpretation; statistical and analytical support to Forest and District projects; and assistance to field units, the Regional Office, OGC and the Department of Justice in matters of appeals and litigation. We are also a national leader in partnerships and collaborative endeavors with other federal and state agencies, universities, and non-governmental organizations. Current Forest Service priorities revolve around Forest planning, ecological restoration, ecosystem services, and climate change response, and the Region 5 Ecology Program is uniquely positioned and qualified to support these priorities. The Ecology Program produces a comprehensive annual report at the conclusion of every calendar year (available at the Ecology Program website - http://fsweb.r5.fs.fed.us/program/ecology/). Based on expressions of interest from our clientele, beginning this year the Ecology Program will also produce a mid-year "highlights" report, providing more detail on selected projects and programs. We hope you enjoy this inaugural Highlights report, and we welcome your comments and suggestions.

Sincerely

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Ecological Restoration

Ecology Field Crew , Freds Fire

Ecological restoration is "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure… and ecological processes necessary to make… ecosystems sustainable, resilient, and healthy under current and future conditions" (USFS 2006). Ecological restoration is a central priority of the US Forest Service, Pacific Southwest Region (R5). The Region 5 Ecology Program plays a critical role in achieving restoration goals on the National Forests in California. Below are a few examples of how the Regional Ecology Program (REP) works to support planning and implementation of ecological restoration activities.

Restoration Planning

- REP played major role in writing and reviewing R5 Ecological Restoration Leadership Intent document
- REP staff wrote natural range of variation (NRV) assessments for major terrestrial ecosystem types in the Sierra Nevada bioregional assessment area, providing an ecological baseline for restoration planning and project development
- REP lead the development of the postfire restoration strategy template for R5
- REP organized the southern California chaparral restoration workshop, June 2013
- REP developed the California Fire Return Interval Departure spatial data layer
- REP field plot datasets are fundamental to the development of habitat restoration projects for sensitive wildlife species such as the Sierra Nevada bighorn sheep, sagegrouse, goshawk, and martin
- REP is working with a university collaborator to generate a spatial model of historical reference conditions in the Yuba River watershed
- REP staff work closely with R5 field units in Forest planning efforts to develop restoration strategies, objectives, and project opportunities
- REP members reviewed the USFS Restoration Framework
- REP staff worked with the R5 Remote Sensing Lab to develop a geospatial dataset that permits more accurate recognition of late seral forest conditions for Northwest Forest Plan forests

"The R5 Ecology Program plays a critical role in achieving our restoration goals"

Post-Fire Recovery

Fuel Treatment Effectiveness monitoring, Modoc National Forest

- REP developed the R5 postfire restoration strategy template and is leading the way in developing postfire restoration strategies on multiple Region 5 Forests
- REP staff serve as interdisciplinary team lead or advisor for postfire restoration strategy development on multiple fires, including the Freds, Sims, Moonlight, Rich, and Storrie Fires
- REP staff have proposed and implemented postfire restoration projects across R5
- REP collaborates with California universities in developing field data-based evaluations of landscape conditions in recently burned forest areas; recent examples include the Angora, Birch, Freds, Pendola, and Rich Fires
- REP coordinates the Region 5 postfire forest regeneration inventory program
- REP staff have served on BAER teams and as Resource Advisors on numerous fires

Promoting Resilience

- REP developed and periodically updates the climate change trend summaries for Region 5 Forests, providing information necessary for management actions designed to foster ecosystem resilience
- REP staff wrote the chapter on climate change and the relevance of historical reference conditions to current and future ecosystem management in PSW-GTR-237, Managing Sierra Nevada Forests
- REP staff edited and contributed chapters to the 2012 book *Historical Environmental Variation in Conservation and Natural Resources Management*, a joint effort of the USFS and The Nature Conservancy to clarify the role of historical ecological reference info in restoration and management in the face of global change
- REP helps field units to incorporate climate change mitigation strategies into project planning and design
- REP staff helped to plan and participated in various statewide and regional climate change vulnerability assessments and climate change adaptation workshops
- REP is working with multiple National Forests to develop fire and forest restoration projects to increase ecosystem resilience in Research Natural Areas and Special Interest Areas
- REP involved in numerous studies of effects of fire restoration on ecosystem processes and patterns, and rare species populations

Collaboration and Training

- REP staff provide technical support to restoration collaborations throughout Region 5; examples include the Willow Creek collaborative (Sierra NF), the Amador-Calaveras Consensus group (Eldorado & Stanislaus HFs), Burney-Hat Creek CFLRP (Lassen NF), and the Northern Sierra and Southern Sierra Partnerships (multiple National Forests)
- REP staff contributed to the development of ecological desired conditions for the Dinkey Collaborative Forest Landscape Restoration Project
- REP staff advise and train graduate students from multiple universities and provide support to thesis research in restoration ecology
- International involvement:
  - REP staff trained Lebanese resource staff from the Lebanon Reforestation Initiative
  - REP staff twice traveled to Paraguay to provide technical assistance to reforestation planning in Atlantic rainforest
  - REP staff has long-term working relationship with Mexican park and forest services in restoration of forests and fire in Baja California forests
  - REP staff advising Brazilian park service on management practices for climate change resilience
  - REP staff works with UC-Davis and USFS-International Programs to organize and carry out annual three-week International Seminar on Climate Change and Natural Resource Management

Fire management field trip, Long Fire, Eldorado National Forest

Inventory and Monitoring

Fen Condition Trend Monitoring, Plumas National Forest

- REP worked with Inyo National Forest to develop monitoring database for R5 Forests, to synthesize monitoring information, and overlay restoration project data with other monitoring information sources. The team is working with the WO Standard Data Management group to develop a corporate application based on this model
- REP staff have installed thousands of permanently marked vegetation field plots across California, to provide baseline data for current conditions and permit assessment of change resulting from restoration activities or other drivers/stressors.
- REP coordinates the regional fuel treatment effectiveness monitoring program
- REP recently received Joint Fire Science Program grant to study the effects of forest thinning treatments on snowpack and water availability
- REP staff serve as monitoring coordinators on multiple Region 5 Forests
- REP collaborated with Fire and Aviation Staff to publish results of fire severity monitoring for the Sierra Nevada Forest Plan Amendment area

Management of the rare, fire adapted Baker cypress

Baker cypress regeneration after the 2007 Moonlight Fire at Mud Lake, Plumas National Forest.

Baker cypress (*Hesperocyparis bakeri*) is a rare fire-adapted conifer endemic to California and southern Oregon. Baker cypress bears closed ("serotinous") cones that depend on fire for seed dispersal and require post-fire conditions, such as bare mineral soil and direct sunlight, to germinate. Fire has been successfully excluded from many Baker cypress populations for almost a century. As a result, many cypress sites are densely crowded with shade-tolerant species and adult cypresses are dying with almost no evidence of regeneration. The intent of our project was to provide land managers with critical information to manage cypress by determining if fire management is necessary to restore cypress populations, and if prescribed burning can successfully promote cypress regeneration. We also investigated factors that affect cypress vigor and canopy seed storage. We collected information on canopy seed storage, stand density, age, health, shrub and understory species cover, fuel loading, and environmental conditions at most of the known populations of Baker cypress (11 sites). We found almost no evidence of regeneration in cypress populations that had not recently burned. Populations must burn before adult trees die to regenerate. Low severity fire does not promote cypress regeneration, suggesting that typical prescribed burns may not effectively restore cypress populations. Young Baker cypress stands do not have sufficient canopy seed storage to regenerate the population, but even very old stands of over 150 years of age still possessed very high numbers of viable seed. Baker cypress canopy seed storage was most strongly influenced by site conditions, particularly soil type; however, stand density and the height of the cypress relative to other species were also strong predictors of canopy seed storage. This suggests that management measures such as selective thinning could be used to promote canopy seed storage of Baker cypress populations.

"Fire has been excluded from many Baker cypress populations for almost a century"

Baker cypress cones opened by a recent fire.

Baker cypress at Goosenest Mountain, Klamath National Forest, where stands are separated by lava flows.

This project was funded by the Joint Fire Science Program with cooperation from the USDA Forest Service.

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Baker cypress seedlings after the 2001 Adobe Fire in the Timbered Crater Wilderness Study Area, Alturas District of the Bureau of Land Management.

"Low severity fire does not promote cypress regeneration, suggesting that typical prescribed burns may not effectively restore cypress populations. "

Main Points:

- Baker cypress stands must burn before adult trees die to regenerate populations. It is critical to return fire to the stands either through wildfires or through prescribed burning.
- Baker cypress canopy seed storage significantly increased in stands 50 years of age or older. Minimum fire return intervals of 35-50 years would be appropriate for most Baker cypress stands. These fire return intervals are typical of upper montane forests where many Baker cypress populations occur.
- Baker cypress do not begin to produce cones until after ~ 15 years. Multiple years of cone production are necessary to allow for sufficient canopy seed storage to replace the population. Fire frequencies that are shorter than 30 years could threaten Baker cypress populations.
- Higher severity fires promote greater cypress regeneration. Fire intensity should be high enough to remove the tree canopy and expose bare mineral soil. Low severity prescribed burns will likely not be sufficient to open closed cones or create favorable environmental conditions for cypress seedlings.
- Up to 150+ years of age, Baker cypress continues to produce and store cones and seeds; canopy seed storage is most strongly influenced by site conditions, such as soil type and competition.
- Site specific management recommendations were developed for each of the eleven Baker cypress populations we evaluated and are available at: http://www.firescience.gov/projects/briefs/06-2-1-17_FSBrief126.pdf

Find out more:

- Rentz. E. and K. Merriam. 2011. Restoration and management of Baker Cypress in northern California and southern Oregon. Pages 282-289 in J. W. Willoughby, B. K. Orr, K. A. Schierenbeck and N. Jensen, editors. Proceedings of the CNPS Conservation Conference: Strategies and Solutions, 17-19 January 2009. CNPS, Sacramento, California.
- Frame, C. 2011. Saving the Cypress: Restoring Fire to Rare, At-risk Species. Fire Science Brief **126:** 1-6. January, 2011. Available on-line at: http://www.firescience.gov/projects/briefs/06-2-1-17_FSBrief126.pdf
- Merriam, K.E. and E. Rentz. 2010. Restoring Fire to Endemic Cypress Populations in Northern California. Final Report Submitted to the Joint Fire Science Program, 59 pp. Available on-line at: http://www.firescience.gov/projects/06-2-1-17/project/06-2-1-17_06-2-1-17_final_report.pdf

The Timbered Crater Wilderness Study Area, managed by the Alturas Disctrict of the BLM, supports the largest Baker cypress population occupying approximately 7,000 acres.

Developing management strategies for a world hotspot of conifer diversity

Sugar Creek Research Natural Area (RNA), located in the Russian Wilderness of the Klamath National Forest, hosts the most diverse assemblage of conifers in the world. The Klamath National Forest is currently working on a management strategy for this unique diversity hotspot to alleviate risks to the RNA from large wildfires following many years of fire suppression.

"The RNA contains both fire intolerant species with historically long fire return intervals and fire dependent species with short fire return intervals. Fire suppression has put both groups at risk."

Main Points

- The 17 conifers found in the Sugar Creek RNA are: Brewer spruce, common juniper, Douglas fir, Engelmann spruce, foxtail pine, incense cedar, Jeffrey pine, lodgepole pine, mountain hemlock, Pacific yew, ponderosa pine, Shasta red fir, subalpine fir, sugar pine, white fir, western white pine, and whitebark pine.
- The extraordinary number of species in the RNA is a product of past plant migrations caused by warming and cooling climates, coupled with high local habitat diversity
- The RNA contains both fire intolerant species with historically long fire return intervals as well as fire dependent species with short fire return intervals. Fire suppression has put both groups at risk.

Contacts and Partners

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http://www.fs.fed.us/psw/programs/rna/sugar_creek.shtml

Key partners Include:

- Northern California Resource Center
- French Creek Firesafe Council
- Humboldt State University
- US Forest Service Pacific Southwest Research Station
- The Wilderness Society

Overview

The Klamath National Forest (KNF) is located in northern California at the intersection of four floristic provinces: the Coast Range, the Southern Cascades, the Great Basin, and the Sierra Nevada. The intersection of such distinct plant communities and geology leads to incredible biological diversity. The Sugar Creek Research Natural Area (RNA), located in the Russian Wilderness of the KNF, hosts the most diverse assemblage of conifers in the world with 17 conifer species in about one square mile. Included are species endemic to the Klamath Mountains (Brewer spruce), those far outside the rest of their geographic range (Engelmann spruce and subalpine fir), and a California endemic (foxtail pine). Lower elevations support an old-growth Mixed Conifer Forest (MCF) with 500 year old sugar and ponderosa pines. The 3,182 acre RNA is home to more than 400 species of herbaceous plants as well as rare and endangered animals such as the northern spotted owl, goshawk, and fisher.

Sugar Creek RNA has not had a large fire in over 100 years, however, the watershed receives lightning strikes every year and there is much evidence of historical fire in the lower elevation mixed-conifer forest. The accumulation of dead and down woody debris and the encroachment of smaller trees and brush due to fire suppression have created potential for a high severity stand-replacing fire in the MCF that could also threaten fire-sensitive species in the riparian and alpine zones. The KNF is partnering with a variety of stakeholders including conservation groups, neighboring landowners, the local community, and the research community in northern California to develop a management strategy. The goal of the strategy is to assist project level planning for the reintroduction of appropriate fire and disturbance regimes necessary to support the unique assemblage of conifers found in and around the Sugar Creek RNA.

Planning for Ecological Restoration in the 2004 Freds Fire, Eldorado National Forest

Key Points:

- The Freds Fire Restoration Strategy presents an overview of proposed restoration activities in the 2004 Freds Fire, which burned 7700 acres in the South Fork American River canyon in 2004.
- The Strategy links directly to current science, such as the GTR-220 (*An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests)* and GTR-237 (*Managing Sierra Nevada Forests*), and regional and national guidance for ecological restoration activities.
- The Strategy describes historic and current conditions across the area affected by the Freds Fire, and develops desired conditions that will guide restoration activities and future proposed projects.
- Project templates provide linkages between proposed on-the-ground activities and Strategy goals and objectives.
- With the help of the Regional Ecology Program, the Eldorado National Forest team developed a restoration strategy template that serves as a model for development of postfire restoration strategies across Region 5.
- With the assistance of UC Davis, the Eldorado National Forest is conducting extensive ecological monitoring within the Freds fire to assist in development and refinement of the strategy.

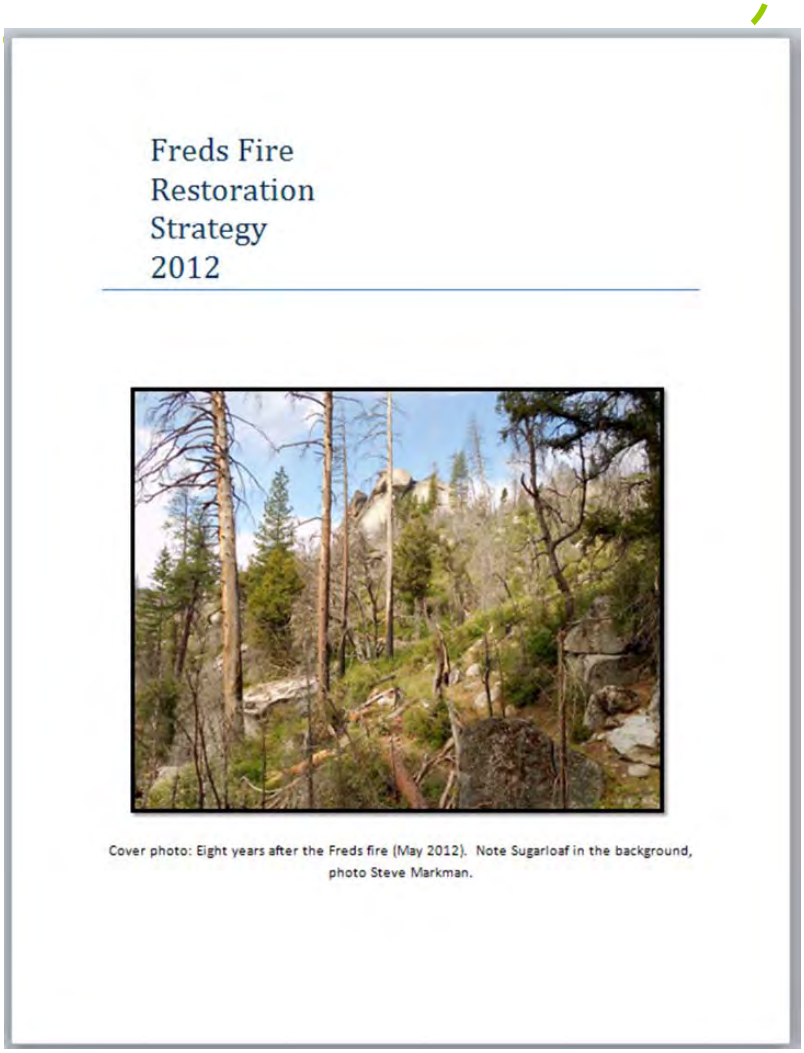
"The Freds Fire Restoration Strategy is a dynamic document that provides a template for postfire restoration across the Region"

UC-Davis field crew collecting ecological data in the Freds Fire, 2012

Project Overview

The Freds Fire Restoration Strategy represents an effort by the Eldorado National Forest, Placerville Ranger District and the Region 5 Ecology Program to develop a landscape strategy for restoration work to be completed in the 2004 Freds Fire. The strategy contains 1) relevant information on past and present conditions, 2) desired future conditions, 3) goals and objectives, 4) monitoring and assessments and 5) proposed projects and associated costs. A timeline is also included, providing a 5 year overview of proposed projects, assessments and monitoring. The Freds Fire Restoration Strategy is a dynamic document that provides a template for postfire restoration across the Region. Additional projects may become necessary following analysis of baseline data, and management may need to be adapted as inventory and monitoring results come in and conditions change on the ground. The template developed by the Freds Fire Restoration Strategy team is now being used as a standard for postfire restoration across Region 5.

Freds Fire in 2012, photo taken by Becky Estes



Cover photo: Eight years after the Freds fire (May 2012). Note Sugarloaf in the background, photo Steve Markman.

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Project Partner:
University of California-Davis

Whitebark pine mortality, regeneration, & recruitment: effects of mountain pine beetle outbreaks

Whitebark pine monitoring, Inyo National Forest

Recent observations of mountain pine beetle outbreaks in whitebark pine (*Pinus albicaulis*) populations on the Inyo National Forest have emphasized a critical need for monitoring of this keystone species in the southern extent of its geographic range. This collaborative project will provide the necessary information to understand patterns of mountain pine beetle host selection and changes in stand structure and composition post-outbreak. Our objectives are to conduct: (1) status-and-trend monitoring of high-mortality and adjacent low-mortality (control) stands in the area, and (2) effectiveness monitoring of stands scheduled for restoration treatments. Long-term monitoring of whitebark pine stands in response to mountain pine beetle and other stressors (e.g., white pine blister rust) will be required to develop restoration and climate adaptation strategies for vulnerable whitebark pine populations.

We have successfully established 66 monitoring plots in three different sites (June Mountain, Rock Creek/Hilton Lakes, and Whitewing Mountain), to represent the scope of the current outbreak occurring in the southern extent of whitebark pine in California. Additionally on June Mountain, we have established stratified baseline plots among whitebark pine stands exhibiting high-mortality (>50% overstory mortality), low-mortality ('control'), and high-mortality stands targeted for future restoration treatments. Continued monitoring of these established plots and installation of plots in new areas will enable us to evaluate the effectiveness of restoration treatments for building ecological resilience in existing and future whitebark pine stands.

Products: Whitebark pine mortality monitoring on the Inyo National Forest - Preliminary Report
Partners: USFS Forest Health & Protection, Inyo National Forest, USFS Whitebark Pine Restoration Pro-

Project Goals:

The goal of the project is to examine patterns and potential causal mechanisms of mortality, regeneration, and recruitment in whitebark pine populations exposed to mountain pine beetle outbreaks in the Inyo National Forest of the southern Sierra Nevada.

This project will contribute to the development of a long-term monitoring plan and restoration/adaptation strategies for vulnerable whitebark pine populations in the region.

Whitebark Pine Monitoring Field crew, Inyo National Forest

Key Findings:

- Densities and basal area of dead whitebark pine trees were orders of magnitude greater in pine-beetle impacted stands compared to control sites.
- Whitebark pine mortality was greatest in the large and medium diameter classes and was not related to the number of tree stems per clump.
- On June Mountain, whitebark pine regeneration (density of seedlings) was substantially greater in stands impacted by mountain pine beetle than control stands. All three sites showed a relatively stable production of whitebark pine regeneration at least within the past 50 years.
- In mortality plots from all sites, there was a shift in the size class distribution of whitebark pine to smaller diameter classes (<15 cm dbh) relative to control plots, and an increase in the relative contribution of live lodgepole pine and red fir to whitebark pine stands.

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Monitoring forest management effects on a rare California endemic shrub

Prescribed fire in a Shasta snow wreath population, Dec. 2011 (Photo credit: Eric Knapp)

The Shasta snow wreath (*Neviusia cliftonii)* is a rare shrub of limited distribution found around the perimeter of Shasta Lake on the Shasta-Trinity National Forest in northern California. Only 21 populations of Shasta snow wreath are known, and they occur almost entirely on Forest Service lands. Permanent monitoring plots were established in 2011 in eight of the populations to better understand the ecology, to characterize responses to disturbances and various management techniques, and to identify conditions that encourage this endemic species to thrive. A portion of one of the populations was burned in December 2011 to measure the effects of prescribed fire on the species.

New growth on Shasta snow wreath in May 2012, six months after prescribed burn (Photo credit: Glenn Shelton)

"Only 21 populations of Shasta snow wreath are known, and they occur exclusively in the eastern Klamath Ranges of western Shasta County "

Prescribed fire in a Shasta snow wreath population, December 2011 (Photo credit: Eric Knapp)

Field crew resampling Shasta snow wreath transects (Photo credit: Martin Lenz)

Overview

The Shasta snow wreath (*Neviusia cliftonii)* is a member of the rose family (Rosaceae) found exclusively in the eastern Klamath Ranges of western Shasta County. Shasta snow wreath's nearest genetic relatives are found in the forests of the southeastern US. It is known from about 20 populations, restricted almost entirely to Forest Service lands. The species was first described in 1992 and very few empirical data exist about its response to various management techniques, including fire. Permanent monitoring plots were established in 2011 in seven of the populations and an additional plot added in 2012 to better understand the ecology, response to disturbances such as fire, and long-term viability of this endemic species. These plots will be followed over time by the R5 Ecology Program and the Shasta-Trinity National Forest with the assistance of summer field crews hired through Humboldt State University.

In December 2011 a portion of one of the populations was burned to obtain information on species response to prescribed fire. A resurvey of the burned area in May 2012 showed vigorous re-sprouting of Shasta snow wreath clumps that had been partially or completely top-killed by the prescribed burn, indicating a favorable initial response to low-severity fire. Fruits were also collected during summer 2011 for seed viability testing, but none proved viable. Preliminary results indicate that populations of Shasta snow wreath may be primarily vegetatively propagated; no seedlings of the species have been observed to date. Future questions of interest include species response to higher severities of fire, overstory removal, understory thinning, and other common forest management techniques.

"A resurvey of the burned area in May 2012 showed vigorous re-sprouting of Shasta snow wreath clumps that had been partially or completely top-killed by the prescribed burn"

Contacts and Partners

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Project Partner:

Humboldt State University

Jeffrey Pine Response to Climate Change

"How do tree seedlings respond when moved uphill? What does this mean for climate change adaptation and future migration?"

Several National Forests in R-5 have established climate adaptation studies to better understand how forests may respond to climate change. The studies monitor performance of seedlings from different elevations at various sites. The San Bernardino National Forest established one such study site at approximately 7480' elevation. Jeffrey pine seedlings from two different elevation seed lots, 7500' and 5500', within the San Bernardino seed zone (zone 994) were planted in three sets of paired plots.

The study area is located inside the 2007 Slide Fire Area along Forest Service Road 2N19B. Vegetation in the study area was completely consumed by the wildfire. In 2008, the remaining standing dead trees were removed, the slash was chipped and the area was planted in 2009. Seedling survival was poor due to dry soil conditions when the 2009 planting occurred. In May 2011, seedlings obtained from the Placerville Nursery were hand planted within a 12 inch scalp using a tree planting shovel. The scalps were mulched with chips from the site. All previously planted seedlings and any natural regeneration existing within the plots were removed to avoid interference with the study. In August 2012, baseline data were collected from seedlings planted in the study plots. The hypothesis is that over time the 5500' trees may survive and/or grow better than the 7500' trees at this higher elevation due to direct or indirect effects of climate change. Already one of the plots in each pair seemed to display greater second season growth, although this is purely anecdotal to date. Monitoring will continue.

Study Plot 2

For more information contact: Chris Stith, Southern California Province Ecologist (cstith@fs.fed.us) and Tom Blush, R-5 Regional Geneticist (tblush@fs.fed.us)

Key partners include: R-5 Silviculture, Placerville Nursery, and University of California-Davis

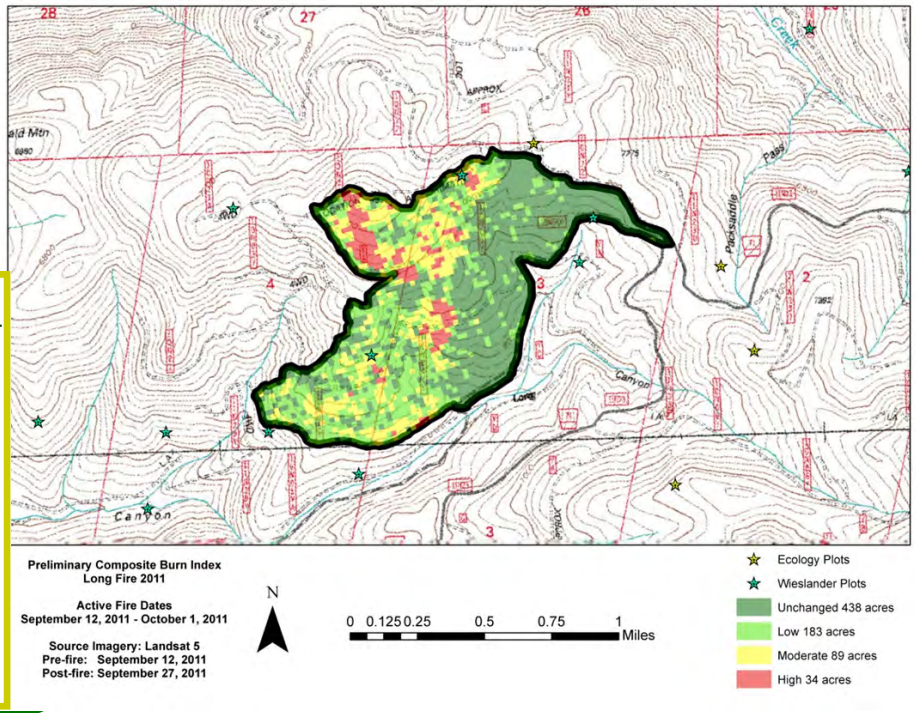
Learning from the Long Fire, Eldorado National Forest

Moderate/High severity patch in the Long Fire, Oct. 2011.

The Long Fire was a wildfire managed for resource benefits that occurred in September, 2011. It was ignited by a lightning strike on September 12th at 7,000 feet in elevation, and burned almost 500 acres over a two week period. Fire severity across the Long Fire was variable, with about 5 percent of the landscape burning at high severity with a mean patch size of 2 acres. The Long Fire is an excellent opportunity for ecological monitoring that can help us to better understand fire effects and forest recovery in red fir forests in the central Sierra Nevada.

Key Points:

- The Long Fire provides learning opportunities for those in the central Sierra Nevada who wish to better understand the implications of managed natural ignitions.
- Preliminary data give us an idea of the spatial and temporal patterns of fire severity within the Long fire (see fire severity map below).
- Field trips and briefs provide an avenue to generate conversation about managed wildfire. An initial field trip in June 2012 was organized by the Eldorado National Forest and the California Fire Science Consortium with fire and fuels managers to discuss everything from initial attack to post-fire effects of natural ignitions.
- Extended monitoring can provide a clearer understanding of how managed wildfire can ecologically benefit forests .



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Key Partners
Sierra Forest Legacy, PRBO, Placerville Ranger District, California Fire Science Consortium

Baja California Collaboration

The Sierra de San Pedro Mártir is one of four reintroduction locations for the California Condor.

"Our Mexican partners have requested an expansion of our collaboration to include the Sierra de la Laguna Biosphere Reserve in southern Baja California."

Background

The conifer forests of the mountains of the northern Baja California peninsula are extremely similar to the forests of the drier mountains of southern California USA and the eastern Sierra Nevada. All of these areas are found within the Mediterranean-climate zone of North America. Although it is only a small part of the North American Mediterranean-climate zone (which encompasses most of California and some of SW Oregon), Mexico's Mediterranean zone is climatically and ecologically unique within Mexico, and it supports many endemic species, many other species at the southern terminus of their geographic range, and a landscape that supports a variety of conifer forests and shrublands that have a close ecological relationship with recurrent fire. The dominant tree species in the Baja California mountains (Jeffrey pine, white fir, sugar pine, lodgepole pine, incense cedar, aspen, etc.) are the same as in the drier California mountains; geologic substrates are very similar (primarily granitic and metamorphic); elevations are comparable; and annual precipitation totals average between 500 and 1200 mm in both places. The largest difference between the two areas is the manner in which they have been managed over the last century. The America forests were heavily logged in places, and have been managed under a policy of strict fire suppression since before WWII, which has led to extremely high levels of forest fuels and very destructive fires. The Baja California forests, on the other hand, have not been logged for the most part and they have only had any sort of real fire "management" since the 1980's – they are thus functioning much more like natural ecosystems. Indeed, preliminary data suggest that fires in the Mexican forests are burning at much lower severity and that they are functioning more like fires functioned in the American ecosystems before US management agencies began putting out all fires.

Collaboration

US & Mexican partners at the MEDECOS international meetings in Los Angeles 2011

Since 2009, the USFS Pacific Southwest Region Ecology Program and the USFS International Programs office have developed a strong collaborative relationship with units and staff of the Mexican national forest and park services (CONAFOR and CONANP) in Baja California, as well as key partners like the Autonomous University of Baja California, The Nature Conservancy -Mexico, and TerraPeninsular, a regional NGO. The overall purpose of these collaborative efforts is to increase coordination, two-way information sharing, and technical assistance in resource and fire management in Mediterranean-climate zone ecosystems on both sides of the US-Mexico border. On the US side of the border, our principal goal is to collect and utilize data from the more pristine Mexican forests that can be used to guide restoration and ecosystem management on the California National Forests, especially in the eastern Sierra Nevada and the California Peninsular Range. On the Mexican side of the border, our principal goal is to support sustainable landscape management in the forested lands of the Mexican Mediterranean-climate zone, through (1) direct and indirect involvement in the development and implementation of fire and resource management plans and (2) provision of technical assistance and training.

Highlights

In its 42 months of existence, the USFS-Mexico collaboration has had a number of notable successes.

- High resolution vegetation maps were developed in 2011 by the USFS for the two peninsular National Parks in the Mexican Mediterranean zone (Parque Nacional Constitución de 1857 [PNC], and Parque Nacional Sierra San Pedro Mártir [PNSSPM]).
- Remotely-sensed imagery was used to assess patterns in fire severity in and around the parks since 1984 and a report is currently being generated.
- Mexican personnel have been trained in vegetation mapping methods and technologies, forest and fuels inventory field protocols, forest carbon mensuration, and monitoring of meadow condition and livestock grazing impacts.
- USFS staff have attended and presented at a number of CONAFOR and CONANP regional meetings.
- Mexican personnel have visited National Forests in California and USFS Region 5 personnel have visited national parks in Baja California.
- A joint US-México symposium was organized for the 2011 MEDECOS (international Mediterranean ecosystem) meetings in Los Angeles.
- A livestock and meadow management workshop was held in the PNSSPM in May, 2013.
- A fuels and carbon assessment of the two National Parks is underway, and LiDAR imagery will be captured from both National Parks in June of 2013.
- Our Mexican partners have requested an expansion of our collaboration to include the Sierra de la Laguna Biosphere Reserve in southern Baja California.

Staff from the Region 5 Remote Sensing Lab, CONAFOR and CONANP work together to sample field data in support of vegetation mapping

Looking Ahead

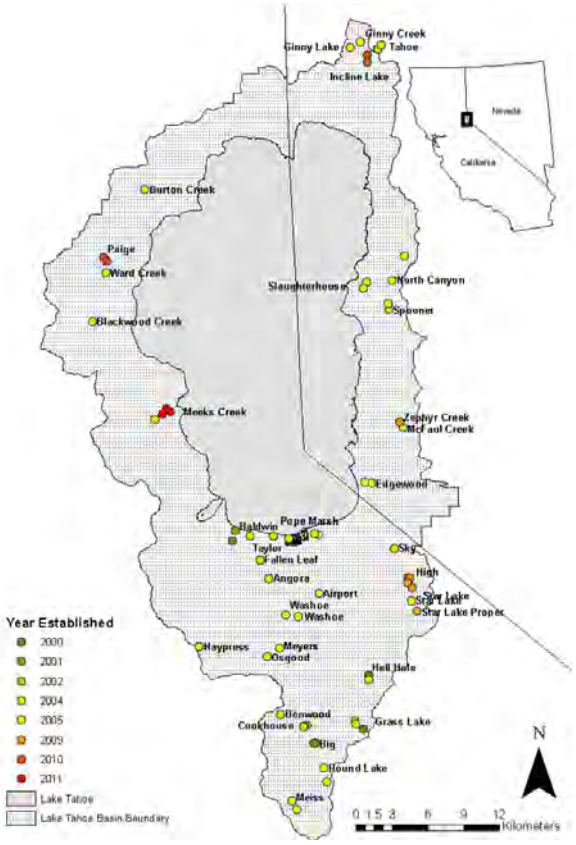
Future possibilities for cooperative projects include further training in prescribed fire and fuels management, development of formal fire management plans for the Baja California national parks, development of standard grazing management practices and policies, formal carbon assessments of the Baja California forests, and increased México-US collaboration in transboundary fire management.

Staff from Region 5 and Sierra Forest Legacy train Mexican personnel from CONANP and the University of Baja California in measurement of fuel loading

The Status of Meadows in the Lake Tahoe Basin

Key Findings:

* Lake Tahoe Basin (LTB) meadows are dominated by species of forbs with a high frequency of grasslike (sedges and rushes) species.
* There was an increase in the richness and diversity of plant species in LTB meadows between 2004 and 2009.
* This study indicates an increase in the presence and frequency of Lodgepole pine in LTB meadows from 2004 to 2009.
* The majority of the meadows in the LTB are moderate to high functioning, moist to wet meadows.
* Climate and disturbance variables were correlated with meadow plant communities, including: hydrologic score, elevation, saturation, precipitation, maximum temperature, litter cover, and number of invasive species.

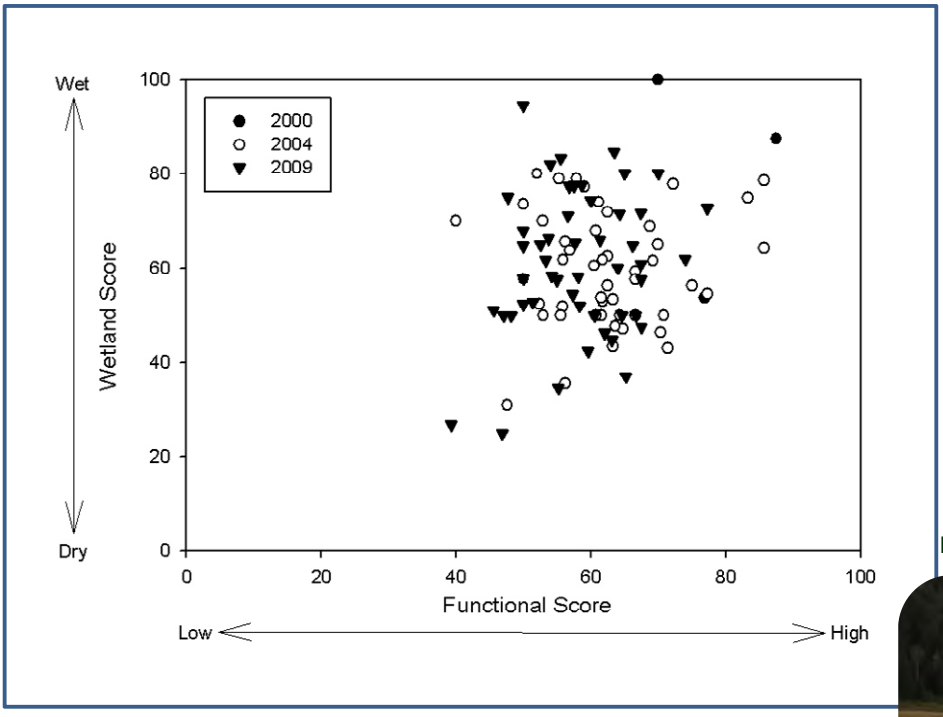


The goals of this study were to assess the current status of meadows in the Lake Tahoe Basin using an ecological matrix as a method for translating meadow trends to the general public and to managers.

LTB0411 Cookhouse Meadow - 2004.

Project Overview

The Lake Tahoe Basin Management Unit has established 66 long term monitoring plots in 37 meadows, following the USFS range monitoring protocol. This protocol was developed to provide a standardized system for determining ecological condition and long-term vegetation trends in meadows. The majority of plots (45) were established in 2004. All plots established before 2009 were revisited in 2009; 52 of the plots in 30 of the meadows have been revisited at least once, and 21 plots have been revisited three or more times. Ecological condition is assessed by a combination of vegetation and soil measurements, including plant frequency, mean rooting depth, soil moisture, ground cover, and soil texture. Change in the ecological condition of the 30 meadows was quantified based on plant functional groups, plant wetland ratings, and native status. Life form, life span, nitrogen fixation, rhizomes, and plant height were compiled to categorize each species' functional group. Each meadow was rated using a hydrologic score and a functional score. In addition to ecological condition, changes in species richness and diversity, rooting depth, and depth to saturation at each meadow were analyzed. Precipitation, minimum and maximum temperature were analyzed as covariates for meadow condition. The intent of this effort is to monitor meadows in the LTB and provide land managers with direction for future meadow restoration efforts. Current meadow conditions in the Lake Tahoe Basin are good. The majority of the meadows are moderate to high functioning, moist to wet meadows. However, there has been an increase in the presence and frequency of Lodgepole pine (*Pinus contorta*) in LTB meadows between 2004 and 2009. Future monitoring at these sites provides an opportunity to identify ecosystem changes early on so that managers may adapt policies if needed. Future monitoring of meadow plots should incorporate measurements that will help us understand the movement of conifers into the meadow.



Lake Tahoe Basin meadow matrix for 49 meadow plots sampled in 2000 and 2004 and then resampled in 2009. The functional score (driven by plant functional groups) is on the x axis and the hydrologic score is on the y axis.

"There was an increase in the diversity of plant species in LTB meadows between 2004 and 2009"

LTB0430 Grass Lake Research Natural Area, 2009

Contact: Shana Gross, Ecologist Lake Tahoe Basin, segross@fs.fed.us; **Partners:** California Tahoe Conservancy, California State Parks, Nevada State Parks, Univ. of California-Davis

Using prescribed fire and thinning to manage rare plant species in the northern Sierra Nevada

Photographs illustrating the types of treatments analyzed (clockwise from top left):

(a) prescribed fire;
(b) hand thinning and pile burning;
(c) group selection harvest;
(d) mechanical thinning.

In 2004, ecologists and botanists from the Lassen, Plumas, and Tahoe National Forests initiated a monitoring program to investigate the response of rare plants to prescribed fire, fuel reduction, and timber harvest implemented under the Herger-Feinstein Quincy Library Group (HFQLG) Pilot Project. Eleven rare plant species, representing a range of ecological traits, were selected and their response to one or more treatments of varying intensities was assessed. The monitoring effort addressed 3 key questions.

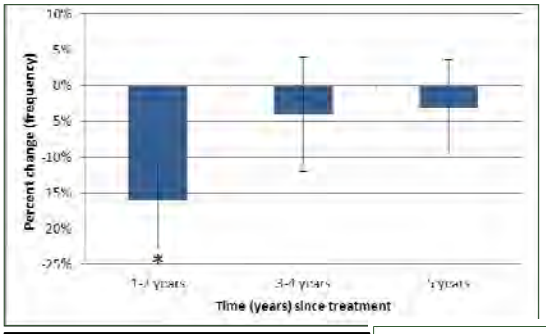
Results suggest that management activities such as prescribed burning and thinning can be effective tools for promoting and improving the long-term resilience of rare plant populations. The rare species that were monitored occur within landscapes where frequent low-intensity fire was once a common and critical ecological process; this may explain why moderate to low intensity fire and timber harvest treatments had negligible or beneficial effects on all of the target species.

Key Questions:

1. Do treatments result in a decline in rare plant species density or frequency? If so, are some treatments more likely to cause a decline than others?
2. Are there key causal factors that can be linked to observed changes?
3. If treatments affect species, how long do the effects last? Do occurrences rebound over time?

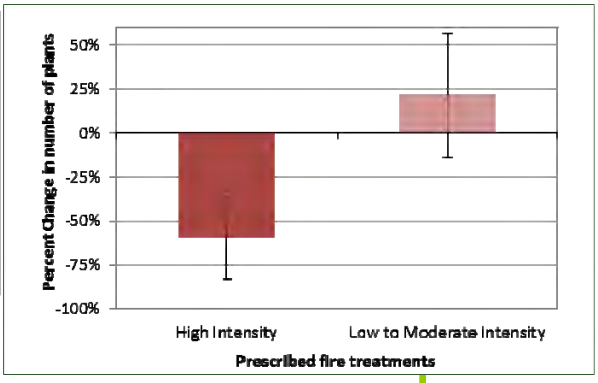
Project Goal:

The goal of this large-scale collaborative monitoring effort was to determine how forest management activities, specifically timber harvest and prescribed fire, can be used to manage rare plant species that have evolved in landscapes



Left: The effect of time since treatment on *Penstemon personatus* frequency. The only value that is significantly different from zero is the change in frequency 1-2 years after treatment

Below: A comparison of high intensity and low to moderate intensity prescribed fire effects on *Arabis constancei* number, suggesting that managers may need to reduce fuel loads within populations prior to burning.



Key Findings:

- Prescribed burning and timber harvest can be used to promote rare plant species that occur in disturbance-prone landscapes.
- Designing appropriate management prescriptions requires understanding the intensity and frequency of natural and human-related disturbance, at both landscape and population scales.
- Low to moderate intensity treatments had neutral or beneficial effects on all of the species monitored; in contrast, the response to high intensity fire and group selection treatment was variable.
- Rare plant monitoring programs should take the following factors into account:
  - Intensity matters. Some species tolerate or even thrive after high intensity treatments (e.g. high severity fire or group selection harvest), while others require lower intensity treatment to persist.
  - Measuring environmental variables is crucial for understanding a species' response to treatment and for designing future management activities.
  - Monitoring over a longer timeframe is important to detect initial population declines and recovery.

Find Out More:

Species-specific monitoring reports:

http://www.fs.fed.us/r5/hfqlg/monitoring/resource_reports/vegetation_and_botany/

Presentations:

Coppoletta, M., K., Merriam, and C. Dillingham. 2011. *Monitoring the Effects of Forest Management Practices on Rare Plant Species in the Northern Sierra Nevada*. N. California Botanists Meeting, Chico, CA, Jan. 10-12, 2011.
http://www.norcalbotanists.org/files/NCB_Symposium_2011_Program.pdf

Merriam, K., E. Wenk, J. Belsher-Howe, M. Coppoletta, and C. Christofferson, 2010. *Prescribed Burning and Thinning Benefits Rare Plant Populations*. Poster: N. California Botanist Meetings, Chico, CA,

http://www.norcalbotanists.org/files/NCB_Symposium_2010_Program.pdf

Contacts:

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Terrestrial Ecological Unit Inventory

Forest-wide inventories of ecosystems and their ecological setting of climate and soils are essential tools for land management. In 2013, the Inyo NF completed a Terrestrial Ecological Unit Inventory (TEUI), which provides maps and descriptions of landscape units within the National Hierarchical Framework of Ecological Units. The TEUI includes a classification and geodatabase of ecosystems on the forest, based upon Geology, Geomorphology, Soils, Climate, and Vegetation. The TEUI is designed for use by managers and specialists to understand the relationships between the biotic and abiotic drivers of ecosystem structure and function, to see how ecosystems are distributed on the landscape, and to understand their unique characteristics. The inventory was ground-truthed and documented through the installation of 455 plots, which have also been used for site-specific monitoring over the last couple of years. The R5 Remote Sensing Lab assisted in the development of a reporting system, which summarizes site morphometry and climate, and provides measures of landscape diversity, fire regime, invasive species, and human uses, including road densities. The TEUI is accompanied by a User Guide that summarizes methodologies used for TEUI in R5, by the Inyo NF, LTBMU, Los Padres Monterey District, and Mendocino NF (in progress).

"Forest-wide plot design provided base data for monitoring of disturbances that could not have been anticipated"

Before and After Oak Fire 2007 and 2008 flood. Four years post-fire, the site is unrecognizable. The stream channel has shifted more than 100 ft. west. Black oak and water birch has been replaced by non-native brome and tumblemustard.

Sample climate & morphometry report from TEUI for one Landtype Association.

LTA Map Unit: 341DI4015 Pumice Valley Sagebrush-Bitterbrush

Unit Description

Pumice Valley is located in the southern Mono Basin, and is characterized by dry, deep, volcanic soils with sagebrush-bitterbrush. The lower elevations have relict lacustrine features.

Setting:

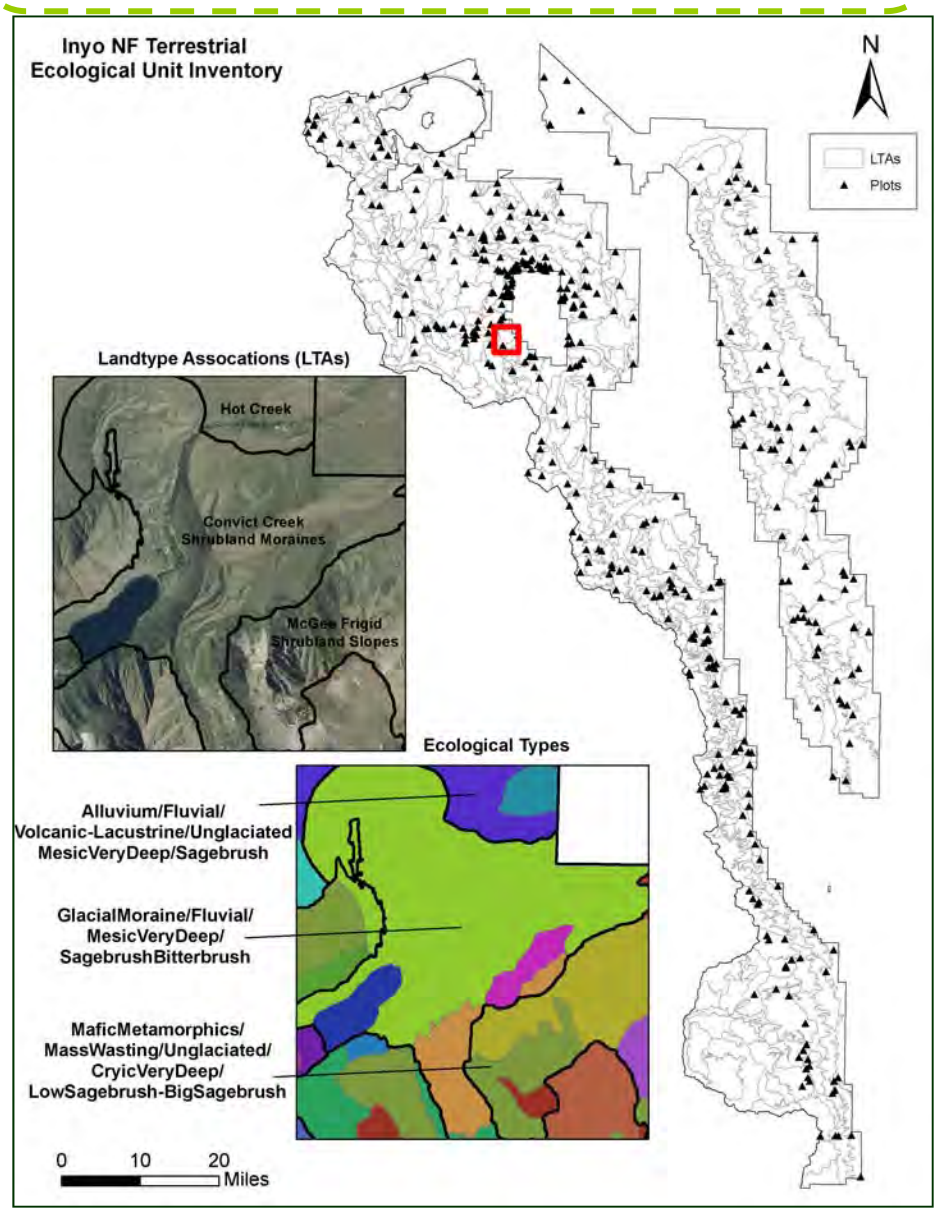
5,756 Acres or 0.28 % of the Forest
Net Mean Aspect: 344 ° from N
Aspect Strength: 0.550
7.5 Minute USGS Quadrangles: June Lake, Lee Vining

	Metric Units				Standard			
	Mean	Min	Max	STD	Mean	Min	Max	STD
Elevation (m and ft)	2,175	2,091	2,421	61	7,135	6,860	7,943	200
Annual precipitation (cm and in)	46	37	60	6	18	15	23	2
Minimum annual temperature (Tmin. °C and °F)	-8.8	-9.1	-8.6	0.1	16.1	15.6	16.5	0.2
Maximum annual temperature (Tmax. °C and °F)	27.5	26.4	28.1	0.3	81.5	79.5	82.6	0.6
Potential Evapotranspiration (PET, cm/mo and in/mo)	8.8	4.4	10.3	0.3	3.4	1.7	4.1	0.1
Actual Evapotranspiration (AET, cm/mo and in/mo)	1.2	1.0	1.5	0.1	0.5	0.4	0.6	0.0
Mean solar flux during growing season (MJ/m^2/day)	25,043	12,289	26,730	650				
	Mean	Min	Max	STD				
Percent precipitation falling as snow (%)	68.2	65.0	72.0	1.7				
Slope (%):	6.2	0.0	21.0	5.5				

Key Points

- The TEUI GIS database covers 2,039,079 acres, with complete coverage mapping of 175 ecological types and 292 landtype associations within the National Hierarchical Framework of Ecological Units.
- Ecological types and LTAs were grouped into coarse-level assessment types, which are being used as the basis for landscape descriptions in the Forest level condition assessment for Forest Plan revision.
- Forest-wide plot design provided base data for monitoring of disturbances that could not have been anticipated, including fires, floods, and vegetation mortality caused by drought (See Photos).

Before and After Oak Fire 2007. Three years post-fire, sagebrush and mountain mahogany have been replaced by bushmallow. Cheatgrass is now present.



Contacts and Partners

This project was funded in part by the Western Wildlands Environmental Threat Assessment Center.

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Burn Pile Effectiveness Monitoring

CV05-7 Christmas Valley Aspen Stand Pile Burn Monitoring – 2012.

The purpose of pile burn effectiveness monitoring is to determine the extent of fuel reduction and to look at potential changes that are taking place to a suite of selected ecological variables.

Management questions include:

- ⇒ What effect does pile burning have on surface fuel loading post burn?
- ⇒ How are slope, density, size of burn piles, fuel characteristics, and location correlated with understory vegetation community response, including seedling regeneration and invasive species?
- ⇒ What effect does pile burning have on erosion and soil reddening?
- ⇒ How does pile burning affect overstory mortality?
- ⇒ Are management objectives met with current burn pile practices?

"Over years of conducting pile burns it has become apparent that other ecological changes take place following a pile burn."

Fuels thinning projects produce a large amount of slash that is often piled and burned. The purpose of hazardous fuels reduction is to reduce fuel loading and continuity to a level that fire suppression can be conducted by ground resources. Over several years of conducting pile burns it has become apparent that other ecological changes take place following a pile burn. Lake Tahoe Basin Management Unit (LTBMU) objectives for fuels treatments where pile burning occurs are to 1) reduce flame lengths to less than 4 feet, 2) reduce fuel loading to less than 10 tons/ acre, 3) reduce the rate of spread of potential catastrophic wildfire, 4) provide defensible space to local communities, and 5) restore ecosystem health. Currently the LTBMU cannot burn more than 15% of any acre in the stream environment zone (SEZ) in any given year and cannot actively light within the stream buffer. The intent of the long-term monitoring is to more quantitatively and consistently determine the treatment impacts and project effectiveness of pile burn monitoring in the SEZ. This information can provide guidance on current regulations for adaptive management. We developed a monitoring protocol for burn pile monitoring. Seventeen monitoring plots were established at four Aspen stands and at one fen/wet meadow stand. Preliminary results will be available by 2014.

TC06-P12 Taylor Creek Aspen Stand burn pile monitoring.

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