

# Chapter 3

## Pacific Southwest Region Partnership

### Partnership Summary

#### Introduction

The Pacific Southwest Region and Pacific Southwest Research Station have drafted partnership strategies that recommit our organizations to broader and more successful collaborations with external partners. In particular, both organizations want to increase partnerships around watershed restoration and forest resiliency. While our goals are the same, the strategic actions we plan to use to increase partnerships are different, as outlined below:

The Research Station intends to focus on developing partnerships that increase our scientific knowledge and understanding of (1) watershed restoration and water quality improvements, (2) urban natural resources stewardship, (3) wildland fire and fuels, and (4) forest resiliency. Among other methods, the Station will do this through sharing best practices with other research stations, tracking partnerships and their outcomes, establishing an incentives program to promote large-scale partnerships, creatively marketing the station's successes and willingness to engage in partnerships, and including partnerships in performance management standards for leaders.

The Region plans to expand the number, quality, and scope of partnerships throughout California and the Pacific Islands, especially in the areas of water and watershed management, healthy forests, engaging youth, recreation, and volunteerism. The Region intends to do this through increased focus on building partnership competencies within our workforce, promoting a collaborative culture at every level and through every line officer, prioritizing strategic alliances with large partners at the regional level, and fully maximizing the use of the partnership authorities we have available.

### Public-Private Partnership Strategy

Achieving our Mission with Shared Stewardship of the Nation's Forests and Grasslands

#### Background & Context

The Pacific Southwest Region has long recognized that investing in strategically chosen and well nurtured partnerships will increase the amount of work we can accomplish on the land.

The public has long recognized that forests provide many benefits, from water and clean air to rural jobs and recreation. Now there is growing recognition of how climate change, population increases, and other threats to forest health will impinge on those ecosystem services. This presents an exciting opportunity for our agency to focus on restoration actions and to engage the public, community groups, and businesses in the work that needs to be done to sustain the health, diversity, and productivity of our lands.

Region 5 articulated these values, threats, and a vision for healthy, resilient ecosystems in its "Leadership Intent for Ecological Restoration." This declaration speaks to the convergence of stakeholder interests and puts forth a call to action that is inspiring Forest Service employees, existing partners, and new, non-traditional partners. Businesses that rely on ecosystem services—water utilities or outdoor retailers, for example—may see an opportunity to make investments in restoration actions that protect those benefits.

There is widespread recognition within our region that, in order to do a good job caring for the land and serving the people, we need to employ partnership and collaboration skills. This Regional Public-Private Partnership Strategy is informed by the Region's 2003 Partnership Plan, the 2011 National Strategy, and conversations and interviews with hundreds of Forest Service employees, partners, and members of the public from 2010 to 2012. The region offers this plan to establish a vision of expanded use and quality of strategic partnerships and to agree upon the focus areas that require our investment in order to reach that vision.

#### Vision

Forest Service Pacific Southwest Region employees cultivate relationships with outside organizations and engage in partnerships as second nature in getting work done to accomplish our mission. The Region takes advantage of all useful authorities and promotes and rewards collaboration with external people and organizations at every turn. This results in better services for the American public and the best possible stewardship of ecosystems on public and private lands.

These partnerships significantly help the Region achieve the goals outlined in the R5 Leadership Intent for Ecological Restoration. Partners make investments of capital, resources, and time that they feel are

wise investments to protect the land that they love and the ecosystem services they value as a citizens or businesses.

### Renewed Partnership Focus

The mission of the Forest Service is to “sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.” Partnerships are essential to carrying out our mission today, and, fortunately, there are hundreds or thousands of organizations in California and the Pacific Islands whose missions overlap in some way with ours. They could have a mission focused on reaching inner-city youth, or restoring chaparral habitat, or providing clean water to consumers, or creating rural jobs, or maintaining great trails for recreation. Wherever another organization’s mission and ours overlap, there is potential for us to work together toward bigger, better outcomes than we each might achieve on our own.

The Region recognizes the value of continuing to develop effective partnerships wherein we invite public participation, embrace stakeholder proposals, and successfully leverage our resources by working together. Following are focus areas where we believe renewed attention and investment will yield progress. Even though the success of partnerships in the agency will ultimately depend upon relationships developed at the field level, the leadership, policy, and support provided from upper management levels are imperative for success. The Regional Leadership Team is committed to enhancing partnerships across the region through supporting the focus areas in this plan.

### Key Strategies

We will expand the number, quality, and scope of public-private partnerships across the region, with an emphasis on water and watershed management, healthy forests, engaging youth, recreation, and volunteerism. To achieve this, we will direct resources and attention to the following focus areas:

1. Capacity and Competencies
2. Collaborative Culture
3. Strategic Alliances
4. Law and Policy

### Capacity and Competencies

We intend to build and maintain partner and employee understanding and ability to engage in rewarding and high impact partnerships that achieve shared goals.

Achieving this vision will require transitioning to become an agency where every staff office—from Ecosystem Management and Public Services to Human

Resources and Law Enforcement—routinely employs partnerships in their work and use the partnership authorities available to them. This will take investment in capacity and employee competency through training opportunities.

We can do this by holding in-person and webinar trainings: we can make broader use of national trainings such as “Managing By Network,” and/or bring courses like that to regional employees in partnership with other federal agencies in California and the Pacific Islands. We can also replicate the successful model started by National Forest Foundation with our Region and Region 6 by hosting peer-learning conferences on the topics of collaboration and partnerships.

### Collaborative Culture

We recognize the importance of including the public in the development of strategies for land stewardship and in the implementation of those strategies. In many cases, we may build our programs of work collaboratively from the beginning with our partners.

We will foster a collaborative culture from all levels of our organization, from Regional Office to Ranger District. For individual employees and for units, becoming better collaborators means focusing on and sharing our end goals with partners and the public, while keeping an open mind and listening to our partners about how we might reach those goals.

We will recognize and support successful existing landscape scale, communities based collaboratives and empower them to share their lessons with others. Examples of successful existing collaboratives include Santa Ana Watershed Project Authority, Dinkey Creek CFLR, Burney Hat Creek All Lands Project, and Amador Calaveras Consensus Group (Mokelumne Watershed). We would like to see these types of collaboratives become the most common way we do business.

The Regional Office, Supervisors Offices, and Ranger Districts will support a collaborative culture by being open to discussions with externals early and often, and by bringing in internal or external facilitators to help collaborative discussions go well. Regionally, one way to support this may be to relaunch a small version of the Region’s past internal facilitator training program. Under this program, certain employees take facilitator skill training courses and may be added to a roster of facilitators available to any staff or unit that requested one for a project or process.

### Strategic Alliances

We will identify and develop priority relationships with particular organizations by giving significant

consideration to shared goals and potential accomplishment. In essence, we will reach our goals through partnerships.

To take advantage of partnerships at every opportunity, we must practice being opportunistic when we are approached by potential partners to do work together. But we are also engaged in thoughtfully cultivating and deepening existing relationships while purposefully targeting new partners. That is what makes partnerships strategic.

We can do this by strengthening our relationship and coordination with the National Forest Foundation and the National Fish and Wildlife Foundation, our Congressionally-chartered fundraising partners. We may also further these alliances by tapping our agency and Department leadership to spearhead discussions with potential strategic partners, to signal our deep commitment to shared goals. By supporting a Yammer account, the Forest Service supports the idea-sharing and creativity required for employees to imagine new potential partners and projects. But we could do even more (e.g., supporting region-wide “communities of practice”) to encourage this kind of professional networking and brainstorming across the region that would lead to the big-landscape, big-partner, high-impact projects that result from strategic alliances.

## Law and Policy

We recognize the need to more instinctively employ available authorities for engaging external organizations at all levels of the organization. Regional Partnership staff will work toward the enhancement and broader interpretation of existing authorities through collaborating with the Washington Office and the Department of Agriculture.

Formalizing partnerships can be challenging and time-consuming due to the diversity of partnership authorities, various ways to interpret those authorities, and complicated processes required for grants and agreements. There are no easy ways around this besides employee training and increased practice. Making our trainings for partnerships, grants, and agreements more interactive, more peer-to-peer and less dependent on powerpoint texts may help this information truly stick with and help more Forest Service workers.

There is also an opportunity to explore expansion and broader interpretation of authorities and policies that advance partnerships. Regional staff has recorded questions and requests from R5 forests concerning partnership authorities, and we now have an opportunity to collaborate with the Washington Office and the Department to explore administrative changes

in FS policy and perhaps even different interpretations of existing policy at the Departmental level.

## Examples of High Priority Projects that Exemplify the Region’s Partnerships

### 1. Dinkey Creek Landscape Restoration

Supported by the Collaborative Forest Landscape Restoration program, a group of about 30 individuals representing a broad range of interests has been developing, implementing, and monitoring restoration projects on 154,000 acres of public and private lands in the High Sierra Ranger District of the Sierra National Forest.

### 2. Mokelumne Watershed Restoration

Eighty five percent of the water that East Bay Municipal Utility District (EBMUD) provides to its customers begins in the Mokelumne watershed on National Forest System land. R5 is in early stages of working with EBMUD, other landowners, and non-profits in the Sierras to quantify the value of ecological restoration projects in that watershed, with hopes for then educating water consumers in the East Bay and implementing restoration projects together in the future. This work will also be implemented in cooperation with the community-based Amador-Calaveras Consensus Group and with the support of the National Forest Foundation.

### 3. Station Fire Treasured Landscape

The National Forest Foundation (NFF) is supporting the Angeles National Forest by raising funds and mobilizing volunteers to restore the areas of the forest affected by the 2009 Station Fire. As the nation’s most urban forest, the Angeles attracts millions of visitors who have seen their outdoor recreation opportunities severely impacted. In choosing the Angeles as a site in its “Treasured Landscapes” campaign, NFF plans to help coordinate existing volunteer groups and to help implement reforestation, invasive species management, and watershed restoration projects within the burned area.

### 4. Burney-Hat Creek

The Lassen National Forest is collaborating with the Fall River Resource Conservation District, Sierra Institute for Community and Environment, the Lassen Volcanic National Park, private timber companies, Pacific Gas & Electric, recreation enthusiasts, and others to develop and implement restoration projects in the Burney-Hat Creek Basin. These projects will reduce fire risk and protect nearby communities, improve ecosystem function and wildlife habitat in

degraded streams and meadows, and provide wood biomass for three co-generation plants.

#### **5. Santa Ana Watershed**

National forests host the headwaters of the Santa Ana River, and this important watershed provides water for over five million residents in Southern California. The Santa Ana Watershed Project Authority (SAWPA) coordinates the watershed’s five major water districts

and began partnering with the San Bernardino and Cleveland National Forests after the 2003 fires to help protect the headwaters and conduct ecosystem restoration projects. The initial collaboration has inspired a Memorandum of Understanding between SAWPA and the Cleveland and San Bernardino National Forests to ensure that water concerns are being communicated, shared, and addressed together to achieve mutually beneficial goals.

# Pacific Southwest Research Station Public-Private Partnership Strategy

## *Science That Makes a Difference*

### Introduction

The Pacific Southwest Research Station (PSW) provides a strong scientific foundation for resource management decisions by drawing from natural resource expertise, decades of data obtained from its experimental areas, and a network of strong and productive partnerships. Engagement of cooperators, communities, private landowners, non-profit organizations, citizens and private interests in these partnerships is critical in the provision of world-class forest research and development. Through participation in partnerships, PSW is able to develop science and technology solutions for partners' priority issues in ways they find effective and useful for sustainably managing forests and grasslands. By working with partners, PSW also expands its capability to participate in conservation through stewardship, research, and intergovernmental coordination. In the contemporary environment of increased economic changes and pressures, PSW must continue to develop effective partnerships where we successfully leverage our resources with stakeholders by working together.

The PSW Public-Private Partnership Strategy ascribes to the vision and principles outlined by the US Forest Service national strategy. PSW invites prospective partners to contribute to its mission of developing and communicating science needed to sustain forest ecosystems and their benefits to society. Following the national strategy, the PSW strategy provides a roadmap for expanding partnerships, broadening strategic alliances, and strengthening collaboration, thereby increasing the potential for exciting new social and capital investments towards communities, ecosystems and outdoor experiences.

### The strategy organizes objectives in four main sections:

1. **“The What”**: Key Focus Areas Key issues upon which PSW partnerships and shared-stewardship will be focused.
2. **“The Who”**: Targeted Partners PSW will strengthen current alliances that are proven-successful, and develop new partnerships with organizations and sectors that are most likely to help PSW maintain relevancy with respect to the four key focal areas.
3. **“The How”**: Partnership Growth Strategies Specific tactics PSW will utilize to foster and advance current and future partnerships in California, Hawaii and the US-affiliated Pacific Islands.
4. **“The Why”**: PSW Partnership Successes Highlighting ten of PSW's high-profile partnerships and projects in California, Hawaii and the US-affiliated Pacific Islands to illustrate the value of effective collaboration in forest and rangeland research and development.

### “The What”: Key Focus Areas

PSW will remain focused on four key research areas as it activates its partnership strategy

#### Create Strategic Opportunities in Water Management and Restoration

PSW plans to maintain alignment with the “Water Management and Restoration” Forest Service R&D Emerging Research Area by engendering partnerships that focus on water resources. Partnerships in California, Hawaii and the U.S.-affiliated Pacific Islands that are invested in water research will enhance the region's ability to provide clean water, air, and water-related ecosystem services, conserve water-dependent species and ecosystems, improve management of watersheds, and plan for and manage changes in water and its associated resources under changing climates and landscapes. Similar to the goals and objectives of the Service-wide partnership strategy, PSW will expand collaboration and partnerships with water utilities, private landowners, and other organizations and sectors to provide scientific information and tools that support watershed restoration and water quality improvement work in priority watersheds, spotlighting the direct connection between healthy forests and clean and consistent supplies of fresh water. As an example of effort in this focus area, PSW is an official member and participant of the California Water Plan “Update 2013” Federal Agency Network.

#### Promote Increased Partnership in Urban Natural Resources Stewardship

PSW envisions healthy, sustainable urban ecosystems for the benefit of all. PSW and collaborative partners

play a significant role in development of science and technology transfer for the advancement of ecosystem services in urban landscapes. PSW will continue to work with partners from socioeconomically diverse communities in California, Hawaii and the US-affiliated Pacific Islands to educate the public, and develop scientific tools that guide appropriate land management. PSW and partners will also expand their efforts to reach out to minority and underserved communities and youth to encourage spending time in nature, promote health, and nurture land stewardship.

### Strengthen Collaboration in Wildland Fire & Fuels Research

Managing fire and the vegetation conditions that fuel fire to accomplish multiple land management objectives is a paramount challenge to communities throughout most of California, Hawai'i and the U.S. affiliated Pacific Islands. PSW and partners will work together to measure, model and predict wildland fire and weather phenomena; determine the ecological effects of fire and fire removal on landscapes; and describe and quantify uncertainty and risk in a science-based decision-making framework for fire and land management planning.

### Promote Increased Partnership in Restoring Forest Resiliency

PSW and partners in California, Hawai'i and the U.S. affiliated Pacific Islands will collaborate to more fully understand and describe the effects of climate change, invasive species, pollution and other threats on carbon sequestration, ecosystem health and biodiversity in forests. PSW will work together with strategic partners to provide scientific knowledge, develop tools, and evaluate management options for restoring, sustaining and enhancing forest function, productivity and resiliency.

### “The Who”: Targeted Partners

PSW will strengthen current alliances that are proven successful, and develop new partnerships with organizations that are most likely to help PSW continue its emphasis on the four key focal areas

High-success partnerships will be distinguished by long-term involvement and a high degree of mutual and community benefit and shared ownership of the partnered efforts.

- Improve partnership between research and management by increased engagement with Forest Service Region 5 PSW will increase and enhance communication and collaboration with the Regional Office in Vallejo, California to further the success of such initiatives as the Region's

Landscape Conservation Plan; the preferred alternative for the new planning rule; and the expansion of job growth in local communities.

- Strengthen and expand opportunities with Native American, American Indian, Pacific Islander and other Tribal Organizations, and effectively engage with Tribes through the use of the USDA Tribal Consultation Policy. In succession with the Service-wide partnership strategy and in adherence with the USDA Tribal Consultation Policy, PSW will increase outreach to Tribal organizations to identify and collaborate on common resource goals and interests.
- Strengthen and expand opportunities with international partners. PSW will build upon its solid foundation of partnerships with international sectors and organizations to leverage scientific knowledge and conduct collaborative research on pressing natural resource issues. PSW will pay particular attention to issues affecting Micronesia and the other US-affiliated Pacific Islands.
- Fully activate our federal, state, and local partnerships, including partners such as USDA agencies, the Department of Interior and its component agencies, CalFIRE, and local power and water utilities.
- Broaden and increase partnerships with Universities, particularly those in California and Hawaii, in order to stimulate local economies, encourage student interest in the Forest Service, and continue tradition of scholarly excellence in the region.
- Strengthen and expand Memorandums of Understanding (MOUs) with minority-serving institutions and professional organizations. To further our outreach efforts, honor and respect the concepts of diversity and inclusion, and increase interest and knowledge of natural resource science in local communities.

### “The How”: Partnership Growth Strategies

Specific, internal strategies and methods for strengthening and increasing collaboration and partnerships in California, Hawaii and the Pacific Islands

- Continue integration of partnership strategies within existing and new Station strategic plans.
- Comply with the RSA rapid strategic partner assessment outlined by the national partnership strategy, through a SWOT or ROI analysis of

PSW’s current partnership and collaboration data, and an informal survey of existing investors/partners.

- More accurately track and manage partnerships and their outcomes through a more centralized information system, and ensure smooth transition through better use of “handover memos”
- Benchmarking-activities with other Forest Service Research Stations to collect best practices.
- Prospect research: explore options for establishing new strategic partners. Perform assessments of new strategic partners and establish investment strategies for those with strong potential.
- Assist with implementation of the US Forest Service 2011 Empowering Collaborative Stewardship Initiative (currently under development) to enhance the Forest Service’s capacity for community and citizen engagement.
- Establish incentives and program requirements to encourage large-scale public-private partnerships. As the Forest Service further implements the “all lands” concept of natural resource management, there is driving need to invest and build new capacity towards large-scale partnership efforts. The broad and diverse scale of such projects promotes the engagement of the full spectrum of partners and the potential leverage of investments for both the federal government and the private sector.
- Use creative media, marketing and communication tools to market PSW’s accomplishments and value as a strategic partner.
- Make partnerships part of leadership Performance Management standards to ensure that members of the Senior Leadership Team envision outreach and collaboration as essential components of job success.

## “The Why”: PSW Partnership Successes

Up-to-date examples of effective and fruitful collaboration between PSW and partner organizations

In fiscal year (FY) 2011, PSW’s partners contributed \$8.25 million through grants and agreements; when leveraged by the Station’s \$10.3 million in contributions, the total value of these partnerships exceeded \$18.5 million. PSW has chosen to highlight ten high-profile partnerships and projects in California, Hawaii and the US-affiliated Pacific Islands, which illustrate the value of effective collaboration in forest and rangeland research and development. These

innovations in shared stewardship are in alignment with the four key focus areas, and bring PSW and Forest Service R&D to greater light as an organization worthy of investment.

## Water Management and Restoration

**50 Years of Hydrologic Data at Caspar Creek:** For nearly half a century, the California Department of Forestry and Fire Protection (CDF) and PSW have cooperated in a comprehensive watershed study at the Caspar Creek Experimental Watersheds on Jackson Demonstration State Forest near Fort Bragg. When formal cooperation began in 1962 (Phase 1), the objective was to document hydrologic changes, erosion impacts, and sediment production resulting from road construction and logging second-growth forests. In the 1980s, Phase 2 began, with the principal objective to investigate potential cumulative watershed effects resulting from even-age (clear-cut) silvicultural activities using cable yarding techniques. Supplemental studies were designed to evaluate various flow routing and sediment transport processes, water quality, fisheries and other biological community responses. A third phase, which commenced in 2011, is comparing sediment projection from legacy sources with and without watershed rehabilitation and harvest. The Caspar Creek data represent the only long-term hydrologic information from managed second-growth conifer forests in the western U.S. Because of its long record and unique conditions, information from Caspar Creek will continue to be valuable to both the research and the land management communities as second- and third-growth forests are increasingly re-entered.

This long-term cooperation between CDF and PSW has been a productive division of labors. The two agencies have jointly decided which studies to undertake, with CDF supervising the construction and maintenance of research facilities and managing the experimental watersheds, and PSW designing the experiments and analyzing the data. Together, CDF and PSW have authored over 150 technical publications as a result of this joint effort. Results from the cooperative Caspar Creek research are being used by state and federal agencies charged with regulating how forestry practices affect flooding, water supply, water quality, riparian condition, aquatic habitat including endangered fish. Such a long-term research and management venture between a state and federal agency is unique. The results to date and a continuation of this cooperation will be priceless to future generations. Consequently, the Department of Forestry and Fire Protection and Pacific Southwest Research Station have agreed to continue cooperative research at the Caspar Creek Experimental Watersheds for the next 100 years.

**Improvement of the Salmon Life-Cycle Framework Model (inSALMO):** Spatially explicit, individual-based models hold great promise for evaluating the influence of physical and biological regimes on the dynamics of animal populations of special concern. Such models can address a variety of key management issues such as prioritization of habitat restoration, analysis of cumulative effects, impacts of invasive species and consequences of climate change. These models are also uniquely capable of evaluating the combined effects on populations of multiple environmental changes, such as habitat restoration, streamflow regulation and climate change. PSW scientists are collaborating with natural resource consultants Lang, Railsback and Associates to produce a spatially explicit, individual-based model for resident salmonid fishes. The objectives of the project are to increase the usability and broaden the applicability of a salmon lifecycle model (inSalmo), apply the model to evaluate habitat restoration, and identify future directions for productive application of the approach. The overall intent of the project is to increase the ability to link physical conditions and processes with salmon population dynamics. The project is expected to yield a model useful for the management of anadromous fishes, such as Chinook salmon in the Central Valley of California.

### Urban Natural Resources Stewardship

**Youth Outreach: The Richmond Edible Forest Project and the “Starts with a Seed” Program:** The city of Richmond represents one of the most diverse populations in Contra Costa County, California. It also has a high poverty rate: it is estimated that more than 13 percent of the residents live below the federal poverty level. But the Richmond Edible Forest Project hopes to help change those statistics by teaching local youth how to garden and produce a healthy food source for themselves and their communities. The Richmond Edible Forest Project is a joint venture between PSW and Urban Tilth, a nonprofit organization in West Contra Costa County. The partnership engages 700 underserved youth in education programs to learn how to install “edible forests” in Richmond parks and school areas. The edible forests are also environmental education sites where PSW scientists and Forest Service land managers can teach kids about the benefits of trees and forested landscapes. After the first edible forest garden is installed, the project will offer a series of 3-hour edible forest garden workshops for school and community gardeners and parks and recreation department staffs from across the Bay area. The Richmond Edible Forest Project continues to provide invaluable resources and training to employ youth to create, maintain and use gardens at multiple sites on public lands throughout the greater Richmond area.

The “Starts with a Seed” program is the result of a partnership between PSW and two State of Hawai’i public charter schools, with the intent of increasing environmental literacy and providing information for thoughtful life-style choices. The program provides a source of native plants for local restoration efforts and helps connect communities throughout Northeast Hawai’i and urban Oahu. The Hawaii charter schools provide greenhouses, locations for workshops, vans and buses for field/service learning trips, cultural knowledge, and time and energy to build and refurbish greenhouses. PSW and watershed partners contribute scientific knowledge, access to forests, and forest restoration sites. The program demonstrates increased “grow” literacy for participants through field-based learning, and workshops which reinforce and integrate current forest restoration practices with Hawaiian culture.

**Urban Forestry: Replicating the “Million Trees” Project in Denver and San Jose:** In 2006, Los Angeles Mayor Villaraigosa called upon PSW scientists to help determine if space exists in the city for one million additional trees, to identify potential tree planting sites, and to estimate future benefits from planting. Using geographic information systems, aerial photographs and remote sensing data, the PSW team found 2.4 million potential tree sites and estimated that over 35 years, one million new trees could capture 14-21 billion gallons of stormwater, reduce air pollution by up to 10,000 tons, and save about 1 million mega-watt hours of electricity. Needless to say, the Mayor was thrilled. The “Million Trees LA” Project has planted over 300,000 trees to date, and PSW has helped the program target residential neighborhoods and commercial areas with the least tree canopy cover. The City and County of Denver and the City of San Jose (with support from the CalFIRE Urban Forestry Leading Edge Grant) are now partnering with PSW to replicate the success of Million trees LA and design healthy urban forests in their communities.

### Wildland Fire & Fuels Research

**Reducing Fire Risk and Restoring Native Forests in Hawaii:** Over the past century, wildfire frequency and size have increased dramatically in Hawaii as a result of invasion by fire-promoting alien grasses. These grasses increase fine fuel loads and alter fuel structure in ways that multiply the likelihood of fire ignition and spread. Furthermore, fire effects and post-fire environmental conditions promote recruitment of alien grasses and inhibit recruitment of native woody species. These changes in community structure and composition result in fuel and microclimate conditions that further increase the likelihood of subsequent fire. In this way, alien grass invasion initiates a grass/fire

cycle that converts native forest to alien-dominated grassland. This cycle is now considered the primary agent of forest to grassland conversion in dry and mesic plant communities in Hawaii and elsewhere in the tropics.

The Department of Defense Strategic Environmental Research and Development Program (DoD SERDP) and PSW have created a collaborative research partnership to attend to the following ongoing project objectives: (1) further define the current condition and historical changes to tropical dry forest ecosystems in Hawaii, (2) develop technology for regional restoration planning and ecosystem monitoring, (3) quantify restoration potential and develop restoration prescriptions for remnant Hawaiian dry forests and shrublands, and (4) develop effective fuel and fire risk reduction measures that initiate succession of degraded grasslands into native woody communities.

Components of the field studies include addressing the major barriers to restoration—grazing by non-native ungulates, invasion of non-native grasses, lack of native species seed and/or propagules, and absence of suitable microhabitat for native species—in a sequential manner across native community types, and developing and testing the effectiveness of a firebreak design that incorporates traditional fuel breaks grading into “greenstrips” planted with fire-resistant native species. PSW researchers are working directly with the Pohakuloa Training Area Environmental Crew. Efforts to reduce fine fuel loading through restoration and greenstripping directly support fire management objectives for military training installations in dry forest regions. Results will jointly benefit a number of land management agencies in Hawaii and the Pacific, including DoD and the State of Hawaii Department of Land and Natural Resources.

**Evaluating the Utilization of Woody Biomass:** Biomass resources have the potential to serve as feed stock for alternative low-carbon transportation fuels such as compressed natural gas (CNG) and ethanol. A key policy concern is to determine how to procure these resources in a sustainable manner. California Assembly Bill (AB) 118 authorized public investment in research that evaluates the sustainability of forest biomass utilization, and required the California Energy Commission (CEC) to develop sustainability standards for projects funded through AB 118. PSW is partnering with CEC to find out where, when and how woody biomass utilization is sustainable. This research project will evaluate the impact of biomass utilization on fire behavior and carbon sequestration, and the resulting ecological and environmental impact on both treated and untreated stands, with and without wildfire. PSW and CEC will investigate the role of California Forest Practice regulations in addressing the sustainability of

forest biomass utilization. In addition, the economics of biomass utilization will be analyzed to identify dynamic interactions among biomass project design characteristics.

## Restoring Forest Resiliency

**The Tahoe Science Program: Helping to Restore Ecosystems in the Lake Tahoe Basin:** Historical land use activities in the Sierra Nevada region, including the Lake Tahoe Basin, have created ecosystems that are less resilient and less resistant to disturbances such as wildfire and insect and disease outbreaks. These ecosystems are also potentially vulnerable to climate change and its associated impacts. SNPLMA, enacted in 1998, specifically allowed for funding from the sale of public lands by the Bureau of Land Management (BLM) to be set aside in support of Lake Tahoe Restoration projects.

In 2006, PSW became the sole federal agency sponsor and assumed responsibility of administering SNPLMA funding as it related to research projects in the Lake Tahoe Basin. This resulted in the creation of the Tahoe Science Program, which identifies and facilitates funding of research projects high in technical merit and relevant to land management and regulatory agencies working in the Tahoe Basin. As part of the grant award program, the Tahoe Science Consortium (TSC) coordinates a competitive review process. The TSC and PSW work closely with one another throughout the review process to ensure that the review process is fair and that the research projects recommended for funding represent high quality science while addressing priority issues identified by agencies. Thus, through the Tahoe Science Program, PSW has an important role as the liaison between researchers and agencies working in the basin. In addition, PSW and the TSC work to promote outreach, synthesis, and integration activities to ensure that research supported by the Tahoe Science Program addresses key management questions, includes input from agencies, produces tools that are useful and accessible, fosters collaboration and communication, builds on previous research, and ultimately addresses the science needs identified in the Environmental Improvement Program.

**Monitor Air Quality in Canada:** The Wood Buffalo Environmental Association (WBEA) manages the largest airshed in the largest municipality in Canada. They operate the most extensive ambient air network in Alberta, with 15 air monitoring stations and 20 passive monitoring stations to date. WBEA programs include air, land and human exposure monitoring, in an area where the main industry is oil sands development. They developed an ongoing partnership with PSW scientists to determine the levels and extent of air pollutants, nitric acid and ammonia in the Athabasca

Oil Sands Region, for evaluation of their spatial and temporal distribution. Thus far, results of the study have shown that concentrations of both nitric acid and ammonia are elevated, particularly in the vicinity of major mining and oil extraction activities. Ammonia is of particular concern from a perspective of possible biological effects, because of its potential for direct toxic effect on lichens and its contribution to the elevated N dry deposition with possible negative consequences for forests and other ecosystems. The WBEA and PSW are continuing this important partnership to gather additional information that will allow researchers to increase their understanding of the effects of emissions on forests.

**The Effects of Forest Fragmentation and Nonnative Rats on Food Webs in Hawaii:** Ecologists have long sought to understand the role of predators as drivers of food web structure, with particular modern emphasis on omnivorous predators in complex communities. Ecologists have also attempted to elucidate the role of ecosystem size as another primary determinant of food web structure, with growing attention to habitat complexity and productivity for mechanistic explanations. However, despite advances within these areas, little is known about whether and how predators and ecosystem size interact to jointly influence food webs at landscape scales. PSW is partnering with Stanford University and the University of Hawaii, Hilo (U of H), to investigate the interactive effects of nonnative omnivorous rats and forest fragment size on arboreal arthropod food webs. Investigators are testing their hypothesis using a combination of i) experimental removal of rats, ii) experimental exclusion of insectivorous birds, iii) remote sensing analysis of ecosystem size, complexity and productivity, and iv) stable isotope analysis of food webs. They are conducting their research across a size gradient of naturally fragmented forests in Hawaii. This collaborative project is unique in that it enables the investigators to train 20 undergraduate summer interns from Stanford and U of H, which is an institution with

a successful record of training underrepresented and Native Hawaiian students in environmental sciences. Findings from the study will have immediate relevance for the conservation and restoration of upper elevation Hawaiian forests, most of which have been fragmented by pastoral land-use and development and impacted by introduction of rats and other nonnative predators. The investigation will improve the scientific basis for making effective management decisions, especially with regards to understanding how rat removal can be used to restore native-dominated food webs.

**Research Stations Working Together with the White Mountain Apache Tribe of Arizona:** Staff scientists from the Rocky Mountain Research Station and Pacific Southwest Research Station have engaged in a collaborative research partnership with the White Mountain Apache Tribe of Arizona for two decades. This partnership has resulted in on-the-ground restoration of dozens of culturally and ecologically significant wetland and spring ecosystems on tribal lands, expanded scientific knowledge as documented in dozens of research publications including peer-reviewed journal articles, and enhanced capacity within the tribal community to assess site conditions and design and implement restoration treatments. The broad and lasting impacts resulting from this unique partnership have been recognized in a forthcoming book on the Tribe's restoration efforts and in the Tribe's National Fire Plan Award for Excellence in Rehabilitation and Restoration. This collaborative effort represents significant progress in meeting priorities of the Chief of the Forest Service by promoting inclusiveness, fire-related research, restoration, and community engagement. Support for this effort has included a variety of grants from federal, state, and tribal entities, including the Tribe's Land Restoration Fund and a Forest Service Chief's grant. Sustained investment in this partnership and replication in other communities would continue to yield these important scientific, ecological, and community benefits.