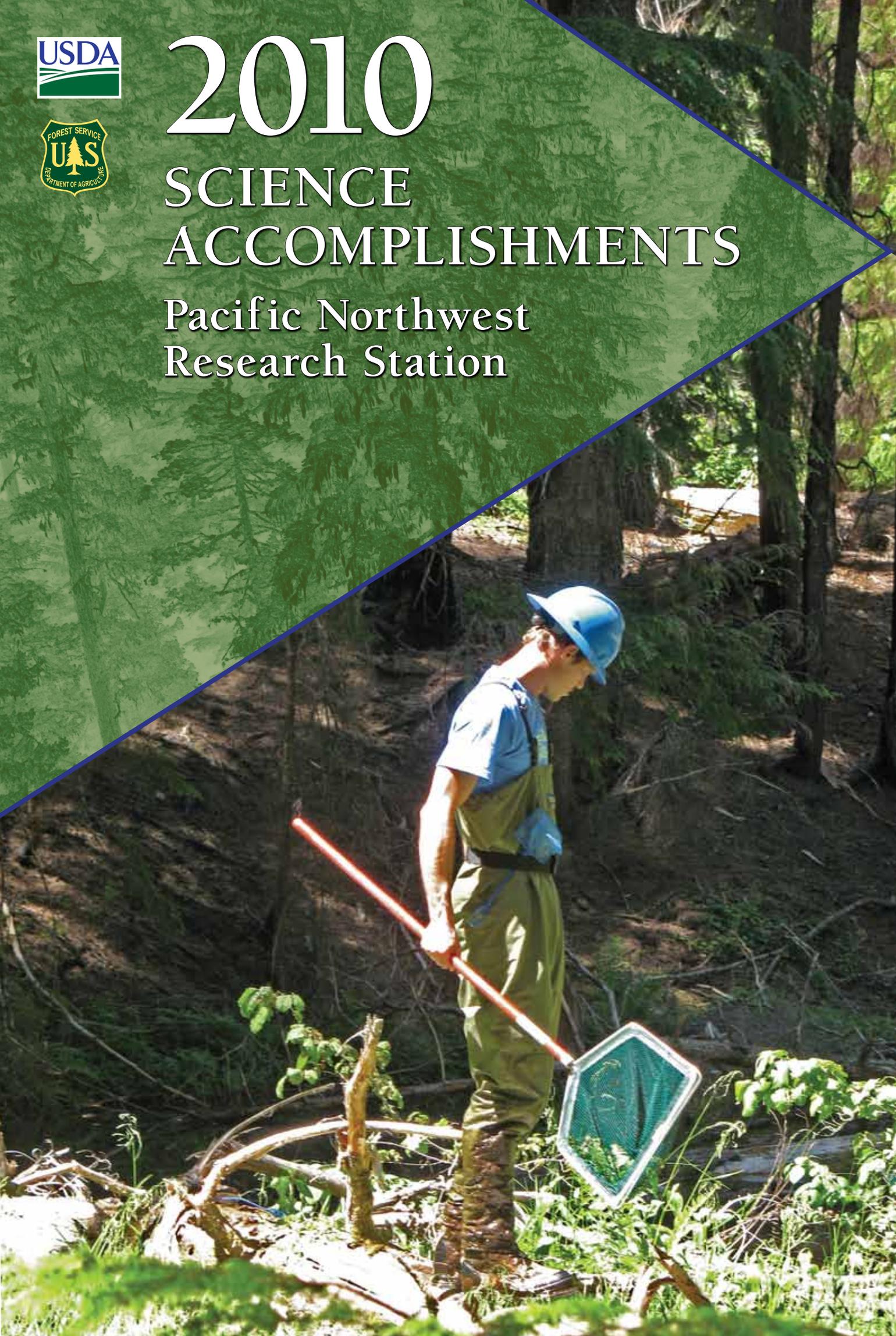


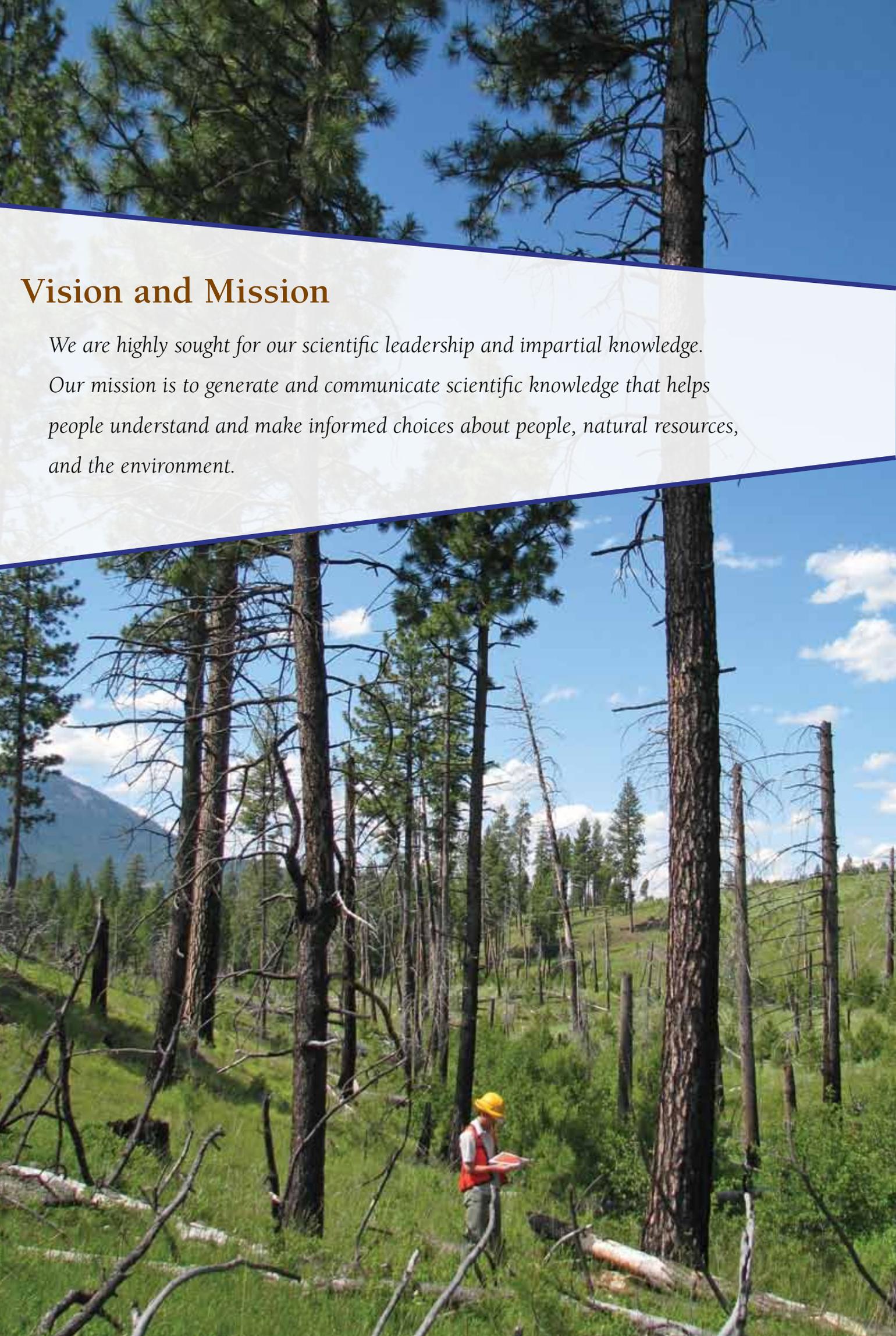


2010

SCIENCE ACCOMPLISHMENTS

Pacific Northwest Research Station





Vision and Mission

We are highly sought for our scientific leadership and impartial knowledge. Our mission is to generate and communicate scientific knowledge that helps people understand and make informed choices about people, natural resources, and the environment.

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A Message From the Station Director



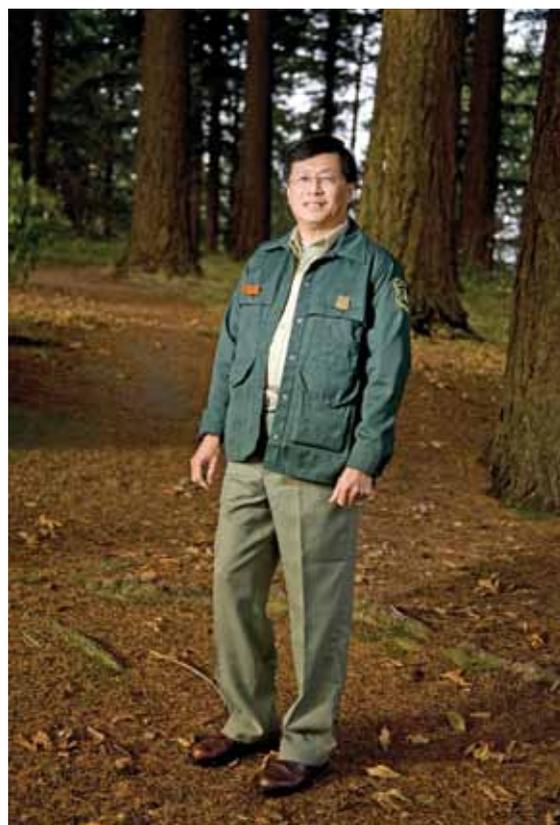
IN 2010, station researchers provided land managers and policymakers with critical information related to ecological processes, environmental threats, forest management, and use of natural resources.

The station also capitalized on opportunities to expand its research in these arenas. The 2009 American Recovery and Reinvestment Act was one such opportunity that has both created jobs and developed scientific knowledge that will enhance management of our natural resources. Thus far, 219 people have been employed with money the station received under the act. They have worked on projects that range from road maintenance to developing computer-based models that predict smoke impacts from wildfires. The variety of jobs created has provided opportunities for people with many different skill sets, illustrating the breadth of “green jobs” that strengthen the Nation’s economy.

An exciting development in 2010 was the creation of a new position within the station: Assistant Director for Program Development. Paul Brewster, formerly the Deputy Regional Forester in Alaska, joined the station’s executive team in this role. His experience in the National Forest System brings a user’s perspective to program development. I look forward to Paul strengthening existing partnerships and developing new ones that will lay the foundation for future research opportunities. This will help the station maintain its role as a major provider of science for natural resource management in the Pacific Northwest.

The station remains a leader in climate change research within the agency. The station co-sponsored the Forest Service’s first national workshop on climate change for national forest leadership and managers. Putting science into practice, our scientists have worked with the Olympic National Park and Olympic and Okanogan-Wenatchee National Forests to develop climate mitigation strategies. Expanding on these experiences, they drafted a guidebook for climate adaptation for all national forests. On a related front, the Climate Change Resource Center, initiated by the station in 2008, is now the agency’s official Web site for climate change research and includes information from all Forest Service research stations.

The year 2010 marked the 30th anniversary of Mount St. Helens’ eruption. I’m proud of the station’s leadership and support of ecological research on the flanks of the volcano over the last three decades. The work accomplished there has yielded information and methods adopted around the world.



Station Director Bov B. Eav.

Meeting the information needs of our clients is always important. One eagerly awaited product released in 2010 was the 5-year report on forest conditions and trends in Washington state produced by our Forest Inventory and Analysis team. The station has now published 5-year reports for Washington, Oregon, and California. The data and analyses in these reports are used by federal and state agencies and private firms. We established plots on the Hawaiian Islands, partnering with the Hawaii Division of Forestry and Wildlife and the Institute of Pacific Islands Forestry, and will begin inventorying the islands’ vegetation in 2011. The information yielded by this work will serve as a baseline against which to measure changes in the islands’ forest resources.

In 2011, I look forward to initiating an intensive inventory of our experimental forests, which range from the boreal forest in Alaska to tropical forests in Hawaii. I anticipate this boreal to tropical transect to provide valuable information related to climate change research.

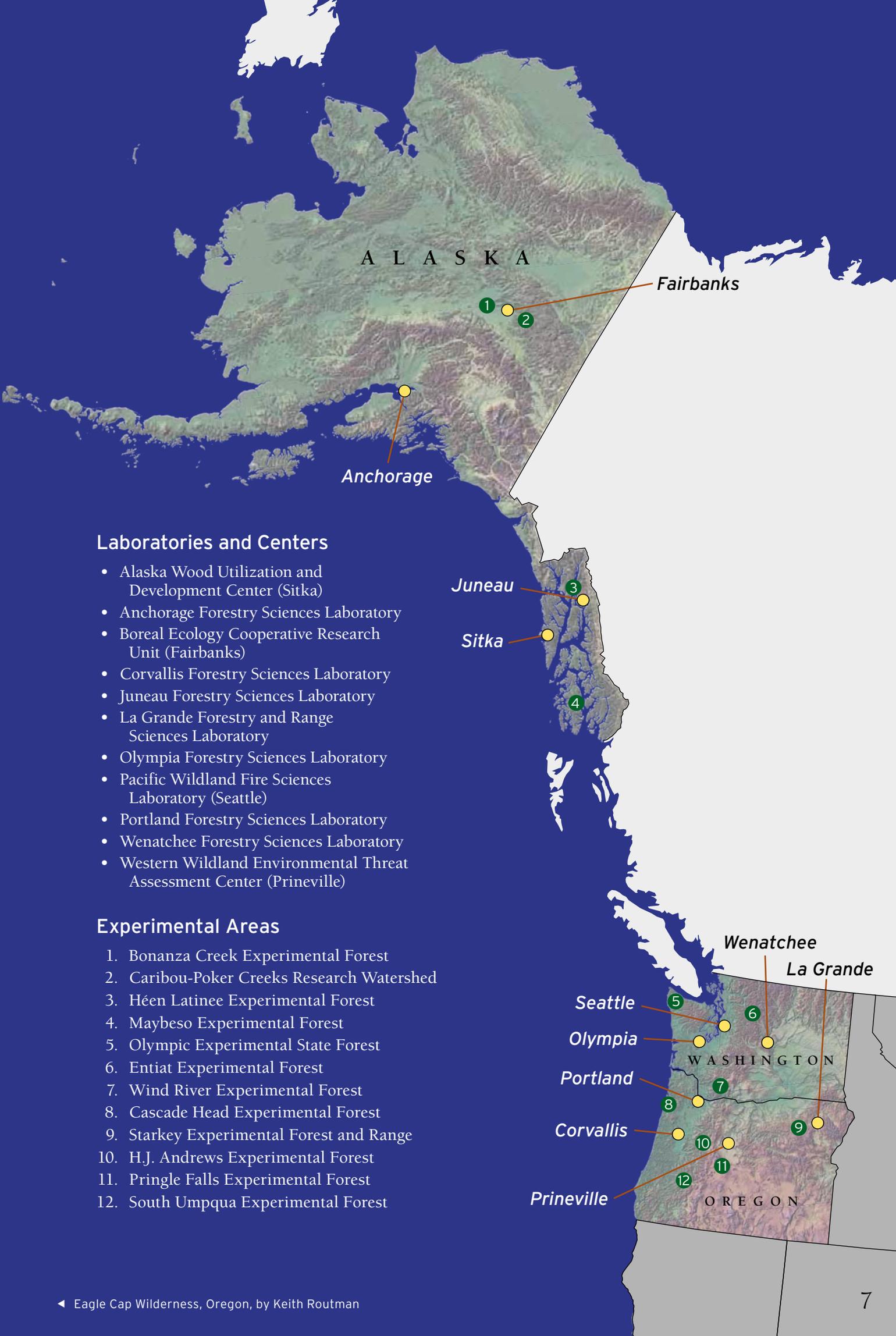
Our progress would not be possible without the dedication of our scientists, support staff, emeritus scientists, university partners, and collaborators at other federal, state, tribal, and nongovernmental organizations. I thank all of you and look forward to our work together in 2011.

Bov B. Eav, Station Director

Pacific Northwest Research Station: The Setting

- ▶ Headquarters in Portland, Oregon
- ▶ 11 laboratories and centers in Alaska, Oregon, and Washington
- ▶ 12 active experimental areas (forests, ranges, and watersheds)
- ▶ Research also conducted in more than 20 research natural areas
- ▶ Pacific Northwest Research Station is one of five research stations in the U.S. Department of Agriculture, Forest Service
- ▶ 405 employees (307 permanent, 98 temporary)





A L A S K A

Fairbanks

1 2

Anchorage

Laboratories and Centers

- Alaska Wood Utilization and Development Center (Sitka)
- Anchorage Forestry Sciences Laboratory
- Boreal Ecology Cooperative Research Unit (Fairbanks)
- Corvallis Forestry Sciences Laboratory
- Juneau Forestry Sciences Laboratory
- La Grande Forestry and Range Sciences Laboratory
- Olympia Forestry Sciences Laboratory
- Pacific Wildland Fire Sciences Laboratory (Seattle)
- Portland Forestry Sciences Laboratory
- Wenatchee Forestry Sciences Laboratory
- Western Wildland Environmental Threat Assessment Center (Prineville)

Juneau

Sitka

3

4

Experimental Areas

1. Bonanza Creek Experimental Forest
2. Caribou-Poker Creeks Research Watershed
3. Héen Latinee Experimental Forest
4. Maybeso Experimental Forest
5. Olympic Experimental State Forest
6. Entiat Experimental Forest
7. Wind River Experimental Forest
8. Cascade Head Experimental Forest
9. Starkey Experimental Forest and Range
10. H.J. Andrews Experimental Forest
11. Pringle Falls Experimental Forest
12. South Umpqua Experimental Forest

Wenatchee

La Grande

Seattle

Olympia

Portland

Corvallis

Prineville

5

6

7

8

9

10

11

12

WASHINGTON

OREGON

Highlights From 2010

Scientists at the Pacific Northwest (PNW) Research Station conduct research on a wide range of topics pertaining to the management and use of natural resources. Land managers and policymakers use the information and tools stemming from this research in their decisionmaking processes.

The following section highlights some key research underway in projects made possible by the 2009 American Recovery and Reinvestment Act and research in climate change, fire, and watershed health.

American Recovery and Reinvestment Act

Creating New Jobs While Promoting Healthy Ecosystems

The PNW Research Station has 10 economic recovery projects underway as part of the 2009 American Recovery and Reinvestment Act (ARRA). The projects address major issues including prioritizing fuel treatments in fire-prone forests, managing smoke impacts, improving salmon habitat, and enhancing natural systems in urban areas. See page 18 for the list of partners who received ARRA funding from the station.



ARRA projects in progress	Funding received in 2009	Amount expended as of Sept. 30, 2010	Number of individuals employed in 2010 with ARRA funding
10	\$14, 211,000	\$3,974,115	219

- ▶ An estimated 219 people have been employed with funds the station has provided to vendors and university and nongovernmental organization cooperators. The station has expended about 20 percent of its economic recovery funding and expects to provide funding for these organizations to hire more people over the next 2 years.
- ▶ The length of employment varies from seasonal to project completion. Most work will be wrapped up in 2 years.
- ▶ Many of the jobs offer training in addition to a paycheck. Workers gain unique expertise and skills that can be applied to future professional scientific careers.

Sophia Polasky

An unemployed returned Peace Corps volunteer was hired with ARRA funds to analyze data for a project examining how the economic recovery investments are affecting socioeconomic well-being in rural areas with high unemployment and poverty rates. “This job has been really beneficial,” says Polasky. “I’ve discovered I like doing research as a career, and now I am planning on getting a graduate degree in anthropology with a forestry focus.”



What job opportunities has ARRA created?

People with skill sets ranging from construction, to field data collection, to high-tech computer modeling have been hired. In particular, the station’s ARRA projects have created opportunities for young people to gain valuable scientific and technical experience that will prepare them for future “green” jobs targeted at improving environmental quality. Here are a few examples:

- ▶ 20 undergraduate interns were hired through the Hispanic Colleges and Universities’ internship program, which spans the United States and Puerto Rico, to assist with developing models to forecast and manage smoke from wildfires.
- ▶ 30 young adults were hired as interns through the University of Washington, Portland State University, Oregon State University, and the World Forestry Center’s Youth Inside Out Program.
- ▶ About 50 jobs for computer modelers, scientists, and support staff have been created in the station’s largest ARRA project to help prioritize fuel treatments.

Josh Halofsky



When he accepted his current ARRA-funded position with the PNW Research Station, the salary from Halofsky’s former job with the Washington Department of Natural Resources was used by the state agency to save a colleague’s job. Now Halofsky is building models that standardize data across Arizona, New Mexico, Oregon, and Washington as part of the Integrated Fuels Prioritization project.

He sees this as stepping stone in his career. “I’ll have publications and an increased skill set,” he explains, “I will have made a lot of great contacts, and I’ll have more experience running a team.”

Climate Change Research

Providing Information to Help Land Managers and Decisionmakers Plan for a Changing Climate

Managing a landscape, an ecosystem, or a forest stand in a changing climate can be daunting given the complexities inherent in climate change processes. Anticipating the effects of climate change requires a holistic understanding of the multiple interactions within and between physical, biological, economic, and social systems.

Looking at Global and Continental Change

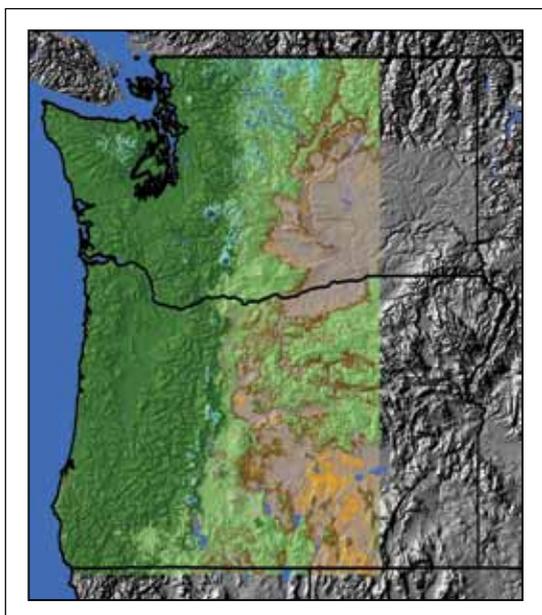
Accurately forecasting potential climate change impacts on terrestrial ecosystems is important for many reasons, including international negotiations on greenhouse gas emissions. The Mapped Atmosphere-Plant-Soil System (MAPSS) project produced simulations of projected vegetation changes worldwide. At a finer scale, simulations were produced for North America at an 8-kilometer resolution.

Use: These simulations were made available to the Intergovernmental Panel on Climate Change and will be available to the next U.S. National Assessment of the Potential Consequences of Climate Variability and Change.

Looking at Regional Change

Land managers charged with managing to promote resiliency in the landscape need to know the likely effects of climate change at a local scale. To address this need, the MAPSS project produced simulations of projected vegetation changes at 800-meter resolution for the western United States. Another study examined likely changes in forest productivity in Oregon and Washington, finding that production may decrease in some parts of the region and increase in others.

Use: This information helps land managers anticipate changes in species composition and production of ecosystem services.



MAPSS vegetation classification map under current climate.

Anticipating Climate-Related Disturbances

Climate change is anticipated to lead to changes in fire and flooding patterns. For example, in California, researchers found that **projected changes in fire behavior over the next century are sufficient to increase the number of fires that escape initial attack**, especially in shrub-covered wildlands.

***Use:** Relatively modest increases to existing firefighting resources appear to be sufficient to compensate for climate change-induced changes in wildland fire outcomes. This information was submitted to California's governor.*

Retreating glaciers in the Cascade Range are exposing unstable slopes of loose sediment susceptible to catastrophic failure and increasing the risk of massive debris flows during intense rainstorms. Such an event in 2006 closed Mount Rainier National Park for 6 months while roads, bridges, and other facilities were repaired.

***Use:** The Forest Service and National Park Service are using this information to reassess the risk to downstream infrastructure.*



Fire Research

Managing the Landscape Before, During, and After Wildfire

The spectrum of fire-related research conducted by station scientists yields information that is used by land and fire managers before, during, and after wildfires. Findings from 2010 furthered understanding of fire behavior, the effectiveness of different fuel reduction techniques, the possibility of restoring native fisheries and wildfire to the landscape, and public awareness about fire risk.

Before the Fire

Thinning is one way to reduce potential fuel. Scientists found, however, that **multiple treatments are likely needed to restore resiliency in fire-adapted ecosystems**, and that thinning followed by prescribed burning was more effective at reducing wildfire severity than thinning alone.

Fire Behavior

Understanding fire and smoke dynamics is vital to ensuring the health and safety of firefighters and nearby communities and other valued resources. Scientists worked with fire managers in the United States and abroad, contributing information that will predict what fire and smoke will do under different conditions.

Public Awareness

If given the chance, fire readily burns across property lines. Gauging public awareness of fire risk and receptivity to risk-reduction activities can help decisionmakers know where to best direct resources and tailor outreach programs to specific audiences.



Tom Iraci

Scientists surveyed private forest and range landowners in eastern Oregon and found that most have treated their land to reduce the risk of wildfire. However, **owners indicated that they lacked sufficient resources to offset the costs of hazardous fuel reduction**, and that they would benefit from cost share funds and markets for logs and wood products generated through thinning.

Public education may be warranted in Colorado, where a survey of homebuyers in Colorado Springs found that most were unaware they were purchasing a home in an area at risk of wildfire.

New Fire Tools

- ▶ **The Fuel Characteristic Classification System (FCCS), Version 2.1:** Predicts surface fire behavior outputs including reaction intensity, flame length, rate of spread, crown fire, and available fuel potential. Available at <http://www.fs.fed.us/pnw/fera/fccs/>

Users: *FCCS is being used on the Okanogan-Wenatchee National Forest, in central Oregon, and in the Lake Tahoe basin for fire hazard planning and evaluating fuel treatment effectiveness.*

- ▶ **Web Tools for Smoke and Fire:** Centralizes access to a number of air quality tools, making it both easier and faster to obtain information for planned prescribed fires and (unplanned) wildland fires. Available at <http://firesmoke.us/wfdss/>

Users: *Incident command teams on wildland fires and land managers involved in prescribed fire operations needing to know how their fires will affect air quality.*

- ▶ **Hand-Piled Fuels Biomass Calculator:** Allows the user to estimate, from easily measured dimensions, the volume and biomass of hand-piled fuels and the emissions produced when those piled fuels are burned. Available at <http://depts.washington.edu/nwfire/handpiles>.

Users: *This calculator was developed to help fuel managers and air quality regulators manage hand-piled fuels and coordinate and mitigate piled fuel disposal through prescribed burning.*

- ▶ **Reference Guide on the Effects of Fire, Insect, and Pathogen Damage on Wood Quality of Dead and Dying Western Conifers:** Summarizes information on deterioration rates for western conifers and the potential suitability of the wood for commercial use. Available at <http://www.treesearch.fs.fed.us/pubs/35067>.

Users: *Land managers evaluating whether to leave or remove dead or dying trees in a stand.*



Watershed Health

Understanding the Links Between Aquatic and Terrestrial Processes

A watershed approach to management requires understanding the connections between terrestrial and aquatic ecosystems in the upper and lower reaches of a drainage. In 2010, station researchers conducted studies yielding information that can be used to maintain the many processes that comprise a healthy watershed.

Restoring Salmon Habitat



Pete Bisson

Considerable resources have been directed to salmon restoration efforts. Are they making a difference? Scientists found that in-stream habitat restoration structures in Columbia Basin watersheds do make detectable short-term, small-scale improvements in fish populations. The effectiveness of built habitat structures, however, may differ for various salmon species and can be difficult to discern owing to variation over time in the abundance of fishes or the quality of other habitat attributes.

Use: *This information was shared with stakeholders interested in salmon recovery and effective intervention treatments.*

Maintaining Integrity of Riparian Areas

Riparian ecosystems are particularly sensitive to the threat of invasive plants and the herbicides commonly used in uplands to control such invaders. As an alternative to herbicides, researchers tested the effectiveness of using flea beetles to control leafy spurge, an invasive weed that has appeared along streams throughout much of the country. They found that releasing large numbers of the beetle (50 per stem) effectively reduced the weed.

Use: *This technique is now being used in Idaho, Utah, and Wyoming, including the Yellowstone and Teton ecosystems.*

Coordinating Management

Scientists and natural resource managers identified key threats to Northwest amphibians and reptiles. They found that these species of concern would likely benefit from standardized regulations for managing native and nonnative species, increased use of data management programs, and jurisdictional stewards for these species to serve as liaisons among fisheries, wildlife, and forestry departments.

Use: *In Oregon, three federal agencies are implementing a conservation strategy for the Siskiyou Mountains salamander on federal lands. The U.S. Fish and Wildlife Service is using this strategy for another salamander species in New Mexico.*

Working With Watershed Councils

Locally organized watershed councils can be effective forums leading to improved water quality and fish and wildlife habitat. Researchers working with the Long Tom Watershed Council in western Oregon found that restoration projects were possible in watersheds under diverse ownership if local landowners were included in initial development of goals and guidelines for restoration work and in ecological monitoring. They also found that by integrating local knowledge, responding to the fears and concerns of local residents, and explaining the reasons for the work undertaken, successful, coordinated watershed-wide restoration planning can occur.

Use: *This information can be used by other watershed councils interested in developing coordinated watershed management that is responsive to ongoing scientific learning.*

New Tools

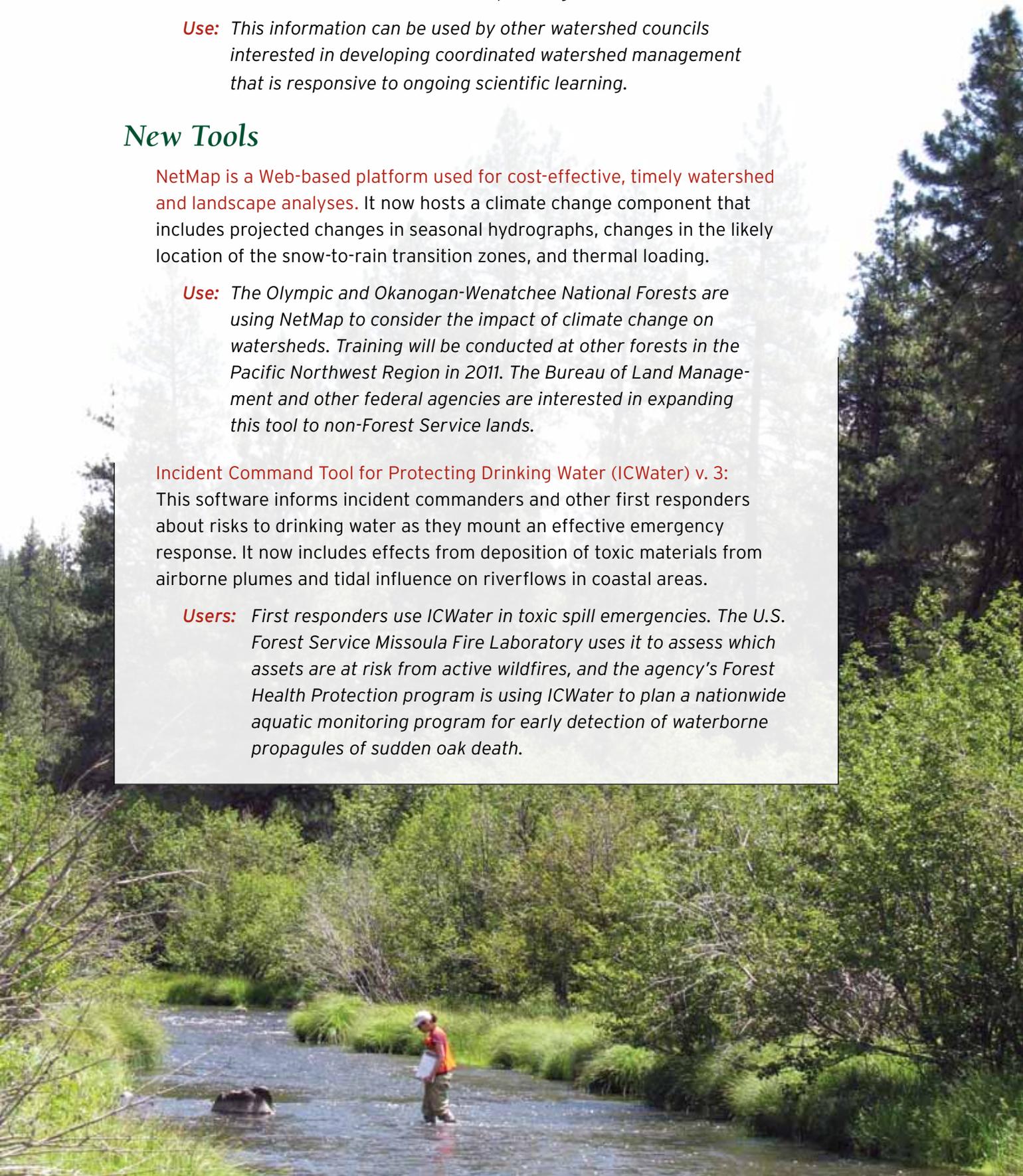
NetMap is a Web-based platform used for cost-effective, timely watershed and landscape analyses. It now hosts a climate change component that includes projected changes in seasonal hydrographs, changes in the likely location of the snow-to-rain transition zones, and thermal loading.

Use: *The Olympic and Okanogan-Wenatchee National Forests are using NetMap to consider the impact of climate change on watersheds. Training will be conducted at other forests in the Pacific Northwest Region in 2011. The Bureau of Land Management and other federal agencies are interested in expanding this tool to non-Forest Service lands.*

Incident Command Tool for Protecting Drinking Water (ICWater) v. 3:

This software informs incident commanders and other first responders about risks to drinking water as they mount an effective emergency response. It now includes effects from deposition of toxic materials from airborne plumes and tidal influence on riverflows in coastal areas.

Users: *First responders use ICWater in toxic spill emergencies. The U.S. Forest Service Missoula Fire Laboratory uses it to assess which assets are at risk from active wildfires, and the agency's Forest Health Protection program is using ICWater to plan a nationwide aquatic monitoring program for early detection of waterborne propagules of sudden oak death.*



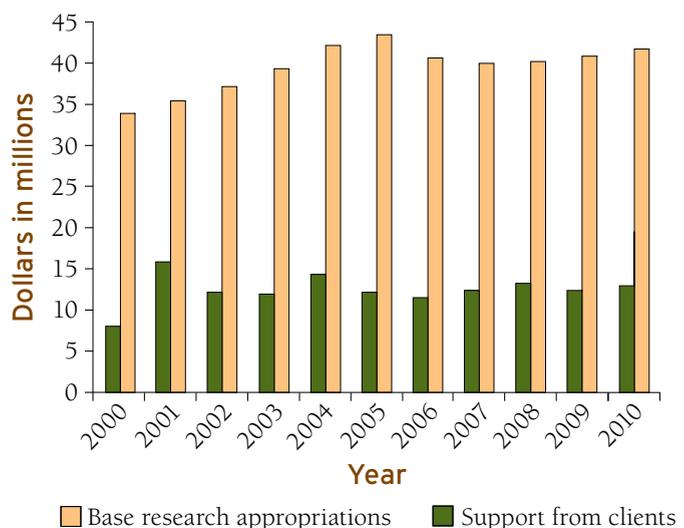
Finances and Workforce

Two sources of funding support the workforce of the Pacific Northwest (PNW) Research Station: federal appropriations, which contribute the greatest percentage of funds, and direct client support, which comes from organizations in need of scientific information.

The numbers below are for the fiscal year: October 1, 2009, to September 30, 2010

*Incoming funding**

- ▶ Base research appropriations: \$41.7 million
- ▶ Client support: \$13.0 million
- ▶ Total funding: \$54.7 million



*Distribution of funds**

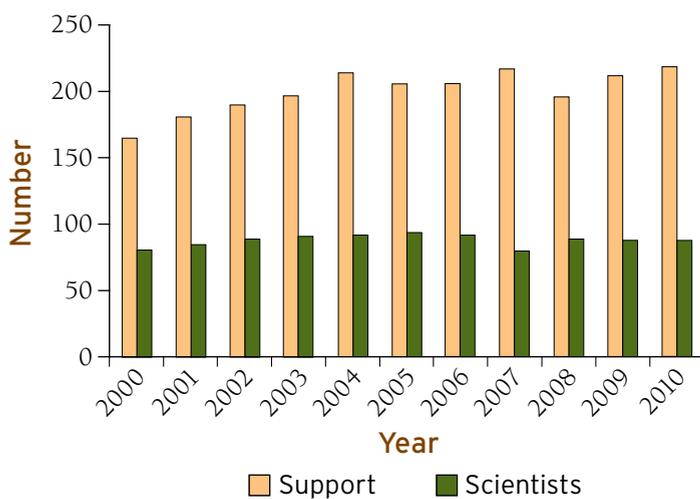
- ▶ Permanent employee cost: \$30.0 million (54.9%)
- ▶ Support and operations: \$14.3 million (26.1%)
- ▶ Distributed to cooperators: \$10.4 million (19.0%)
- ▶ Of \$10.4 million to cooperators, 86.5% went to educational institutions

* Does not include funds from the American Recovery and Reinvestment Act (ARRA). See page 9 for details on these funds.

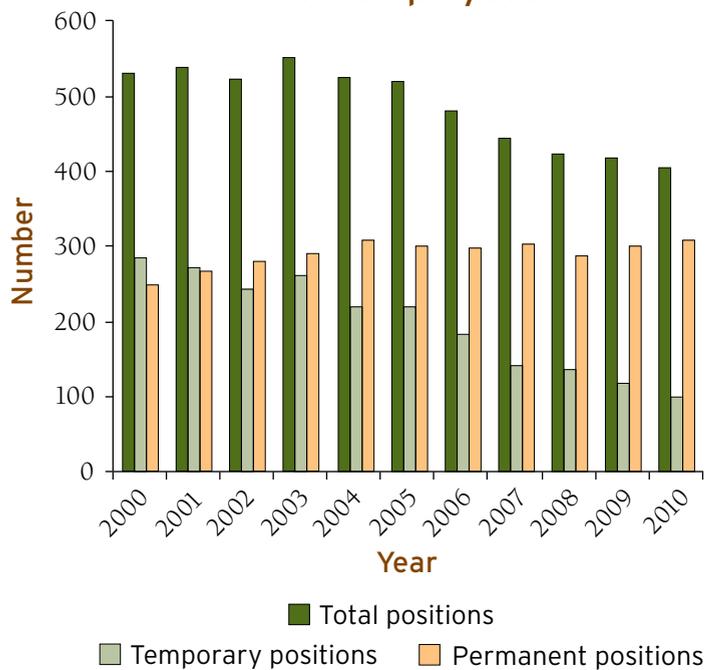
Workforce statistics:

- ▶ Total station workforce: 405 employees
- ▶ Permanent workforce: 307 employees
- ▶ Of the permanent workforce, 88 employees (28%) are scientists
- ▶ Temporary workforce: 98 employees

Permanent employees by type



Total employees



Funding Partners for 2010

Cooperators Who Received Funding From the PNW Research Station for Studies

Note: cooperators funded all or in part by the American Recovery and Reinvestment Act are marked by an asterisk (*)

Educational Institutions

Auburn University*
California Polytechnic State University*
Colorado State University
Eastern Oregon University
Fort Lewis College*
Loyola University
Montana State University, College of Engineering,
Western Transportation Institute
Ohio State University Office of Sponsored Programs
Oregon State University*
Portland State University*
Southern Oregon University*
University of Alaska Fairbanks
University of Arizona, Department of Anthropology
University of Arizona, International Arid
Lands Consortium
University of Hawaii at Hilo
University of Idaho
University of Minnesota
University of Montana
University of New Mexico*
University of Oregon
University of Redlands
University of Vermont and State Agricultural College
University of Washington
Virginia Polytechnic Institute and State University
Washington State University
Western Washington University

Native Tribes

Douglas Indian Association, Juneau, Alaska

Other Federal Agencies

Department of Commerce, National Oceanic
and Atmospheric Administration, National
Marine Fisheries Service
Department of Defense, U.S. Army Corps of
Engineers, Institute for Water Resources
Department of the Interior, Bureau of
Land Management

State Agencies

Oregon Department of Forestry*

Municipal and County Agencies

Hillsboro, Oregon, Clean Water Services
King County, Washington

Nongovernmental Organizations

Cascade Land Conservancy*
Cascadia Conservation District*
Conservation Biology Institute*
Desert Research Institute
Earth Systems Institute*
Juneau Economic Development Council
Mount St. Helens Institute
National Council for Air and Stream Improvement
The Institute for Culture and Ecology*
Western Forestry and Conservation Association
World Forestry Center*

Private Industry and Associations

Essa Technologies, Ltd.
MacGregor Bates, Inc.

Foreign Institutes

New Zealand Forest Research Institute (Scion)

Clients Who Provided Funding to the PNW Research Station for Studies

Educational Institutions

Evergreen State College
University of California

Other Federal Agencies

Department of Agriculture, Agricultural
Research Service
Department of Agriculture, Office of the Chief
Economist, Climate Change Program Office
Department of Commerce, National Oceanic
and Atmospheric Administration, Fisheries
Science Center
Department of Commerce, National Oceanic
and Atmospheric Administration, National
Marine Fisheries Service
Department of Defense, U.S. Army Corps of
Engineers, Institute for Water Resources
Department of Defense, U.S. Army, Joint
Base Lewis-McChord
Department of the Interior, Bureau of
Land Management

Department of the Interior, Fish and Wildlife Service
Department of the Interior, Geological Survey
Environmental Protection Agency
National Aeronautics and Space Administration,
Goddard Space Flight Center

State Agencies

Alaska Department of Fish and Game
Oregon Watershed Enhancement Board

Municipal Agencies

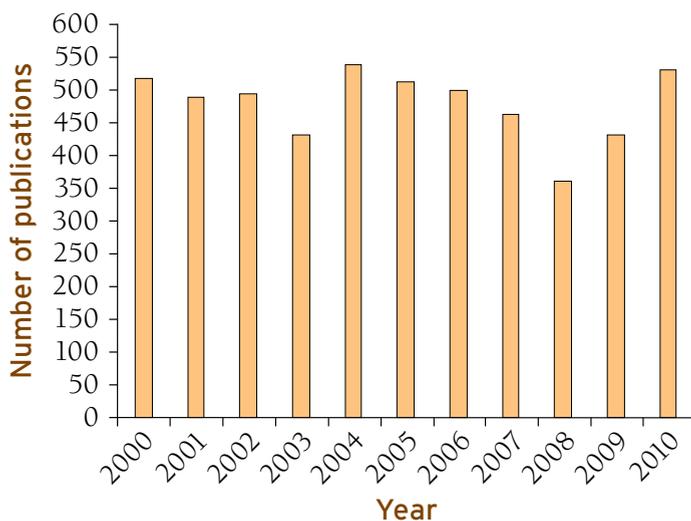
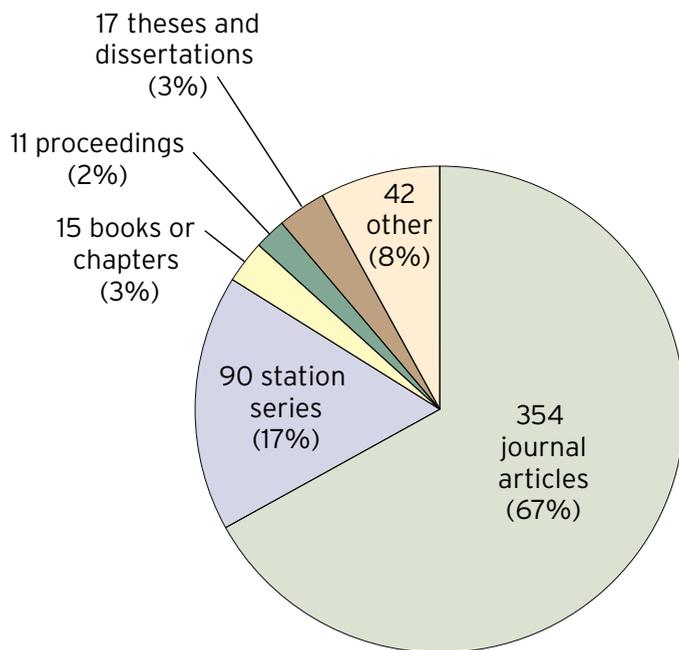
East Bay Regional Park District

Nongovernmental Organizations

Eco Logical Research
Institute for Systems Biology
Northwest Power and Conservation Council
Rocky Mountain Elk Foundation
The Nature Conservancy
The Wolverine Foundation, Inc.

Publications

- ▶ **529 total publications.** (This includes station series publications, journal articles, books or book chapters, theses and dissertations, and other publications.)
- ▶ **142,591 hardcopies** of station publications distributed.
- ▶ **1,876 station series publications available online** via the station's Web site and Treearch (<http://www.treearch.fs.fed.us>).
- ▶ **10 issues of *PNW Science Findings*** published, about 9,800 copies of each issue distributed.
- ▶ **250 followers of the station's Twitter account**—up from 100 in 2009. Reporters, fire professionals, and nonprofit groups make up the majority of subscribers who receive instant electronic alerts (tweets) to station news releases, new publications, and other information.

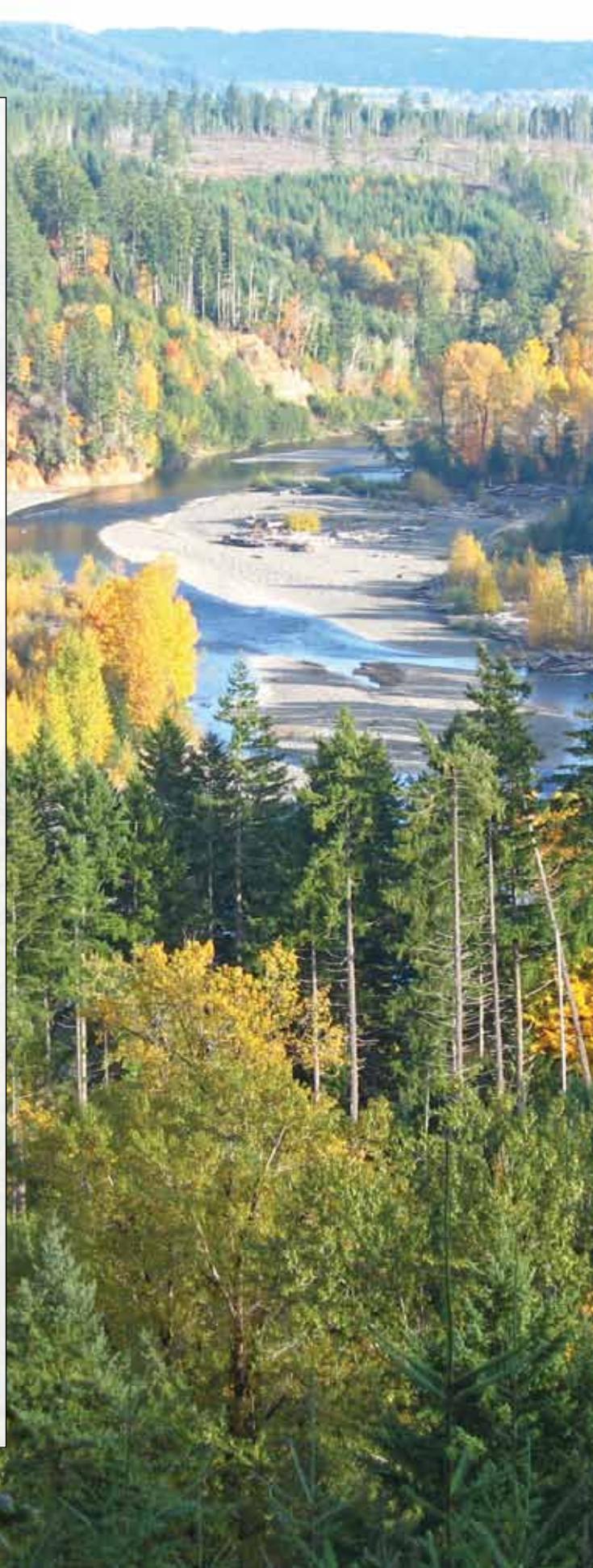


Climate Change



Key Findings and Products

- ▶ Global simulations of the effects of climate change on terrestrial ecosystems were published and made available to the Intergovernmental Panel on Climate Change. Higher resolution simulations for North America (8-kilometer resolution) and the U.S. West (800-meter resolution) were released for testing by stakeholders.
- ▶ The Climate Change Resource Web site becomes the Forest Service's national Web site for climate change research and development.
- ▶ The station co-sponsored the Forest Service's first national workshop on climate change adaptation as part of the Westside Climate Initiative. The event and resulting guidebooks provide the scientific basis for planning and decisionmaking in relation to climate change across all national forests.
- ▶ The *Water, Climate Change, and Forests* report is published and distributed to all units in the National Forest System, the Western Governors Association, and others.
- ▶ Strategically placing dispersal corridors for headwater species allows populations to move across ridgelines in response to climate change and maximizes existing protected areas.
- ▶ Potential forest productivity in Oregon and Washington over the next century varies for different climate scenarios.
- ▶ Cascade Range volcanoes may be at greater risk for debris flows as climate warms. As glaciers retreat, loose sediment is exposed on the steep flanks of the volcanoes, potentially forming destructive debris flows during intense rainstorms.
- ▶ Climate change is predicted to produce more extreme wildfire behavior and lessen the success of initial suppression efforts in California.





Tools

Analyzing climate change effects on wildlife and habitats in the western Arctic, Alaska

Description:

This work provides a template and procedure for combining sources of models, data, and expert knowledge pertaining to forecasting climate change effects on hydrology, vegetation, wildlife habitats, and wildlife species.

Use:

This template and procedure is being used to guide the U.S. Geological Survey's "Wildcast" Program on forecasting climate change effects.

How to get it:

Contact Bruce Marcot, bmarcot@fs.fed.us,
Ecological Process and Function Program

NetMap, now with climate change component

Description:

NetMap is a Web-based platform for doing cost-effective, timely watershed and landscape analyses. NetMap contains models that allow the user to conduct analyses on various parameters that influence aquatic ecosystems such as wood recruitment, erosion sources, and potential habitat. It now hosts a climate change component that includes projected changes in seasonal hydrographs, changes in the likely location of snow-to-rain transition zones, and thermal loading.

Use:

Personnel on the Olympic and Okanogan-Wenatchee National Forests attended workshops to learn how to use NetMap to consider the impact of climate change on watersheds. Training will be conducted at other forests in the Pacific Northwest Region in 2011. The Bureau of Land Management and other federal agencies have expressed interest in expanding this work to non-Forest Service lands.

How to get it:

<http://www.netmaptools.org/>

Contact:

Gordon Reeves, greeves@fs.fed.us,
Land and Watershed Management Program

Global to regional simulations of climate change on terrestrial ecosystems now available



ACCURATE FORECASTING of potential climate change impacts on terrestrial ecosystems is critically important for many reasons, including international negotiations on greenhouse gas

Use: International organizations to private landowners request climate change simulations.

emissions. Global to continental-scale carbon balance and vegetation change could enhance or diminish climate change over the next century via trace gas and other biophysical feedbacks. At landscape to regional scales, however, land managers are concerned about potential forest dieback, changes in species composition, possible catastrophic disturbances, and decline or changes in ecosystem services.

The Nested Scale Experiment is the latest endeavor of the Mapped Atmosphere-Plant-Soil System (MAPSS) project. It addresses natural resource management questions at global, continental, regional, and local scales by attempting to sample the range of uncertainties in future climate scenarios, as well as the scaling of uncertainties from coarse to high-resolution grids. The model simulations are developed to

help ecosystem planners and managers at all scales answer two fundamental questions: How will climate change affect ecosystem structure and composition? How will climate change affect ecosystem function (goods and services)?

A sample of the global-scale portion of these massive simulations has been published. The complete results present a formal uncertainty analysis of ecosystem change under climate change and will be available to the Intergovernmental Panel on Climate Change, the next U.S. National Assessment of the Potential Consequences of Climate Variability and Change, and all other stakeholders. Simulations for North America (8-kilometer resolution) and for the U.S. West (800-meter resolution) were presented at national and regional workshops and released for testing. Federal and state agencies, local and regional governments, nongovernment organizations, and private landowners have requested use of the simulation outputs.

Contact: Ron Neilson, rneilson@fs.fed.us, Ecological Process and Function Program

Partners: USDA Forest Service Northern, Pacific Southwest, and Rocky Mountain Research Stations; USDI Bureau of Land Management, Bureau of Reclamation, and National Park Service; state and local governments; universities; and nongovernmental organizations

For more information:
<http://www.fs.fed.us/ccrc/video/skamaniam.html>

Jon Williams



South-central Alaska.

Climate Change Resource Center Web site goes national



THE CLIMATE CHANGE Resource Center was initiated in 2008 by the Pacific Northwest Research Station. The Web site quickly became a collaborative project involving the Pacific Southwest and Rocky Mountain Research Stations. It was designed to provide information, access to relevant research findings, decision-support, and other tools to help land managers develop adaptation and mitigation strategies for climate change. Its resources include video lectures, searchable libraries, selected tools, and the latest information about potential impacts to natural resources under various future climate scenarios.

In 2010, the Climate Change Resource Center became the Forest Service's national Web site for climate change research and development. It now includes information from research stations across the Forest Service. Land managers, reporters, and interested members of the public from around the country can now find information relevant to their region, placed within the context of global change. The number of visits to the site has steadily grown as more people learn about this resource. In 2010, the site had 108,297 page views from 174 countries.

Contact: Michael Furniss, mfurniss@fs.fed.us, Communications and Applications Group

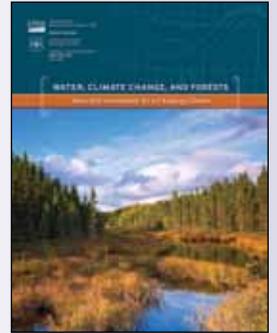
Partners: USDA Forest Service Northern, Pacific Southwest, Rocky Mountain, and Southern Research Stations, Eastern Forest Environmental Threat Assessment Center, Western Wildland Environmental Threat Assessment Center

For more information: <http://www.fs.fed.us/ccrc/>

Water, Climate Change, and Forests provides framework for watershed stewardship

WATER FROM forested watersheds provides irreplaceable habitat for aquatic and riparian species and supports our homes, farms, industries, and energy production. Secure, high-quality water from forests is fundamental to our Nation's prosperity and is our stewardship responsibility. Yet population pressures, land uses, and rapid climate change combine to seriously threaten these waters and the resilience of watersheds.

Water, Climate Change, and Forests: Watershed Stewardship For a Changing Climate, published by the station, provides a framework for watershed stewardship in a rapidly warming world. It identifies steps for thinking, collaborating, and acting to implement practices that maintain and restore watershed processes and services.



The report was distributed to all units in the National Forest System. The Rocky Mountain Region of the Forest Service funded a second printing and distributed 1,200 additional copies. The Western Governors Association gave one to each of its members. The report's lead author received a personal note of appreciation from the Secretary of Agriculture.

Contact: Michael Furniss, mfurniss@fs.fed.us, Communications and Applications Group

Partners: USDA Forest Service National Forest System, Northern, Pacific Southwest, and Rocky Mountain Research Stations, State and Private Forestry

For more information: Furniss, M.J.; Staab, B.P.; Hazelhurst, S. [et al.]. 2010. Water, climate change, and forests: watershed stewardship for a changing climate. Gen. Tech. Rep. PNW-GTR-812. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 75 p. <http://www.treeseearch.fs.fed.us/pubs/35295>

Adapting to climate change: a short course for land managers

THIS SHORT COURSE summarizes the state-of-the-science for natural resource managers and decision-makers regarding climate variability, climate projections, and ecological and management responses

Use:
DVD distributed
at 2009 U.N.
Climate Change
Conference in
Copenhagen.

to climate variability. The information and talks included were produced from a July 2008 workshop at the H.J. Andrews Experimental Forest that brought together key U.S. Forest Service

and U.S. Geological Survey scientists, and a select group of pioneering resource managers who served as reviewers.

The short course was produced as a DVD, which was approved by the U.S. State Department and

Michael Furniss



Scientists and land managers discuss climate change mitigation strategies.

distributed at the 2009 U.N. Climate Change Conference in Copenhagen. Smartphone versions of the lectures were also produced. The short course was sent to all units within the National Forest System, and some are using it in weekly seminars.

Contact: Michael Furniss, mfurniss@fs.fed.us, Communications and Applications Group

Partners: USDA Forest Service Pacific Southwest and Rocky Mountain Research Stations, White River National Forest; University of Washington; U.S. Geological Survey

For more information: Furniss, M.J.; Millar, C.I.; Peterson, D.L. [et al]. 2009. Adapting to climate change: a short course for land managers. [DVD]. Gen. Tech. Rep. PNW-GTR-789. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. <http://www.treearch.fs.fed.us/pubs/34229>

Smartphone version:
http://www.fs.fed.us/ccrc/hjar/index_st.html

Station co-sponsors agency's first national workshop on climate change adaptation



THE STATION played a lead role in developing and convening “Adapting to Climate Change on National Forests: A Workshop for Resource Managers” in April, 2010. The workshop for national forest leadership, managers and others focused on processes used to facilitate learning about climate change science, vulnerability assessment of resources to climate change, adaptation to climate change across diverse resource disciplines,

and implementation of adaptation in planning. It provided a forum for distributing a draft guidebook for climate change adaptation in national forests and discussing how the principles being employed on the Olympic National Forest and in Olympic National Park can be used and emulated at other locations. Small group discussions provided an opportunity for learning, sharing of information, and development of recommendations to national leadership regarding climate change adaptation. The workshop and resulting guidebooks were a major milestone in the nascent effort by the Forest Service to prepare for climate change. They provide the scientific basis for planning and decisionmaking across all national forests and fostered the learning and communication needed by various management units to move forward with climate change adaptation.

Contact: David L. Peterson, peterson@fs.fed.us, Threat Characterization and Management Program

Partners: USDA Forest Service, Pacific Southwest and Rocky Mountain Research Stations

Collaborative learning efforts are needed to deal with climate change

CLIMATE CHANGE adaptation strategies for federal forests require an integrated socioecological perspective. The recent shift toward ecologically based forest management provides a good starting place for conserving biological diversity under climate change. Nevertheless, undesirable changes in species and ecosystems will occur, and a number of adaptive actions could be undertaken to lessen the effects of climate change.

Current environmental policies appear to be flexible enough to accommodate many adaptive actions. It is less certain, however, if sufficient social license and economic capacity exist to undertake these actions. Given the history of contentious debate about federal forest management in the Pacific Northwest, it is likely that some of these actions will be seen as double-edged swords, spurring social resistance, especially where actions involve cutting trees. If society and managers are to learn how to think about climate change and implement adaptive actions, collaborative learning efforts need to be rejuvenated and expanded.

This research fills a knowledge gap on how social dimensions influence the development and implementation of adaptive strategies for climate change in the Pacific Northwest. The findings are being used in discussions with managers from the Pacific Northwest Region and Willamette National Forest on how to develop strategies for dealing with climate change at multiple scales.

Contact: Tom Spies, tspies@fs.fed.us, Ecological Process and Function Program

Partner: Oregon State University

Pilot project yields watershed vulnerability assessments for 11 participating forests

PROLONGED DROUGHT, extreme floods, and water quality problems are likely to be intensified by climate change in most regions of the United States. However, watersheds differ greatly in their vulnerability and resilience to climate change. To build and restore resiliency in a watershed, people need to identify and understand its vulnerabilities. It is

essential to map watershed vulnerabilities when crafting strategies that will provide critical water and aquatic habitats in the coming decades.

A station hydrologist is leading a watershed vulnerability assessment project on 11 national forests throughout the country. Researchers and forest managers are collaborating on this pilot project to evaluate the risks that climate change poses to important water resources on each participating forest. The working group uses a Web site to provide science support and facilitate collaboration among members. Each forest has prepared a draft that assesses watershed vulnerability at the sub-basin, watershed, and subwatershed scales. The next step will be identifying priority areas and developing recommendations for reducing vulnerability and building resilience on each forest.

Contact: Michael Furniss, mfurniss@fs.fed.us, Communications and Applications Group

Partners: USDA Forest Service Pacific Northwest Region, Rocky Mountain Research Station, Chaquamegon-Nicolet, Chugach, Coconino, Gallatin, Grand Mesa-Uncompahgre, Helena, Ouachita, Sawtooth, Shasta-Trinity, Umatilla, and White River National Forests



Tom Iraci

Both drought and flooding are expected to intensify as the climate changes.



The coastal tailed frog is one of many species that likely would benefit from linked headwaters that facilitate the mixing of gene pools among subpopulations in adjacent watersheds.

Strategically linking headwater habitats across ridgelines benefits amphibians and management



THE MOVEMENT of stream-breeding amphibians overland across forested ridgelines to adjacent drainages can be interrupted by forest disturbances. To mitigate this, station scientists

Use:
National forests consider opportunities to implement new management design.

developed criteria for placing and managing dispersal corridors extending out from headwater riparian reserves, up and over ridgelines to

the neighboring headwater riparian area. This design considers placing linkage areas at stand-to-landscape scales, for example (1) in north-south directions to allow population resiliency in the face of climate change, (2) across watershed boundaries that have no aquatic connectivity, (3) at landscape nodes where three discrete watersheds join, and (4) by co-locating linkages with debris-flow-prone areas, existing reserves, and federal lands. Scientists modeled this approach for the Oregon Coast Range.

Federal biologists, land managers, and watershed stewardship councils are interested in this design. Implementation is being considered on several national forests in the Pacific Northwest Region as well as on federal lands in Arizona and New Mexico.

Contact: Dede Olson, dedeolson@fs.fed.us, Land and Watershed Management Program

Partners: USDI Bureau of Land Management; Earth Systems Institute

Briefing papers provide decisionmakers with current knowledge about climate change

SCIENTIFIC KNOWLEDGE about climate change is ever expanding and difficult to assimilate. For effective policy formulation and land management, decisionmakers and policy analysts need periodic syntheses of climate change information. Station scientists have compiled six briefing papers based on literature reviews and syntheses pertaining to specific questions about climate change. The main topics addressed are economic effects on the forest sector at the national and global scales, costs of forest carbon sequestration as part of mitigation strategies, and mitigation aspects for nonindustrial private and public forest ownerships in the U.S. forest sector. Salient findings from the literature are summarized in the synthesis of the literature, along with identified research needs.

Contact: Ralph Alig, ralog@fs.fed.us, Goods, Services, and Values Program

Partners: Ohio State University, Oregon State University, USDA Forest Service Northern and Southern Research Stations

For more information: Alig, R.J., tech. coord. 2010. Economic modeling of effects of climate change on the forest sector and mitigation options: a compendium of briefing papers. Gen. Tech. Rep. PNW-GTR-833. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 169 p. <http://www.treesearch.fs.fed.us/pubs/36794>

Projections indicated changes in forest productivity in Oregon and Washington

 USING CLIMATE and site productivity data from 3,356 plots, station and university scientists developed a spatial model to estimate the impacts of climate change on potential productivity of forests in Oregon and Washington. Potential productivity was modeled as a function of annual temperature, precipitation, and precipitation in excess of evapotranspiration. The model, coupled with climate change output from generalized circulation models, was used to predict the productivity impacts of four different scenarios developed by the International Panel on Climate Change. The projections indicated decreases for some currently productive regions but increases in many areas that currently have low productivity. Overall results differed between the west and east sides of the Cascade Range, and Washington had a greater overall increase than Oregon. Potential productivity is projected to increase after 50 years, ranging from 1.5 percent for the scenario with constant levels of carbon dioxide to a 7-percent increase for a high population growth or high energy use scenario.

These projections should only be viewed as possible changes in potential productivity, as they are based on many assumptions and do not reflect changes in natural disturbance or shifts in forest management or public policy. For managers and policymakers, they suggest the relative magnitude of effects and the potential variability of impacts across a range of climate scenarios. Future work could improve projections by including interactions of climate-related productivity changes with genetic and species migration limitations and fire, insect, and disease disturbances.

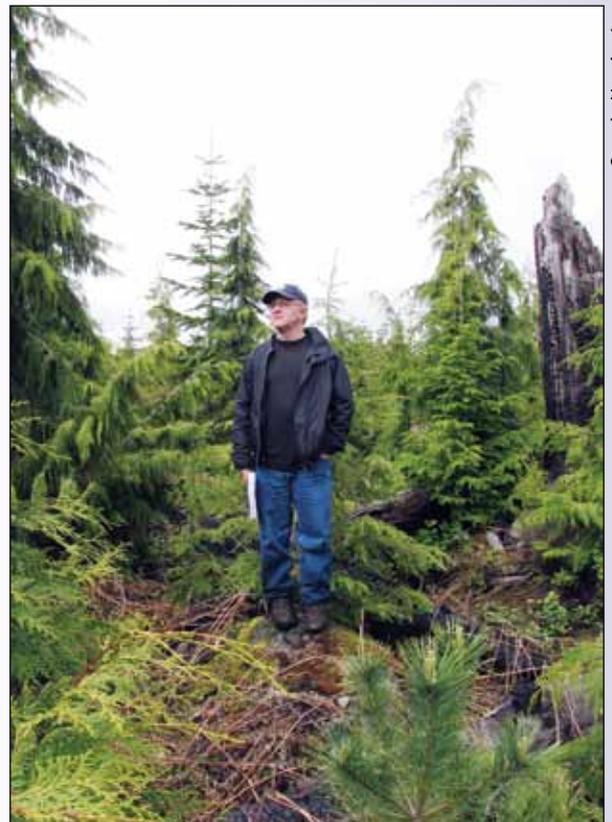
Findings from this study received media coverage, appearing on ABC News and in the *New York Times*, *Sacramento Bee*, and *The Olympian*.

Contact: Tara Barrett, tbarrett@fs.fed.us, Threat Characterization and Management Program

Partner: Oregon State University

Maps of biomass dynamics support North American Carbon Program

KNOWING WHERE and at what rates biomass accumulates or is lost across broad scales is critical to understanding how forest disturbance and regrowth processes influence carbon dynamics. Station scientists modeled live, aboveground tree biomass by using Forest Inventory and Analysis field data and applied the models to more than 20 years of Landsat satellite imagery to derive trajectories of aboveground forest biomass for study locations across the continental United States. Maps of biomass dynamics were integrated with maps depicting the location and timing of forest disturbance and regrowth to assess the biomass consequences of these processes over large areas and long timeframes.



Connie Harrington

Understanding rates of biomass accumulation is critical to understanding how forest disturbance and regrowth influence carbon dynamics.

These maps enable a first approximation of continental rates of biomass loss and accumulation as a result of forest disturbance and regrowth and can be used to support the North American Carbon Program. Scientists from a variety of universities and government agencies that model

carbon dynamics are using this information. Policymakers and managers now have information to use in understanding how forest biomass has changed over the past 20 years to inform their decisions about how forest management affects biomass change today and in the future.

Contact: Warren B. Cohen, wcohen@fs.fed.us, Resource Monitoring and Assessment Program

Partners: Montana State University, NASA Goddard Space Flight Center, Oregon State University, University of Maryland, USDA Forest Service Northern and Rocky Mountain Research Stations



Keith Routman

Olympic National Forest, Washington.

Comparison of methods finds similar estimates of total aboveground biomass, differing estimates of merchantable biomass

RELIABLE METHODS for estimating tree biomass and carbon stocks on forest land are increasingly in demand, as concerns over global climate change raise questions about issues such as carbon accounting and bioenergy feasibility studies. But models for estimating tree biomass differ. Station scientists examined and compared three approaches that might be useful for regional analyses. They found that the three methods produce relatively similar estimates of total aboveground biomass for softwood species in Oregon, but substantially different estimates for the proportion of total biomass that is merchantable. At the local scale, for example when analyzing the carbon dynamics of a proposed management regime on a watershed, or assessing a bioenergy project where profit margins are slim, the differences in results could profoundly affect outcomes.

Contact: Xiaoping Zhou, xzhou@fs.fed.us, Focused Science Delivery Program

Managing forest land for profitability in southwest Germany will be increasingly difficult under climate change

CLIMATE CHANGE predictions have indicated probable shifts in tree species distributions as moisture and temperature conditions change. But restricting discussion to the ecological effects of climate change hinders mitigation and adaptation planning. Considering the economic viability of any forest management action is also important. Researchers conducted an economic evaluation of the expected range shifts of major European tree species in southwest Germany, including Norway spruce, a highly productive species. Using two climate change scenarios from the Intergovernmental Panel on Climate Change, they predicted losses in the potential growing area of Norway spruce by 2030, 2065, and 2100. Based on 2004 prices with an interest rate of 2 percent, the financial loss resulting from reduced growing area ranged from \$857 million to \$3.9 billion. Studies like these can help managers design adaptation strategies such as active forest transformation that can minimize economic losses.

Contact: Susan Hummel, shummel@fs.fed.us, Goods, Services, and Values Program

Cascade Range volcanoes may be at greater risk for debris flows as climate warms



ONE OF THE most visible impacts of climate warming in the Pacific Northwest is the retreat of glaciers located on the flanks of volcanoes in the Cascade Range. As glaciers retreat,

Use: Forest Service and National Park Service use findings to assess risk to downstream infrastructure.

they expose steep, unconsolidated sediment that is prone to gully and may fail catastrophically during intense rainstorms, resulting in debris flows. These flows can travel downslope for many miles at great speeds with enormous destructive potential. Such was the case in November 2006 when a record rainstorm initiated multiple debris flows on all major volcanoes in the northern Cascades. These flows destroyed roads and bridges and resulted in the unprecedented closure of Mount Rainier National Park for more than 6 months.

Station scientists studied how, where, and under what circumstances such debris flows initiate. They discovered previously unreported links between receding glaciers, areas of stagnant and debris-mantled ice, and initiation zones for debris flows. These findings are helping the Forest Service and National Park Service reassess the risk to downstream infrastructure from such events and provide a potentially important example of how climate warming may be affecting mountain environments. These studies also are being coupled with downstream work by the U.S. Geological Survey to help explain changing patterns of channel aggradation and increased flooding potential for lowland areas surrounding Cascade Range volcanoes. The *Christian Science Monitor* and *Los Angeles Times* reported on these findings.

Contact: Gordon Grant, ggrant@fs.fed.us, Ecological Process and Function Program

Partners: Oregon State University, Mount Rainier National Park, U.S. Geological Survey, National Science Foundation



Gordon Grant

Retreating glaciers leave loose sediment exposed, increasing risk of large debris flows following heavy rain.

More fires likely to escape initial attacks as climate changes in California



SUBTLE SHIFTS in fire behavior induced by anticipated climate changes over the next century are sufficient to increase the number of fires that escape initial attack, especially in shrub-

Use:
California governor considers findings in climate change action.

covered wildlands in California. Comparison between high and reduced-emissions scenarios shows that the lower emissions scenario is sufficient to produce modest reductions in the anticipated negative impacts on wildland fire severity

and outcomes. Relatively modest augmentations to existing firefighting resources appear to be sufficient to compensate for climate change-induced changes in wildland fire outcomes.

This information was submitted to the governor of California to serve as a basis for action on climate change in the state.

Contact: Jeremy Fried, jsfried@fs.fed.us, Resource Monitoring and Assessment Program

Partners: ATMOS Research and Consulting; U.S. Department of Energy, Lawrence Berkeley National Laboratory; Universidad Rey Juan Carlos; University of California, Berkeley

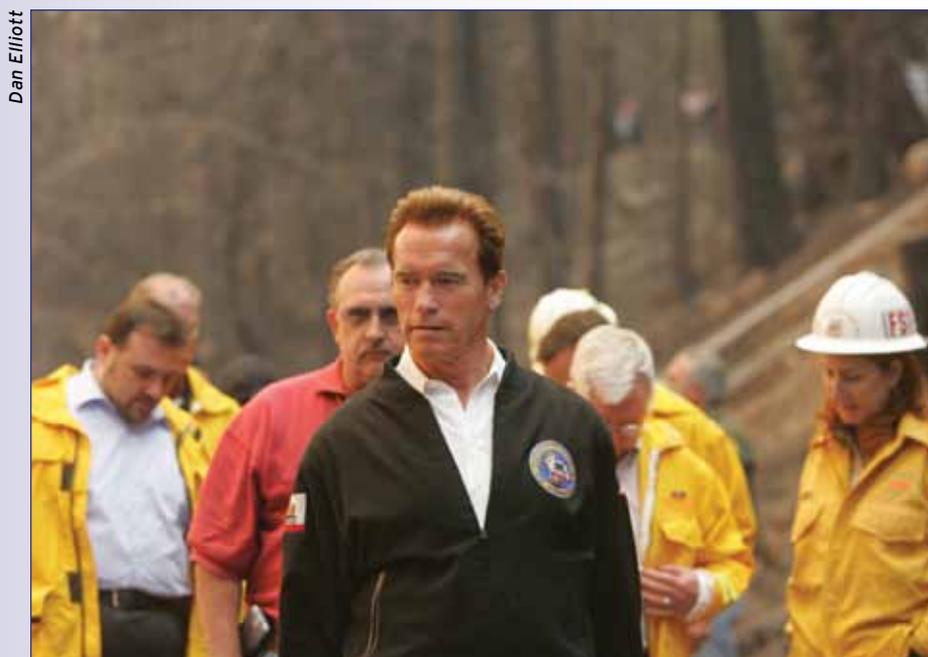
New insights into managing ecosystem productivity in a changing climate

STATION SCIENTISTS and collaborators developed a forest management strategy called GreenWave. This strategy is based on the realization that the amount of solar energy captured by green plants is the single dominant ecosystem process controlling the collective delivery of nearly all societal benefits derived from forests. Through this approach, all private and public-sector jobs associated with managing forests can be thought of as contributing to the national green economy. The GreenWave concept has several principles, including: (1) Current ecosystem productivity does not necessarily equal potential ecosystem productivity. Limitations in current productivity can be addressed by altering species composition, water-holding capacity, and nutrient supply. (2) Energy (measured with carbon budgets) is a currency that can be used to track solar capitol as it flows through societal benefit streams and analyze tradeoffs between different resources or ecosystem services.

Because the annual energy use from fossil-based carbon in the United States is less than 0.5 percent of the incoming solar energy to U.S. forest land, GreenWave accounting can play a major role in examining tradeoffs between energy production and other forest uses.

Contact: Bernard Bormann, bbormann@fs.fed.us, Land and Watershed Management Program

Partners: University of Washington, USDA Forest Service Pacific Northwest Region, USDI Bureau of Land Management



California Governor Arnold Schwarzenegger views aftermath of 2007 Grass Valley fire.

Dan Elliott



South-central Alaska.

Special issue focuses on forests, management, and climate change

A STATION SCIENTIST served as the guest editor for a special issue of *Forest Ecology and Management* titled “Adaptation of Forests and Forest Management to Changing Climate.” The issue stemmed from an international conference held in Sweden in 2008 that brought together about 350 scientists and forest managers to discuss what needs to be accomplished globally and to share knowledge and experience to ensure that local adaptation decisions are supported by global science.

The concepts presented are thought provoking, and the applications include management tools for evaluating risk and reducing vulnerabilities of global forests in a changing climate.

Contact: Catherine Parks, cparks01@fs.fed.us, Threat Characterization and Management Program

Partners: Canadian Forest Service, Food and Agricultural Organization of the United Nations, International Union of Forestry Research Organizations, Natural Resources Canada, Swedish University of Agricultural Sciences, USDA Forest Service Pacific Southwest Research Station

For more information: *Forest Ecology and Management*. 2010. 259(4).

Community Sustainability



Key Findings

- ▶ Researchers found that access to parks and trails helps promote active lifestyles in Oregon and identified 11 counties where residents had inadequate levels of physical activity. The state is using this information to prioritize trail development in these at-risk counties.
- ▶ As the cost of raw materials increased, the lumber industry in western Washington remained viable by investing in machinery and reducing sawmill employment.
- ▶ The Green Cities Research Alliance, a new research program in the Seattle metro area, identified 600 environmental stewardship organizations and 70 private sustainable design groups around Seattle and Tacoma. The research alliance will study the combined, positive environmental effects of these groups.
- ▶ Protecting ecosystem services requires understanding consumer demand as well as supply. Scientists developed a decision-support tool to identify where provision and use of ecosystem services overlap with disturbance-prone sites.





Tool

*An online version of **Production, Prices, Employment, and Trade in Northwest Forest Industries***

Description:

This online resource offers downloadable data on the current timber situation in Alaska, Washington, Oregon, California, Montana, Idaho, and British Columbia, as well as 50 years of historical data. Data sets include lumber and plywood production and prices; timber harvest; employment in forest products industries; international trade in logs, pulpwood, chips, lumber, veneer, and plywood; log prices in the Pacific Northwest; volume and average prices of stumpage sold by public agencies. The extensive data sets can be downloaded into Microsoft Excel®, a commonly-used program. This online version complements the printed quarterly publication by the same name that has been published continuously since 1963.

Use:

The Forest Service and other federal agencies, Oregon Department of Forestry, Washington Department of Natural Resources, universities in Washington, Oregon, Idaho, and Montana, and private land managing and consulting firms have all responded positively to this product, commenting on the timeliness and usefulness of the site.

How to get it:

<http://www.fs.fed.us/pnw/ppet/>

Contact:

Jean Daniels, jdaniels@fs.fed.us,
Goods, Services, and Values Program



Parks and trails help promote active lifestyles

 THE PERCENTAGE of American adults who are obese has more than doubled in 30 years, inciting warnings of an obesity epidemic. The dramatic increase in rates of obesity and inactivity

Use:
Oregon prioritizes new trails for counties with low physical activity.

raises critical health concerns, many of which can be mitigated by physical activity. Station scientists looked at the role parks and recreation can play in addressing

these public health concerns. They found parks, trails, bikeways, and sidewalks increase opportunities for people to meet recommended daily levels of physical activity through outdoor recreation. Their analysis of county-level data in Oregon showed that the availability of trails is associated with higher proportions of physically active adults.

This study helped identify at-risk communities that could be targeted with recreation planning and development. The study enabled the Oregon Parks and Recreation Department to identify 11 of Oregon's 36 counties as being "in need"—that is, showing inadequate levels of current and projected physical activity. To address these disparities in recreational opportunities, Oregon is prioritizing the development of close-to-home nonmotorized trail access in identified at-risk counties. This study was also used to project health status indicators to 2020 for the 2008 to 2012 Oregon Statewide Comprehensive Outdoor Recreation Plan. Results from this study also led the Oregon Parks and Recreation Department to develop a statewide trails Web site that will provide information on trail availability and accessibility in Oregon.

Contact: Jeff Kline, jkline@fs.fed.us, Goods, Services, and Values Program

Partners: Oregon Parks and Recreation Department, Oregon State University

Urban ecology research provides employment opportunities for youth

YOUNG ADULTS and teens are being hired to help with field work for urban ecology research on riparian habitats in the greater Portland, Oregon, metro area. Made possible through the American Recovery and Reinvestment Act, this project focuses on exposing minority youth to jobs in science-related fields, as this is an area where minorities are currently underrepresented. As participants learn the techniques of field work, they are gathering valuable data on the impact of urbanization on vegetation, soil, and habitat quality for species such as salamanders in urban stream environments.



Frank Vanni

Young adults hired through an American Recovery and Reinvestment Act project collect samples from a stream in the Portland area.

In 2010, two graduate students and four field technicians were hired and gained valuable career skills in natural resource science. By identifying and encouraging these students, the Forest Service is providing employment to underrepresented youth and also making strides toward the goal of improving the quality and diversity of the applicant pool for the workforces of natural resource agencies and businesses.

Contact: Jamie Barbour, jbarbour01@fs.fed.us, Focused Science Delivery Program

Partners: Portland State University, Oregon State University, University of Washington, World Forestry Center's Youth Inside Out Program

Lumber industry reduced employment, invested in machinery to offset rising log costs

 A STATION SCIENTIST examined the lumber industry in western Washington to understand production trends and how changes in production costs translate to changes in the manufacturing process. Trends in lumber production are of particular interest because sawmills are a traditional source of jobs and economic prosperity in rural areas. The industry was highly sensitive to changes in log costs; after all, it is impossible to create lumber without wood. Further results suggest that log cost variability had lasting consequences for sawmill workers. Producers compensated for rising raw material costs by reducing labor costs. This was accomplished by reducing sawmill employment and investing in machinery and equipment. These findings suggest that policies that lead to higher log costs may have unintended consequences for sawmill employment.

Contact: Jean Daniels, jdaniels@fs.fed.us, Goods, Services, and Values Program

Partners: University of Washington

Protecting ecosystem services requires understanding consumer demand as well as supply

 SOCIETY TENDS to want more goods and services from forests than forests are able to supply. This leads to a growing deficit between an ecosystem's production capacity and society's rate of consumption. Most research on ecosystem services focuses on how to increase or sustain their supply. This is accomplished in various ways, for example, by compensating a landowner for retaining forest rather than selling it to developers. However, this type of system lacks a feedback mechanism, such as payment for services used, that acts to moderate consumer behavior.

One solution is to find effective ways to communicate the imbalance between supply and demand. In terms of natural resource management, station scientists created a decision-support tool to identify areas across the landscape where provision and use of ecosystem services overlap with disturbance-prone areas. In these vulnerable areas, targeted management interventions have a much greater

Rising costs for raw material led sawmills to invest in machinery and reduce employment.



chance of preventing the loss of ecosystem service flows than if these actions were applied uniformly or haphazardly across the landscape.

Contact: Trista Patterson, tmpatterson@fs.fed.us, Goods, Services, and Values Program

Partners: State University of New York, College of Environmental Science and Forestry; The Nature Conservancy; University of Alaska

Green Cities Research Alliance launched in Seattle metro area



THE STATION launched a study of the positive environmental “footprint” of 600 organizations that engage in environmental stewardship activities in Seattle and Tacoma and the 70 private groups that practice sustainable design in the Seattle metro area. This project is part of a research collaboration called the Green Cities Research Alliance in the Puget Sound area.

A database of the stewardship organizations and sustainable design groups was created as part of this project. It will be used for conducting an organizational network analysis and studies on stewardship motivations and health implications of outdoor activities. These results will be linked to other studies, funded by the American Recovery and Reinvestment Act, to better understand the positive environmental effects of citizen-based stewardship activities.

Contact: Dale Blahna, dblahna@fs.fed.us, Goods, Services, and Values Program

Partners: University of Washington; Cascade Land Conservancy; EarthCorps; Institute for Culture and Ecology; King County, Department of Natural Resources and Parks; City of Seattle Parks Department and Office of Sustainability; State of Washington, Community and Urban Forestry



EarthCorps

EarthCorps volunteers remove invasive ivy from a Seattle green space.

Oil prices influence homeowners' decision to use wood for heating

HEATING OIL is the primary fuel for home heating in southeast and interior Alaska. As heating oil prices rose in Alaska in 2008, so did interest in renewable energy for home heating. Wood energy has the potential to be an efficient and less costly replacement for oil, but requires investment in equipment such as wood stoves.

Station scientists surveyed Alaska residents to learn their preferences for wood energy products and equipment and gauge their willingness to switch to wood heating. The scientists found that cost was a primary factor in influencing consumer motivation to switch to wood energy. A fuel oil price of \$4.00 to \$5.00 per gallon would be needed to induce most homeowners to switch to wood heating. Although prices hit this mark during the summer of 2008, they have since declined. Similarly, most consumers would be willing to pay up to \$3,000 for a new wood energy system. Poor economic conditions over the past few years, however, could discourage their willingness to pay or ability to borrow money. Most respondents said they were not familiar with standards set by the Environmental Protection Agency (EPA) for residential burning and air quality or with EPA-certified woodstoves.

Contact: Dave Nicholls, dlnicholls@fs.fed.us, Goods, Services, and Values Program

Partner: University of Alaska-Fairbanks

For more information: Nicholls, D.L.; Brackley, A.M.; Barber, V. 2010. Wood energy for residential heating in Alaska: current conditions, attitudes, and expected use. Gen. Tech. Rep. PNW-GTR-826. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p. <http://www.treesearch.fs.fed.us/pubs/35579>



Allen Brackley

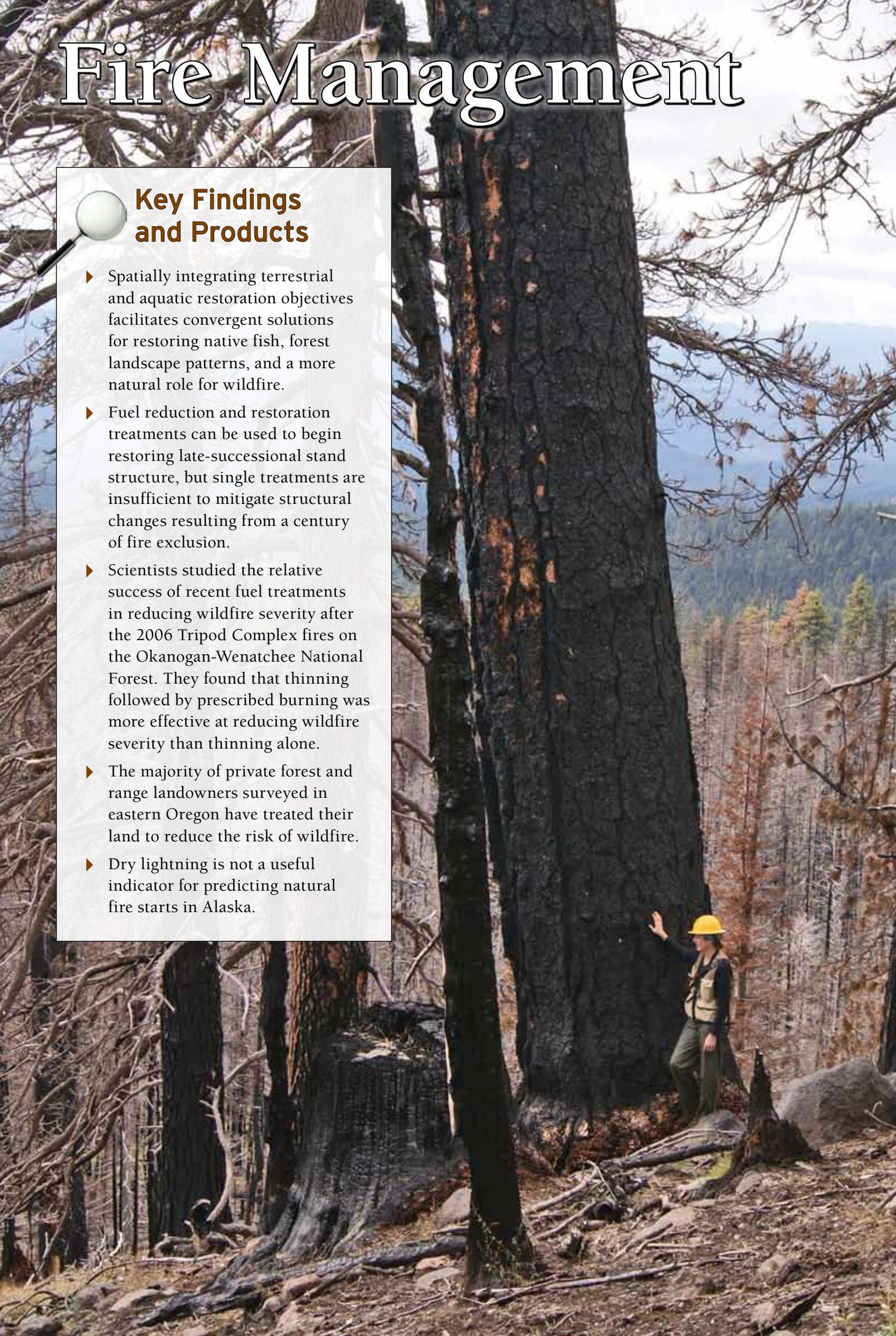
Many survey respondents in Alaska indicated interest in converting to a wood-based home heating system if heating oil costs rose to \$4 to \$5 per gallon.

Fire Management



Key Findings and Products

- ▶ Spatially integrating terrestrial and aquatic restoration objectives facilitates convergent solutions for restoring native fish, forest landscape patterns, and a more natural role for wildfire.
- ▶ Fuel reduction and restoration treatments can be used to begin restoring late-successional stand structure, but single treatments are insufficient to mitigate structural changes resulting from a century of fire exclusion.
- ▶ Scientists studied the relative success of recent fuel treatments in reducing wildfire severity after the 2006 Tripod Complex fires on the Okanogan-Wenatchee National Forest. They found that thinning followed by prescribed burning was more effective at reducing wildfire severity than thinning alone.
- ▶ The majority of private forest and range landowners surveyed in eastern Oregon have treated their land to reduce the risk of wildfire.
- ▶ Dry lightning is not a useful indicator for predicting natural fire starts in Alaska.





Tools

Fuel Characteristic Classification System, Version 2.1

Description:

The Fuel Characteristic Classification System (FCCS) was designed to build and catalogue fuels, from the ground to the canopy, based on inventory data, photo series, or literature. The system will predict flame length, rate of spread and surface fire behavior, crown fire, and available fuel potential using a 9 point index. Version 2.1 was released in 2010 with refined fire behavior equations and a total carbon calculator. Another improvement includes mapped FCCS fuelbeds for the continental United States.

Use:

The FCCS is becoming a widely used tool to build and characterize fuels for specified areas at any scale. For example, FCCS fuelbeds have been created for the Okanogan-Wenatchee National Forest, central Oregon, and Lake Tahoe basin and associated fire behavior predictions and total carbon represented by the fuelbeds have been mapped. This information is being used for fire hazard planning and evaluating fuel treatment effectiveness. The FCCS version 2.1 has been distributed through three workshops and fact sheets with an attached CD-ROM. It is also available online.

How to get it:

<http://www.fs.fed.us/pnw/fera/fccs/>

Contact:

Roger Ottmar, rottmar@fs.fed.us,
Threat Characterization and Management Program

Hand-Piled Fuels Biomass Calculator

Description:

This calculator was developed to help fuel managers and air quality regulators manage hand-piled fuels and coordinate piled-fuel disposal through prescribed burning. By using easily measured dimensions, the user can estimate the volume and biomass of hand-piled fuels and the emissions produced when those piled fuels are burned. The estimation equations were developed from field measurement. The developers presented the calculator at the Joint Fire Science Program Biomass Roundtable, which prompted a request and additional funding to further develop and enhance this tool for fuel management.

How to get it:

<http://depts.washington.edu/nwfire/handpiles>

Contact:

Clint Wright, cwright@fs.fed.us,
Threat Characterization and Management Program

For More Information:

Wright, C.S.; Balog, C.S.; Kelly, J.W. 2009. Estimating volume, biomass, and potential emissions of hand-piled fuels. Gen. Tech. Rep. PNW-GTR-805. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 23 p.
<http://www.treesearch.fs.fed.us/pubs/34607>

Tom Iraci



2006 Mount Hood Complex Fire.

Tools

Web Tools for Smoke and Fire

Description:

This new Web portal site centralizes access to a number of air quality tools, making it both easier and faster to obtain information for planned prescribed fires and unplanned wildland fires. The site includes several help features, including a glossary and phone-based technical assistance.

Use:

Incident command teams on wildland fires and land managers involved in prescribed fire operations have to know how their fires will affect air quality. Feedback from users indicates this is a successful effort to help fire managers gain needed information.

How to get it:

<http://firesmoke.us/wfdss/>

Contact:

Sim Larkin, larkin@fs.fed.us,
Threat Characterization and Management Program

Reference Guide on the Effects of Fire, Insect, and Pathogen Damage on Wood Quality of Dead and Dying Western Conifers

Description:

This desktop reference and companion field guide for land managers updates previous work and summarizes how fire, insects, and pathogens affect the wood quality of common conifer species across the western United States and western Canada. The guide summarizes what is known about deterioration rates for these species, factors influencing deterioration, species-specific changes in wood quality, and the potential suitability of the wood for commercial use.

How to get it:

This information will help land managers weigh the pros and cons of leaving or removing dead or dying trees in a stand.

Contact:

Eini Lowell, elowell@fs.fed.us,
Goods, Services, and Values Program

For More Information:

Lowell, E.C.; Rapp, V.A.; Haynes, R.W.; Cray, C. 2010. Effects of fire, insect, and pathogen damage on wood quality of dead and dying western conifers. Gen. Tech. Rep. PNW-GTR-816. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 p. <http://www.treearch.fs.fed.us/pubs/35067>

Integrating management of native fisheries and wildfire is possible



WILDFIRE IS a critical land management issue in the western United States. Efforts to mitigate the effects of altered fire regimes have led to debate over ecological restoration versus species conservation. Fire-related management activities may disrupt watershed processes and degrade habitats of currently sensitive fishes. Restoration of more natural fire regimes, however, might also benefit longer term habitat complexity and the persistence of species and populations that are now only remnants of once-larger and more diverse habitat networks.

Station scientists explored this idea in the context of native fisheries and wildfire in the South Fork Boise River basin, but expect the approach to be relevant in other settings as well. They found that developing common language between forest, fire, and fishery managers; clearly communicating goals and objectives; and analyzing spatially explicit objectives will help identify conflicts and opportunities to enable more collaborative management. Conflict most likely cannot be eliminated, but if attention is first focused to reveal domains where convergence and conflict are anticipated, collaborative management, planning, and further analyses could become more tractable. By identifying areas where terrestrial and aquatic management can support each other, the domain of areas needing more complex analyses or solutions may be much reduced.

Contact: Paul Hessburg, phessburg@fs.fed.us, Ecological Process and Function Program

Partners: USDA Forest Service Boise National Forest and Rocky Mountain Research Station



Agnes Przeszlowska

Field crew conduct a stream survey on a tributary to the Middle Fork John Day River in the Malheur National Forest as part of a modeling project that will project changes in riparian vegetation and salmon habitat based on various disturbances such as fire.

Multiple treatments likely needed to restore resiliency in fire-adapted ecosystems



ACROSS THE Western United States, the structure of many low-elevation dry conifer forests is considerably different than it was prior to Euro-American settlement. These altered conditions contribute to the increased probability of unnaturally severe and extensive wildfires. Strategies for reducing fuels and restoring fire-adapted ecosystems include thinning live and dead trees and burning surface fuels to reduce the risk of severe surface and crown fires. In the past decade, federal and state agencies have reduced hazardous fuels on nearly 30,000 square miles of public lands. These treatments may be effective in initiating short-term changes in forest structure and may shift existing diameter distributions toward those that might persist in late-successional forests, but single treatments or entries are insufficient to mitigate structural changes resulting from nearly a century of fire exclusion.

This information will help land managers implement fuel reduction and forest restoration treatments that capitalize on different strategies for shifting residual tree diameter distributions.

Contact: Andrew Youngblood, ayoungblood@fs.fed.us, Land and Watershed Management Program

Partners: University of California Berkeley; University of Montana; U.S. Geological Survey; USDA Forest Service National Forest System, Pacific Southwest and Rocky Mountain Research Stations

Thinning followed by prescribed burn mitigates fire severity in dry, mixed-conifer forests



STATION SCIENTISTS conducted an opportunistic study to determine the relative success of recent fuel treatments in mitigating wildfire severity, as represented by tree mortality, tree damage, and changes in fuel structure. The 2006 Tripod Complex fires burned more than 180,000 acres of mixed-conifer forest in the Okanogan-Wenatchee National Forest in north-central Washington. The burned area involved recent fuel treatments including thin-only units

and units where thinning was followed by a prescribed burn. The study provided strong quantitative evidence that without treatment of surface fuels, thinning alone is not a viable surrogate for pre-scribed fire in these dry, mixed-conifer forests. In contrast, thinning followed by prescribed burning to reduce surface fuels appears to be an effective strategy for mitigating wildfire severity. Three years after the fire, more than 57 percent of trees survived in thin+prescribed burn units versus 19 percent in thin-only and 14 percent in control units. Even small thin+prescribed burn units (10 to 12 acres in size) had low fire severity, suggesting that unit size is not as important as treatment type in predicting fire severity.

Millions of acres of dry western forest lands have hazardous fuel accumulations. These findings will likely be used by fire managers to plan and justify prescribed burning programs and reduce future fire severity.

Contact: David L. Peterson, peterson@fs.fed.us, Threat Characterization and Management Program

Partners: Joint Fire Science Program, University of Washington, USDA Forest Service Pacific Northwest Research Station

Forest stand after thinning and prescribed burning.



Tom Iraci

Most family forest owners in eastern Oregon treat land to reduce wildfire risk



AS WILDFIRES consume increasing areas of western U.S. forests each year, private landowners are being encouraged to reduce wildfire risk on their property. Station scientists wanted to know how nonindustrial private forest owners in eastern Oregon perceive and address wildfire risk. They discovered that 75 percent of surveyed owners of ponderosa pine forests had treated some portion of their land between 2003 and 2008. Primary residents were almost eight times more likely to reduce fire risk on their property than absentee owners. Also, owners living near public lands were more likely to manage their land, providing the added benefit of buffering fire risk between public and private land. Lack of knowledge or skills did not emerge as a significant barrier to fire risk management, implying that educational strategies may not be the best investment of public funds. Instead, owners indicated that they lacked sufficient resources to offset the costs of hazardous fuel reduction, and that they would benefit from cost share funds and markets for logs and wood products generated through thinning.

This study identified types of landowners who might benefit from policies and programs for wildfire risk reduction. It also revealed insights into the management motivations and constraints of different groups of owners, which can help decisionmakers tailor policies and programs to specific audiences.

Contact: Paige Fischer, paigefischer@fs.fed.us, Goods, Services, and Values Program

Tom Iraci



Nonindustrial private forest owners surveyed in eastern Oregon indicated they wanted help offsetting the costs associated with reducing hazardous fuels on their land.

Most homebuyers in Colorado Springs unaware of wildfire risk before purchasing

THE PAST FEW decades have seen an influx of people buying homes in the wildland-urban interface, where fuel loads are often elevated owing to aggressive fire suppression over the past century. Some agencies and organizations have responded by targeting education programs at people who already live in these areas, but there has been little information about the role of wildfire risk on the home purchase decisions in fire-prone areas. Of the homebuyers surveyed in this study, only 27 percent realized they were purchasing a home in an area at risk of wildfire prior to making an offer on the house. When asked what would have been a good way for homebuyers to become more informed about wildfire risk, the most common response was that they wanted to get this information from their realtors.

Contact: Geoffrey Donovan, gdonovan@fs.fed.us, Goods, Services, and Values Program

Partners: USDA Forest Service Rocky Mountain Research Station, Montrose Interagency Fire Management Unit

Fire forecasting system accurately predicts area burned during 2009 fire season

MIDTERM FORECASTS of drought and fire potential help fire management agencies plan how they will move assets and where they will locate firefighting resources for the season. Station researchers produce continuously updated 7-month forecasts of fire potential and drought for the conterminous United States by using the MC1 Fire Forecasting System.

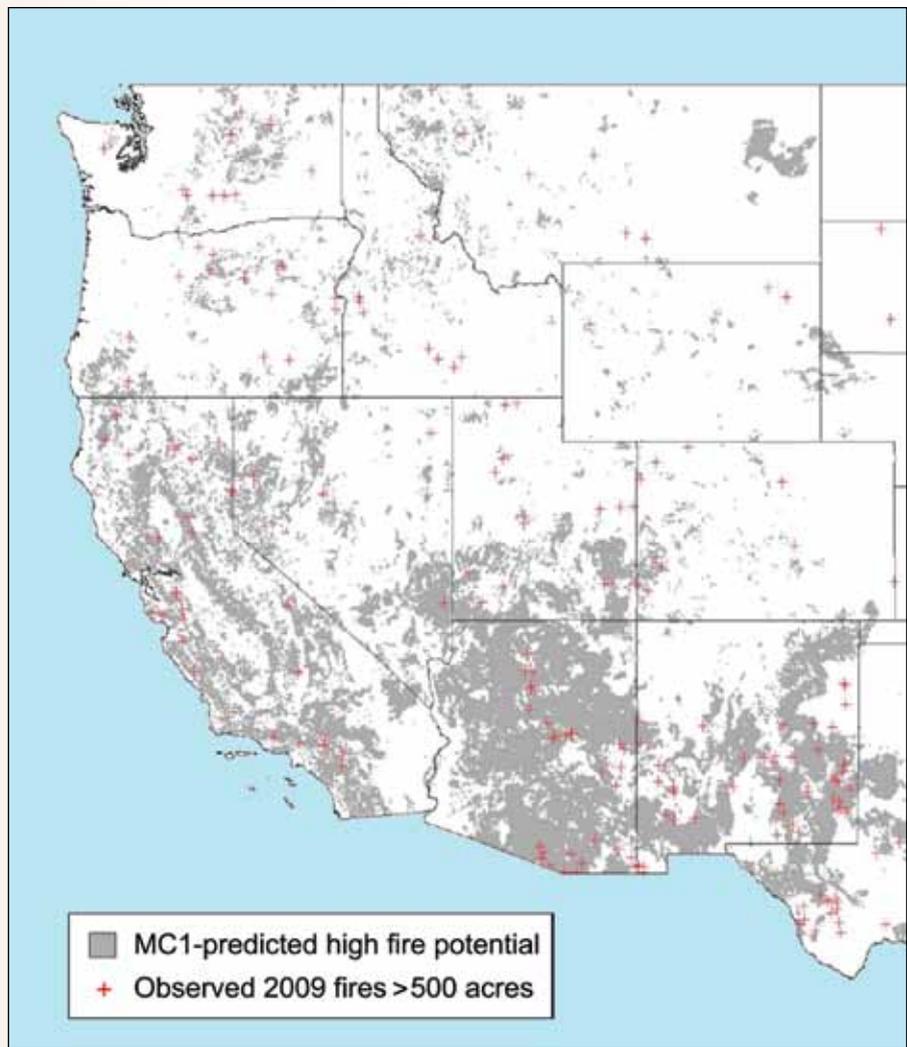
The MC1 hindcast for 2009 predicted 3,251,064 acres burned (just 9 percent greater than the observed area). The spatial resolution of the 2010 forecasts has been increased by more than two orders of magnitude, and twice as many drought and fire potential indexes are now posted monthly to the Web site for

the Mapped Atmosphere-Plant-Soil System (MAPSS) project. Currently, nearly 200 land managers from various resource agencies are alerted each month to new fire forecasts posted on the station's MAPSS Web site.

Contact: Jim Lenihan, jlenihan@fs.fed.us, Ray Drapek, rdrapek@fs.fed.us, Ecological Process and Function Program

Partners: National Interagency Coordination Center, National Interagency Fire Center, Oregon State University, University of Alaska

For more information:
<http://www.fs.fed.us/pnw/mdr/mapss/index.shtml>



Fire forecasts can help fire management agencies strategically locate their resources during the fire season. Above is a hindcast produced by the MC1 Fire Forecasting System indicating areas of high fire potential for the 2009 fire season (gray areas) and point locations of large (> 500 acre) fires during 2009.

Dry lightning not a useful indicator for predicting natural fire starts in Alaska



THROUGHOUT THE western United States, dry lightning—lightning occurring with little or no precipitation—is a major natural cause of wildfires. Scientists found in Alaska, however, there is no significant difference between the average values of the moisture and stability variables used to distinguish dry and wet thunderstorm days. This suggests the high-based, dry thunderstorms seen in the western U.S. are not typical in Alaska's interior. This finding allows more focused delivery of relevant information to land and fire managers in Alaska.

The Web site derived from this project now shows only daily maps of the predicted probability of large lightning outbreaks for Alaska, rather than multiple maps. This will help land and fire managers in Alaska more accurately recognize when the chance of lightning fires is high.

Contact: Miriam Rorig, mrorig@fs.fed.us, Threat Characterization and Management Program

Partners: National Oceanic and Atmospheric Administration Storm Prediction Center, Joint Fire Science Program

Scientists investigate smoke plume dynamics in Australia

THE AUSTRALIAN federal government and state of Victoria requested the assistance of station scientists in understanding the catastrophic fires that burned in Victoria on February 7, 2009. Specifically, they

*Use:
Australian agencies use new information to improve fire warning systems.*

wanted insight into the growth and behavior of the smoke plume during the various fires. After visiting the fire sites and analyzing data provided by the Australian

Bureau of Meteorology, the scientists determined that the plume's structure was strongly influenced by changing air properties with height and time. These changes determined the direction and distance of spot fires, as well as the overall behavior of the fires, in ways that made them more unpredictable. The scientists also provided computer code and documentation that are enabling Australian researchers to examine these types of air-mass changes in their fire weather and fire behavior models.

The Bureau of Meteorology and Victoria Department of Sustainability and Environment are testing new ways to incorporate this information about middle-troposphere conditions in their fire behavior and fire danger warning systems.

Contact: Brian Potter, bpotter@fs.fed.us, Threat Characterization and Management Program

Partners: Australian Bureau of Meteorology, Bushfire Cooperative Research Centre, and Victoria Department of Sustainability and Environment



Smoke plume from fires in Victoria, Australia, in 2009.

Scientists quantify smoke model uncertainty for users

STATION SCIENTISTS combined the most commonly used fuel maps and consumption models to calculate the range in fuel consumption the various combinations produce. This provides an estimate of the uncertainty in model-based consumption estimates so that managers can better understand the state of the science and develop a realistic sense of confidence in model results.

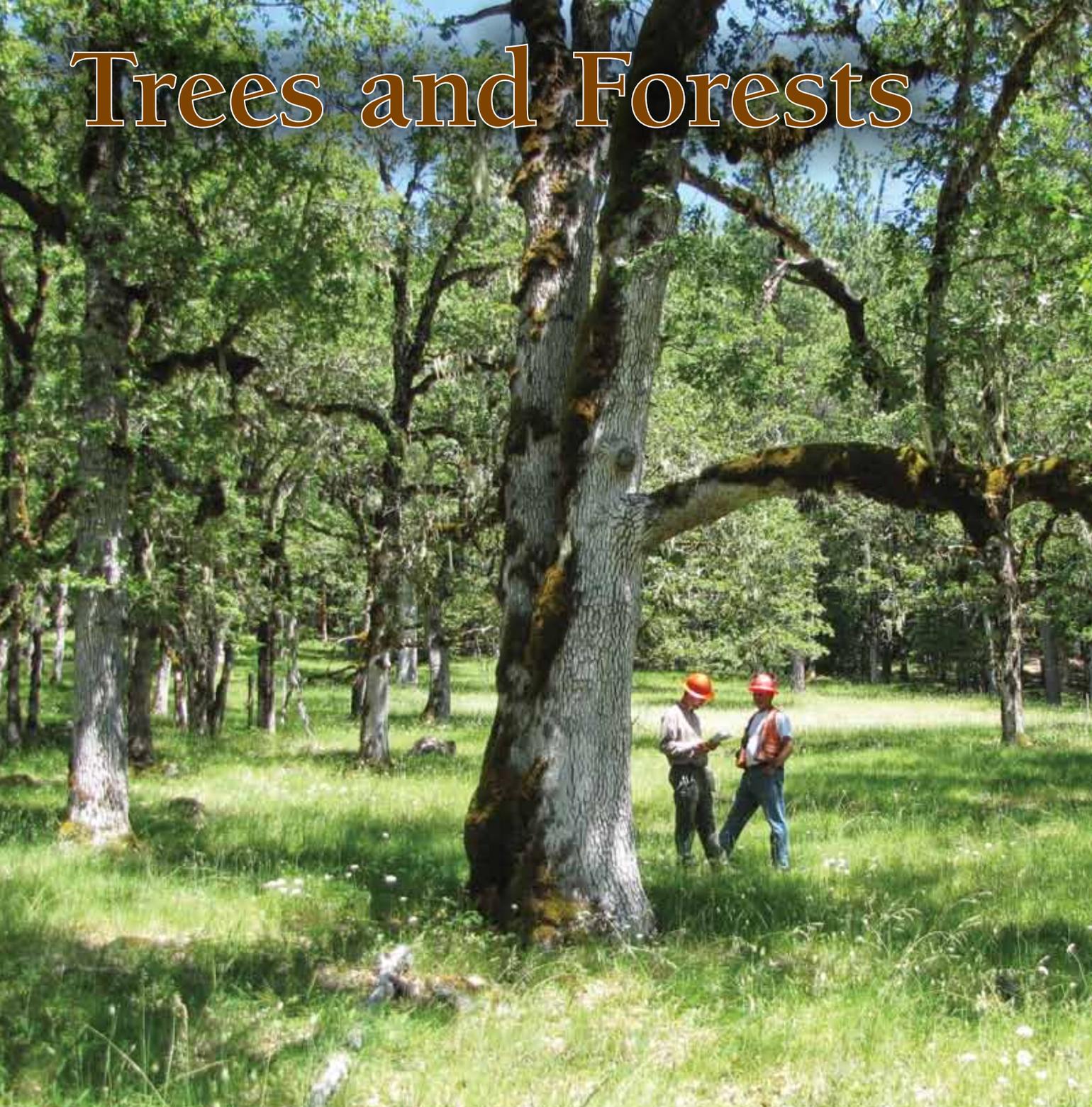
The results are presented as part of an interactive Web site that allows users to select a location and then look at maps and tables showing the fuel model and consumption model data for that location. This is the first step in a larger project aimed at providing users with clear information on limitations and uncertainties in the models routinely used for fuel and smoke management.

Contact: Sim Larkin, larkin@fs.fed.us, Threat Characterization and Management Program

Partners: Joint Fire Science Program, Sonoma Technologies, Inc.

For more information: See <http://data.semip.org>

Trees and Forests



Key Findings and Products

- ▶ *Planting Native Oak in the Pacific Northwest*, a summary report, is released. The information presented on acorn storage and nursery practices to facilitate survival of Oregon white oak seedlings in the field is quickly adopted by many people planning native oak regeneration programs.
- ▶ Five-year report highlights forest conditions and trends from 2002 to 2006 for all forest lands in Washington state.
- ▶ Forest Inventory and Analysis work began on the Hawaiian Islands with installation of potential study plots on O'ahu, Lanai, and Hawaii.
- ▶ Large dead wood, which provides important wildlife habitat, is projected to increase on federal land and decrease on private land within Oregon's coastal forests.



Tool

Updated Variants of the Forest Vegetation Simulator

Description:

The Forest Vegetation Simulator (FVS) is a widely used forest growth model. New versions of the Pacific Northwest Coast and West Cascades variants were developed to improve its ability to accurately predict the growth and survival of Oregon white oak.

Use:

FVS is widely used within the Forest Service and by others to evaluate the effects of proposed management actions on stand development and to project stand development over time. In Washington and Oregon, there is increasing interest in active management of Oregon white oak. The new versions of FVS improve the model's ability to predict the effects of management on oak and to project the development of stands that contain oak.

How to get it:

<http://www.fs.fed.us/fmnc/fvs/index.shtml>

Contact:

Peter Gould, pgould@fs.fed.us,
Land and Watershed Management Program

Oregon white oak regeneration enhanced through proper seed and seedling management

 OREGON WHITE OAK has become a species of conservation emphasis for several state and federal agencies and nongovernmental organizations in Oregon and Washington. The tree is now found in a fraction of the area it was prior to Euro-American settlement. Cost-sharing programs are available for reestablishing the oak on the landscape, but prior to recent work by station scientists, planting recommendations were based on guidelines for other oak species in different regions of North

America and Europe or on guesswork. Station scientists have conducted several studies specific to Oregon white oak. They found that proper acorn storage, nursery practices, and container culture can improve root morphology and lead to improved success of seedlings in the field.

This information has been quickly adopted by many people planning regeneration programs. A summary publication on regenerating native oak in the Pacific Northwest has been widely distributed, with almost 2,000 copies requested the first 4 months after publication.

Contact: Constance Harrington, charrington@fs.fed.us, Land and Watershed Management Program

Partners: Southern Oregon University, Washington Department of Natural Resources Webster Nursery

For more information: Devine, W.D.; Harrington, C.A. 2010. Planting native oak in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-804. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 25 p. <http://www.treearch.fs.fed.us/pubs/34610>



Warren Devine

Science-based guidelines for planting and caring for Oregon white oaks have been quickly adopted by people planning regeneration programs to halt the decline of this native tree. Above, a technician examines growth on an oak seedling 8 years after planting.

Five-year report summarizes forest conditions in Washington

 SCIENTISTS SUMMARIZED and interpreted basic information about public and private forest land in Washington. Topics include land use change, ownership, timber volume, biomass and carbon stocks, biodiversity, insects and diseases, invasive plants, air pollution, and more. This report, based on data from 2002 through 2006, establishes a baseline against which future conditions can be compared and trends can be identified. This information is useful to state and federal agencies and private firms.

The authors identified several key findings in the report. They found that Washington's forests are presently a net sink for carbon, and most timber production is coming from private

lands. Nonnative invasive plant species already are well established in Washington's forests, covering 4 percent of all forest land on average. They also found lichen communities indicative of nitrogen pollution in forests west of the Cascade Range, particularly in the Puget Trough ecoregion, which runs the length of the state along the Interstate-5 corridor.

Contacts: Karen Waddell, kwaddell@fs.fed.us, Resource Monitoring and Assessment Program

Partners: Washington Department of Natural Resources, USDA Forest Service Pacific Northwest Region

For more information: Campbell, S.; Waddell, K.; Gray, A., tech. eds. 2010. Washington's forest resources, 2002 to 2006: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-800. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 189 p. <http://www.treearch.fs.fed.us/pubs/35068>

Forest Inventory and Analysis begins work on Hawaiian Islands



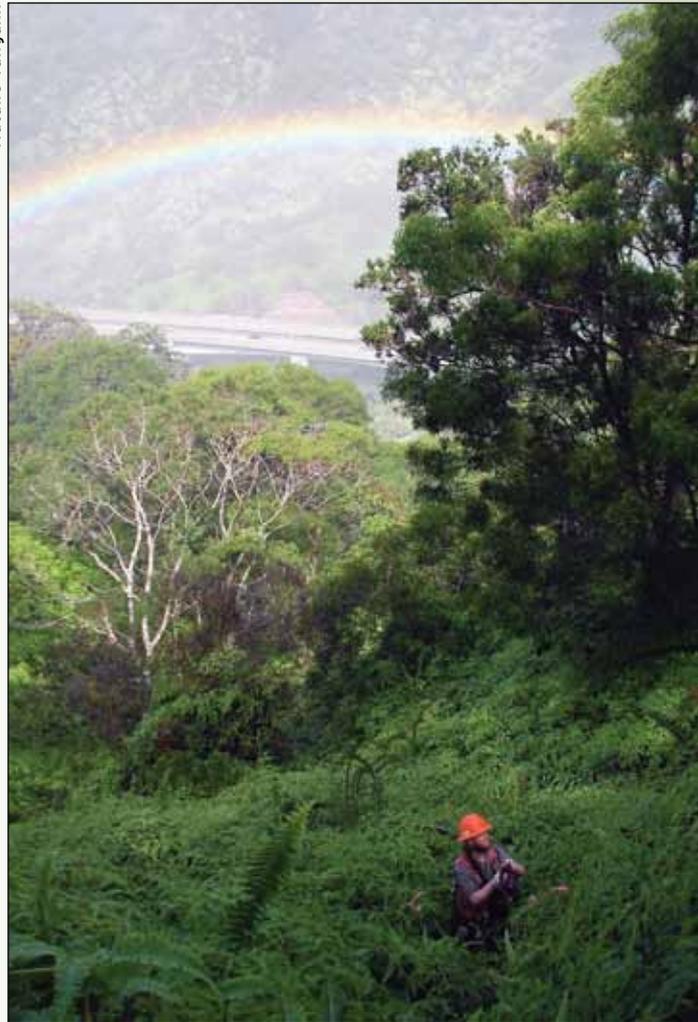
POLICYMAKERS and natural resource managers need up-to-date, consistent, and credible information on the status and trends of forests in Hawaii and the Pacific Islands to guide decisions at state, national, and international levels. The Pacific Northwest Research Station is responsible for delivering the Forest Inventory and Analysis program in Hawaii and is partnering with the Hawaii Division of Forestry and Wildlife, the Institute of Pacific Islands Forestry, and numerous other agencies including state governments and foresters throughout the Pacific to implement this inventory.

In 2010, the station hired Hawaiian field crew who installed most of the potential plots on the islands of O'ahu and Lanai and began work on the island of Hawaii. The station also strengthened its partnerships with the Hawaii Division of Forestry and Wildlife and the Institute of Pacific Islands Forestry and established itself as an important future resource to understanding the status and trends of Hawaii's forest resources.

Contact: Robert Pattison, rrpattison@fs.fed.us, Resource Monitoring and Assessment Program

Partners: Hawaii Division of Forestry and Wildlife, USDA Forest Service Pacific Southwest Research Station Institute of Pacific Islands Forestry

Natalie Tangalin



A field technician installs a potential study plot on the island of O'ahu.

Severe fires in Alaska's boreal forests will likely lead to abrupt shifts in plant community composition

IN THE LAST 10 years, fires more severe than in the past have burned Alaska's boreal forests. Scientists have found that this change in fire regime is leading to vegetation changes in these forests. Mature black spruce stands currently occupy more than 40 percent of the forested landscape of boreal Alaska and are highly adapted to low-severity fires, in part because of accumulation of large amounts of organic soil, which buffers postfire shifts in species composition. As fires have increased in severity, organic layers of the soil have burned completely,

exposing larger amounts of mineral soil. Mineral soil creates a high-quality seedbed for deciduous tree species such as birch and aspen, which can outcompete conifers such as black spruce. This change in fire regime could critically alter the composition of upland boreal forests.

Land and fire managers are using these results to predict future successional trajectories following fire in Alaska's boreal forest.

Contact: Teresa Hollingsworth, thollingsworth@fs.fed.us, Ecological Process and Function Program

Partners: Bonanza Creek Long-term Ecological Research Program, National Science Foundation, University of Alaska Fairbanks, University of Saskatchewan

Oregon coastal old-growth forests developed under different disturbance histories

OLD-GROWTH FORESTS provide unique features compared to younger stands, thus many management plans in the Pacific Northwest aim to increase the area of late-successional forest. Researchers examined existing old-growth forests in the northern Oregon Coast Range that might serve as examples of desired future

conditions and developmental pathways. Many old-growth attributes in all forests in the region also were assessed. Researchers found that most old-growth stands had experienced moderately severe disturbances during their development. Nevertheless, most of the stands had the full complement of old-growth attributes (large shade-intolerant trees, smaller shade-tolerant trees, snags, and down wood).

Results from this study suggest that although old-growth forests can develop along multiple disturbance pathways, stand composition and productivity constrain development. Expecting all late-successional stands to have the full complement of old-growth attributes may not be realistic. Managers could use the detailed stand descriptions and inferred disturbance histories as reference points for establishing desired future conditions. Analyzing the frequency of old-growth attributes could be a more informative approach to regional monitoring than efforts based on stand diameter class.

Contact: Andrew Gray, agray01@fs.fed.us, Resource Monitoring and Assessment Program

Partner: Northwest Forest Plan Adaptive Management Program

Jill Johnstone



Increasingly severe wildfires in Alaska's boreal forests, historically dominated by black spruce, are exposing larger amounts of mineral soil favored by birch and aspen seedlings.



Large dead wood provides important wildlife habitat.

Large dead wood in coastal forests projected to increase on federal land, decrease on private



LARGE DEAD WOOD, both standing snags and fallen logs, provide important wildlife habitat and structural features in a stand. Station scientists assessed potential effects of future forest management on dead wood for a 300-year

Use:
Forest Service,
BLM incorporate
findings in
Coast Range
management.

period across a forest region spanning 14,300 square miles and numerous ownerships. They found that the amount of dead wood was projected to increase over the simulation period across the region, primarily because conservation-oriented management on federal lands increased the volume and number of large logs and snags. Large snags and logs decreased on forest industry lands as legacy dead wood derived from historical natural disturbance events was not replaced through management. Conservation-oriented policies designed to maintain or increase dead wood may have a strong positive influence on large dead wood abundance and related biodiversity in parts of a region also under intensive management.

This information is being incorporated into dead wood management for wildlife on land managed by the Forest Service and Bureau of Land Management in Oregon's Coast Range. The Oregon Department of Forestry has requested that these model approaches and systems be applied to state land, and researchers of dead wood in Germany have also inquired about the approach.

Contact: Rebecca Kennedy, rebeccakennedy@fs.fed.us, Threat Characterization and Management Program

Events taking place early in forest succession have long-lasting effects

BECAUSE SECOND-GROWTH forests often make poor habitat for old-growth dependent species, land managers are interested in restoring old-growth characteristics to these forests. However, information about how old-growth features are naturally acquired is incomplete. Station scientists used legacy stumps and historical data to reconstruct

the stand structure and composition for two old-growth stands harvested around 1930. Both stands had a 250-year-old Douglas-fir overstory with scattered older Douglas-fir. Each stand followed a different successional pathway to an old-growth condition, and both modern stands also are following different pathways. One site had a modern composition similar to its historical composition, but the second site was compositionally different. Early successional conditions, including seed availability, were probably responsible for the differences between the modern and historical stands as well as between the two modern stands. Accelerated restoration of old-growth structure may be possible through repeated artificial gap creation, but the second site will remain compositionally different from its historical stand. Land managers interested in restoring old-growth characteristics to second-growth stands will find this information useful as will ecologists interested in forest succession.

Contact: David Peter, dpeter@fs.fed.us, Threat Characterization and Management Program

For more information: Peter, D.H.; Harrington, C.A. 2010. Reconstructed old-growth forest stand structure and composition of two stands on the Olympic Peninsula, Washington state. Res. Pap. PNW-RP-583. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p. <http://www.treearch.fed.us/pubs/34287>

Canopy structure may not develop linearly

FOREST STRUCTURE, as measured by the physical arrangement of trees and their crowns, is a fundamental attribute of forest ecosystems that changes as forests develop. Unfortunately it is difficult to characterize forest structure over large land areas by using field measurements. Looking for another option, researchers used information derived from airborne laser scanners (LIDAR data) to describe and classify conifer forest structure across a broad range of age classes.

They found that characteristics normally associated with older forests (variability in vertical structure and in the size and distribution of gaps in the canopy, for example) may be present in younger stands, and that some older stands may lack these same characteristics. These results suggest that canopy structure may not develop in a linear fashion and emphasize the importance of measuring structural conditions rather than relying on development models to estimate structural complexity across forested landscapes.

Contact: Bob McGaughey, bmcgaughey@fs.fed.us, Resource Monitoring and Assessment Program

Partners: Seattle Public Utilities, University of Washington



Janet Ohmann

This stand in the Middle Santiam Wilderness, Willamette National Forest, has many of the attributes associated with an old-growth forest, including a multilayered canopy, snags, and down wood. These characteristics may also be present in younger stands.



Hemlock forest near Ketchikan, Alaska.

Marc Much

New maps facilitate richer analysis of older forest and associated species

THE 1994 Northwest Forest Plan (NWFP), covering federal lands within the range of the northern spotted owl in the Pacific Northwest, is one of the most significant forest conservation efforts in the world. As part of a 15-year report on the effectiveness of the plan, researchers used the gradient nearest neighbor (GNN) mapping technique to develop forest maps for two years: 1996 and 2006 in Washington and Oregon, and 1994 and 2007 in California. The GNN maps integrate forest data collected on regional inventory plots with satellite imagery that is normalized through time using LandTrendr algorithms. This results in more stable multiyear estimates than is possible with traditional image-processing techniques.

The GNN maps provide detailed attributes of forest composition and structure spanning all land ownerships and allocations in the NWFP area. Mapped attributes of forest structure—such as densities of large trees, snags, and down wood—and canopy layering are being used to identify older forest and model habitat for the northern spotted owl, marbled murrelet, and aquatic species.

Contact: Janet Ohmann, johmann@fs.fed.us, Resource Monitoring and Assessment Program

Partners: Oregon State University; USDA Forest Service Pacific Northwest Region; USDI Bureau of Land Management, Fish and Wildlife Service

Symposium, published proceedings synthesize ecology and use of western redcedar and yellow-cedar

APPRECIATION FOR the biological, cultural, and economic values of western redcedar and yellow-cedar has grown in recent years, but relatively little information on these values has been available in the scientific literature. Information from the last major meeting on western redcedar was published in 1988, and there has never been a comprehensive conference focusing on yellow-cedar. To remedy this, the PNW Research Station, along with the British Columbia Ministry of Forests and University of Victoria, convened a symposium on these two west coast species. Participants synthesized the state of knowledge on the two species, which are similar in appearance but differ in many other ways including cultural uses, taxonomic position in the cypress family, wood properties, and markets. The abstracts and short contributed papers from the symposium were published as a general technical report.

Contacts: Constance Harrington, charrington@fs.fed.us, Land and Watershed Management Program and Paul Hennon, phenon@fs.fed.us, Threats Characterization and Management Program

Partners: British Columbia Ministry of Forests, University of Victoria

For more information: Harrington, C. 2010. A tale of two cedars—international symposium on western redcedar and yellow-cedar. Gen. Tech. Rep. PNW-GTR-828. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 177 p. <http://www.treesearch.fs.fed.us/pubs/36731>



Connie Harrington

Scientists and land managers share knowledge about the ecology and use of yellow-cedar and redcedar on a field trip near the Jordan River outside Victoria, British Columbia.

Presence of tanoak reduces Douglas-fir mortality from black-stain root disease

BLACK-STAIN root disease is a native pathogen of conifers in the Pacific Northwest. The disease reduces growth and ultimately kills the infected tree. As part of a study on the effects of tanoak competition on Douglas-fir, a station scientist discovered that where tanoaks and other hardwood had been retained in the stand, there was less mortality from the root disease in 20- to 24-year-old Douglas-fir compared to stands where all tanoaks had been removed when the stand was 2 years old.

The scientist hypothesized that the presence of hardwood roots may have slowed conifer root growth and served as a physical barrier to the spread of disease. On public lands in southwestern Oregon where this study took place, forest managers are already retaining low to moderate densities

of hardwoods to increase biodiversity and provide wildlife habitat; such practices should also reduce the spread of black-stain root disease.

Contact: Tim Harrington, tharrington@fs.fed.us, Threat Characterization and Management Program

Partners: Oregon State University, USDA Forest Service Rogue-Siskiyou National Forest

More Scotch broom found where logging debris was removed

SCOTCH BROOM, a nonnative, invasive plant species, is a severe competitor of young Douglas-fir. A station scientist and partners in the forest industry conducted a study to see if the presence or absence of logging debris affected planted Douglas-fir and associated vegetation. Their study sites included areas where only harvested logs were removed, leaving behind branches and treetops, and areas where all branches and treetops were taken off site.

Tim Harrington



Woody debris after logging was removed at the site above; 3 years later Scotch broom, a nonnative invasive shrub, covered 26 percent of the area. Where logging debris was left on site, Scotch broom covered 6 percent of the area.

They found that intensive forest harvesting practices that remove most of the logging debris will increase abundance of Scotch broom. Three years after debris was removed, Scotch broom, which was present in the understory prior to forest harvesting, covered 26 percent of the area, whereas it covered 6 percent of the area where debris was retained. In the fourth year after the debris treatments, survival of planted Douglas-fir was lower where debris was removed (62 percent) compared to where it was retained (79 percent). This information will help land managers increase productivity of forest plantations by reducing the negative, indirect effects of debris removal.

Contact: Tim Harrington, tharrington@fs.fed.us, Threat Characterization and Management Program

Partners: Green Diamond Resource Company, Virginia Tech

New index quantifying threat of bark beetle infestation helps identify regions at risk in Mexico

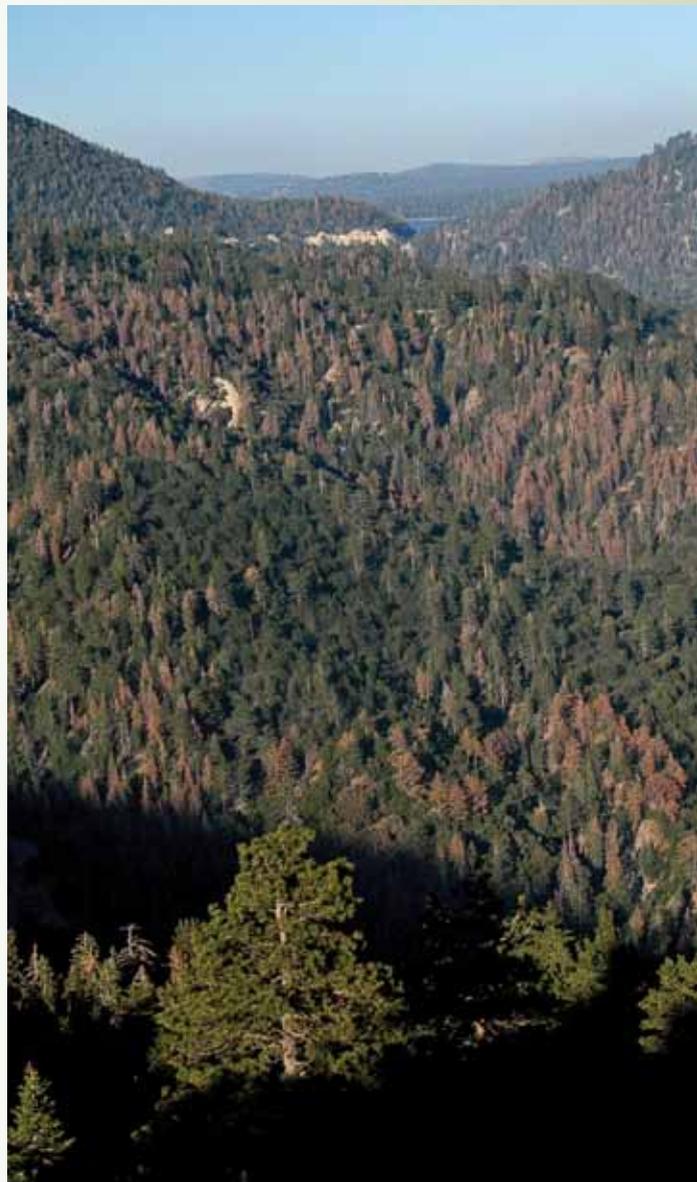
MEXICO HAS A variety of bark beetle–pine species associations. Station scientists estimated the threat of beetle infestations based on factors such as pine and beetle species density, host preference, and

Use: Mexico's Commission of Forestry uses findings to produce risk atlas. level of mortality caused by beetle species. Despite vast areas of overlap between pine forests and bark beetles in Mexico, regions of highest beetle pressure are restricted to small zones within certain mountain systems.

Pine diversity is the major determining factor of bark beetle threat at the regional level, whereas disturbances from extensive logging and ecosystem change are key factors behind high bark beetle threats at the local level.

The spatially explicit, quantitative index of bark beetle threat was used to identify areas that might be greatly affected by these insects. Mexico's Commission of Forestry used these results to produce a bilingual (Spanish and English) atlas for forestry

Tom Iraci



Bark beetle mortality in Southern California.

professionals that shows distributions of the bark beetle species that represent the greatest threat to pine forests in Mexico. It was also used to provide a geographic database to assist with forest management and conservation in Mexico.

Contacts: Alan Ager, aager@fs.fed.us, Western Wildland Environmental Threat Assessment Center, and Jane Hayes, jlhayes@fs.fed.us, Threat Characterization and Management Program

Partners: Instituto Politécnico Nacional de México

Special issue of *Forest Pathology* addresses white pine blister rust

A STATION SCIENTIST served as the senior guest editor for a special issue of *Forest Pathology*. The issue focused on white pines, blister rust, and *Ribes*—a plant genus (includes currant) that hosts the disease. The publication, released August 15, 2010, marks the centennial of two historical events that have shaped forests and their management across western Canada and the United States. First was the Great Fires of 1910 in the northern Rockies. The political reaction to the fires led to the Forest Service's policy of aggressive fire suppression. The ecological response to the fires was widespread and abundant regeneration of white pines and *Ribes*. The second event was detection of white pine blister rust in western North America. From early infested sites in southern British Columbia, the rust spread throughout the Pacific Northwest moving from its *Ribes* hosts to the pines. It continues to be a leading cause of white pine mortality, either directly or by weakening the tree so it is more susceptible to other damaging agents, including bark beetles. The special issue synthesizes information on developing and implementing management strategies and practices to identify, protect, and sustain ecosystems threatened by white pine blister rust.

Contact: Charles G. "Terry" Shaw, cgshaw@fs.fed.us, Western Wildland Environmental Threat Assessment Center

Partner: USDA Forest Service Rocky Mountain Research Station

For more information: *Forest Pathology*. 2010. 40(3-4).

Hydraulic lift by herbaceous plants slows soil drying in a Neotropical savanna

HYDRAULIC LIFT, the movement of water via roots from moist, deeper soil layers to drier shallow soil layers, is widespread among tree species. Shallow-rooted herbaceous plants are often assumed to compete for water hydraulically lifted by trees.



Fabian Scholz

A partially excavated root system of a tree in a tropical savanna near Brasilia, Brazil, showing several directional sap flow sensors installed in major lateral and descending roots to detect hydraulic lift.

In Brazilian savanna trees, hydraulic lift helps maintain conductivity of shallow roots during the prolonged 5-month dry season. To determine the relative contribution of trees and herbaceous plants to hydraulic lift in a Brazilian savanna during the dry season, researchers conducted model simulations and experimental manipulations involving removal of the herbaceous plant layer. Surprisingly, they found that water hydraulically lifted by trees contributed only 2 percent to partial daily recovery of soil water storage, whereas the herbaceous plant layer contributed the remaining 98 percent. During the peak of the dry season, hydraulic lift by herbaceous plants replaced over 20 percent of ecosystem evapotranspiration, highlighting its important role in the water economy of savanna ecosystems.

These findings have important implications for predicting and understanding the hydrologic and ecological consequences of the ongoing conversion of tropical savannas to other vegetation types such as herbaceous crops and tree plantations.

Contact: Rick Meinzer, fmeinzer@fs.fed.us, Ecological Process and Function Program

Partners: North Carolina State University, University of Miami, Universidad Nacional de la Patagonia San Juan Bosco



Chris Schnepf, Bugwood.org

White pine blister rust.



Rhonda Mazza

Columbia Gorge, Washington.

Clear, unified purpose needed for agency's NEPA processes

NATIONAL ENVIRONMENTAL Policy Act (NEPA) analyses place more demand on Forest Service budgets and human capital than any activity other than fire. Yet NEPA guidance can be perceived

Use:
Forest Service is using findings to improve procedures and clarify policies.

as ambiguous and the Forest Service lacks a defined purpose for its NEPA processes, spurring inefficiency and other problems. Implementers find themselves pulled in many directions, communication is hampered, and the public image of the agency can suffer when the process is perceived as cumbersome and excessive.

A study of Forest Service employees explored the wide-ranging perceptions of how processes associated with NEPA should be implemented. Researchers found that competing visions of NEPA's purpose often lead to struggles for influence in the decision-

making process. This makes it challenging for the agency to fulfill its environmental responsibilities. The diversity of strategies reflects an understanding among agency personnel that no one-size-fits-all solution for planning approaches exists, yet the lack of coherence can lead to conflict in reaching land management decisions, and can cause NEPA practitioners to become disenchanted with their work.

The information from this study is being used by Washington office NEPA planners to improve administrative procedures and policies for environmental assessment and disclosure activities. It is also of interest to agency personnel, particularly NEPA implementers, disciplinary specialists, and advisory teams as they collaborate to fulfill the requirements of NEPA processes.

Contact: David Seesholtz, dseesholtz@fs.fed.us, Focused Science Delivery Program

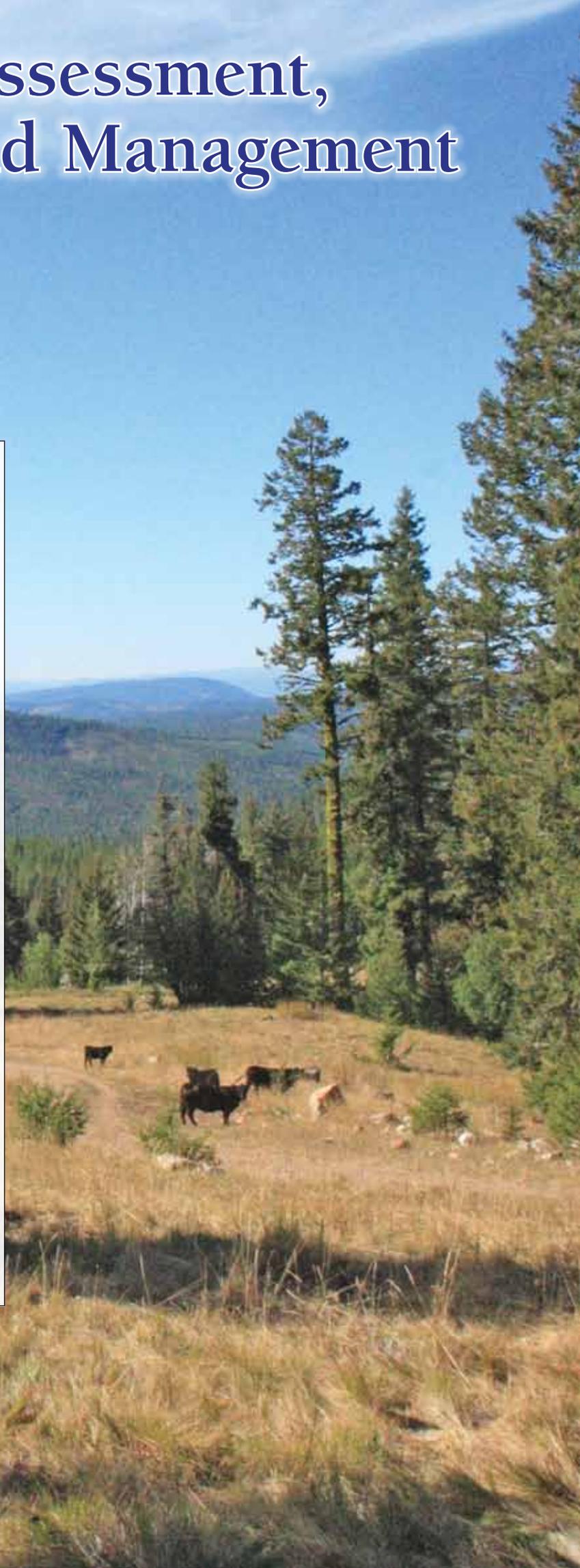
Partner: Virginia Tech

Landscape Assessment, Modeling, and Management



Key Findings and Products

- ▶ Landscape analysis suggests that current management strategies in dry east-side forests will result in fewer large trees, and forests with low resistance to disturbances such as fire or insect outbreaks.
- ▶ A new decision-support system facilitates regional midscale analysis of wildfire danger in the Pacific Northwest. This scale of analysis (about 5,500 units each roughly 20,000 acres in size) supports coordinated fuel treatment planning across the entire region and across federal resource agencies and partners.
- ▶ Shrublands of the Great Basin are declining rapidly in area and quality, and remaining vegetation communities are at high risk of loss. Landscape-scale management based on differences in ecological resistance and resilience can reduce these risks.
- ▶ Scientists defined the first critical loads for nitrogen deposition in Pacific Northwest forests west of the Cascade Range based on the response of nitrogen-sensitive lichen species.





Tools

Ecosystem Management Decision-Support (EMDS) System v. 4.0

Description:

EMDS version 4.0 provides integrated, spatially enabled, multiscale decision support for environmental analysis and planning. The basic objectives of any EMDS application are to (1) develop an improved understanding of the state of the environment at whatever spatial scales are relevant to an application area, and (2) assist with design of strategic solutions for environmental protection and restoration.

EMDS 4.0 continues to maintain compatibility with the latest releases of the world's leading geographic information system technology, ArcGIS. Numerous major system enhancements were introduced at version 4.0 to improve the robustness and usability of the system, and ensure its continued viability for the foreseeable future.

Use:

Major users include the U.S. Army Corps of Engineers, Environmental Protection Agency, Forest Service, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, all forest management bureaus in the U.S. Department of Interior (USDI), as well as numerous state or provincial resource agencies, universities, and environmental research institutes around the world.

Recent specific applications include decision support for forest fuels management for the Forest Service and USDI bureaus (2007 to 2011). EMDS 4.0 was also used in the 2011 integrated restoration and protection strategy for the Forest Service's Northern Region.

How to get it:

<http://www.institute.redlands.edu/emds>

Contact:

Keith Reynolds, kreynolds@fs.fed.us,
Ecological Process and Function Program

Threat Mapper

Description:

Threat Mapper employs several new technologies for wildland threat detection, mapping, and assessment. It includes an interactive, online mapping system that integrates risk maps generated by the Forest Service and other land management agencies. Users are able to examine spatial patterns of multiple threats and the human and ecological values they potentially affect.

Threat Mapper also includes a data mining application that can search for spatial data posted on Internet GIS (geographic information system) servers. Systematic data mining of the 30,000 Internet map servers and estimated 1 million spatial data sets available online may provide a novel method for early detection and assessment of ecosystem change and impending natural disturbances.

A third component of the Threat Mapper project is the Threat News Explorer, which uses a search engine to locate news articles and blog content relevant to wildland threat assessment. The site is a convenient way to track ongoing news about wildfires, bark beetles, climate change, and other important wildland threats.

All components of the Threat Mapper project are hosted on an Amazon EC2 elastic cloud computer.

Cloud computing is an inexpensive and relatively simple solution for federal agencies to build and host online mapping systems for internal and external users.

Use:

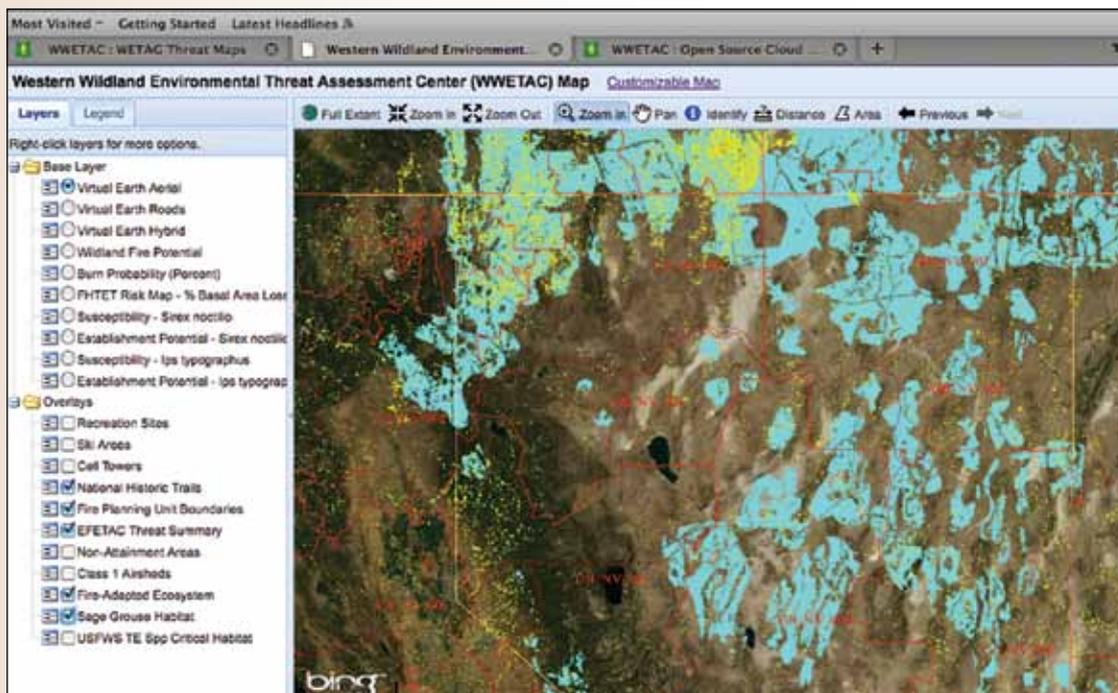
Researchers and managers can use the mapping features to explore the spatial relationships between and among wildland threats and high-value resources such as wildlife habitat, power infrastructure, and wildland-urban interface residences. They can load local GIS data into the display for further analysis. The search engine components of the Threat Mapper facilitates efficient information gathering. The Threat News Explorer enables scientists to monitor news specific to their arenas of study. In the context of wildland threats, these news articles may be the first indication of the spread of an infestation and also may be helpful in discovering social and cultural issues pertaining to these threats.

How to get it:

http://www.fs.fed.us/wwetac/threat_map

Contact:

Alan Ager, aager@fs.fed.us, Western Wildland Environmental Threat Assessment Center



Screen shot of a Web-based interactive map that allows users to identify spatial relationships among various threats.

Mary Rowland



Sage grouse habitat in the Great Basin is being lost by encroaching woodlands and nonnative annual grasses.

Managing Great Basin shrublands for ecological resistance and resilience can reduce risk to habitat



NATURAL AND HUMAN processes are causing extensive rapid ecological changes in arid and semiarid ecosystems worldwide. These changes are evident in the Great Basin and require landscape-

Use: Federal agencies use findings as a basis for new management policies for Great Basin shrublands.

based approaches for management based on concepts of ecological resistance and resilience. Station scientists demonstrated the use of these concepts in a five-step analytical approach by using

greater sage-grouse habitat as an example. Their analysis indicates that large areas of the Great Basin currently provide sage-grouse habitat, but many areas with low resistance and resilience may be lost to continued woodland expansion or to invasion by nonnative annual grass. Preventing these losses will require landscape strategies that prioritize management areas based on their degree of resistance and resilience in response to woodland expansion or nonnative grass invasions. Focused management in areas of moderate or high resistance and resilience is likely to maintain the largest shrubland areas over time.

Results and analytical methods from this research are being used nationally and regionally by the Bureau of Land Management to devise changes in land management policies and strategies. The U.S. Fish and Wildlife Service and Forest Service also are including this information in land use planning documents for the Great Basin.

Contact: Michael Wisdom, mwisdom@fs.fed.us, Ecological Process and Function Program

Partners: National Center for Ecological Analysis and Synthesis, USDA Forest Service Rocky Mountain Research Station, USDI Bureau of Land Management



G. Kramer

Sage grouse.



Tom Iraci

Malheur National Forest, Oregon.

Current management of dry eastern Washington forests is leading to smaller trees

 STAND AND landscape conditions of dry forests have been altered significantly over the last century, resulting in larger and more severe fires and insect outbreaks. The ecological

Use:
Management collaborative is using findings to develop alternative management approaches.

complexity of the forested landscape east of the Cascade Range calls for a landscape-scale management approach. The Tapash Collaborative, a partnership of natural resource management agencies and

organizations, commissioned an analysis that provides a cross-ownership landscape context for questions regarding dry forest restoration, fire management, wildlife habitat, and economic opportunities. Researchers used integrated models to examine the interactions among management, natural disturbances, and forest structure.

Model projections suggest that current management strategies are resetting succession, resulting in younger, high-density, small-diameter forests. This new type of forest structure may be more susceptible to wildfires and insects if management and fire suppression follow the status quo. These disturbance-prone forests are not treated frequently or intensely enough and therefore are severely affected by natural disturbances, which again resets succession. The feedback loop continues pushing the landscape toward a new disturbance regime. This has implications for many wildlife habitat and economic opportunities. Another implication may be a general decline in available biomass and aboveground carbon stored in trees across the landscape.

The Tapash Collaborative is using these analyses to consider alternative management approaches and policy scenarios.

Contact: Miles Hemstrom, mhemstrom@fs.fed.us; Focused Science Delivery Program

Partners: Tapash Collaborative (The Nature Conservancy, USDA Forest Service, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, and the Yakama Nation)

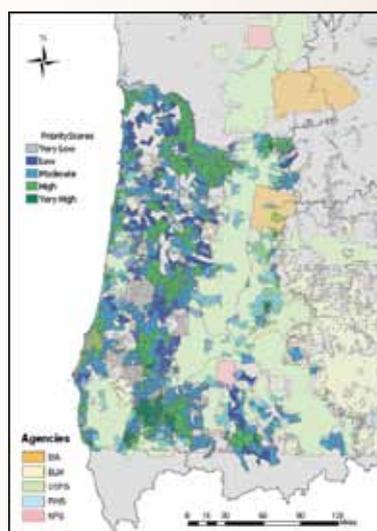
New tool facilitates fuel treatment planning across ownerships

 THE POTENTIAL for wildfire continues to pose serious threats to lives, property, and natural resources across the Pacific Northwest. Five federal natural resource agencies plus the states of Oregon and Washington share a common need to manage forest fuels to reduce wildfire potential on their administrative units as well as threats to adjacent ownerships and municipalities. Station scientists and their partners have developed a decision-support system that can be used for midscale analyses (units of about 20,000 acres) to assess wildfire potential and fuel treatment priorities across the region. Analysis at this scale facilitates efficient fuel management across multiple agencies. For example, an interagency team of fuel managers can much more easily plan coordinated fuel treatment programs by consulting midscale maps of wildfire potential and fuel treatment priorities, taking into account priorities associated with their respective administrative units and proximity to communities.

The prototype for this decision-support system can accommodate application to all potential federal partners as well as the states of Oregon and Washington. The development team is currently working with its current federal partners on an application for the Pacific Northwest.

Contact: Keith Reynolds, kreynolds@fs.fed.us, Ecological Process and Function Program

Partners: USDA Forest Service Pacific Northwest Region and Rocky Mountain Research Station, USDI Bureau of Land Management Oregon District



Output from the Ecosystems Management Decision-Support system helps interagency fuel managers set watershed priorities for forest fuels treatment in the Pacific Northwest.

Scientists identify amount of nitrogen pollution that triggers shift in lichen communities



A CRITICAL LOAD for nitrogen is the maximum amount of nitrogen deposition that an ecosystem or ecosystem component can accommodate without being damaged. Certain species of lichen are exceptionally sensitive to airborne nitrogen pollution, thus air quality management that uses lichen critical loads is expected to protect the larger forest ecosystem. Researchers analyzed how lichen communities west of the Cascade Range respond to nitrogen inputs. They found that when nitrogen deposition reached 3 to 9 kilograms of nitrogen per hectare per year, there was a 20- to 40-percent decline in ecologically important lichen species that are used by wildlife and involved in nutrient cycling. Forests exceeding this critical load also characteristically see a three- to fourfold increase in “weedy” nitrogen-loving lichen species.

Critical loads for pollutants provide benchmarks of ecological harm that guide pollution permitting and regulation. Critical loads developed for the

most sensitive indicator species, like lichens, should convey ecosystem-wide protection. This research is likely to be integral to all forthcoming integrated science assessments conducted by the Environmental Protection Agency for establishing secondary standards for nitrogen compounds. These critical loads may be used by managers to set and negotiate target pollutant loads for lands under their charge.

Contact: Sarah Jovan, sjovan@fs.fed.us, Resource Monitoring and Assessment Program

Partners: USDA Forest Service Pacific Northwest Region, Washington State University

Cloud computing makes geospatial information available to a broader range of users

LAND MANAGEMENT agencies produce voluminous amounts of geospatial data while planning and executing management activities. Disseminating these data is problematic because technical skills and software are required to import and view in a dynamic (zoom, pan, etc.) environment. Hosting map services in the Internet-based environment known as the “cloud” does not require purchasing or maintaining a server, and capacity can expand and contract as necessary based on the demand of the hosted application. Station scientists pioneered an application that is believed to be the first in the Forest Service to use cloud technology to serve geospatial data. They used Amazon EC2 Virtual Server® and installed GeoServer, free open source software for publishing geospatial data.

Federal agencies have been directed to use cloud services because of the cost savings over traditional purchasing and hosting of server hardware. The results from this application to geospatial data services indicate using cloud services is a stable and user-friendly way to publish map data. This work was presented at the 1st international conference on computing for geospatial research and application in Washington, D.C.

Contact: Alan Ager, aager@fs.fed.us, Western Wildland Environmental Threat Assessment Center

Partners: KingBird Software, Inc., USDA Forest Service Remote Sensing Applications Center

Sarah Jovan



Usnea longissima is one species of lichen that is very sensitive to air pollution.

30th Anniversary of Mount St. Helen's eruption receives broad coverage

MAY 18, 2010, marked 30 years since Mount St. Helens erupted in southwestern Washington. Station scientists have spent the past three decades on the flanks of the volcano studying how the ecosystem has responded to such a large, intense disturbance. Results are being used worldwide, in particular, in Chile where station scientists are collaborating with Chilean counterparts to formulate new research on the Chaiten volcano.

In honor of the 30th anniversary, National Geographic published a 24-page article featuring the station's lead scientist on Mount St. Helens. NOVA, of Public Broadcasting, also produced two documentaries on the 30 years of research on the volcano. Via these media outlets, several million viewers were exposed to the research taking place on Mount St. Helens.

Contact: Charlie Crisafulli, ccrisafulli@fs.fed.us, Land and Watershed Management Program

Partners: Oregon State University, Universidad de Chile, University of Maryland, Utah State University, University of Washington-Tacoma, U.S. Geological Survey

For more information:

<http://ngm.nationalgeographic.com/2010/05/mount-st-helens/funk-text>

<http://www.pbs.org/wgbh/nova/earth/mt-st-helens.html>



Rhonda Mazza

A camera crew films Charlie Crisafulli (in photo below) as he conducts a small mammal survey on Mount St. Helens.

Rhonda Mazza



Watershed Health



Key Findings

- ▶ Working with a watershed council in western Oregon, researchers found science-based restoration projects were possible in watersheds under diverse ownership if local landowners were included in initial development of goals and guidelines for restoration work and in ecological monitoring.
- ▶ In-stream habitat restoration structures in Columbia Basin watersheds make detectable short-term, small-scale improvements in fish populations.
- ▶ Riparian buffers 50 feet wide adjacent to thinned stands in headwater forests had vegetation and down wood comparable to riparian areas adjacent to unthinned stands 5 years after treatment.





Tools

Incident Command Tool for Protecting Drinking Water (ICWater) version 3

Description:

ICWater version 3 now includes effects from deposition of toxic materials from airborne plumes and tidal influence on riverflows in coastal areas. These added features help incident commanders better assess risk to drinking water during toxic spill emergencies.

Use:

This tool is used primarily by incident commanders. The Missoula Fire Laboratory uses it to assess which on-the-ground assets are at risk from active wildland fires. They also use it to assess which public drinking water systems are potentially vulnerable to disruption by wildland fire at a national scale. Forest Health Protection is using ICWater for planning a nationwide aquatic monitoring program for early detection of waterborne propagules of sudden oak death.

How to get it:

<http://eh2o.saic.com/icwater/>

Contact:

Doug Ryan, dryan01@fs.fed.us, Focused Science Delivery Program

LTERMapS Internet Mapping Application

Description:

This tool uses Google Maps technology to provide information on Long-Term Ecological Research (LTER) sites. The U.S. LTER network comprises 26 sites representing a diverse array of ecosystems. With this new tool, users can view current weather at all LTER sites, zoom into individual sites, and view aerial images (provided by Google). The tool provides a consistent interface to brief site descriptions, a photo library, list of contacts, and links to individual LTER site Web pages.

Use:

Researchers, LTER staff, and members of the public wanting to know more about LTER sites will find this tool useful.

How to get it:

<http://www.lternet.edu/map/>

Contact:

Theresa Valentine, tvalentine@fs.fed.us, Ecological Process and Function Program

◀ Scientists and land managers tour a site on the Siuslaw National Forest where a study of the effects of different thinning treatments on adjacent riparian areas is underway, by John Laurence

Watershed restoration projects benefit from science-based stakeholder participation



COOPERATION AND commitment among stakeholders are critical components of science-based watershed restoration, yet prior to work by station scientists and collaborators, little

Use:
Watershed council integrates social networks with science to achieve restoration goals.

guidance existed about how to develop science-based stakeholder participation. Through work with the Long Tom Watershed Council in western Oregon, station scientists and

collaborators defined key elements of an effective social infrastructure. They found that restoration projects were possible in watersheds under diverse ownership if local landowners were included in initial development of goals and guidelines for

restoration work and in ecological monitoring. They also found that management that integrates local knowledge, is responsive to the fears and concerns of local residents, and explains the reasons for the work undertaken, has the potential to result in coordinated watershed-wide restoration planning and success.

The Long Tom Watershed Council used this experience to define their process and identify key successes in watershed restoration and management. Other watershed managers can use these findings to integrate science with social networks and develop coordinated watershed management that is responsive to ongoing scientific learning. These findings also have been incorporated in an on-line Integrated Watershed Management course offered by Oregon State University.

Contact: Rebecca Flitcroft, rflitcroft@fs.fed.us, Land and Watershed Management Program

Partners: Long Tom Watershed Council, Oregon State University



Cindy Thieman

A volunteer collects macroinvertebrate samples from a stream in Oregon's Long Tom Watershed.

Strategically managing flows may help accommodate diverse, growing needs for water in the West

SCIENTISTS CONDUCTED an assessment of threats to riparian ecosystems in the western United States. Riparian ecosystems are a high conservation priority because they provide a disproportionate quantity of ecosystem services relative to their extent on the landscape. In the arid western U.S., riparian ecosystems and wetlands occupy from 0.8 to 2 percent of the landscape, yet they provide habitat, water, and other resources to more than half the wildlife species in the region and harbor the highest plant, bird, insect, reptile-amphibian, and mammal biodiversity of any terrestrial ecosystem. Riparian areas also subsidize aquatic ecosystems; provide links across and within landscapes for the passage of organisms and the exchange of material; perform important biochemical cycling and water quality functions; store groundwater; attenuate floods; serve as areas for agriculture, human development, and recreation; and are associated with a range of other services valued by humans and important ecologically.

As human demand for water continues to increase and climate change threatens to alter flow regimes, management activities that help meet human needs while supporting river function become critical. One way to do this is to strategically manage flow factors such as timing, frequency, and duration. Federal relicensing of hydropower dams presents opportunities for this. Other mechanisms for protecting riparian health include protecting the soil and vegetation throughout the watershed.

Contact: Charles G. "Terry" Shaw, cgshaw@fs.fed.us, Western Wildland Environmental Threat Assessment Center

Partner: Colorado State University

Soil type plays a critical role in nutrient cycle that connects salmon to terrestrial ecosystems in coastal temperate rain forests

AFTER SALMON return from the ocean and spawn upstream, they die and their spent carcasses wash up along the streambanks. As they decompose, their nutrients are cycled back into the terrestrial system. It has long been assumed that these

salmon-derived nutrients play an important role in the watershed, and there was some concern about the impact declining salmon runs might have on terrestrial ecosystems. However, the underlying assumption about the role of salmon-derived nutrients in the watershed had never been explicitly tested.

Station scientists tested this assumption by delineating riparian zones along salmon spawning channels on Prince of Wales Island in southeast Alaska. They found two distinct soil types in those zones and tested the soil's response to the presence of decaying salmon by measuring the amount of the nitrogen isotope ^{15}N present. The ^{15}N isotope, which is abundant in the ocean but not as common in terrestrial systems, has historically been used to trace presumed salmon-derived nutrients in riparian systems. Contrary to conventional wisdom, the scientist found the soil closest to the stream (which happened to be the younger soil) had significantly lower concentrations of the nitrogen isotope ^{15}N compared to the older soil found farther away from the stream.

From this research, the scientists developed a model that provides a way to constrain the natural



Dave D'Amore

Field crew collecting soil samples on the banks of Rio Roberts Creek on Prince of Wales Island, Alaska.

variability encountered in studies of riparian nutrient cycles associated with the feedbacks between salmon-derived nutrients and terrestrial ecosystems. This will help improve estimates of the fate of salmon-derived nutrients in soils and vegetation.

Contact: Dave D'Amore, ddamore@fs.fed.us, Land and Watershed Management Program

Partner: University of Notre Dame



Rhonda Mazza

Field crew conducting stream survey on Mount St. Helens.

Salmon habitat restoration can lead to small-scale improvements in population



STATION SCIENTISTS monitored and evaluated assessments of in-stream habitat restoration structures designed to enhance survival and vigor of juvenile chinook salmon and steelhead in Columbia Basin watersheds. They found that in-stream habitat restoration structures make detectable short-term, small-scale improvements in fish populations. They also found that the effectiveness of built habitat structures may differ for various salmon species and can be difficult to discern owing to variation over time in the abundance of fishes or the quality of other habitat attributes. Their findings help identify temporal variation in the use of treated versus untreated habitat and determine if there are measurable changes in traits such as growth and movement. The scientists are sharing this information with stakeholders interested in salmon recovery and effective intervention treatments.

Contact: Karl Polivka, kpolivka@fs.fed.us, Land and Watershed Management Program

Partners: National Marine Fisheries Service, Integrated Status and Effectiveness Monitoring Program; Upper Columbia Salmon Recovery Board, Upper Columbia Regional Technical Team; USDE Bonneville Power Administration

Synthesis of riparian science frames future work at Olympic Experimental State Forest

THE WASHINGTON Department of Natural Resources (DNR) wants to use the experimental capacity of the Olympic Experimental State Forest to investigate management options that could result in a forested landscape more closely resembling the range of conditions produced by natural disturbances. To this end, station scientists reviewed and synthesized riparian science, providing the conceptual foundation for designing silvicultural treatments in riparian areas that emulate natural disturbances.

The review of riparian research and monitoring identified significant knowledge gaps that will be

addressed by watershed-scale riparian experiments on the experimental forest and perhaps on adjoining national forest and park lands. These experiments are expected to yield information useful to land managers in the rain-forest-dominated region of the western Olympic Peninsula.

Contact: Pete Bisson, pbisson@fs.fed.us, Land and Watershed Management Program

Partners: Washington Department of Natural Resources, University of Washington, USDA Forest Service Olympic National Forest, USDI Olympic National Park

Scientists assess sampling methods for conifer-dominated riparian zones

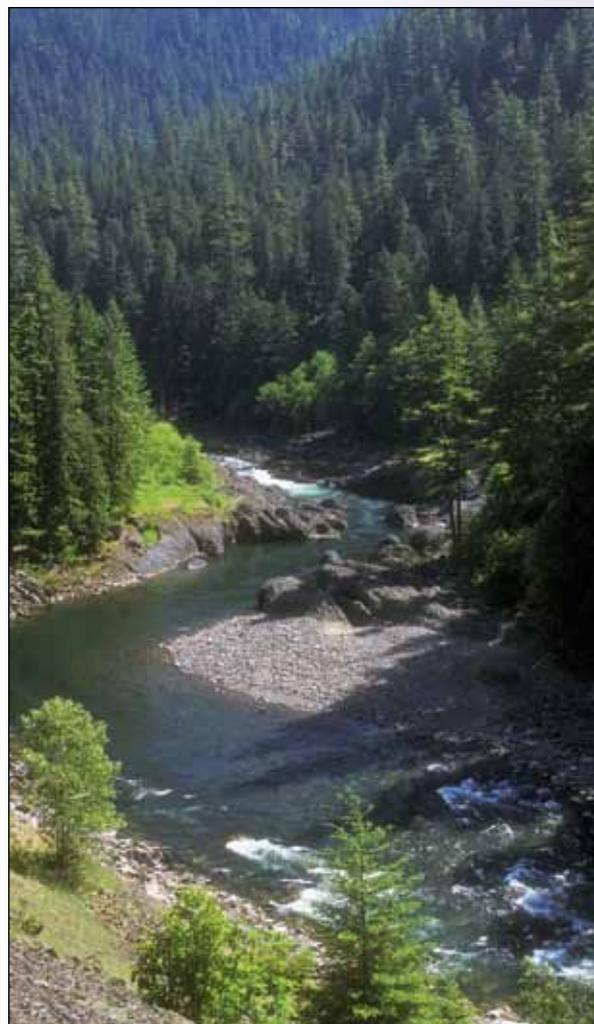
FOREST VEGETATION in riparian zones is often more diverse than that of adjacent terrestrial areas. More frequent disturbances and environmental gradients associated with stream channels and hillslope topography create an array of habitats that differ between riparian and upslope forests. Accurate sampling of forest attributes in riparian areas is integral to monitoring and research efforts undertaken by the broad spectrum of private and public resource management entities.

To determine which sampling methods work best in western Oregon, station scientists examined 16 alternatives to quantify selected characteristics of overstory conifers in riparian areas. In general, they found that designs that used rectangular strips were superior to either fixed-area circular or radial plots or variable-area plots. Sampling 9-acre-wide strips perpendicular to the stream was the best sampling alternative.

These findings are being applied to ongoing research studies of riparian forest practices at the station. They are likely to be more broadly applied to general forest inventory activities and specifically in conjunction with effectiveness monitoring for stream wood, shade, and water temperature on federal lands.

Contact: Paul D. Anderson, pdanderson@fs.fed.us, Land and Watershed Management Program

Partners: USDI Bureau of Land Management, Oregon State University



Tom Iraci

Clackamas River, Oregon.

No noticeable vegetation, down wood changes in riparian buffers 5 years after thinning adjacent stand



THE COMBINED effectiveness of thinning to increase structural complexity and maintaining riparian buffers to preserve riparian function in young, managed forests is not well documented. To address this knowledge gap, station researchers surveyed down wood and vegetation cover along transects that ran from the center of streams through riparian buffers 16 to 500 feet wide into thinned and unthinned stands. In the thinned stands, 80 trees per acre were left in 60 to 65 percent of the stand, while 10 percent of the stand was cut in circular openings ranging from 0.25 to 1 acre; 10 percent was left in circular leave islands also ranging from 0.25 to 1 acre in size, and the remainder was left unthinned in



Members of the Southern Idaho Biocontrol Program help with a study to determine if releasing large numbers of flea beetles is an effective way to control leafy spurge, an invasive weed.

riparian buffers. Researchers found the herbaceous cover in thinned stands was similar in wide buffers and increased in the narrowest buffers. Small-wood cover became more homogeneous in the 5 years following thinning. These results indicate that changes in wood and vegetation cover within buffers 50 feet or wider were not evident 5 years after the thinning treatments.

This study provides pertinent information for land managers about the short-term dynamics of vegetation and down wood in response to commercial thinning operations typically practiced on federal lands and elsewhere. Applying similar analytical methods designed to detect similarities rather than differences also may be used to assess the effectiveness of other mitigation measures such as those relating to riparian microclimate and stream temperature.

Contact: Paul D. Anderson, pdanderson@fs.fed.us, Land and Watershed Management Program

Partner: USDI Bureau of Land Management

New technique uses insects to control an invasive riparian weed

RIPARIAN ECOSYSTEMS are particularly sensitive areas that can be threatened by invasive species and by the herbicide or pesticide options commonly used in uplands to control the invaders. Leafy

Use: *Salmon-Challis National Forest, ranching communities, and others use technique to control leafy spurge along streams.*

spurge is one such invasive weed that has appeared along streams throughout much of the country.

Station scientists set out to determine if the weed could be controlled in

infested riparian areas by releasing a large number of flea beetles (*Aphthona* spp.), an easily collected natural enemy of leafy spurge. They focused their efforts by releasing large, or “inundative,” numbers of biological control insects on weed populations found in small isolated patches along three streams in southwestern, central, and eastern Idaho.

They found that releasing 10 beetles per flowering stem had inconclusive, potentially small negative effects on leafy spurge biomass, crown, stem, and seedling density. But releasing 50 beetles per flowering stem reduced the biomass, crown, and stem density by 80 percent and seedling density by 60 percent, compared to untreated plots.

These findings enabled the Jordan Valley Cooperative Weed Management Area to receive a \$25,000 grant to employ inundative beetle releases on leafy spurge in areas along tributaries of the Owyhee River in Idaho. The Salmon-Challis National Forest is using this protocol to reduce leafy spurge populations on islands in the Salmon River. Forest Health Protection personnel in Ogden, Utah, used inundative releases to effectively control leafy spurge in regional riparian areas. Inundative releases of biocontrol insects also were used in the “Hold the Line” Program to deter the spread of leafy spurge into the Yellowstone and Teton ecosystems.

Contacts: Robert Progar, rprogar@fs.fed.us, Threat Characterization and Management Program

Partners: USDA Agricultural Research Service, Forest Health Protection, Rocky Mountain Research Station; USDI Bureau of Land Management; Idaho Department of Agriculture

Willows host fungi that help clean polluted soil and water

REESTABLISHING native vegetation on land contaminated by heavy metals is a challenge for land managers. Toxic levels of cadmium, lead, nickel, and copper affect plant metabolism and photosynthesis, and possibly affect belowground fungal communities and their associations with plant roots.

A collaborative research project between Slovenian and American scientists focused on distinct mycorrhizal fungal groups associated with plant hosts growing on heavy metal-enriched sites. Willows, for example, have been successfully used for revegetating heavily contaminated land and are known to form mycorrhizal associations with several distinct groups of fungi. The scientists found that these mycorrhizal associations may add to the adaptability of willows on soil polluted with heavy metal.

This research provides insights on the ability of willows to clean up harmful toxins in water and soil and will contribute to the success of projects around the world that are using green plants to remove or neutralize pollutants from the environment.

Contact: Jane E. Smith, jsmith01@fs.fed.us, Land and Watershed Management Program

Partners: University of Ljubljana, Slovenia; Institute for Systematics of Higher Fungi, Ljubljana, Slovenia



Entiat River, Washington.

Tom Iraci

Wildlife



Key Findings

- ▶ A comprehensive map of marbled murrelet habitat reveals that federal land provides most (64 percent) of the quality nesting habitat, and that habitat on federal land has declined by about 77,000 acres (3 percent) from the baseline in 1996, mostly due to wildfire.
- ▶ Northern spotted owl populations continue to decline on federal lands, despite the considerable reduction in timber harvest during the last 15 years. This finding comes from a new meta-analysis of all data from 11 long-term population studies of northern spotted owls in Washington, Oregon, and California.
- ▶ Station scientists helped develop procedures for panels of experts determining if a rare species should potentially be listed as endangered, threatened, or not listed under the Endangered Species Act.
- ▶ Station scientist sequenced entire mitochondrial genomes for 40 North American fisher and found subspecies and populations of the fisher reflect population structure that predates current management practices.



Tool

Northern Spotted Owl Dispersal Assessment Tool

Description:

This tool is used to assess northern spotted owl dispersal habitat. It has a stand-level habitat quality component based on the Ecosystem Management Decision-Support system. These results are further assessed for connectivity by using customized programming based on graph theory.

Use:

The Washington Department of Natural Resources is using this tool on the approximately 1.6 million acres of forested state trust lands they manage under a habitat conservation plan between the Washington Department of Natural Resources and the U.S. Fish and Wildlife Service.

How to get it:

Contact Sean Gordon, sgordon@fs.fed.us,
Ecological Process and Function Program

New map provides comprehensive view of murrelet nesting habitat



THE MARBLED MURRELET is listed as threatened under the Endangered Species Act, and its conservation is a key objective of the Northwest Forest Plan. Understanding the status and trend of the murrelet's nesting habitat is one way to judge whether the plan is effective in meeting its conservation objective.

A station scientist led an effort to model the amount, distribution, and trend of murrelet nesting habitat throughout the bird's range in Washington, Oregon, and northern California. The result is a comprehensive



Martin Raphael

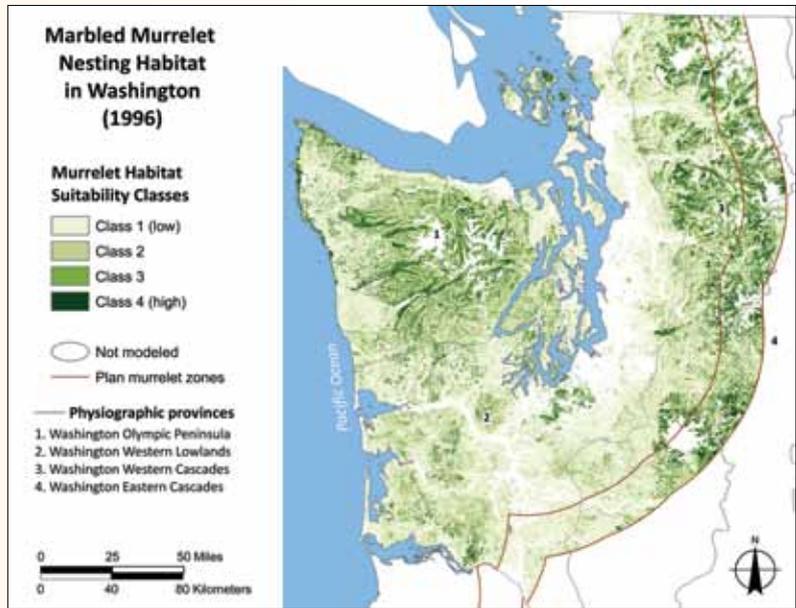
Marbled murrelet.

map depicting relative suitability of habitat over all lands within this range. Overall, federal lands provided the 64 percent (2.4 million acres) of higher-suitability potential nesting habitat, mainly in "reserved" land allocations. Federal lands are less important in California, where most

coastal forests are in nonfederal ownership and where little habitat remains. Murrelet nesting habitat declined about 3 percent (77,000 acres) from the 1996 baseline on federal lands and declined by 30 percent (413,000 acres) on nonfederal lands. Two-thirds of the loss on federal lands was due to wildfire in Oregon, most of which occurred in the 2002 Biscuit Fire. Timber harvest accounted for most losses on nonfederal lands.

Contact: Martin Raphael, mraphael@fs.fed.us, Ecological Process and Function Program

Partners: USDA Forest Service Pacific Northwest and Pacific Southwest Regions, USDI Fish and Wildlife Service



Map of marbled murrelet nesting habitat in Washington.

Rigorous procedures developed for recommending species listing under the Endangered Species Act



STATION SCIENTISTS were invited by the U.S. Fish and Wildlife Service to help develop and apply a rigorous procedure to aid in the difficult process of determining the potential listing status

Use: U.S. Fish and Wildlife Service adopts new procedure for determining potential listing status under the ESA.

(endangered, threatened, or not to be listed) of a rare species under the Endangered Species Act. The procedure combines expert panels of scientists and agency managers and uses structured decisionmaking.

The Red Tree Vole Listing Advisory Panel successfully used the procedure, with oversight and facilitation by a station scientist. The procedure is being applied by U.S. Fish and Wildlife on other species listing decisions.

Contact: Bruce Marcot, bmarcot@fs.fed.us, Ecological Process and Function Program

Partners: USDI Fish and Wildlife Service

Northern spotted owl populations continue to decline



AS PART OF the Northwest Forest Plan, federal agencies are required to monitor long-term population trends of northern spotted owls on federal lands. An updated analysis of the data from these studies is conducted every 5 years and published in a peer-reviewed journal. Many federal agencies and nonfederal stakeholders are interested in this analysis because the recovery of the spotted owl is a major goal of the Northwest Forest Plan.

The large group of scientists who conducted the meta-analysis found that spotted owl populations continue to decline on federal lands, despite the considerable reduction in timber harvests over the last 15 years. One possible explanation for this continued decline is competition with the closely related barred owl, which invaded the Western United States during the last century. Another possible cause is continued loss of habitat from fire, insect damage, and timber harvest.

Contact: Eric Forsman, eforsman@fs.fed.us, Ecological Process and Function Program

Partners: Colorado State University; Green Diamond Timber Company; Hoopa Tribal Forestry Program; Oregon State University; Raedeke and Associates; Simon Fraser University; USDA Forest Service Pacific Northwest Region; USDI Bureau of Land Management Fish and Wildlife Service, National Park Service

For more information: Forsman, E.D.; Anthony, R.G.; Dugger, K.M. [In press]. Population demography of northern spotted owls. *Studies in Avian Biology*.



Northern spotted owl.

Forest structure is a good indicator of flying squirrel habitat

FLYING SQUIRRELS are the primary prey of threatened northern spotted owls throughout much of Oregon and Washington. Understanding squirrel habitat may be critical to recovery of spotted owl populations—a requirement affecting overall forest management across most federal and state lands in the region. Flying squirrels can also be used to measure the health of regional forests as they are part of an important ecological link connecting trees, fungi, and predators like owls and weasels. Management strategies that involve tree removal, even ones designed to have positive long-term ecological effects, almost always result in reduced squirrel populations. A squirrel-structure-predation connection explains this phenomenon and provides ecological rationale for developing and testing new strategies that could help keep squirrels on the landscape following management activities.

Pacific Northwest land managers operating under the Northwest Forest Plan now have a quantitative method for measuring and analyzing forest structure and squirrel habitat. This information can also be used to model regional squirrel and owl habitat under alternative management scenarios and to create new silvicultural prescriptions potentially beneficial for flying squirrels and northern spotted owls.

Contact: Todd Wilson, twilson@fs.fed.us, Ecosystem Process and Function Program

Partners: Southern Oregon University; The Nature Conservancy; U.S. Army, Joint Base Lewis-McChord; USDA Forest Service Rogue-Siskiyou National Forest, Olympic National Forest

Tom Iraci

Bruce Marcot



Diminishing sea ice has prompted concern for the Pacific walrus.

New model projects potential fate of Pacific walrus

RECENT YEARS have seen the smallest area of Arctic sea ice ever observed, prompting great concern over the future of associated wildlife, including the Pacific walrus. Under invitation from, and a formal

Use: work agreement with, the U.S. Geological Survey (USGS), a station scientist developed and implemented a probability-based model that projects the potential fate of the walrus populations

U.S. Fish and Wildlife Service uses findings in deliberations over listing the walrus under the ESA.

under effects of climate change, habitat conditions, and human-caused stressors throughout the 21st century.

Results from this study were presented at a major conference on marine mammals and to the U.S. Fish and Wildlife Service's (FWS) Pacific Walrus Listing Team, which is using the results to determine whether to list the species under the Endangered Species Act (ESA). The modeling methods will be used on other species evaluations by FWS and USGS, and this specific model is providing USGS with a tool to guide future research.

Contact: Bruce Marcot, bmarcot@fs.fed.us, Ecological Process and Function Program

Partner: U.S. Geological Survey Alaska Science Center

Genetic studies reveal population structure of fisher predate management



TECHNOLOGIES INITIALLY motivated by the Human Genome Project have been modified to bring affordable genomics to conservation genetics. Using this technology, station scientists

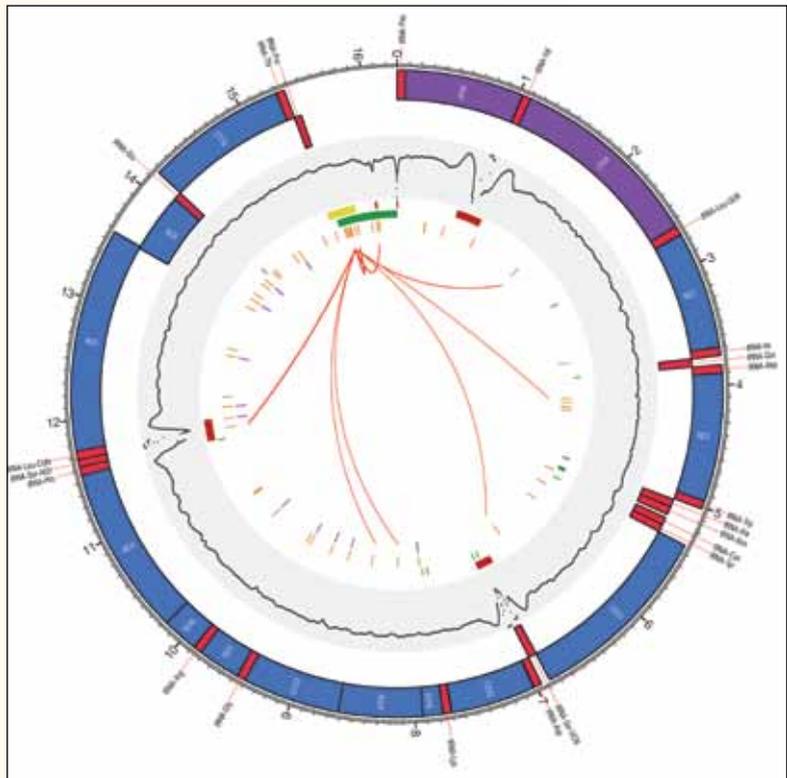
Use: sequenced entire mitochondrial genomes from 40 fishers. Previous research, based on a portion of the mitochondrial genome, had observed such low levels of genetic variation

Results from genetic sequencing used to inform decisions on listing fisher population under the ESA.

within fishers that individuals from the Great Lakes Region and Pacific West appeared identical. Entire mitochondrial genome sequences have provided sufficient information to support taxonomic subspecies, as well as identify unique populations. These results indicate that the observed genetic structure represents a pattern that has been in place for thousands of years, much longer than current land management practices.

Distinct population segments of fisher have recently been petitioned for listing under the

Richard Cronn



New technologies enable researchers to identify genetic differences within a species, for example, identifying populations from different regions. This diagram of the fisher mitochondrial genome shows the location of genes (blue, red, purple), and variable nucleotide positions (tick marks, inner circle).

Endangered Species Act (ESA), and conclusions from this proposed listing are currently pending. This research is being used to aid management decisions about whether these populations warrant protection under the ESA. Scientifically informed management decisions regarding fishers can now be made, whereas in the recent past, technical information about the fisher was limited.

Contact: Richard Cronn, rcronn@fs.fed.us, Landscape and Watershed Management Program

Partner: USDA Forest Service Rocky Mountain Research Station



Tom Iraci

Mule deer.

Continued decline of mule deer habitat in central Oregon projected as development increases

CENTRAL OREGON has been a hotspot of tourism, recreation, and development in recent years. This development has had numerous environmental impacts including declining mule deer populations.

Use: Findings inform land use zoning decisions by state legislature. This decline has become the single most pressing issue for the Oregon Department of Fish and Wildlife in the eastern part of the state. Researchers used models

to evaluate the potential impacts of future forest and range land development on mule deer winter range. They found that development will continue to encroach onto mule deer winter range in central Oregon through 2040.

Predictions from this study have helped other researchers to identify appropriate locations for more geographically focused studies of fine-scaled habitat impacts. The maps and predictions were also integral to a broader analysis effort that was developed to inform deliberations by the Oregon

State legislature, the Deschutes Land Trust, and the State of Oregon over legislation on land use zoning in central Oregon.

Contact: Jeff Kline, jkline@fs.fed.us, Goods, Services, and Values Program

Partner: Interagency Mapping and Assessment Project (IMAP)

Conservation priorities identified for Northwest amphibians and reptiles

SCIENTISTS AND natural resource managers from across western Canada and the western United States synthesized conservation concerns and priorities for 105 species of amphibians and rep-

Use: A tri-agency conservation strategy develops for the Siskiyou Mountains salamander. They identified key threats to these species and found that management was hindered by a lack of basic ecological knowledge, insufficient funding, and limited communication

regionwide. These species of concern would likely benefit from standardized regulations for managing native and nonnative species, increased use of data management programs, and jurisdictional stewards for these species to serve as liaisons among fisheries, wildlife, and forestry departments.

This heightened awareness of herpetological conservation has resulted in several new conservation partnerships in the Northwest. In Oregon, for example, three federal agencies are implementing a conservation strategy for the Siskiyou Mountains salamander on federal lands. The U.S. Fish and Wildlife Service is using this strategy for another salamander species in New Mexico.

Contact: Dede Olson, dedeolson@fs.fed.us, Land and Watershed Management Program

Partners: USDA Forest Service Pacific Southwest Research Station, Natural Resources Conservation Service; USDI Bureau of Land Management, Geological Survey, and Fish and Wildlife Service; BC Ministry of the Environment; Oregon Department of Fish and Wildlife; Montana Natural Heritage Program; Wyoming Natural Diversity Program; University of Wyoming; Idaho Department of Fish and Game; Washington Department of Fish and Wildlife; Alberta Conservation Association; National Center for Conservation Science and Policy; E. Wind Consulting; Weyerhaeuser Company; Longview Timberlands; Idaho State University; University of Alaska Southeast; University of Washington; Oregon State University; Quest University, BC, Canada

Learning Events



Visitors to Mount St. Helens. Photo by Simmons Buntin.

Symposia, Workshops, and Tours

~ 2,430 people participated in symposia and workshops

~ 1,400 people went on field trips

~ 4,800 people participated in conservation education activities

THE PNW RESEARCH Station sponsors scientific and technical events each year, often in partnership with other agencies, organizations, and universities. Following are descriptions of some of these events.

A Tale of Two Cedars: The station co-sponsored an international symposium on western redcedar and yellow-cedar at the University of Victoria in British Columbia. The 50 attendees explored current knowledge and management experience with these two culturally, commercially, and ecologically important tree species in Alaska, British Columbia, and the Pacific Northwest.

Adapting to Climate Change in National Forests: This workshop sponsored by the Forest Service's western research stations brought together resource managers, Forest Service leadership, scientists, and representatives from other agencies and organizations to share information on adaptation to climate change and develop plans for future adaptation.

About 130 people attended the event, held in Stevenson, Washington.

Alaska Sustainable Outdoor Recreation and Tourism Workshop: This workshop, "Renewing body and spirit, inspiring passion for the land," engaged recreation leaders from inside and outside the Forest Service in tailoring a regional approach to the implementation of the new national recreation strategy being piloted in Alaska. About 100 participants attended the event held in Juneau.

An Introduction to Next-Generation Genome Sequencing: This workshop was part of the Botanical Society of America's annual meeting in Providence, Rhode Island. It gave the 55 participants hands-on training in sequence analysis, using exercises and data developed at the PNW Research Station and Oregon State University.

ArcFuels Workshop: Two hands-on workshops provided participants with the opportunity to learn about vegetation growth and fire behavior modeling through the ArcFuels interface for fuel management planning and hazard and risk assessments. The workshop at the University of Idaho in Moscow had 20 participants and was followed by a seminar on quantitative wildfire risk. A second workshop at Northern Arizona University in Flagstaff had 40 participants and was coupled with a discussion on model outputs with respect to land management.

Coho Modeling Group Workshop: This workshop, held at the Corvallis Forestry Sciences Laboratory, provided a forum for 18 professionals with federal and state agencies to explore alternative approaches to representing the life stages of Coho salmon within a changing environment.

Density Management Study Field Tour: PNW principal investigators of a density management and riparian buffer study toured a site near Mount Hood with 25 members of the Clackamas River Watershed Stewardship Council to explain the research and key findings that may be relevant to management of the Portland metro area water source.

Developing and Applying New Elk Habitat Models in Western Oregon and Washington: Station scientists presented initial results of elk habitat selection modeling to 10 tribal elders at the Muckleshoot Indian Tribal Headquarters in Auburn, Washington. They discussed potentially using this information on ceded lands for targeting elk habitat improvement projects.

Dragonfly Eyes: This workshop at H.J. Andrews Experimental Forest attracted 20 participants, including scientists, writers, philosophers, artists, architects, and social scientists. The gathering provided an opportunity for people from different professional backgrounds to share their perspectives on how people view, depict, and elicit action concerning future landscape change.

Forest Inventory and Analysis (FIA) California

Client Meeting: FIA hosted a symposium in Sacramento, California, to share findings and discuss current research in the Pacific Northwest. The following day, the FIA team hosted a data workshop where clients were guided through methods for analyzing FIA data and had the opportunity to ask questions. About 100 people attended the event.

Genetic Resource Management: This climate change workshop in Corvallis, Oregon, brought together 40 national forest geneticists and others to discuss impacts of climate change on vegetation and genetic resources, and to identify possible strategies to adapt to those impacts within the Forest Service's genetic resource management programs.

Integrating Ecological and Fuel Management

Objectives: This workshop brought together 210 practitioners from multiple disciplines to discuss and develop stand-level prescriptions that integrate ecological and fuel management objectives for dry forest restoration and advance conservation of the northern spotted owl in the eastern Cascades of Washington, Oregon, and California.

Keeping Wildlife Wild Day: A station scientist spoke to 30 people at a 1-day event designed to educate visitors at Mount Rainier National Park about the importance of not feeding or interacting directly with wildlife.



Scientists, writers, philosophers, artists, architects, and social scientists discuss perceptions of landscape change during a workshop at H.J. Andrews Experimental Forest.

Michael Furniss

Long-Term Ecological Research Field Trip:

Sixteen scientists and artists visited Bonanza Creek Experimental Forest in Alaska to describe the effects of a changing climate on Alaskan boreal forests.

Lookout Mountain Field Trip: The 60 people on this field trip learned about planned research at Pringle Falls Experimental Forest aimed at developing and testing silvicultural prescriptions for dry forest management.

Mount St. Helens 30th Anniversary Science Pulse: The station hosted a week-long scientific gathering of researchers and their staff at the volcano. About 140 participants from dozens of universities, national laboratories, and agencies gathered 30-year post-eruption benchmark measurements of key ecological parameters, fostered collaboration, and defined future research opportunities. The pulse was also an opportunity to recruit the next generation of researchers as many of the original scientists are approaching retirement age. A concurrent humanities pulse gathered 12 poets and writers who contributed their perspectives on understanding the volcanic landscape.

Natural Resource Expo: The annual meeting of the Association of Oregon Counties, an advocate for county governments and county officials in improving their services, was held in Portland, Oregon. Scientists from the PNW Research Station presented 10 posters, providing an opportunity to showcase applied research, particularly in topic areas relevant to local issues. About 300 people attended the expo.

Northwest Scientific Association Symposium: This symposium, “30 Years of Research at Mount St. Helens—Lessons of Local and Global Importance,” highlighted several long-term geological and biological studies that have transformed current understanding of volcanic processes and hazard assessment and ecosystem responses to large, intense natural disturbance. About 100 scientists, land managers, and writers attended.

Restoring Oak Woodlands: About 35 landowners and natural resource professionals attended a fieldtrip to the North Bank Wildlife Management Area in the BLM Roseburg District to learn about restoring oak woodlands to improve habitat for Columbian white-tailed deer. Station experts on Oregon white oak led parts of the discussion.

Connie Harrington



Landowners learn about restoring Oregon white oak woodlands to improve deer habitat.

Roads Workshop: Participants learned from a station hydrologist how climate change will likely alter road construction standards and what effect changing weather patterns will have on forest road systems. The workshop, sponsored by the Western Forestry Association, was attended by about 200 practitioners from industry, government, and non-governmental organizations throughout the Pacific Northwest.

Staney Community Forestry Project:

Four workshops were held on Prince of Wales Island, Alaska, to develop a common understanding of the current environmental, economic, and social conditions in the project area and to develop a vision for what the area should be like in 25 to 50 years. The workshops also produced specific desired future conditions for five sectors: timber supply, economic opportunity, terrestrial habitat, aquatic habitat, and subsistence. The 60 participants included scientists and managers from the Forest Service and Alaska state agencies, representatives from the island's communities, and others with interest in the island.

Sensor Network Technologies: A 3-hour workshop was held in Estes Park, Colorado, to exchange information about sensor network development. A series of short talks, followed by a panel discussion specifically focused on identifying gaps in sensor network tool development explored possibilities for coordination of tool development and enhancing adoption of existing tools through training and support. About 45 people attended.

The Power of Nature: About 500 people attended this public lecture, "Reflections on Mount St. Helens 30 Years Post-Eruption." The event was sponsored in part by the PNW Research Station. Guest speakers included ecologist Jerry Franklin, poet Gary Snyder, and writer Ursula Le Guin.

Watershed Management and Research: Station scientists led a research tour on stream and riparian issues in the Capitol State Forest near Olympia, Washington. The seven attendees were students participating in the "Minority Students in Natural Resources" program at Portland State University.

Webinars on Climate Change and Forest Vegetation Models: Two Webinars titled "Integrating Climate Change with Forest Vegetation Models for Adaptation Planning" were hosted at the University of Washington. In total, 300 participants from the United States and Canada learned about the numerous factors that need to be considered when trying to integrate climate change models with vegetation models used in forest planning and management.

Katie Nussbaum



Middle school students enjoy the Canopy Connections program at H.J. Andrews Experimental Forest.

Conservation Education

Canopy Connections: During 8 days in May, 185 middle school and high school students visited H.J. Andrews Experimental Forest. They rotated among four lessons created and presented by eight students in the University of Oregon's Environmental Leadership Program. Activities included climbing and observing in the old-growth canopy, studying function and parts of a tree, discovering old-growth habitats, and learning how to identify native plants and their uses.

Career Paths in Natural Resources: Station scientists visited Eastern Oregon University, where they talked to 36 students about career paths in natural resources with various government agencies and nongovernmental organizations.

Climate Change and Water: Forty educators attended this lecture as part of the Forestry Institute for Teachers held at Humboldt State University.



A station science technician helps a young volunteer identify plants as part of the Crater Lake BioBlitz.

Crater Lake BioBlitz: A station scientist gave a presentation on Cascadia amphibians to about 50 members of the public at the rim of Crater Lake. Station personnel assisted with a day-long amphibian inventory of the national park conducted by more than 50 volunteers.

Dry Ice—Discovering the Properties of CO₂: Third graders in the Liberty Elementary School District of Albany, Oregon, discovered the properties of carbon dioxide (CO₂) by watching dry ice change from a solid to a gas. The 60 participants also learned that CO₂ is an ingredient in soda pop, that humans exhale it, and plants inhale it.

Forests Inside Out! The station was able to use funding from the American Recovery and Reinvestment Act funding to continue its partnership with the nonprofit World Forestry Center in Portland, Oregon, to support Forests Inside Out!, a successful summer conservation education program. This program is a series of 2-day indoor and outdoor experiences for 300 children ages 6 to 10 and family members from diverse and underserved communities in the greater Portland metro area. Eight high school students who are graduates of the station-supported Inner City Youth Institute were hired as mentors for the program.

Forest Camp: The Siuslaw National Forest hosted outdoor school for 200 sixth graders at Camp Tadmor in Lebanon, Oregon. Several station employees taught the Web of Life segment of the camp, including a component describing the important and functionally diverse roles of fungi in the forest ecosystem.

Forestry Days: About 300 sixth graders in the Clatsop County school district of Astoria, Oregon, learned about the ecology of forest fungi.

Inner City Youth Institute: The station provided continued support to the Inner City Youth Institute (ICYI). ICYI encourages underrepresented youths to pursue higher education and careers in the natural resource and environmental fields. ICYI sponsored forest ecology programs in Portland inner city middle and high schools and a summer camp program for high school students from Portland. This summer's camp was held at Oregon State University (OSU) and H.J. Andrews Experimental Forest. Participants spent a day on campus learning about OSU's degree programs and gaining a sense of what life might be like for a college student. The remainder of the week was spent at the experimental forest learning about forest ecosystems from onsite scientists.

Learning About Cedar and Forest Ecology: Alaska Native students and educators learned about cedar trees at the Alaska Native Brotherhood/Alaska Native Sisterhood Grand Camp. Others learned about forest ecology at the Tlingit and Haida Culture Camp. About 55 people participated in the events.

Marys Peak Watershed Tour: About 100 middle school students learned about healthy watersheds and the importance of headwater areas.

Mentoring an Aspiring Wildlife Biologist: A station scientist consulted and verified species for a student at Sandy High School, Oregon. The scientist went on to mentor the student in the process of surveying for wildlife species. They discussed sampling methods for expected amphibians, reptiles, birds, and mammals in the area. The student now aspires to become a wildlife biologist and has developed a keen interest in research.

Mount St. Helens 30th Anniversary: The station partnered with the Mount St. Helens Institute to present a virtual science field trip to over 3,000 fourth through eighth grade students across the country.

Natural Resources Internships: Two students at Green River Community College in Auburn, Washington, participated in formal internships with station scientists to fulfill their degree requirements. The students worked 400 hours and kept detailed diaries of their work experience.

Natural Resources Program Advisory

Committee: Station scientists served on a formal advisory committee to establish and oversee a 2-year community college curriculum and field experience in natural resource management for Wenatchee Valley College in Washington. They also hosted an annual field trip for 20 students in the field methods lab course.

New Market Skills Center: Forty high school students learned about careers in forestry and forest research. The center in Tumwater, Washington, provides career and vocational and technical skills to high school students interested in employment directly after high school and/or preparation for entering college or apprenticeship.

Northwest Science Expo: The station sponsored “Outstanding Forest Science” awards to a high school student and a middle school student at this science fair for young scientists, engineers, and mathematicians at Portland State University in March. The station also participated in judging.

Petri Dish Experiments: Sixty third graders at Liberty Elementary School in Albany, Oregon, learned scientific methods and gained experience by using a dissecting microscope to closely examine bacteria and fungi lurking on their hands. Hand-cleansing treatments were compared by counting different-colored fungi or bacteria growing on nutrient agar in Petri dishes.

SalmonWatch: Forty biology students at Crescent Valley High School in Corvallis, Oregon, learned about the biological and cultural aspects of northwest salmon. The learning experience included a field trip to the Alsea River led by several station scientists

Stream Amphibian Project: Station scientists helped five eighth-grade students at Jane Goodall Elementary and Middle School in Salem, Oregon, complete a year-long science project examining abundance and diversity of stream amphibians in an old-growth forest and a secondary forest of the Oregon Coast Range.

Keara Gann



Students from the Jane Goodall Environmental Middle School in Salem, Oregon, learn about stream ecology with station scientists.

Streamkeeper Academy Lecture Series: A station scientist presented “On the Track of the Elusive Wolverine.” About 65 people attended this lecture held at the Northwest Stream Center in Everett, Washington.

Washington State Science and Engineering Fair: The station sponsored an “Outstanding Forest Science Project Award” to a tenth-grade high school student at the Washington State Science and Engineering Fair at Olympic College, Bremerton, Washington, in April.

What Eats Plankton? A station scientist organized an event at a day care facility in Corvallis, Oregon, on marine food webs and led art activities modeling plankton out of styrofoam and plankton necklaces out of clay. Fifteen 3- to 4-year-olds participated.

Honors and Awards



Best Paper in Ecology and Society

Rebecca Flitcroft, a research fisheries biologist with the Land and Watershed Management Program, was the lead author of an article entitled “Social Infrastructure to Integrate Science and Practice: the Experience of the Long Tom Watershed Council.” The journal *Ecology and Society* published the article in a special issue, honoring it as the year’s best example of translating transdisciplinary science theory into practice.

Early Career Scientist

Lee Cerveny, a research social scientist with the Goods, Services, and Values Program, received the Forest Service’s Research and Development’s Early Career Scientist award. It was given in recognition of her outstanding contributions in the application of social science to natural resource management.

Geological Society of America Fellow

Gordon Grant, a research hydrologist with the Ecological Process and Function Program, was elected Fellow of the Geological Society of America, reflecting career contributions in the geological sciences. Dr. Grant was also selected to give the M. Gordon Wolman Lecture at the Biennial Meeting of the Council of Universities for the Advancement of Hydrological Sciences, Inc., an honor reflecting career contributions in hydrological sciences.

International Association for Landscape Ecology

Rebecca Kennedy, a research ecologist with the Threat Characterization and Management Program, was honored with a certificate of appreciation for outstanding service as Web site coordinator for the U.S. chapter of the association.

International Network of Research on Coupled Human and Natural Systems

Rebecca Kennedy, a research ecologist with the Threat Characterization and Management Program, was selected as a Fellow under the network, which is supported by the U.S. National Science Foundation.

Outstanding Editing

Mary Rowland, a wildlife biologist with the Ecological Process and Function Program, was honored by the Pacific Northwest Region and Washington office’s Wildlife Ecology Unit for outstanding productivity and achievement as the editor of the *Habitat Monitoring Technical Guide*. The document will provide national guidance for wildlife habitat monitoring in support of forest planning and broad-scale assessments.

Ralph W. Schreiber Conservation Award

Eric Forsman, a research wildlife biologist with the Ecological Process and Function Program, received this conservation award from the American Ornithologists Union (AOU) on behalf of the Northern Spotted Owl Demographic Team. The award was presented during the annual meeting of the AOU Cooper Ornithological Society and the Society of Canadian Ornithologists in recognition of contributions toward the conservation of the northern spotted owl.

Regional Silviculturist of the Year

Paul Hennon, a research forest pathologist with the Threat Characterization and Management Program, was named regional silviculturist of the year by the Alaska Region of the Forest Service for his work there.

Special Exhibition at ESRI International User Conference

Ron Neilson, a research bioclimatologist with the Ecological Process and Function Program, was invited to have a special exhibition booth at the Climate Change Showcase at the 30th ESRI international user conference in San Diego, California.

PNW Research Station Organization

Station Director

Bov B. Eav
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2100
E-mail: beav@fs.fed.us

Deputy Station Director

Cynthia D. West
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2104
E-mail: cdwest@fs.fed.us

Assistant Director for Administration

Lesley A. Kelly
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2102
E-mail: lakelly@fs.fed.us

Assistant Director for Communications and Applications

Cynthia L. Miner
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2135
E-mail: clminer@fs.fed.us

Assistant Director for Program Development

Paul Brewster
Forestry Sciences Laboratory
11305 Glacier Highway
Juneau, AK 99801-8545
Phone: 907-586-7801
E-mail: pbrewster@fs.fed.us

Assistant Director for Research

Susan A. Willits
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2115
E-mail: swillits@fs.fed.us

Program Managers

Ecological Process and Function

Beatrice Van Horne
Forestry Sciences Laboratory
3200 SW Jefferson Way
Corvallis, OR 97331
Phone: 541-750-7357
E-mail: bvhorne@fs.fed.us

Goods, Services, and Values

R. James Barbour (Acting)
Forestry Sciences Laboratory
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2542
E-mail: jbarbour01@fs.fed.us

Focused Science Delivery

R. James Barbour
Forestry Sciences Laboratory
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2542
E-mail: jbarbour01@fs.fed.us

Land and Watershed Management

John A. Laurence
Forestry Sciences Laboratory
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2191
E-mail: jalaurence@fs.fed.us

Resource Monitoring and Assessment

Charles E. Peterson
Forestry Sciences Laboratory
P.O. Box 3890
Portland, OR 97208-3890
Phone: 503-808-2026
E-mail: cepeterson@fs.fed.us

Threat Characterization and Management

Marcia Patton-Mallory
Forestry Sciences Laboratory
1133 N Western Ave.
Wenatchee, WA 98801
Phone: 509-664-1715
E-mail: mpattonmallory@fs.fed.us

Western Wildland Environmental Threat Assessment Center

Nancy Grulke
3160 NE 3rd Street
Prineville, OR 97754
Phone: 541-416-6583
E-mail: ngrulke@fs.fed.us

The attached CD-ROM contains the following:

- ▶ 2010 Science Accomplishments
- ▶ PNW Research Program Reports
- ▶ 2010 PNW Research Station Publications

Credits

Assistant Director for Communications
and Applications—Cynthia L. Miner

Managing Editor—Rhonda Mazza

Writer—Rhonda Mazza

Publishing Director—Frank Vanni

Graphic design—Keith Routman and
Rhonda Mazza

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by Walter Foss

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The Forest Service of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the national forests and national grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

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Pacific Northwest Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890
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