

# USDA Forest Service

## Pacific Southwest Research Station



*Serving California, Hawai'i, and the Pacific Islands*

# 2012 Accomplishments Report





## Vision and Mission

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The Pacific Southwest Research Station is a world leader in natural resources research through our scientific excellence and responsiveness to the needs of current and future generations. Our mission is to develop and communicate science needed to sustain forest ecosystems and their benefits to society.

## About Us

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The Pacific Southwest Research Station (PSW) represents Forest Service Research and Development in California, Hawai'i, and the U.S.-affiliated Pacific Islands. Our region has the lowest, driest desert in the country, the highest elevations within the 48 contiguous States, and the wettest tropical forests. An abundant diversity of native plants and animals and nearly half of the nation's threatened and endangered species live in this region. At PSW, we develop and deliver science to help inform decisions about natural resource management, conservation, and environmental protection. Much of our work is accomplished in cooperation with other research and development institutions, such as universities, and state and other federal agencies.

# Science that makes a difference.

Sherri Eng



I am extremely proud to present the Pacific Southwest Research Station's 2012 Accomplishments Report. This has been an exciting, challenging, and very rewarding year for all of us at PSW. I was fortunate to be appointed as the permanent Station

Director in 2012, and I am thrilled to officially join the high-performing team at PSW. I look forward to continuing to build on past successes as we focus our research efforts on critical issues impacting the public and our natural resources well into the future. The goal of the Forest Service's Research and Development programs is to improve lives by improving the connections between people, trees, and forest ecosystems. We're going to continue to ensure that our research remains relevant, and that we conduct rigorous science in an efficient and effective business environment that best serves our nation.

To accomplish our goals, we must be mindful of the interactions among people, ecosystems, and myriad environmental changes. Human activities have an increasing impact on the functioning of our ecosystems and understanding the interplay between social dynamics and natural resources will be an increasing part of our work. We appreciate the

unique and rich diversity of the peoples of California, Hawai'i, and the Pacific island states, and embrace the perspectives of our constituents as we shape our research programs to best serve their needs through inclusion and outreach. Key research emphasis areas for PSW include adapting to a changing climate; human cultures and natural resource stewardship; integrated fire ecology and management; conservation of at-risk species and communities; and sustainable energy and environmental impacts.

More than 50 percent of California's fresh water comes from National Forest Lands. In addition to supplying clean water for residential and industrial use, it also supports the approximately \$37 billion in food and commodities produced in California's agriculture economy. Nearly 20 percent of California is National Forest Lands that support 38,000 jobs. We are increasing our strong partnership with the National Forest System (NFS) in our region, investing in research that will assist land managers with new planning rules, developing and sustaining healthy and resilient forests in the face of change, contributing to accelerated restoration of our forests and grasslands, and providing clean, reliable water and other environmental infrastructure to sustain and enhance quality of life.

We remain committed to serving the public through community service programs. Four that I am particularly proud of are mentioned in the pages that follow. Many of

them are financially supported through grant programs, but equally importantly through the dedicated volunteers from PSW and their families who regularly give their time and energy to support these initiatives.

I am particularly excited about our prospects for the future at PSW. As we continue to refine our focus on our primary emphasis areas, we look forward to building out our capacity and capabilities across the station. A key contributor to our success is the development of our Hawai'i facility, the Institute of Pacific Island Tropical Forestry (IPIF). We will fill the Director's position in Hilo, HI in FY13, and count this addition as a critical factor in supporting our research in Hawai'i and throughout the U.S.-affiliated states in the Pacific. The IPIF Director will supervise the scientists and support staff at IPIF and manage the Hawai'i Experimental Tropical Forest on the island of Hawai'i, and will work closely with our collaborators and partners in the state of Hawai'i and the Pacific region to sustain our viability and relevancy.

The coming year poses many challenges and unknown outcomes with budget, policy, and environmental impacts on every facet of our work. At PSW, we look forward to the challenges that lie ahead, and work in concert with all of the Forest Service to better position ourselves to deliver innovative science to ensure environmental health and community stability throughout California, Hawai'i, and the U.S.-affiliated Pacific Islands.

*Alex*

**Alexander L. Friend, Ph.D.**  
Station Director, Pacific Southwest Research Station



# Adapting to a Changing Climate, Urban Natural Resources Stewardship, Water, and Wildland Fire

Four strategic plans outline the Pacific Southwest Research Station's (PSW) direction over the next decade for adapting to a changing climate, urban natural resources stewardship, water, and wildland fire. In each of these areas, PSW's research, development, and technology will be interdisciplinary and collaborative. The strategies reach across PSW's research programs and are coordinated with the Forest Service Pacific Southwest Region, National Forests, other Research Stations, universities, and other government organizations. The plans focus on natural resources in California, Hawai'i, and the U.S.-affiliated Pacific Islands.

## ADAPTING TO A CHANGING CLIMATE

Pat Winter



For nearly a century, Forest Service Research and Development has investigated important stressors on the Nation's forests and rangelands and developed practices to manage for healthy, sustainable, productive, and resilient ecosystems. Over

the last two decades, our research has specifically improved the understanding of how a changing climate impacts our Nation's forests, rangelands, and urban areas. We have also examined how forests and forest management can reduce emissions or increase carbon sequestration to help mitigate a changing climate by reducing greenhouse gases in the atmosphere.

## WATER

California State University, Fresno



Approximately 87 percent of our country's fresh water supply originates from forests and agricultural lands. More than 200 million people rely on their drinking water from public and private forests and grasslands. PSW's research helps inform future

management decisions to protect water-related goods and services, such as abundant and clean drinking water, fish and wildlife habitat, slowing of storm runoff, and water-related recreational opportunities. Our water strategy plan concentrates on four critical components: projecting the impacts of disturbance on water and the resulting goods and services; understanding the watershed processes that will be impacted by these disturbances; identifying critical aquatic species at risk and developing appropriate tools and management practices to mitigate adverse impacts; and developing best management practices and tools to maintain watershed health in natural ecosystems and for urban areas to help mitigate the impact of a changing water supply.

## URBAN NATURAL RESOURCES STEWARDSHIP

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More than 80 percent of the U.S. population lives in urban areas, cities and suburbs. Forest Service Research and Development strives to foster the proper care of natural resources and the advancement of ecosystem services in urban landscapes.

PSW and its partners continue to develop tools that will assist the citizenry in making appropriate planning and management decisions on creating healthy and sustainable urban ecosystems for their communities. Focus areas include: urban water, green infrastructure, humans and fire, and environmental justice.

## WILDLAND FIRE

Steve McKelvey



The mission of PSW's wildland fire research is to provide the knowledge and tools that managers need to reduce negative impacts and enhance beneficial effects of fire and fire management on society and the environment. Our science will guide land

management practices so they reflect an understanding of the diverse impacts of fire and fuels management, and of fire's role as a disturbance on a regional, as well as global scale; assist individuals and communities to recognize their options and accept their responsibilities regarding fire safety when living in fire-affected ecosystems; and provide fire managers with state-of-the-art, science-based knowledge and decision-support tools.



## USDA Forest Service Pacific Southwest Research Station Overview

Research is organized into four science programs:

### 1) Conservation of Biodiversity

Station scientists conduct research on genes, species, habitats, landscapes, and the biological processes necessary to maintain diversity of organisms and functioning ecosystems. Research focuses on enhancing the conservation, ecology, and evolution of species and habitats, and the restoration and maintenance of degraded ecosystems.

### 2) Ecosystem Function and Health

Station scientists examine forest function and conduct research to protect and preserve water, air, and soil resources while considering the effects of a changing climate, unpredictable precipitation, air pollution, and growing threats from pests and pathogens.

### 3) Fire and Fuels

Station scientists conduct research on how fire behavior affects fuel types and conditions and how physical properties of fuels influence fire severity and intensity. Research includes decision-support models that analyze risk, resource allocation economics, and fire danger forecasting.

### 4) Urban Ecosystems and Social Dynamics

Station scientists examine the interconnections of people and natural resources. Research focuses on developing knowledge and tools in natural resource management to better serve the public, and to connect urban dwellers with public lands through urban forestry and social science research.



## Pacific Southwest Research Station

- Headquarters in Albany, Calif.
- Eight laboratories in California and Hawai'i
- 12 active Experimental Forests and Ranges; one Experimental Watershed
- Research is also conducted in more than 90 research natural areas (RNAs)
- Pacific Southwest Research Station is one of five research stations in the U.S. Forest Service
- 249 employees (160 permanent, fluctuating up to 89 temporary)
- Conterminous with Region Five of the National Forest System

# Pacific Southwest Research Station at a Glance

## FY 2012 STATISTICS

### Incoming Funding

Base research appropriations: **\$22.5 million**  
 Extramural funding received: **\$3.7 million**  
 Total funding: **\$26.2 million**

### Distribution of Funds

Fixed costs (salaries, operations, overhead): **\$20.3 million**  
 Appropriated funds distributed to cooperators: **\$5.3 million**

### Workforce

**Total station workforce: 249**

Permanent: 160

Temporary: 89

**Science staff: 197**

Scientists: 56

Science support: 141

**Leadership and Administrative support staff: 52**

### Publications

**Total publications: 267**

*Of the total publications, 149 (56%) were peer-reviewed*

**Journal: 130**

**Other publications: 131**

**Forest Service series: 6**

### Web Metrics

Number of visits to the PSW web site: **99,720**

Number of visitors to the PSW web site: **65,382**

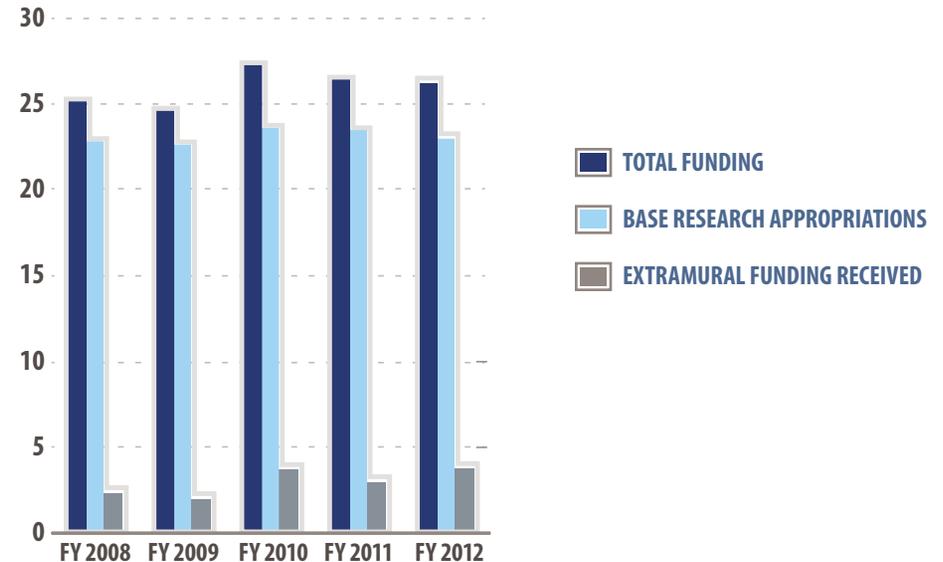
Source countries or territories visits originated from: **188**

Page views of PSW publications through Treerearch: **17,225**

Followers on Twitter(@usfs\_psw): **300**

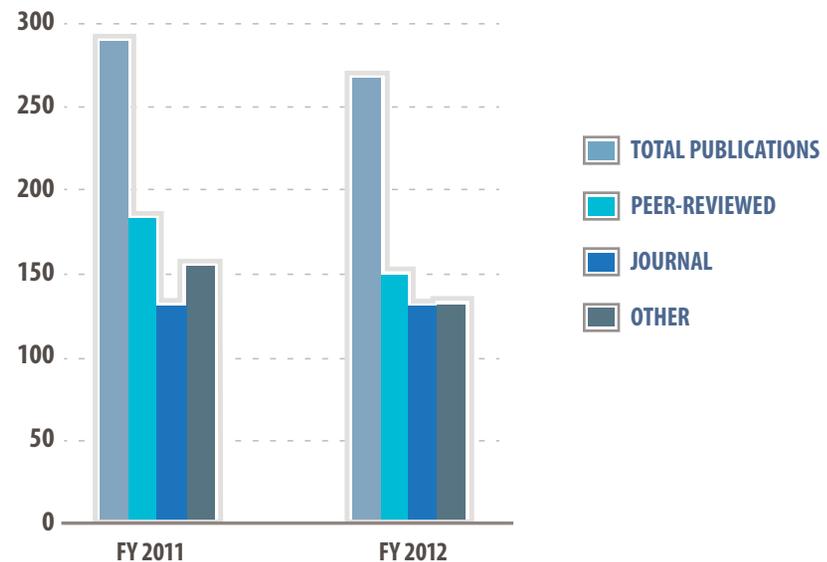
## INCOMING FUNDING

IN US \$ MILLIONS



## PUBLICATIONS

NUMBER OF PUBLICATIONS



# Funding Partners for 2012

## Cooperators Who Received Funding for Studies From PSW

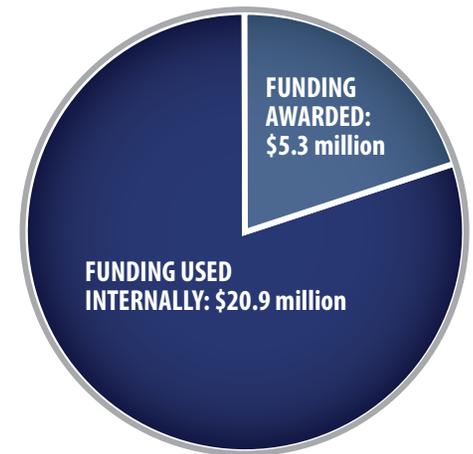
Association of Fire Ecology  
 BMP Ecosciences  
 Cal Poly Corporation  
 California Conservation Corps  
 California Forestry Association  
 California State University  
 Carnegie Institution of Washington  
 Claremont Graduate University  
 Colorado State University  
 Conservation Biology Institute  
 Coral Reef Research Foundation  
 Cornell University  
 EcoLayers, Inc.  
 EM Hydrology, LLC  
 Environmental Incentives  
 Forest Research Agency, United Kingdom  
 Hawaii Wildfire Management Organization  
 Hui Kako'o O Laupahoehoe  
 Humboldt State University  
 Integral Ecology Research Center  
 Klamath Bird Observatory  
 Macgregor Bates  
 Michigan State University  
 North Carolina State University  
 Northern Arizona University  
 Oregon State University  
 Pennsylvania State University  
 Phytosphere Research  
 PRBO Conservation Science  
 Riverside-Corona Resource  
 Conservation District  
 Spatial Informatics Group  
 Texas A&M (Texas AgriLife Research)

Texas Southern University  
 The Nature Conservancy  
 University of Alabama, Huntsville  
 University of British Columbia  
 University of California Cooperative  
 Extension, Berkeley  
 University of California Cooperative  
 Extension, Marin County  
 University of California, Berkeley  
 University of California, Davis  
 University of California, Los Angeles  
 University of California, Merced  
 University of California, Riverside  
 University of California, San Diego  
 University of California, Santa Barbara  
 University of Florida  
 University of Hawaii  
 University of Montana  
 University of Nevada, Reno  
 University of Wisconsin  
 Urban Tilth  
 US Department of Agriculture -  
 Agricultural Research Service (ARS)  
 US Department of Commerce -  
 National Oceanic and Atmospheric  
 Administration  
 US Department of the Interior - Fish  
 and Wildlife Service  
 US Department of the Interior -  
 National Park Service  
 US Department of the Interior - US  
 Geological Survey  
 Washington State University

## Clients Who Provided Funding for Studies to PSW

Bat Conservation International  
 California Department of Fish and Wildlife  
 California Department of Forestry and  
 Fire Protection (CalFIRE)  
 California Energy Commission  
 City and County of Denver  
 Forest Research and Management  
 Institute, Romania  
 Iberdrola Renewables  
 ISCA Technologies Inc.  
 Lang, Railsback & Associates  
 New York Botanical Garden  
 Redwood Community Action Agency  
 San Francisco Public Utilities Commission  
 Save the Redwoods League  
 University of California, Berkeley  
 University of Nevada, Reno  
 US Department of Agriculture -  
 Agricultural Research Service  
 US Department of Agriculture - Animal  
 and Plant Health Inspection Service  
 US Department of Agriculture - National  
 Institute of Food and Agriculture  
 US Department of Defense - Army Corp  
 of Engineers  
 US Department of Defense Strategic  
 Environmental Research and  
 Development Program (SERDP)  
 US Department of Energy  
 US Department of the Interior - Bureau of  
 Land Management  
 US Department of the Interior - Fish and  
 Wildlife Service

US Department of the Interior - National  
 Park Service  
 US Department of the Interior - US  
 Geological Service  
 Wood Buffalo Environmental Association



**Of the \$26.2 million available to PSW, 20.2% was awarded as grants to our cooperators.**

# Community Service

## STARTS WITH A SEED, PSW-HILO

In April 2011, the station's Institute of Pacific Islands Forestry in Hilo, Hawai'i launched the Starts with a Seed program with the mission to connect children to Hawai'i's forests. Funding from the More Kids in the Woods program in FY2012 helped expand and ensure the program's success. The program hosted 441 K-12 students, 35 community members, and 11 university students on field trips and service learning trips. Many of the participants came from urban and/or underserved communities.



Kainana Francisco

Field trips are designed to pique participants' curiosity as they experience the outdoors, develop an appreciation for forests, learn about ongoing research projects, and hear about native tree uses and stories. Service learning trip participants gather native seeds for propagation, prepare planting sites, and plant native plants in degraded forest areas with partners. Program coordinators also conducted two "train the trainer" workshops on ecological restoration techniques, where 11 educators and students gathered seeds and conducted plant monitoring.

The program worked with two East Hawai'i charter schools to purchase, build, and supply a greenhouse for each campus. Additionally, the

program connected Hawai'i Island students to students in the Jasper National Park stewardship education project located in the Canadian Rockies in Alberta. Students shared experiences and points of view on temperate/tropical forests via video teleconference.

Program partners include Mauna Kea Watershed Alliance, University of Hawaii at Hilo, Pacific Internship Programs for Exploring Science, Department of Hawaiian Homelands, Hawai'i National Park Service, Kohala Watershed Partnership, Three Mountain Alliance, Kohala Center, and the Hawaii Division of Forestry and Wildlife (Natural Area Reserves).

## PROGRESS RANCH COMMUNITY GARDEN PROJECT, PSW-DAVIS

Forest Service employees from the Pacific Southwest Research Station and State and Private Forestry in Davis, Calif. kicked off Earth Day on April 22, 2012, by completing a three-month community garden project for a local boys' home. Forty volunteers worked with six boys from Progress Ranch, a residential home in Davis for boys ages 6-12, to build raised bed gardens in the facility's backyard. Each boy tended to and planted vegetables in his own plot.



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The project met the objectives of the USDA's "People's Garden" Initiative objectives for community service, partnerships, and sustainability. Employees contributed more than \$500 for construction materials and the local Ace Hardware store and its employees donated another \$175 for seeds, seedlings, trellises, and other materials.



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## RICHMOND EDIBLE FOREST, PSW-ALBANY

On Jan. 16, 2012—Martin Luther King Jr. National Day of Service—staff from the station's Albany headquarters partnered with the Urban Tilth in Richmond, Calif. to plant some 60 fruit trees on the Richmond Edible Forest. They joined nearly 400 community volunteers who worked on multiple sites along the Richmond Greenway—a former three-mile rail byway bordered by 32 acres of community gardens, composting sites, and recreational space in a densely populated, underserved community—removing weeds, collecting seeds, and replanting garden beds. For the past several years, station staff has collaborated on the edible forest with Urban Tilth, a nonprofit that promotes community agriculture in west Contra Costa County, by providing scientific expertise, as well as physical labor, to the project. The edible forest serves as an environmental education site where station scientists and Forest Service land managers teach kids about the benefits of trees and forested landscapes.

The project is a partnership between the U.S. Forest Service, Urban Tilth, the city of Richmond, and the West Contra Costa Unified School District. The partnership engages 700 underserved youth in



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education programs to learn how to install “edible forests” in Richmond parks and school areas.

PSW helped fund The Richmond Edible Forest Project through a U.S. Forest Service More Kids in the Woods program grant. The More Kids in the Woods program's goal is to work with community partners to help America's youth learn more about their local environment and careers in natural resources.

## CENTRO DE NIÑOS, PSW-RIVERSIDE

Scientists and staff at the station's Riverside lab continued its long-time community relationship with Centro de Niños, a children's center run by Concilio for the Spanish Speaking of the Inland Empire. The Riverside, Calif.-based nonprofit is dedicated to providing childcare services and bilingual instruction to children of underserved and financially needy families in the area.

During the 2011 holiday season, station scientists and staff kicked off a Thanksgiving food drive and a holiday toy drive for Centro de Niños children and families. Eleven families received a box with all the fixings for a Thanksgiving dinner, including a turkey, potatoes, rice, beans, yams, flour, canned vegetables, juices and dessert. To get into the holiday spirit, about 90 children, ages 3-5, took home a special holiday gift.

In September 2012, just prior to the beginning of the new school year, scientists and staff donated backpacks, lunch boxes, pencils, paper, crayons and other school supplies to 12 entering kindergarteners from Centro de Niños. They also donated 325 pounds of dried goods to Centro de Niños through the Feds Feed Families campaign.

“I believe in making sure that everyone has an opportunity to succeed,” said Armando González-Cabán, a research economist at PSW-Riverside, who has been volunteering for Centro de Niños for more than 25 years. “These children are from families in need, so why not do something for them to make their lives better?”



# Recent activities and achievements on PSW's Experimental Areas:

## **Stanislaus-Tuolumne Experimental Forest (STEF)**

Prior to historical logging and fire suppression, forests of the Sierra Nevada were extremely heterogeneous, which helped make them resilient to fire and other threats. Today, forest management practices focus on improving the resilience of forest stands to large-scale crown fires. Mechanically thinning small trees while retaining larger ones is one way to improve resilience. But this type of thinning can lead to a relatively even forest structure—consisting of trees of the same age—which decreases the habitat diversity for wildlife and other forest species. PSW scientists recently performed variable-density thinning on the STEF in an effort to produce a more grouped arrangement of trees, which would create heterogeneity at a scale beneficial for wildlife and understory plant species, while simultaneously increasing resilience to wildfire.

Michael Sullivan

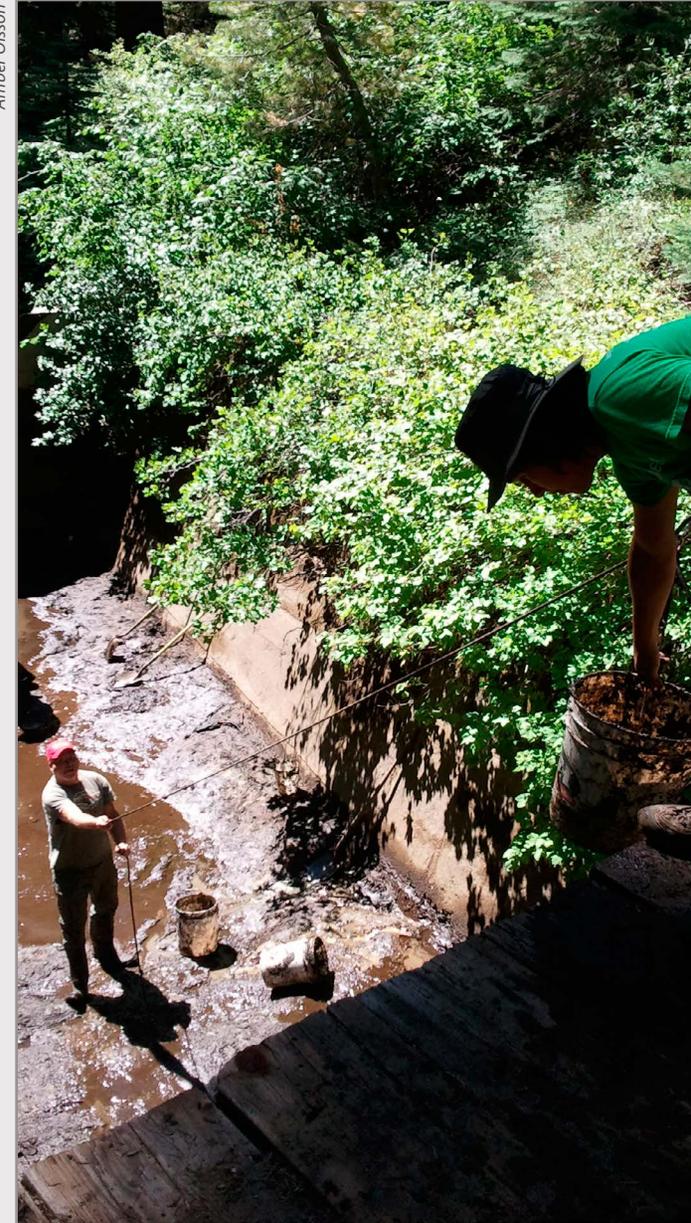


## **Kings River Experimental Watershed (KREW)**

National Forests in the Sierra Nevada provide 45 percent of the surface water to California. All life needs water, and these waters support human activities, such as agriculture and recreation, as well as quality stream conditions for fish and wildlife. The Kings River Experimental Watersheds (KREW) project has watersheds at the rain-snow-interface zone and at the snow-dominated zone. The lower elevation site is representative of what the high elevation site is expected to become as climate changes. This research project compares the condition and processes of watersheds with forest management practices to ones that are undisturbed. No paired-watershed research on forest management existed in the Sierra Nevada before PSW established the KREW project in 2000.

Although all watersheds receive about the same amount of precipitation, those that are snow-dominated produce more streamflow over a longer time period. Sixty percent of the water in the streams comes from subsurface flow while over-land-snowmelt runoff contributes less than 40 percent. Trees at the rain-snow-interface zone are active all winter and use significantly more soil water than previously believed, thus allowing less subsurface water to enter streams. These results indicate that even if the same amount of precipitation occurs as climate changes in the southern Sierra Nevada, less of it will come as snow. Higher elevation trees will likely use more water resulting in less water flowing from headwater streams to valley rivers, and an earlier and shorter peak in streamflow. The current information on streamflow variability and water balance will be compared to data collected after tree thinning in 2012 to see if any detectable increase in water availability occurs from vegetation removal for forest restoration.

Amber Olsson



# Ecosystem Function and Health

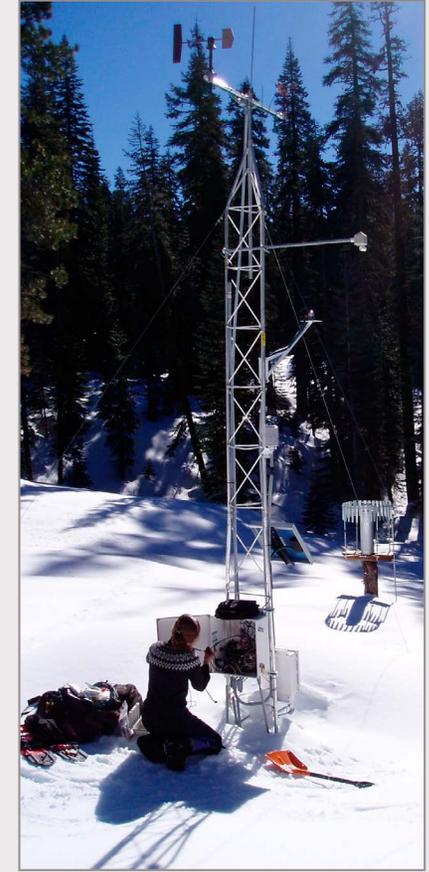
Our forests and wildland ecosystems are exceedingly diverse and provide a wide array of societal goods and services. From clean water, timber and non-timber products, and carbon sequestration to recreational use, aesthetic beauty, and native biodiversity, these ecosystems are national treasures that contribute to the prosperity of current and future generations. A growing list of environmental pressures, including climate and land-use change, water scarcity, and an increasing human population, threaten the health and integrity of these ecosystems.

**The Ecosystem Function and Health Program** focuses on the interactions among changes in or brought about by biotic and abiotic factors, such as temperature and precipitation, invasive species, air pollution, insects, pathogens, and past and current land management actions. Station scientists conduct research that provides an integrated understanding of the biophysical conditions that threaten ecosystem resilience, including how environmental changes are initiated and progress, what thresholds are associated with these changes, and what the consequences are of crossing identified thresholds.

Andrzej Bytnerowicz



Sherri Eng



Sean Eagen

## Research focuses on the following areas:

- Determine how biophysical factors influence the function and productivity of tropical, subtropical and temperate ecosystems;
- Quantify and predict ecosystem responses and adaptation to environmental stressors;
- Define and measure the impacts of biotic and abiotic stresses on hydrological and atmospheric systems; and
- Develop models and tools, and evaluate management options for restoring, sustaining and enhancing ecosystem function and productivity.

## 2012 Research Highlights

### Prescribed burning and mechanical thinning pose little risk to forest ecology

Current conditions of many seasonally dry forests in the western and southern U.S., especially those that once experienced low- to moderate-intensity fire regimes, leave them uncharacteristically susceptible to high-severity wildfire. Using prescribed fire and mechanical thinning are generally successful in making stands more resilient to high-intensity wildfire. Station scientists and collaborators found that these fuel reduction methods can be conducted with few negative consequences to the ecosystem. While mechanical treatments do not serve as surrogates for fire, their application may help mitigate costs and liability in some areas. Treatment effects on fire hazard are transient, indicating that repeated applications are necessary to maintain desired effects.

### Study shows sources of air pollution in the Lake Tahoe basin

Station scientists conducted a study in the Lake Tahoe Basin to address the distribution of ozone, its precursors, and nitrogen oxides. Scientists used passive samplers to monitor air quality at 34 sites located at various elevations in and around the basin. Scientists found that air pollution from the California Central Valley caused high concentrations of ozone on the western slope of the Sierra Nevada, but these emissions did not affect air quality in the Lake Tahoe Basin. Local emission sources are most likely the cause of elevated ozone levels at high elevation sites on the eastern side of the basin. These findings will help to develop management strategies aimed at improving air quality of the Lake Tahoe Basin.

### Air pollution thresholds used to protect U.S. ecosystems

Advances in defining thresholds for acceptable air pollution exposure have greatly increased the capacity to protect and restore at-risk ecosystems. The use of these thresholds applies to impacts on aquatic and terrestrial ecosystems that are affected by pollutants, such as mercury, sulfur and excess nitrogen. This research will benefit air quality specialists, land managers, scientists, policymakers and the U.S. Congress. The critical loads developed in this work are being applied for natural resource protection by the Forest Service, National Park Service, and others. A federally-mandated peer reviewed report was also submitted to Congress providing an update on the status of pollutant emissions, atmospheric deposition, ecosystem effects, and projections of emissions necessary to prevent future adverse ecosystem effects in the U.S.

### Streamflow and water balance data to gauge the effects of a changing climate on California's water resources

Research at the Kings River Experimental Watershed in the southern Sierra Nevada has established the current and natural range of variability for headwaters watersheds for the first time. Reliable data collection and analysis is critical to answering vexing questions about how various silvicultural treatments impact water quality, quantity, and

biodiversity. This is the only site that that can provide this information in the southern Sierra Nevada. Years of data will be compared to erosion and sediment measurements taken after forest thinning and prescribed fire to quantify effects of forest restoration activities. This effort provides unparalleled data on infrastructure, characterization, and research history for climate research and supports partnerships within our national networks that include the National Science Foundation's National Ecological Observatory Network (NEON), the Southern Sierra Critical Zone Observatory (CZO), and the University of California.

### Managing Sierra Nevada forests

There has been widespread interest in applying new forest practices based on concepts presented in the 2009 U.S. Forest Service General Technical Report PSW-GTR-220, "An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests." A new 2012 report (PSW-GTR-237) summarizes the state of the science in topics relevant to this forest management approach, presents case studies of collaborative planning efforts and field implementation of these new practices, and clarifies some of the concepts presented in GTR-220. It also describes a method for assessing forest heterogeneity at the stand level using the Forest Vegetation Simulator and a new geographic information system tool for project level planning that classifies a landscape into different topographic categories. While this collection of papers presents information and applications relevant to implementation, it does not offer standards and prescriptions. Forest management should be flexible to adapt to local forest conditions and stakeholder interests. This report does, however, strive to clarify concepts and present examples that may improve communication with stakeholders and help build common ground for collaborative forest management.



Andrzej Bytnerowicz

# Fire and Fuels

Steve McKelvey



Managing fire and the vegetation conditions that fuel fire is a paramount challenge to land managers throughout most of California, Hawai'i and the U.S.-affiliated Pacific Islands. The mission of the **Fire and Fuels Program** is to provide scientific findings that will improve management actions intended to enhance resiliency and sustainability of wildland ecosystems affected by fire, and reduce the potential for adverse effects resulting from wildland fire, including loss of life and property.

## Research focuses on the following areas:

- Improve measurement, modeling, and prediction of wildland fire and weather phenomena in complex landscapes and fuels;
- Determine the ecological effects of fire and fire removal on landscapes throughout California, Hawai'i, and the U.S.-affiliated Pacific Islands;
- Evaluate the short- and long-term outcomes of fuels, fire, and post-fire management strategies;
- Determine and quantify the interactions between climate, vegetation, and fire in the face of a changing climate and improve our understanding and predictability of these interactions in order to manage forests and wildlands more effectively; and
- Describe and quantify uncertainty and risk in a science-based decision-making framework for fire and land management planning.

## 2012 Research Highlights

### Science helps guide forest planning

Station scientists led an innovative year-long effort to synthesize and distill recent scientific research which will guide the revision of land and resource management plans for national forests in the Sierra Nevada. Highlights of this approach included analysis and design of treatments that reduce the extent of severe wildfire while avoiding impacts to sensitive species; consider opportunities to promote resilience of local communities; and apply principles of adaptive management to evaluate outcomes. The science team produced an integrated report on strategies to promote long-term socioecological resilience in the Sierra Nevada bioregion in the face of climate change, increases in wildfire severity and extent, demographic changes, and other expected stressors.

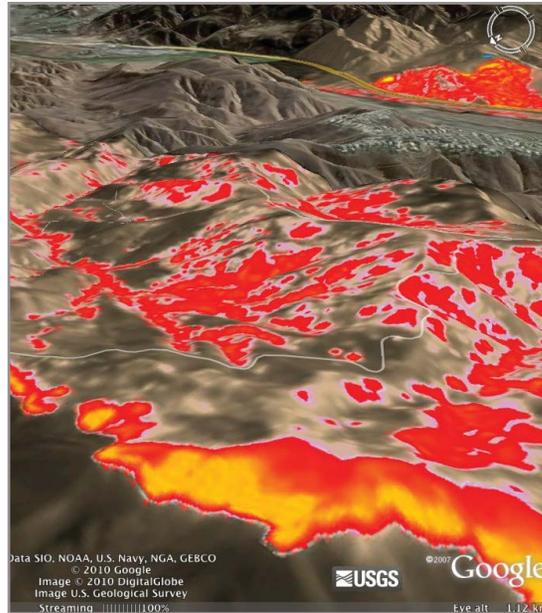
### Managing wildfire may increase forest restoration

Forests in the Sierra Nevada are vulnerable to large and severe wildfires that have the potential to impact human communities, habitat for sensitive wildlife species and water resources. Increasing the amount of fire on a landscape to reduce the potential damage of future wildfires may seem counterintuitive. However, station scientists have found that using managed wildfire under less-than-extreme fire weather conditions across large portions of Sierra Nevada forests may alleviate the current hazardous fuels/fire deficit problem.

### Fire size and severity trends in Northern California show that managed wildfire may reduce severe fire outbreaks

Research indicates that fire size and severity have been increasing over the last several decades. This assessment of large wildfires in Northern California indicates that using managed wildfire under less-than-extreme fire weather conditions forests may help alleviate the current hazardous fuels/fire deficit problem. Analysis of wildfire trends from 1910–2008 revealed ways to increase forest resilience and limit severe fire effects, reducing vulnerability to large and severe wildfires by managing wildfires for resource benefits. Findings suggest that under conditions typical of widespread lightning-fire outbreaks, wildfires could be more extensively used to achieve ecological and management objectives in Northern California.

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### FireMapper technology tracks effectiveness of fire retardant

Aerial assault on wildland fires with air tankers and fire retardant is a critical and expensive element of modern fire suppression. Yet the practical effects of retardant application on fire behavior have not been critically assessed across the range of conditions encountered in active, large wildfires. PSW is using its specialized FireMapper remote-sensing system in a nationwide study quantifying and assessing the response of fires to retardant applied under operational conditions.

### Station partners with NOAA to predict fire risk

An in-depth knowledge of the spatial and temporal variability of fire weather variables is needed to predict fire danger. In response to this need, the Forest Service and the National Oceanic and Atmospheric Administration (NOAA) began engaging in collaborative research in weather and climate-related physical fire science. Station scientists will develop a management system that can predict the timing, location, and severity of wildfires. This collaborative research will enhance the understanding of fire risk using climate forecasts, and will provide a tool to improve the development of forest and wildland management strategies.

# Urban Ecosystems and Social Dynamics

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The interconnection between humans and nature is complex and enduring. People need and yearn for the resources that only nature can provide: clean water, clean air, natural scenic beauty, and a connection to the land and wildlife. The Pacific Southwest Research Station strives to maintain forests, sustain functioning ecosystems in urban and wildland areas, enhance and protect quality of life, and ensure benefits to society through interdisciplinary research that examines urban ecosystems and social dynamics of natural resources conservation, management, and restoration.

**The Urban Ecosystems and Social Dynamics Program** conducts research and communicates science needed to understand and enhance the interconnections among ecosystems, people, and societies.

## Research focuses on the following areas:

- Determine the relationships among human uses, human values, ecosystem services, and management;
- Ascertain the roles of changing demographics, urbanization, socioeconomics, and technology on use and sustainability of natural resources; and
- Examine the impacts of public policies on ecological and social patterns and processes along rural-to-urban gradients.

## 2012 Research Highlights

### Assessing the impact of a changing climate on forest diseases

A changing climate is projected to have far-reaching environmental impacts both domestically and abroad. A PSW report examined the impact of climate change on forest diseases and how these pathogens will ultimately affect forest ecosystems in the Western United States and Canada. Drawing on a large body of published research, the report details the effects of eight forest diseases under two climate-change scenarios—warmer and drier conditions, and warmer and wetter conditions. Forest diseases discussed in the report include foliar diseases, *Phytophthora* diseases (such as sudden oak death), stem rusts, canker diseases, dwarf mistletoes, root diseases, and yellow-cedar decline.

### Relationship to forests linked to recreationists' self-identity

Recreational uses of forest lands are psychologically and socially important. Data collected from recreationists in both the United States and Greece show that a person's attraction and connection to the forest has a positive effect on his or her sense of identity and social bonding with others. This suggests that forest recreation experiences are both immediately fulfilling and important to one's quality of life and sense of self. This research contributes to an understanding of the role of outdoor recreation and will help inform managers and policymakers who set priorities on socially-relevant ecosystem functions and services.



George Gonzalez, City of Los Angeles

### Urban tree growth modeling: why tree size matters

It is well-known that large trees provide more ecosystem services than small trees. Station scientists have developed growth equations for urban tree species throughout the U.S. and are catalyzing new collaborations between researchers and professionals in the planning and management of high performing landscapes. This research helps managers select, locate, and manage trees to more effectively cool urban heat islands, conserve energy, filter air pollutants, reduce runoff, sequester carbon, and promote human well-being. This science has resulted in a greater awareness of tree benefits, increased investment in tree management, and more productive urban forests.

### Guidelines help fire managers in Europe combat large fires

Historically, forest fires have played a significant role in shaping European, and most particularly, Mediterranean forest ecosystems. During the last few decades, socio-demographic changes in the Mediterranean basin countries have significantly altered land use patterns. These have resulted in abandonment of large areas, reduction in agricultural crops, and reconversion to forest lands. A concomitant resulting change has been an increase in the number, intensity, and size of large fires in Europe. In response to these events, the European Union Commission chartered a fire science research project to address the causes and consequences of large fires in Europe and offer potential solutions. PSW was a member of the international Scientific Steering Committee, providing guidance and technical review for the Fire Paradox Project. From this project, fire scientists developed guidelines for policymakers and fire managers on how to better respond to fire management problems in their regions.



Elke Schuster

# Conservation of Biodiversity



Mark Linnell

Our geographic area includes oceanic islands, elevational clines from coastal to alpine ecosystems in temperate and tropical ecosystems, and species and communities that occur nowhere else in the world. The area faces significant species extirpations and extinctions, with remaining natural areas continuing to be threatened.

**The Conservation of Biodiversity Program** provides high-quality, relevant information across the conservation continuum: status, threats, vulnerable components, response of organisms and ecosystems to threats, tradeoffs in desired management outcomes, efficacy of management approaches through adaptive management, restoration and recovery techniques and tools, and effectiveness monitoring and evaluation techniques.

## Research focuses on the following areas:

- Determine environmental conditions needed for terrestrial species persistence;
- Identify conditions that can support aquatic biodiversity and ecosystem services;
- Determine the genetic origins of traits that can enhance tree adaptability and utility; and
- Develop innovative approaches to reduce ecological impacts of non-native species.



Laura Warman

## 2012 Research Highlights

### Model gauges effects of passage barriers on trout populations

Loss of habitat connectivity in stream networks can create problems for the persistence of valuable populations of aquatic animals. Resource managers need tools to identify and prioritize actions. Station researchers and cooperators used a spatially-explicit model of a northwestern California watershed to establish a framework to better understand the effects of barriers on fish populations and identify those of greatest significance to population size and persistence. The approach has been used to address a variety of key management issues, including cumulative effects analysis, the effects of streamflow diversions on fish populations, prediction of habitat restoration outcomes, and the effects of water quality on fish populations.

### Forest Inventory Analysis (FIA) data helps estimate habitat value

Wildlife species use habitat at various scales. Resting locations are often the most difficult to assess and monitor over large areas. Because these habitats are critical to the conservation of the fisher (*Martes pennanti*), a rare forest carnivore, forest managers require quantitative tools to monitor resting conditions over time. Station scientists developed a predictive model using Forest Inventory Analysis plot data to characterize the value of resting habitat across northwestern California and quantitatively evaluate the effect of forest management on these habitats.

### Landbird monitoring network gathers, archives and shares bird population data

Landbirds play a vital role in the environment. With an increasing focus on global-scale environmental issues, there is an urgent need to address large-scale issues for landbird populations. A wealth of data from projects is lost yearly that can inform these analyses, especially long-term trends in bird populations. Station researchers partnered with other governmental agencies, organizations and individuals to create the Landbird Monitoring Network of the Americas (LaMNA) to help fill this gap by actively searching, archiving, and making datasets available for future generations. LaMNA currently has archived almost 4 million records of capture and census data from 60 cooperators in North and South America, and works to increase communication between researchers through its web site ([www.klamathbird.org/lamna](http://www.klamathbird.org/lamna)) and regular newsletters, as well as facilitating large-scale studies between multiple researchers.



North Central Research Station Archive, U.S. Forest Service, Bugwood.org

### Brown Creepers respond negatively to forest edges

Station researchers studied the response of Brown Creepers (*Certhia americana*) to forest edges in the Sierra Nevada. They found that Creepers were more abundant in plots with less high-contrast edge, nested farther from soft and moderate edges, and reproduced more successfully farther from moderate or hard edges. Results suggest that Creepers responded, in part, to edges with greater contrast between adjacent patches that primarily resulted from natural discontinuities. These findings were surprising as previous work suggested that edge effects and the processes underlying them may differ in western coniferous forests due to their intrinsic natural heterogeneity. These results highlight the importance of retaining fairly large patches of continuous mature and late-seral forest.

### Using a "fantasy football" model to build hybrid ecosystems in Hawaiian lowland wet forests

As novel assemblages of native and non-native species become increasingly common globally, many conservation and restoration efforts have concentrated on the removal of exotic—and often invasive—species. In some cases, removing non-native species is no longer economically or ecologically feasible. Station scientists developed an approach similar to fantasy football, where "teams" of species are picked to work together to form self-sustaining units in Hawai'i. Scientists presented an approach for species choice ("players") based on characteristics of native and non-invasive species, and on diversity indices from existing forests. New hybrid communities can be experimentally assembled based on principles of complementarity and redundancy.

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