2007 SCIENCE ACCOMPLISHMENTS
of the Pacific Northwest Research Station

United States Department of Agriculture
Forest Service

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.

Vision and Mission

Contents

On the cover: Turnagain Pass, Alaska. This page: Mack Creek, H.J. Andrews Experimental Forest, Oregon. Both photos by Tom Iraci.

A Message From the Station Director

Station Director Bov Eav

As I look back at 2007 for the

Pacific Northwest (PNW) Research Station, I am very gratified at the contributions of our scientists and support staff in producing scientific knowledge and tools. This year has brought unprecedented recognition of the contributions of our scientists. Ralph Alig (research forester), Ron Neilson (bioclimatologist), and David L. Peterson (research biologist) were recognized with the Nobel Peace Prize for their contributions to the International Panel on Climate Change. Their participation in this rigorous endeavor is truly remarkable. They and those who have supported their efforts bring great pride to the Station and the Forest Service.

Also, two scientists at the Station were promoted to super grade scientists, representing the highest graded positions in Forest Service Research and Development. The Chief of the Forest Service recognized Richard Haynes with the Distinguished Science Award, Bruce Marcot with the Global Stewardship Award, and Gail Hodgson with the Excellence in Budget and Financial Accountability Award. And there are more. Please turn to page 84 for a description of these and other awards the Station received in 2007.

The PNW Research Station is extremely fortunate to have many retired scientists work with us as emeritus scientists. Their continued work with the Station is very valuable. This year, Jim Trappe, Walt Thies, and Nan Vance became PNW emeritus scientists.

Our partnerships are very important to the work we do, and I want to acknowledge that nearly all accomplishments reported here are possible because of those who work side-by-side with us in generating and delivering new knowledge and developing tools that will help inform land management. This past year we reached out to many of our partners and clients as we developed a strategic business plan that will help guide our work for the next 3 to 5 years. We also had several field

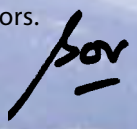
visits with Congressional staffers as we presented information on climate change, fire, and urban development.

I look forward in 2008 to new efforts we have started related to climate change. We are working hard to find new ways to generate and deliver science to meet an incredible demand for information as people adapt and mitigate the changes we have begun to experience. We also are reaching out to partners in new endeavors. For example, to better understand urban areas as forested environments, we are working with the University of Washington, Northern Research Station, and others.

I invite you to read this report at whatever pace you might choose: glance through the photos and captions. You might pause at the key findings and tools. And we hope there are headings that will draw you. Following are findings related to climate change, an area that the Station has been studying for about 20 years.

- A vegetation model, developed by one of our Nobel Peace Prize winners, indicates that climate change likely will affect many forest types and increase fire frequency on one-third of the global land surface. Federal, state, and private land management agencies, and The Nature Conservancy have inquired about these MD1 Dynamic General Vegetation Model climate change projections.
- Models are predicting warmer temperatures will lead to less snow accumulation and less runoff during longer dry seasons. This information about snowmelt helps managers anticipate effects of climate change on snow regime.
- Different landscapes have widely different responses to warming climate with ground water becoming the primary source of summer streamflow in parts of Oregon and California with a warming climate. Public water and energy utilities are incorporating information about sources of summer water supply in western Oregon into long-range management plans.
- Land-use changes affect carbon storage and ecosystem goods and services. Scientists found that Oregon's land-use planning program resulted in substantial carbon storage over the past decade, sufficient to offset more than twice the increase in carbon emissions over the same period. The Oregon Department of Forestry and Environmental Protection Agency are using this and other land-use studies to develop climate change strategies.

The coming year promises to be one marked by further change and accomplishment. I wish you the best in all your 2008 endeavors.



Pacific Northwest Research Station: The Setting

- 11 laboratories and centers in Alaska, Oregon, and Washington
- 11 active experimental areas (watershed, range, and experimental forests)
- Research also conducted in more than 20 research natural areas (RNAs)
- Headquarters in Portland, Oregon
- Pacific Northwest Research Station is one of five research stations in the U.S. Department of Agriculture, Forest Service
- 443 employees (302 permanent, 141 temporary)

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)

Experimental Areas

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

Left: Research ecologist samples pond near Mount St. Helens for presence of amphibians. Photo by Tom Iraci.

Goal Accomplishments

GOAL 1: Develop a fundamental understanding of ecological, social, and economic systems and their interactions

KEY FINDINGS

- *Models predict warmer temperatures will lead to less snow accumulation and less runoff during longer dry seasons.*
- *Significance of groundwater will increase in parts of the Cascade Range as the climate warms.*
- *Vegetation model indicates climate change likely will affect many forest types and increase fire frequency on one-third of global land surface.*
- *Nutrient chemistry of streams changes seasonally and differs among stream types in southeast Alaska.*
- *Scientists summarize historical climate data and create climate maps to forecast atmospheric conditions contributing to large wildfires.*
- *During the Biscuit Fire in southern Oregon, areas that had been salvage-logged and replanted after an earlier fire appeared to burn more severely than comparable unmanaged areas.*
- *First field study of Washington's wolverine population finds the species may be particularly vulnerable to local extinction.*
- *Two distinct lineages in the chloroplast genome of modern-day sugar pine reveal genetic difference among populations with measurable resistance to white pine blister rust and those with no resistance.*

Left: Blue Mountains, Oregon. Photo by Miles Hemstrom.
Above: Mount Hood, Oregon. Photo by Tom Iraci.

Richard Woodsmith

Climate change models project less snow accumulation. Here graduate students measure snow depth on the Entiat Experimental Forest.

Models predict future snowpack and rate of melt

In the Cascade Range of the Pacific Northwest, snowpacks store winter precipitation for release later in the year. In the semiarid environment east of the Cascade crest, this melted snow is critical for recharging groundwater aquifers and streams. The warmer temperatures predicted with a changing climate likely will mean less snow and less spring and summer recharge and runoff. These effects will reduce water supply during longer dry seasons in the summer and fall for this environment. This will affect the water supply for society at large as well as federally protected salmon species and other aquatic life.

In this study, scientists applied the SNOBAL and ISNOBAL models to two different climate regimes in the Cascade Range to determine rate of snowmelt. They found that solar radiation, both direct and indirect, was the principal factor in snowmelt in the western and eastern Cascade environments, and the rate at which wind and temperature affected snowmelt depended on the topography and vegetation. Simulating snowmelt processes helps managers anticipate effects of environmental change on the snow regime in the Pacific Northwest.

Contact: Richard D. Woodsmith, rwoodsmith@fs.fed.us, Aquatic and Land Interactions Program

Partners: Oregon State University; USDA Forest Service Okanogan-Wenatchee National Forest

Different landscapes have widely different responses to warming climate

Station scientists have found that where large groundwater systems are present, these aquifers are the primary source for rivers in western and central Oregon and northern California during the dry summer months. Scientists traced the source of late summer water in this region to groundwater stored in permeable lava flows in the Cascade Range. These immense groundwater reserves help explain why many large rivers in this region continue to have relatively high flow volumes in the summer when high-elevation snowpacks have receded and when many other rivers throughout the West are quite low.

Using these findings, scientists modeled how regional streamflow will be affected by climate change. They found that different landscapes will have widely different responses to a warming climate because of differences in their groundwater dynamics. Regions of the West fed by groundwater will continue to have streamflow under climate warming, in contrast to areas fed exclusively by snowpack, such as the southern Sierras in California. These same groundwater regions, however, will be most sensitive to a warming climate and will lose a greater proportion of their flow volumes because the annual recession or multimonth decrease in flow will start earlier in the year and last longer for these slow-draining systems.

These findings have significant implications for how rivers, dams, and water supplies are managed in the future throughout the West. They are being incorporated into long-range management plans and strategies developed by public water and energy utilities, and also are helping scientists develop better models for predicting late summer streamflows.

Contact: Gordon E. Grant, ggrant@fs.fed.us, Ecosystem Processes Program

Partners: Eugene Water and Electric Board; Oregon State University; University of California, Santa Barbara

Outcome: Public water and energy utilities are incorporating information about sources of summer water supply in western Oregon into long-range management plans.

Climate change likely will affect many forest types and increase fire frequency

A changing climate means trees and other plant species may become suited to different areas than where they are currently located. This has profound implications for biodiversity and economic concerns. To help anticipate this change, scientists developed the MC1 Dynamic General Vegetation Model, which projects what might grow where under different temperature and precipitation regimes. The model also projects fire frequency under different climate scenarios. These climate scenarios are linked to high, moderate, and low trajectories for future greenhouse emissions. Simulations showed that areas of tropical woodland, temperate mixed forest, and tundra and alpine vegetation are potentially the most vulnerable to impacts of future climate change, and that approximately one-third of the global land surface could experience increased fire frequency.

Numerous federal, state, and private land management entities have asked Station scientists about these findings. The Nature Conservancy is considering these research results as it incorporates climate change into conservation action plans.

Contacts: James Lenihan, jlenihan@fs.fed.us; Ronald Neilson, rneilson@fs.fed.us, Managing Disturbance Regimes Program

Partners: Oregon State University, The Nature Conservancy

Outcome: The Nature Conservancy along with federal, state, and other private land management agencies have inquired about MD1 Dynamic General Vegetation Model climate change projections.

A warmer climate is projected to shrink range of lodgepole pine in Alberta

Lodgepole pine, the dominant tree in Alberta, Canada, is prevalent throughout western North America and is a commercially valuable timber species. Through a series of studies using the province's extensive permanent study plot network, a Station scientist and his colleagues estimated the effects of global climate change on lodgepole pine over the next century.

Warren Olney

Mount Hood, Oregon.

John Laurence

Pine seedling growing in ashes.

Model simulations indicate that in areas where enough moisture is present, lodgepole pine will actually thrive with warmer temperature, with dominant trees growing about 3 additional feet per decade of the 90-year simulation. Because the warmer climate is also projected to be drier, however, the future range of the lodgepole pine is projected to be much smaller than it is currently. In Alberta, the species would be confined to the foothills of the Canadian Rockies under this climate scenario.

This information enables land managers to begin planning ahead for a climate that is projected to change faster than the slow-growing species can adapt.

Contact: Robert A. Monserud, rmonserud@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Alberta Sustainable Development; Russian Academy of Science, Siberian Branch

Modest increases in global temperatures could significantly alter ecosystems in northwestern Yunnan, China

Potential impacts of climate change on global, regional, and local biodiversity are a significant environmental concern. The Hengduan Mountains of northwestern Yunnan Province, China, support many rare and endemic species as well as alpine and coniferous forest ecosystems of critical value to the local human population. Simulation runs of the MC1 Dynamic General Vegetation Model under three climate-forcing scenarios projected that even modest increases in temperature could cause significant alteration of these ecosystems. For example, simulated increases of 6.8 °F in average annual temperature in the latter part of the 21st century were projected to cause coniferous forests to shift to more temperate forest types and loss of alpine meadows–with attendant loss of habitat for many rare and endemic species that depend on the coniferous forest and alpine ecosystems as well as socioeconomic values.

This project and its outcomes contribute to the larger goals of the Forest Service to help conserve forests worldwide and are part of The Nature Conservancy's ongoing work in northwestern Yunnan. Outcomes will be used to help identify how future climate change will affect conservation targets in China, primarily in alpine, subalpine, and coniferous forest ecosystems.

Contacts: James Lenihan, jlenihan@fs.fed.us, Managing Disturbance Regimes Program

Partners: Colorado State University, The Nature Conservancy

Outcome: The Nature Conservancy is using climate change work in Yunnan, China, to help conserve various forest types.

Land-use changes affect carbon storage and ecosystem goods and services

The ability of trees to store carbon makes conserving forest land an effective way to offset increases in carbon emissions and consequently mitigate greenhouse gas production and resulting climate change. As a result, land-use laws can play a key role in determining the amount of carbon that is stored. Scientists found that Oregon's land-use planning program resulted in substantial carbon storage over the past decade, sufficient to offset more than twice the increase in carbon emissions in Oregon over the same period. Nationally, forest land conservation can contribute significantly to carbon storage as well as enhance other ecosystem goods and services associated with forests. For example, additional research linking land-use projections with forest fragmentation analyses quantifies how land-use changes affect biodiversity in Western States. Forest land

conversion and fragmentation are shown to not only reduce carbon storage but also to reduce forest biodiversity.

These findings were used by the Oregon Department of Forestry and the Environmental Protection Agency to develop strategies for addressing global climate change within a multisector economy. More broadly, the research lends support to current interests within the Forest Service in taking a greater leadership role in the conservation of forest land and other open space nationally.

Contact: Jeff Kline, jkline@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Oregon Department of Forestry, Oregon State University, Texas A&M University, U.S. Environmental Protection Agency

Outcome: Oregon Department of Forestry and Environmental Protection Agency use land-use studies to develop climate change strategies.

Stream chemistry changes seasonally in southeast Alaska

The productivity and quality of stream habitats is determined by the input of organic material produced outside the stream, such as branches and leaf litter, and production of organic matter from within the stream, which is largely controlled by the availability of nitrogen and phosphorous. Recent research in southeast Alaska indicates that the chemistry of different stream types changes seasonally in predictable ways.

Understanding differences among glacial, clearwater, and brownwater streams, as well as current conditions and the natural range of variation among these stream types is critical for predicting future change related to climate warming. This information will help land managers categorize watersheds into functionally distinct groups, which will allow them to tailor activities specifically to a watershed, reducing the need for onsite surveys.

Contact: Rick Edwards, rtedwards@fs.fed.us, Aquatic and Land Interactions Program

Partners: University of Alaska Southeast

Forested wetlands and bogs have lower rates of mineralization than previously believed for southeastern Alaska

A detailed study of field and laboratory experiments conducted by scientists showed that nitrogen and phosphorus mineralization rates are very low in southeastern Alaskan wetlands. In contrast, the high internal nutrient recycling rates in open bogs indicates that these ecosystems retain nitrogen and phosphorus. Forested wetlands do not have as great a potential for internal nutrient cycling as bogs and are sites for exchange between vegetation and surface waters.

Nitrogen and phosphorus can influence the ability of terrestrial ecosystems to sequester carbon, so understanding the magnitude of nitrogen and phosphorus cycles is necessary for estimating carbon cycling and sequestration.

David D'Amore

Nitrogen and phosphorus levels in soil indicate the ability of this southeast Alaska bog to sequester carbon.

Knowledge of mineralization rates also is important to developing models of carbon sequestration that determine future scenarios of vegetation succession under changing climate conditions.

Contact: David D'Amore, ddamore@fs.fed.us, Resource Management and Productivity Program

Partners: University of Alaska-Fairbanks, University of Alaska-Southeast

NEW TOOL

Regional Wetland Delineation Manual for Alaska

Description: A guide for delineating wetlands in Alaska that uses indicators that are specific to Alaska's ecosystems to determine wetland boundaries based on soils, plants and hydrology.

How to get it: The guidebook is available online from the U.S. Army Corps of Engineers at http://www.usace.army.mil/cw/cecwo/reg/erdc-el_tr-07-24.pdf

Contact: David D'Amore, ddamore@fs.fed.us, Resource Management and Productivity Program

Historical climate data and new maps aid predictions of large fires

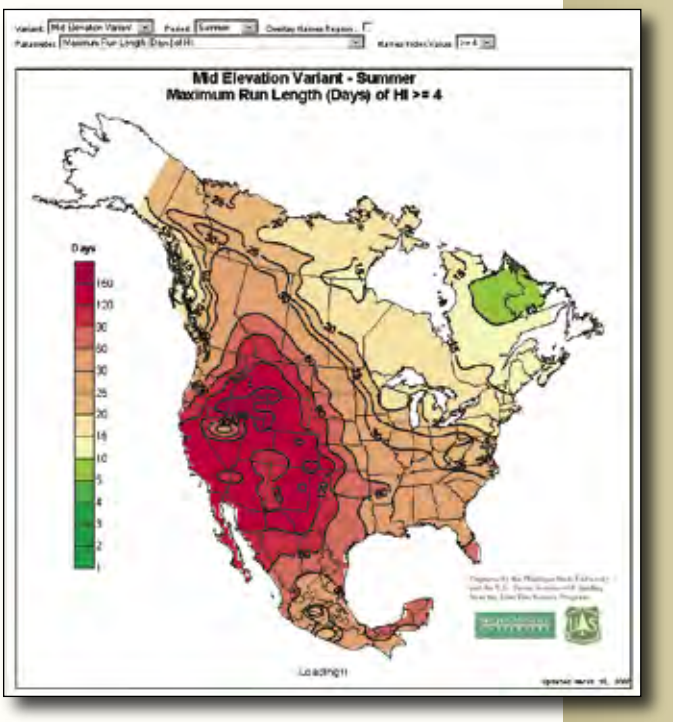
"Blowup" fires are situations where fuel conditions and the weather at the ground fail to foretell sudden increases in fire intensity or spread. These blowups create extremely dangerous situations for wildland firefighters. Since 1988, fire weather forecasters have used the Haines Index to evaluate the potential for large fires, based on the stability and moisture content of the lower atmosphere. But until now, there has been no information available about what "normal" atmospheric conditions are for a given location. To address this need, Station scientists developed a North American climatology for the Haines Index that summarizes atmospheric information from 1961 to 2000. They produced 7,600 maps (now available at http://www.airfire.org/haines) to provide context for evaluating existing conditions and context for forecast conditions.

Fire behavior analysts, long-term analysts, and the National Predictive Service Group are using the Haines Index Web climatology information. The historical climatology is also an integral part of a recently completed Joint Fire Science Program study to evaluate how climate models predict the Haines Index will change over the next 100 years. This information will help guide long-term resource management and policy decisions.

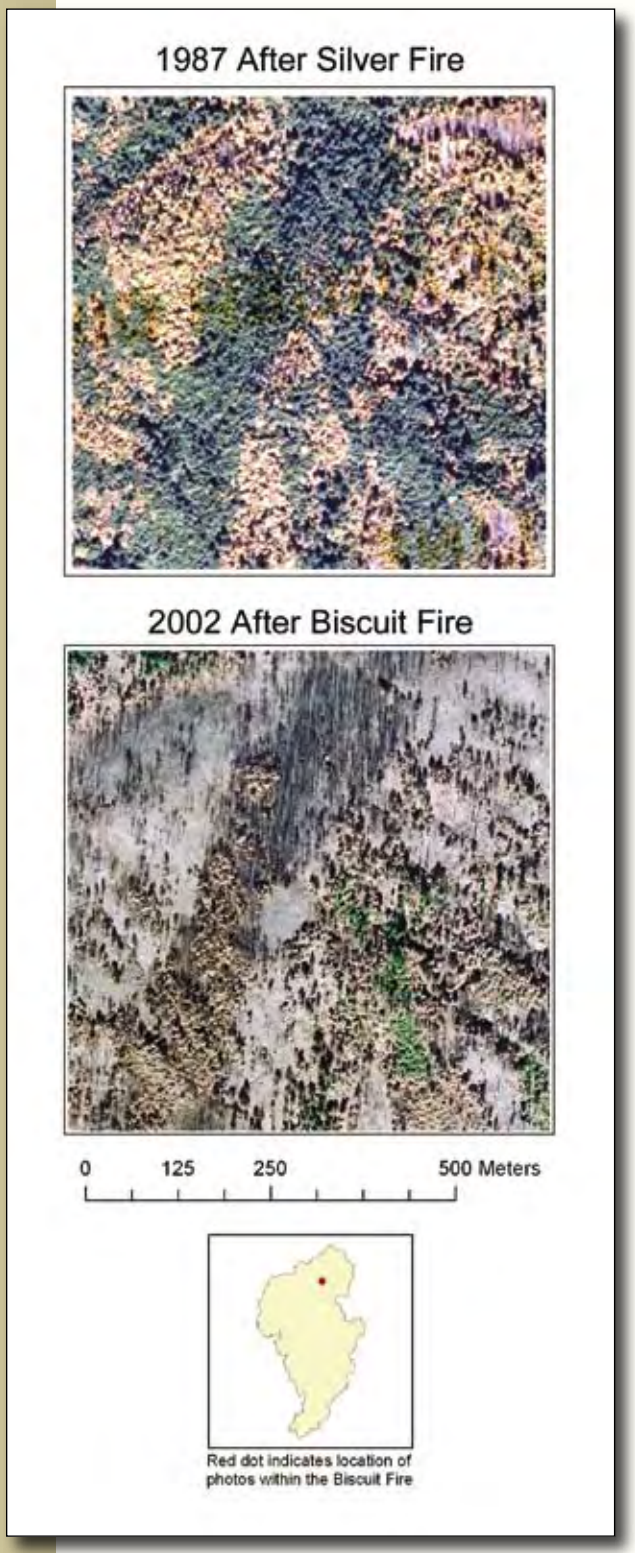
Contact: Brian Potter, bpotter@fs.fed.us, Managing Disturbance Regimes Program

Partners: USDA Forest Service Northern Research Station, Joint Fire Sciences Program; Michigan State University; National Predictive Services Group

Outcome: Fire analysts use climatology maps to predict large fires.



This fire climatology map, based on historical data, shows the number of consecutive days when weather in the lower atmosphere creates dangerous and erratic fire conditions. Users can select from over a thousand maps such as this one for various regions, seasons, and other predictors from http://www.airfire.org/haines.



Areas that burned severely in the 1987 Silver Fire tended to burn again at high severity in the 2002 Biscuit Fire, regardless of management treatment.

Reburn severity differs depending on management history of forest vegetation

Following the massive Biscuit Fire in southern Oregon in 2002, Station scientists had the unique opportunity to study the effects a past fire and subsequent management can have on future fire severity. Parts of the area that burned in 2002 also were burned in 1987 by the Silver Fire and then either salvage-logged, planted, and managed to establish Douglas-fir plantations or left to naturally regenerate.

Using satellite and aerial imagery and management records, scientists found that areas burned severely in the Silver Fire tended to burn again at high severity in the 2002 Biscuit Fire, regardless of management treatment. Areas that were salvaged-logged and planted after the initial fire, however, burned more severely than comparable unmanaged areas, suggesting that slash left over from logging and fuel conditions in conifer plantations can increase fire severity for some time despite removal of large woody fuels.

The work also reveals that in mixed fire regimes such as southwest Oregon, the occurrence of one wildfire does not necessarily reduce the severity of a second wildfire burning within a decade or two. This is contrary to what has been found in drier forest types.

This study is the first to look at how postfire management can affect vegetation burn severity in a subsequent fire. Continued research is needed to further understand the causes of these results and to better understand the tradeoffs associated with postfire forest management.

Contact: Thomas A. Spies, tspies@fs.fed.us, Ecosystem Processes Program

Partner: Oregon State University

Matthew Horning

Postfire resprouting is one of the many traits being analyzed in the bitterbrush common gardens in Madras, Oregon.

High level of genetic diversity found in antelope bitterbrush, an important postfire species

Antelope bitterbrush is a dry-land shrub that occupies an important ecological niche in many fire-prone communities across the Western United States. Because it is an important food source for wildlife species, bitterbrush is frequently planted by federal agencies in postfire revegetation and landscape restoration activities.

Station scientists have begun to analyze the genetic diversity of bitterbrush as part of a larger effort to develop seed movement guidelines. Analyses to date reveal high levels of genetic diversity in the species. Markers developed in this study are now being applied to assess the genetic diversity in bitterbrush cultivars that are widely planted on public lands. These results will be combined with quantitative genetic data to identify adaptive traits in this key restoration shrub.

Contact: Matthew Horning, mhorning@fs.fed.us and Richard Cronn, rcronn@fs.fed.us, Resource Management and Productivity Program

Partners: USDA Forest Service, Pacific Northwest and Pacific Southwest Regions; USDA National Research Initiative

Washington's wolverine population may be vulnerable to local extinction

Relatively little is known about the distribution and ecology of the wolverine, one of the rarest mammals in North America. Wolverines once lived in the Sierra Nevada of California, but now the northern Cascade Range in Washington represents the southern extent of their current range along the Pacific Coast, making the species a candidate for listing under the Endangered Species Act.

During the winters of 2005–06 and 2006–07, scientists captured and radio-collared four wolverines in the North Cascades—a pregnant female, a juvenile female, and two subadult males. Using satellite technology, scientists monitored the wolverines' movements and documented areas of use ranging from 900 to

The first field study of Washington's wolverines indicated that the species population is small and isolated.

GOAL 1: Develop a fundamental understanding of ecological, social, and economic systems and their interactions

1,200 square miles. Early results from the field study—the first to study the species in the Pacific Northwest—suggest that Washington's wolverine population is small and isolated and may be particularly vulnerable to local extinction.

The study's findings have provided the first empirical evidence of a resident wolverine population in the Pacific Northwest and have helped characterize the species' use of boreal forest habitats in the North Cascades. This work contributes new information critical to the conservation of wolverines in the contiguous United States and to the numerous land management agencies charged with the species' management.

Contact: Keith B. Aubry, kaubry@fs.fed.us, Ecosystem Processes Program

Partners: USDA Forest Service Okanogan-Wenatchee National Forest, Washington Department of Fish and Wildlife

Rare salamander lives in areas prone to catastrophic disturbance

Van Dyke's salamander is likely the rarest small vertebrate in the Cascade Range. It lives in small, steep streams and seeps within the volcanic regions of Mount St. Helens and Mount Rainier. The salamander is sedentary; most of the animals monitored in this study moved less than 6 feet during a 4-month period. Its scarce and patchily distributed habitat in an active volcanic region, combined with its low mobility and reproductive rates are presumably factors that have resulted in the small, highly fragmented population that exists today. The salamander is likely a relic from the Pleistocene 10,000 to 14,000 years ago and is undergoing a slow decline that may be accelerated if predicted global warming trends occur. The U.S. Forest Service, National Park Service, and Washington Department of Fish and Wildlife are using results from this study to develop conservation plans and to meet survey protocols of the Northwest Forest Plan.

Charlie Crisafulli

Van Dykes's salamander is likely the rarest small vertebrate in the Cascade Range.

Contact: Charlie Crisafulli, ccrisafulli@fs.fed.us, Aquatic and Land Interactions Program

Partners: Oregon State University, Central Washington University

Charlie Crisafulli

Small, steep streams in the volcanic regions of Mount Rainier and Mount St. Helens are home to the rare Van Dyke's salamander.

John Lehmkuhl

This riparian area along Devil's Gulch in the Okanogan-Wenatchee National Forest contributes to the forest's biodiversity.

Midelevation riparian zones contribute to bird diversity in dry forests

Riparian areas are critical to biodiversity, but that importance varies greatly across regions, landscapes, and elevations. Station scientists quantified breeding bird abundance, diversity, and indicator species in riparian and upland dry forests along large streams in the eastern Cascade Range, Washington. Riparian areas did not have more species than upland forests, but riparian bird community composition was different from that of upland forests and contributed to landscape-scale avian diversity. Results from this study indicate that current riparian buffers could be effective avian refuges and movement corridors. Scientists also identified indicator species for predicting and monitoring changes in bird species composition after management practices or environmental changes.

Forest managers may use findings and models from this work to predict the biodiversity value of specific riparian areas and could use the indicator species identified in this study to predict and monitor shifts in bird species composition from fuel reduction and other management practices.

Contact: John Lehmkuhl, jlehmkuhl@fs.fed.us, Managing Disturbance Regimes Program

Partners: USDA Forest Service, Okanogan-Wenatchee National Forest

Douglas-fir needles protect trees against disruptions in water transport

Xylem is an extremely important tissue in plants that is responsible for transporting water from roots to leaves. Because it relies on constant tension to transport water upwards, xylem is extremely sensitive. The entry of gas bubbles—known as emboli—can break the cohesion of the water column and disrupt water transport. In the branches of Douglas-fir, for example, embolism is not readily reversed and must be limited if the xylem is to remain conductive for many years.

Scientists found that, in contrast to stems, the xylem of Douglas-fir needles undergoes daily cycles of embolism and refilling. The stomata, which are small openings on the leaf surface where water vapor is released during transpiration, respond to this variable hydraulic signal by limiting their release of vapor, which prevents tension in stems from reaching levels where embolism-induced loss of transport capacity increases rapidly. Scientists found that both the hydraulic architecture of leaves and stomatal control of transpiration are finely tuned to height-related increases in xylem tension. This allows taller trees to keep their stomata open for photosynthesis while maintaining the tension necessary for successful water transport.

These findings are fundamental to understanding how trees cope physiologically with increases in water stress that are associated with increasing height.

Contact: Rick Meinzer, fmeinzer@fs.fed.us, Ecosystem Processes Program

Partner: Oregon State University

Scientists are unraveling the mystery of how tall trees transport water to their tops.

High-tech method works well to measure soil depth in the Sierra Nevada

Soil depth can influence where trees and shrubs grow, particularly in forests that experience summer drought. Visual surface conditions and low-tech methods for estimating soil depth may overlook thick layers of weathered bedrock that can serve as a potential rooting medium for deep-rooted trees and shrubs. This study evaluated different methods for measuring soil depth in the mixed-conifer forests of the Sierra Nevada. Only the refraction seismic method was able to measure various soil profiles with different levels of rock content. This method involves geophones connected to a computer, which calculates soil depth based on the intensity of sound vibrations and the length of time it takes for these vibrations to hit bedrock. Understanding subterranean influences on the spatial distribution of vegetation is another component to understanding where and how forests grow.

Contact: Andrew Gray, agray01@fs.fed.us, Forest Inventory and Analysis Program

Partners: USDA Forest Service Pacific Southwest Research Station, Oregon State University

New model predicts seasonal variation in soil water redistribution

In earlier studies, Station scientists found that deep roots play an important role in ensuring conifer survival during the Pacific Northwest's dry summer months. Conifer roots take up water from deep soil layers and then hydraulically redistribute it near the surface, slowing the drying of upper soil layers and reducing seasonal dieback of shallow roots.

Scientists have now constructed a simple model that predicts how water will be hydraulically redistributed by roots in the region's ponderosa pine and Douglas-fir forests. Using parameters such as rooting density, driving force for water movement, and root conductivity, the

Left: Lookout Creek, H.J. Andrews Experimental Forest, Oregon. Photo by Tom Iraci.

model enhances scientists' ability to predict seasonal variation in hydraulic redistribution of soil water. More broadly, the model improves understanding of the relationship between vegetation and water availability, which can inform management strategies.

Contact: Rick Meinzer, fmeinzer@fs.fed.us, Ecosystem Processes Program

Partners: Oregon State University, U.S. Environmental Protection Agency

Douglas-fir, western hemlock differ in their ability to extract soil water

Douglas-fir and western hemlock are two of the most abundant and widely distributed conifers in western North America. Although both species can—and often do— co-occur in forests, their distributions typically extend to different extremes along a moisture gradient: Douglas-fir occurs in drier, interior sites, whereas western hemlock is found in wet coastal areas.

To better understand the basis for the species' ecological distributions, scientists studied patterns of soil water extraction and root distribution around old-growth Douglas-fir and western hemlock trees. They found that, although western hemlock tended to have greater root areas, Douglas-fir were better able to seasonally extract water from the soil. This apparent greater efficiency of Douglas-fir roots helps explain why the species grows better on dry sites than does western hemlock.

These findings contribute to the fundamental understanding of these species' distributions and are of interest to silviculturists, forest ecologists, tree physiologists, and others charged with developing management strategies.

Contact: Rick Meinzer, fmeinzer@fs.fed.us, Ecosystem Processes Program

Partner: U.S. Environmental Protection Agency

Diversity in chloroplast genomes tracks the prevalence of blister rust resistance in sugar pine

Like all North American five-needle pines, sugar pine is susceptible to white pine blister rust, a serious fungal infection that is one of the most destructive diseases of the *Pinus* genus. In sugar pine, rust resistance is genetically conferred, and this resistance is more prevalent in the southern latitudes of the sugar pine's range.

To understand the historical forces responsible for this gradient in resistance, scientists conducted a chloroplast DNA survey of sugar pine and its near relatives from North America and Asia. Results revealed two distinct chloroplast lineages, indicating a major historical break in the ancestral gene pool of modern-day sugar pine. Scientists found that the published frequencies of the gene that confers blister rust resistance differs significantly, depending on the chloroplast lineage.

Although chloroplasts, the microscopic components responsible for photosynthesis within plant cells, are not directly linked to resistance, the partitioning of chloroplast diversity between populations showing no resistance and measurable resistance indicates that these genetically distinct groups have only recently come into contact.

These data are being used to develop models that quantify the historical prevalence of blister rust resistance in sugar pine and to understand the molecular genetic basis of blister rust resistance in white pines.

Contact: Richard Cronn, rcronn@fs.fed.us, Resource Management and Productivity Program

Partners: Oregon State University; USDA Forest Service, Pacific Northwest and Southwest Regions

Traditional and local ecological knowledge tapped to conserve biodiversity

Maintaining and restoring native biodiversity is a common goal of forest management in the Pacific Northwest. Station scientists asked about 100 natural resource managers from various institutions what kind of research information would help them reach this goal. They learned managers were interested in knowing how traditional ecological knowledge could be incorporated into efforts to conserve biodiversity in the region.

By synthesizing existing literature on traditional and local ecological knowledge related to forest management among American Indians, family forest owners, and commercial nontimber forest products harvesters, several key points emerged: (1) integrating this knowledge into forest biodiversity conservation is most likely to be successful if the knowledge holders are engaged as active participants in conservation efforts, (2) more information is needed about how different groups are currently implementing their ecological knowledge through forest use and management actions and about the ecological effects of these actions on biodiversity, and (3) several promising models exist for integrating traditional and local ecological knowledge into forest management, but the social, economic, and policy constraints that prevent this knowledge from flourishing should be addressed alongside any strategy for knowledge integration.

Contact: Susan Charnley, scharnley@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Oregon State University, Institute for Culture and Ecology.

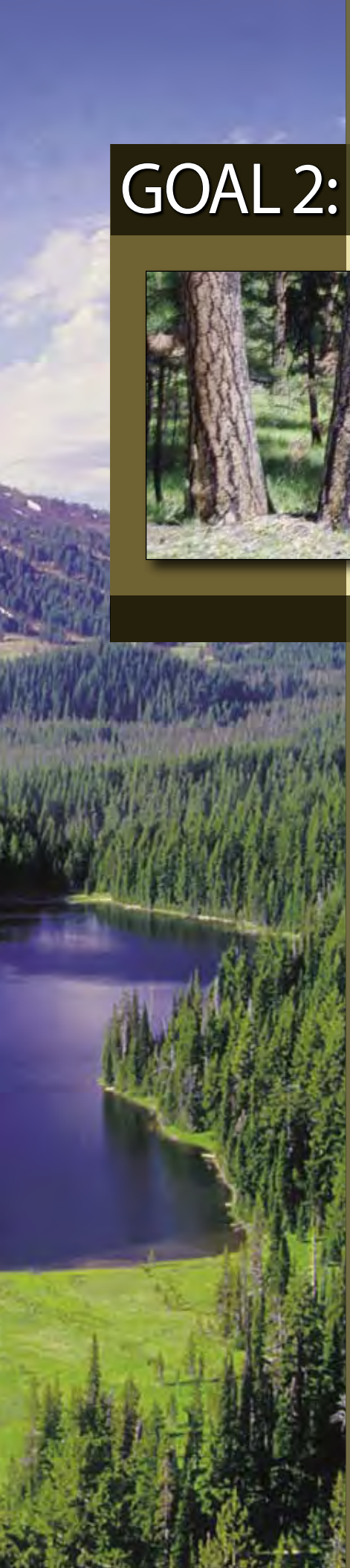
Jerry Bednarczyk

Buckbean (Menyanthes trifoliata).

Continue to Part 2

Return to Part 1

GOAL 2: Assess the status and trends of ecosystems and natural resources and their uses



KEY FINDINGS

- *Species most susceptible to sudden oak death were thriving prior to disease introduction.*
- *Palau's forests are maturing but urbanization and conversion to nonforest uses have led to decreases in forest area.*
- *Population growth and associated residential development in counties with national forests and grasslands put pressure on the resources of these public lands.*
- *National timber assessment indicates increases in U.S. demand for timber will be met by increased harvests on private land and through imports.*
- *Timber statistics reveal younger forests with fewer trees per acre are growing in eastern Washington on private land and public land not administered by the Forest Service.*
- *New tree height models for west coast forests improve accuracy of inventory data and reduce cost of data collection.*
- *Updated FUSION software lets users more easily process LIDAR forest vegetation data, and expanded tutorials are now available online.*

Left: Mount Bachelor and Todd Lake, Oregon. Photo by Tom Iraci.
Above: Ponderosa pines on the Ochoco National Forest, Oregon. Photo by John Hutmacher.

Historical data reveal long-term effects of wildfire on watershed processes

Wildfire affects water quantity and quality in a watershed. These effects may be long-lasting and depend, in part, on rehabilitation actions that occur after the fire. In this study, scientists used rare historical data from the Entiat Experimental Forest to create models to evaluate the effects of a severe 1970 wildfire on streams draining forested headwaters. Preliminary results indicate that runoff from the burned area more than doubled. These increases in peak flows resulted from less vegetation present to draw groundwater, greater snow accumulation, and more rapid snowmelt.

Richard Woodsmith

A study established in 1970 after a wildfire on the Entiat Experimental Forest enabled scientists to study long-term effects of fire on watershed processes. Here a field technician checks a flume that measures runoff from the area burned in 1970.

After more than 25 years of inactivity, the study watersheds were reinstrumented in 2004 with stream gauging, water quality, and meteorological stations to assess the rate of recovery toward prefire conditions. This data will also be used in future investigations of the effects of prescribed burning and other fuel control treatments on hydrologic processes.

The information gained from this research will enable scientists and managers to better predict the effects of severe wildfire on hydrology and to better understand the hydrologic recovery process after major disturbances. It will also inform management decisions regarding the need and strategies for postfire rehabilitation.

Contact: Richard D. Woodsmith, rwoodsmith@fs.fed.us, Aquatic and Land Interactions Program

Partners: Oregon State University, USDA Forest Service Okanogan-Wenatchee National Forest

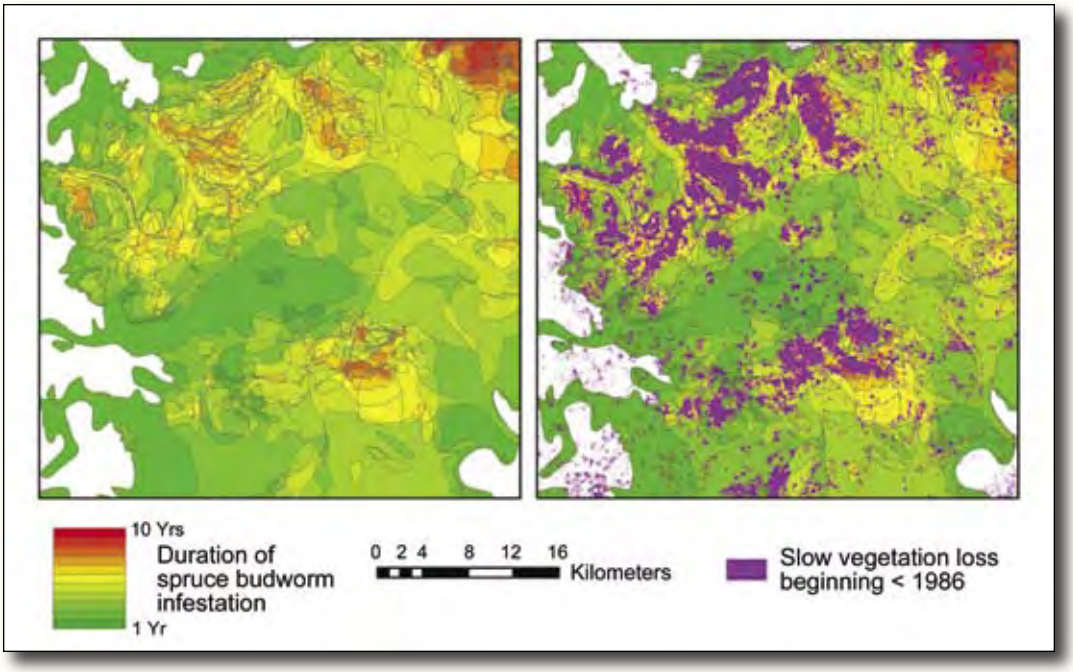
New satellite-based mapping technique captures full range of forest disturbance and recovery across landscapes

Satellite-based maps help researchers and land managers visualize forests and landscapes across the Pacific Northwest. Until recently, satellite-based maps of forest disturbance have only been able to capture major, stand-replacing events such as clearcuts and intense fires, not the complete range of forest disturbance and recovery.

To improve the usefulness of satellite-based maps, Station scientists developed and validated a fundamentally new approach to mapping that captures both major events and other disturbances—including partial cuts and thinnings and insect and disease mortality. The new approach also is capable of mapping year of disturbance, intensity of disturbance, and the rate of recovery.

The products derived from this new satellite-based mapping approach are useful to a wider range of research and public constituencies. The approach's ability to map subtle disturbances will allow better understanding of changing forest management practices across private and public lands over the past two decades. Mapping insect mortality can potentially contribute to fire-fuels management and planning efforts. The ability to conduct yearly mapping also allows richer studies of the connections between forests and economies over time.

Contact: Robert E. Kennedy, robertkennedy@fs.fed.us, Ecosystem Processes Program



Advances in satellite mapping capture a greater variety of forest disturbances and rates of recovery.

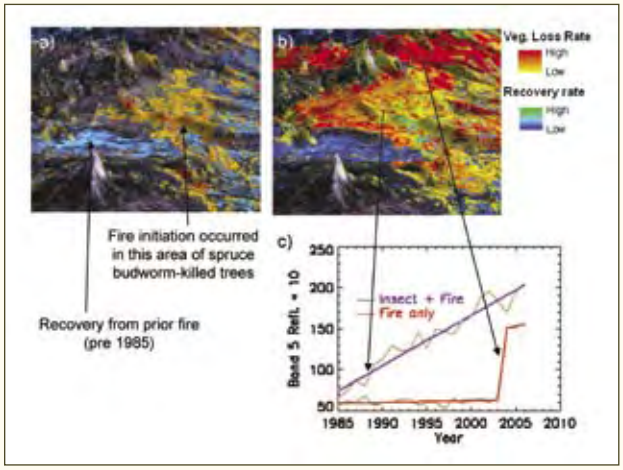
NEW TOOL

MapCurves

Description: The identification of key differences between maps is the basis for much vegetation cover and habitat change-detection study done under the aegis of landscape ecology or climate change research. MapCurves is a new quantitative method for comparing two or more maps; it unambiguously and quantitatively shows the degree of agreement (i.e., spatial concordance) between the maps. MapCurves graphically and quantitatively evaluates the degree of fit among any number of maps and quantifies a goodness-of-fit for each polygon, as well as the entire map.

Outcomes: We live in a world with an ever-shifting climate, and changing patterns of land cover, biogeography, dominant processes, and habitats. Each of these changes may be reflected in maps that people can visually inspect, but they are difficult to compare. MapCurves allows users to compare maps not only visually but also quantitatively. For example, MapCurves is an ideal method for comparing maps derived from remotely sensed or simulated images, using chronological sequences of vegetation cover resulting from succession, disturbance, or climatic change.

How to get it: Journal of Geographical Systems. 8: 187–208, or contact Paul Hessburg, phessburg@fs.fed.us, Managing Disturbance Regimes Program



Tanoak was thriving prior to introduction of sudden oak death pathogen

Sudden oak death in the United States was first observed in California in 1995. Since then, it has spread rapidly through many host species. Several counties in California and one forest site in Oregon are under quarantine, which affects removal of forest products from these areas.

Tara Barrett

Tanoak, a common tree in coast coniferous forests in California, is dying from sudden oak death. To help forest managers contain and control the disease, scientists used historical inventory data to identify forest conditions before the disease was introduced.

Understanding the ramifications of this disease requires a baseline knowledge of the forest conditions before the disease was first observed. Forest inventory data collected between 1981 and 1984 and between 1991 and 1994 from private and public land in California enabled researchers to determine the distribution and abundance of the vulnerable species and to determine the rates of change and mortality prior to the onset of sudden oak death. The study found that host tree species, particularly tanoak, had been increasing in number and size prior to the first observation of the disease.

Inventory information continues to be collected annually on private and public forest land to better understand the impacts of sudden oak death on coastal California ecosystems. By understanding mortality rates prior to the introduction of sudden oak death, forest managers will be better able to determine appropriate forest management activities as they try to control and contain the spread of the disease.

Contact: Tara M. Barrett, tbarrett@fs.fed.us, Forest Inventory and Analysis Program

Partners: USDA Forest Service Forest Health Protection

Palau's forest area declines slightly

The Republic of Palau encompasses a series of islands lying 500 miles southeast of the Philippines. Its tropical forests have endured occasional typhoons; clearing for development, agriculture, and mining; introduced human-caused fires; and significant battles on some islands during World War II. This inventory revealed that since 1985, trees generally are getting larger, but some forest area has been lost to agriculture and urban development. Currently about 2.2 percent of Palau is classified as urban. Further urban development is expected on the island of Badeldaob; the nation's capital was relocated there in 2006, and a new road

Joe Donnegan

Palau coastline.

Left: New growth in tree crown viewed from the canopy crane at Wind River Experimental Forest. Photo by Tom Iraci.

Joe Donnegan

Field crews inventoried Palau's tropical forests.

circumnavigating the island has created access to previously remote areas.

Results from this inventory enable resource managers in Palau to manage for sustainable supplies of wood, control invasive species and erosion, detect and plan for land-use change, and manage disturbances such as fire and animal damage. This inventory also provided an exchange of expertise among local students and foresters, and foresters and ecologists from mainland United States, Guam, Yap, and American Samoa. Multiple clients have asked for this data, including Palau forestry staff, the Natural Resource Conservation Service, university researchers, the Institute for Pacific Islands Forestry, the United Nations Food and Agriculture Organization, the Pacific Southwest Region of the USDA Forest Service, and U.S. Fish and Wildlife Service.

Contact: Joseph A. Donnegan, jdonnegan@fs.fed.us, Forest Inventory and Analysis Program

Partners: Foresters and ecologists of Palau

Outcome: Recent forest inventory enables Palau's resource managers to manage for sustainable wood supplies and healthy forests.

Residential development expected to increase along borders of national forests

The U.S. population is projected to increase by around 135 million people by 2050. Counties with national forests and grasslands are already experiencing some of the greatest population growth and the National Forests on the Edge project indicates that an additional 21 million acres of nearby rural land will likely experience substantial increases in residential development in the coming decades.

People are attracted to the rural areas around public land, in part, by the recreational opportunities provided by these lands. In

Eric White

Proximity to federal land is a selling point for many prospective home buyers.

addition, the country's 155 national forests and 20 grasslands provide clean water, clean air, wildlife habitat, and forest products that support rural economies and urban lifestyles. Monitoring changes in recreation use as a result of an increasing local population provides managers with information that will help them address changes in recreation demands while also managing for other resources.

In coordination with the National Forests on the Edge project, scientists developed monitoring approaches to estimate recreation activity by using readily available Forest Service data. These findings were shared with State and Private Forestry and the National Forest System. The projections of residential development also are being provided as a tool for local and state agencies to use in natural resource planning.

Contact: Ralph Alig, ralig@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Colorado State University; USDA Forest Service National Forest System, State and Private Forestry, Cooperative Forestry, and Washington Office.

Outcome: Local and state agencies are using residential projections in natural resource planning.

Increasing demands for timber will be met by private harvests and imports

The latest assessment of the U.S. timber situation, conducted under the mandate of the Forest and Rangeland Renewable Resource Planning Act (RPA), indicates that the Nation will use 38 percent more timber in 2050 than it does now, and domestic harvests will increase by 24 percent. This increase in demand will likely be met through increased harvests on private land in the South and through increased imports. Canada is currently the largest supplier of timber to the United States, but by 2050 the volume of imported timber from other countries is projected to increase by 23 to 26 percent. Two other possible futures have opposing impacts on consumers. First, reduced pine plantations in the South would lead to higher product prices and increased imports of lumber and other wood products. Second, increased thinning of public lands in the West would reduce imports, lower product prices, and thus reduce market incentives for sustainable forest management on private land.

Andrew Gray

Timber harvests between 1990 and 2001 exceeded growth on nonfederal land in eastern Washington.

This study contributes to the 2005 RPA Timber Assessment Update and the Interim Update of the 2000 Renewable Resource Planning Act Assessment.

Contact: John Mills, jmills@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Oregon State University, USDA Forest Service Forest Inventory and Analysis (all units) and Forest Products Laboratory

Younger, smaller trees characterize non-Forest Service forests in eastern Washington

Timber management has many implications for future timber revenues and nontimber forest resources. A 2001 inventory sampled all private and public land in 20 counties in eastern Washington, except those administered by the Forest Service and those that were reserved from timber management. Timber statistics reveal that in the 11 years between inventories, the area of land producing timber products in eastern Washington has remained relatively

stable, but the volume of available timber per acre has declined. The current timber market does not place a premium on wood quality, so younger trees are being harvested. The intensive forestry practices found on private land in this study contrast with protection management and longer rotations generally found on Forest Service land.

Information on the status and trends of forest resources in Washington is invaluable to land managers, investment bankers, policymakers, and others in evaluating future investments and management options for their lands. Data from this study were included in *The Future of Washington Forests*, a report to the state legislature published by the Washington Department of Natural Resources.

Contact: Andrew Gray, agray01@fs.fed.us, Forest Inventory and Analysis Program

Partner: Washington Department of Natural Resources

Outcome: Findings about Washington's timber resources reported to state legislature.

Scientists assess accuracy of LIDAR measurements

Tree height is a fundamental measurement taken during forest inventory and is used to determine forest biomass, carbon stocks, growth, and site productivity. This measurement is typically time-consuming and, therefore, costly to obtain when using conventional field techniques. The emergence of airborne LIDAR (light detection and ranging) remote sensing has provided an economical and efficient means of obtaining tree heights over large areas of forest. But its accuracy needed to be assessed and compared to alternative field techniques.

Misha Yatskov

New tree height models for California, Oregon, and Washington are used to reduce measurement error. Here a forest technician measures tree heights with a laser.

This study determined optimal LIDAR system settings for acquiring accurate individual tree heights for overstory trees in conifer forest stands of the Pacific Northwest. Scientists also found that LIDAR-obtained height measurements were more accurate for Douglas-fir than for ponderosa pine. The field-based height measurements were slightly more accurate than the LIDAR measurements, but the field measurements were acquired under ideal conditions, in open stands where tree crowns were easily visible.

Contact: Hans-Erik Andersen, handersen@fs.fed.us, Forest Inventory and Analysis Program

Partner: University of Washington

New mathematical models help find efficient inventory methods

Periodic inventories of our Nation's forests are critical for assessing forest health, monitoring management outcomes, and planning for the future. In these inventories, some types of measurements, such as tree heights, can be measured or modeled in different ways. For example, tree heights can be measured in the field, modeled from diameter, or measured with airborne laser scanning systems (see LIDAR finding above). Alternatives for estimating forest attributes typically differ in cost of data collection and accuracy. This study developed a mathematical optimization method for evaluating these types of tradeoffs. Using the example of measuring or modeling tree heights, the research showed how managers can find efficient solutions to the problem of deciding how to collect inventory data.

As part of the example application, new tree height models were developed for west coast forests and have been programmed into the data recorders used by the field crew

Charlie Crisafulli

Field crew sampling the vegetation on the pumice plain at Mount St. Helens.

conducting inventories in Washington, Oregon, and California. This has improved the accuracy of inventory data while reducing the time costs involved with data collection and analysis.

Contact: Tara M. Barrett, tbarrett@fs.fed.us, Forest Inventory and Analysis Program

Outcome: Field crew use more efficient and accurate methods for obtaining tree heights.

LIDAR forest vegetation measurement software updated, expanded tutorials now available online

The FUSION system, user-friendly software for processing and displaying airborne laser scanning data has been updated by Station scientists and is being distributed through the USDA Forest Service's Remote Sensing Application Center (RSAC).

The software has been enhanced to ease processing of data for large projects, and several new metrics have been added to help characterize vegetation structure over large land areas. FUSION tutorials, developed by RSAC, provide an online software installation guide and task-specific instruction focused on interactive display and presentation features of FUSION as well as the data processing environment. By using the tutorial and companion sample LIDAR data set, users can learn how to process LIDAR data into ground models and forest canopy height models, measure individual trees, and automate processing tasks for large projects.

The FUSION LIDAR software system has been used for several projects on national forests by researchers at several universities and by other federal, state, and private groups to display and analyze forest vegetation.

Contact: Bob McGaughey, bmcgaughey@fs.fed.us, Resource Management and Productivity Program

Partners: Fort Lewis Military Reservation, Joint Fire Science Program, Precision Forestry Cooperative, University of Washington, Weyerhaeuser Company

More information: http://www.fs.fed.us/eng/rsac/fusion/

GOAL 3: Develop science-based options for informed management

KEY FINDINGS

- *Homeowners' attitudes toward different fuel treatments differ across the Nation.*
- *New decision-support tool evaluates fire danger and helps land managers prioritize areas for fuel treatment.*
- *Decision-support application delivers rational and transparent funding process for prioritizing treatment of forest fuels.*
- *Fuel treatments in wildland-urban interface in central Oregon may shift wildfire behavior but not reduce its probability.*
- *Fuel Characteristic Classification System facilitates fuel mapping, estimates of fire hazards, and potential ecological effects of fire.*
- *Fire-dependent ecosystems in northeastern Oregon are resilient to various fuel treatments, suggesting additional treatments are needed to reduce fire hazard.*
- *Framework to assess fuel treatment projects used to determine potential effects of treatments on spotted owl habitat.*
- *Fine-scale vegetation maps model fire risk to spotted owl habitat and identify areas at risk of gypsy moth outbreaks in eastern Oregon.*
- *Interior Northwest Landscape Analysis System tools provide a framework for analyzing landscape management scenarios and help translate planning directives into management projects.*
- *As more people recreate on public land, planning methods and tools need to be reevaluated.*
- *Using wood residues to economically generate electricity is a niche operation where feasibility is determined by access to wood, harvesting costs, and capital costs of building the facilities.*
- *Native Douglas-fir will be poorly adapted to climates expected by the end of the 21st century; planting stands with seeds from various locations is one option for preparing for climate change.*
- *Headwater streams play key role in contributing wood to fish-bearing streams.*
- *Continuous, fixed-width riparian buffers appear to offer more protection to aquatic life in headwater streams than intermittent, variable-width buffers or no buffers.*
- *Riparian buffers conserve the diversity of forest mammals along headwater streams in Washington.*
- *New models indicate areas most susceptible to spread of noxious weeds in Crook County, Oregon.*
- *New research highlights ways the Forest Service can administer the National Environmental Policy Act (NEPA) more efficiently.*

Left: Ochoco National Forest. Photo by Tom Iraci. Above: Small log discussion. Photo by Dean L. Parry.

Regional differences found in homeowners' attitudes toward fuel treatments

Fuel treatments at the wildland urban interface are not universally accepted by the homeowners they are intended to benefit. Without public approval, it is difficult for land managers to effectively reduce fire hazard on neighboring public land or to engage homeowners in activities that would reduce fire hazard on private property. To help managers understand and predict homeowners' attitudes toward different types of fuel treatments and their intentions to approve the use of such treatments, scientists developed a survey that was tested and administered in California, Florida, and Michigan.

The survey revealed that California residents tended to have positive attitudes toward mechanical treatments to remove fuel and toward defensible space ordinances that require homeowners to remove flammable vegetation near their homes. Florida residents tended to have more positive attitudes toward prescribed burns, whereas fewer Michigan residents were supportive of mechanical treatments or prescribed burns. Although strong regional differences were observed, nearly all homeowners in the wildland-urban interface were generally supportive of at least one of the fuel management approaches under consideration.

Land managers can use and adapt this survey to poll homeowners living in fire-prone areas around the country. When necessary, managers can follow up with targeted information that may change homeowners' beliefs and attitudes toward fuel management activities.

Contact: Jeremy Fried, jsfried@fs.fed.us, Forest Inventory and Analysis Program

Partners: Cornerstone Strategies, Michigan State University, University of California

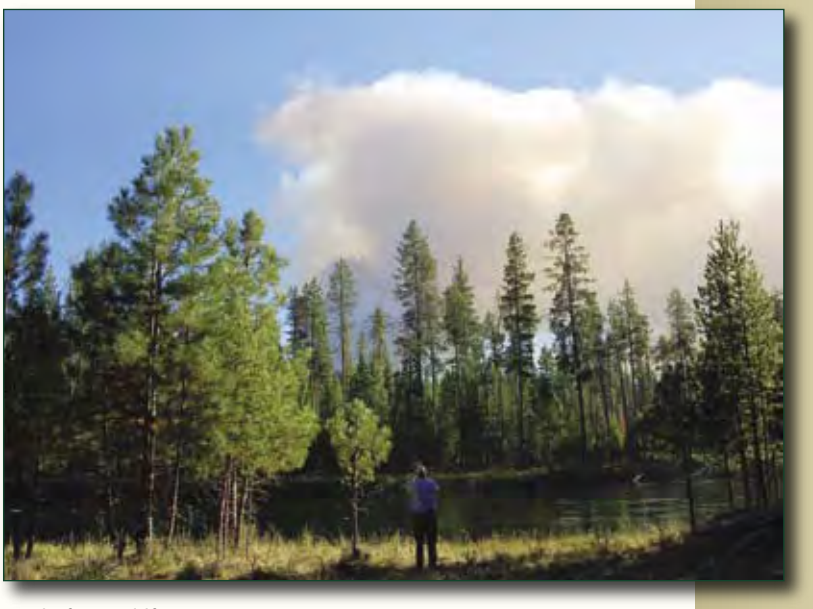
Outcome: An adaptable survey allows land managers to assess homeowners' attitudes toward fuel treatments

Roger Ottmar

Foresters learn how to use the Natural Fuels Photo Series to assess fuelbed characteristics during a regional fuels workshop held near Albuquerque, New Mexico.

Education program changes homeowners' attitudes toward fire risks

A dream house in the western foothills or a tinderbox in a fire-prone area? Too often the unsuspecting homeowner in the wildland-urban interface finds the latter description is more accurate. Every summer, wildfire threatens homes that have been built in areas prone to frequent fires. Station scientists and the Colorado Springs Fire Department developed a study to determine if educating the public about fire risk would influence the local housing market.



John Laurence

Smoke from wildfire.

Before the education campaign, housing prices in Colorado Springs were greatest in areas that also had the greatest wildfire risk. Presumably, prospective buyers valued the view afforded by a house on a ridge and were unaware of the increased wildfire risk in such a location. After the education campaign, scientists observed no correlation between wildfire risk and housing price. This suggests that the education campaign successfully changed homeowners' attitudes toward wildfire risk, although there was some evidence that this effect was fading over time.

The Colorado Springs Fire Department has used this study to demonstrate the efficacy of their program and to refine their ongoing educational efforts. The results also may be useful to land mangers trying to raise public awareness about other natural hazards.

Contact: Geoffrey H. Donovan, gdonovan@fs.fed.us, Human and Natural Resources Interactions Program

Partners: USDA Forest Service Rocky Mountain Research Station, National Institute of Standards and Technology, Colorado Springs Fire Department

Outcome: Colorado Springs Fire Department develops an education campaign for informing homeowners about fire risk.

Fuel treatments in wildland-urban interface may change fire behavior but not its probability

Managing dry forests on the eastern slopes of the Cascade Range involves striking a balance between the desired forest structure and the risk of wildfire or insect outbreaks. Management decisions are based on different objectives, environmental settings, social acceptability, and natural disturbances. To help managers weigh all these factors and predict potential outcomes of their actions, the Interagency Mapping and Assessment Project (IMAP) compiled data and developed methods and models for mid- to broad-scale landscape assessment and planning.

The IMAP team assessed 680,000 acres in the central Oregon Cascades using three different management scenarios suggested through public input. The simulations showed (1) fuel treatments in the wildland-urban interface may shift wildfire behavior as fires burn in grass, shrubs, and open forests but may not reduce overall wildfire probability; (2) treatments designed to encourage multistory large-tree forests resulted in increased wildfire and insect outbreaks; and (3) managing toward historical conditions resulted in increases in single-story

large-tree forests and decreases in high-severity wildfire and insect outbreaks.

IMAP models are being used in forest plan revisions for the Umatilla, Malheur, and Wallowa-Whitman National Forests. Models are currently being developed for the Fremont-Winema, Deschutes, and Ochoco National Forests.

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

Partners: Oregon Department of Forestry; USDI Bureau of Land Management; Oregon State University; USDA Forest Service Pacific Northwest Region; The Nature Conservancy; Oregon Natural Resources Institute

Outcome: Three national forests are using IMAP models to evaluate management options.

New tool used to evaluate fire danger and prioritize areas for fuel treatment

FireDanger is a new decision-support system that allows land managers to evaluate the risk of severe wildland fire and prioritize subwatersheds for vegetation and fuels treatments. Scientists used FireDanger to assess 11.8 million acres in the Rocky Mountain region in Utah. Fire danger was assessed for each evaluated watershed in a logic model as a function of three primary topics: fire hazard, fire behavior, and ignition risk. A decision model then summarized fire danger conditions of each watershed in the context of the amount of associated wildland-urban interface. Additional logistical factors such as proximity to population centers, presence of endangered species, slope steepness, and road access may all be taken into account in selection of specific watersheds for treatment. Station scientists and their partners are building a version of this model suitable for all public and private land ownerships in Oregon and Washington.

Contacts: Paul Hessburg, phessburg@fs.fed.us, Managing Disturbance Regimes

Partners: USDA Forest Service Pacific Northwest Research Station, Communications and Applications Program; Rocky Mountain Research Station, Missoula Fire Sciences Laboratory, The LANDFIRE Project, http://www.landfire.gov/

Fuel treatment funding process becomes more transparent

Federal land-management agencies responsible for managing forest fuels have been criticized by oversight agencies such as the General Accountability Office (GAO) for not providing a rational and transparent explanation for their processes of allocating funding for fuel treatment. Responding to this situation, scientists developed a national-level decision-support application for integrated fuel analysis and fuel-treatment planning. The application was specifically designed to provide a rational and transparent decision process. Additionally, the application can be used to evaluate agency performance with respect to fuel-treatment outcomes over the long term, thus supporting a key requirement of environmental management systems.

An initial version of this application tested favorably in 2006 with the Forest Service's Fire and Aviation Management office, regional fuel managers, Congressional staff on natural resource committees, and GAO. Following this success, the modeling process was repeated in 2007 for the Forest Service with some modifications based on feedback from fuel managers. The U.S. Department of the Interior adopted the application in a slightly modified form for use in all of its forest-resource bureaus.

Contact: Keith M. Reynolds, kreynolds@fs.fed.us, Communications and Applications Program

Partners: USDA Forest Service Fire and Aviation Management; USDI Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, and National Park Service

Outcome: Federal land-management agencies look to adopt a transparent funding process for fuel treatments.

Steve Wondzell

Prescribed burn on the Umatilla National Forest.

NEW TOOLS

Fuel Treatment Evaluator (FTE) 3.0

Description: FTE 3.0 was developed to address complicated questions about financing fire hazard reduction treatments. This tool helps users simulate silvicultural treatments and analyze resulting harvest costs and biomass revenue.

Outcomes: FTE 3.0 was used in an assessment of 12 Western States to evaluate treatments to reduce fire hazard and to identify locations where removed products might help offset treatment costs.

How to get it: Visit http://ncrs2.fs.fed.us/4801/fiadb/fire_tabler_us/rpa_fuel_reduction_treatment_opp.htm

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

Partners: USDA Forest Service Forest Products Laboratory, Northern Research Station, Rocky Mountain Research Station, and Forest Inventory and Analysis

Digital Fuels Photo Series

Description: The Digital Photo Series (DPS) is a Web-based application that delivers the content from the Natural Fuels Photo Series volumes in an electronic format. The DPS can be used to assess landscape conditions through the appraisal of live and dead fuels and stand characteristics. Although designed for online use, it can also be run from the computer desktop when an Internet connection is unavailable. The DPS currently includes data and images for all 14 published volumes, with 36 series containing a total of 398 sites. The DPS complements the published volumes by adding content and by consolidating fuel and vegetation data in one central location. The application is robust and flexible, allowing for additions of other published photo series or photo-accompanied fuel data. The application has been demonstrated at eight regional fuels workshops, three conference workshops, and the most recent session of Technical Fire Management.

Outcomes: The Digital Photo Series delivers fuel and vegetation structure and composition data to fuel, fire, and natural resource managers and scientists for use in strategic planning, project implementation, and modeling efforts. For example, the underlying fuels and vegetation database has been supplied to developers of the LANDFIRE mapping reference database and the FIRETEC fire behavior simulation model.

How to get it: Contact Clint Wright, cwright@fs.fed.us, Managing Disturbance Regimes Program

Photo Series for Quantifying Forest Residues in Managed Lands of the Medicine Bow National Forest

Description: This photo series presents a visual representation of a range of fuel loading conditions specifically found on the Medicine Bow National Forest. The photos are grouped by forest type and past management practices. This field guide describes the distribution of different types of woody fuels and includes some vegetation data.

Outcomes: Medicine Bow National Forest is using this tool.

How to get it: General Technical Report RMRS-GTR-172. Photo series for quantifying forest residues in managed lands of the Medicine Bow National Forest. http://www.fs.fed.us/rm/pubs/rmrs_gtr172.pdf

Roger Ottmar

Firefighters are briefed before conducting a multiday prescribed burn on the Okanogan-Wenatchee National Forest that tested the Fuel Characteristic Classification System.

Method improved for documenting fuel conditions

The Fuel Characteristic Classification System v. 1.1 (FCCS) documents actual fuel conditions and determines potential fire characteristics. The FCCS contains hundreds of fuelbeds that describe real fuels in six strata from crown to ground, calculations of fire behavior characteristics as a function of environmental conditions, and calculations of fire potentials that express hazard for surface, crown, and available fuels. Older systems only quantified fire behavior for surface fuels, severely limiting their usefulness. The Canadian Journal of Forest Research accepted seven articles documenting the FCCS for publication; these will provide a foundation for the scientific and management communities who use the system.

The Okanogan-Wenatchee National Forest has developed a comprehensive map of FCCS fuelbeds. The Forest Service's Central Oregon Fire Planning Unit is developing a comprehensive map of FCCS fuelbeds that will be used for planning and decisionmaking within the Fire Planning and Analysis program. A large multiday prescribed burning project on the Naches Ranger District of the Okanogan-Wenatchee National Forest used FCCS fuelbeds for assessing fuels and estimating emissions.

Contact: David L. Peterson, peterson@fs.fed.us, Managing Disturbance Regimes Program

Partners: Air Sciences Inc., University of Washington

Outcome: The EPA is using FCCS in a national wildland fire emissions inventory.

Integrating models help predict smoke dispersal from prescribed fires

Air quality restrictions often make it difficult to use prescribed fires to achieve fuel management goals. To manage smoke from prescribed fire, explicit knowledge is required about fuel loading, consumption, and heat release, as well as the ability to predict smoke emissions and dispersal. During two prescribed burns on the Okanogan-Wenatchee National Forest, scientists found that integrating the Fuel Characteristic Classification System (FCCS) and Consume 3.0 provided accurate predictions of fuel loading, fuel consumption, and heat release, which are important inputs required by smoke dispersion models such as BlueSky. A smoke monitoring

NEW TOOL

Fuel Characteristic Classification System (FCCS) v. 1.1

Description: The Fuel Characteristic Classification System (FCCS) v. 1.1 is a tool that enables land managers, regulators, and scientists to create and catalog fuelbeds and to classify those fuelbeds for their capacity to support fire and consume fuels. Version 1.1 refines the system to include calculations of flame length and rate of spread at benchmark environmental conditions for each fuel, and assigns the fire behavior fuel model that is the closest match.

Outcomes: FCCS outputs are being used in a national wildland fire emissions inventory by the Environmental Protection Agency (EPA) and in the development of fuelbed, fire hazard, and treatment effectiveness maps on the Okanogan, Wenatchee, and Deschutes National Forests. It is also being used for the eastern Oregon local fire planning unit test area for the Fire Planning Analysis program. The Landscape Fire and Resource Management Planning Tools Project, a multipartner project, is using FCCS to produce consistent and comprehensive maps and data describing vegetation, wildland fuel, and fire regimes across the United States. The system has been taught at 5 regional fuels workshops and 12 regional and national training sessions. The University of Idaho has incorporated FCCS into a two-credit continuing education class.

How to get it: Visit http://www.fs.fed.us/pnw/fera/fccs/, or Roger D. Ottmar, rottmar@fs.fed.us, Managing Disturbance Regimes Program

Roger Ottmar

A multiday prescribed burn on the Okanogan-Wenatchee National Forest also enabled scientists to test the BlueSky smoke dispersal model. Here field crew collect fuel samples to determine moisture content prior to the burn.

system was implemented, and more than 20 BlueSky forecast scenarios were run each day for the burning effort using ignition pattern and timing scenarios jointly designed by fuel managers and PNW scientists.

This project tested the integration of several new procedures and tools to increase the likelihood of conducting multiday, landscape-scale prescribed burns with minimal effects to air quality. The findings from this project will be used to improve the Okanogan-Wenatchee National Forest smoke management program and revise the BlueSky model. The model will be released to all users including USDA Forest Service, Fire Consortia for Advanced Modeling of Meteorology and Smoke (FCAMMS), the National Weather Service, Environmental Protection Agency, and Northwest AirPact.

Contacts: Roger Ottmar, rottmar@fs.fed.us, Managing Disturbance Regimes Program

Partners: Washington Department of Natural Resources; Washington Department of Environmental Quality; USDA Forest Service Pacific Northwest Region and Okanogan-Wenatchee National Forest; Northwest Coordination Center; National Weather Service

Fire-dependent ecosystems in northeastern Oregon are resilient to fuel treatments

Prescribed burns, burning plus thinning, and thinning are the three most commonly used fuel reduction techniques in the West. The questions are, how effective are these treatment in a given situation, and what effect do they have on the residual stands? Scientists used the Fuel Characteristic Classification System (FCCS) to assess changes in fire hazard resulting from the three treatments and an untreated control when applied to a ponderosa pine forest in northeastern Oregon. They found that although fire hazard may decline in the short term, the treatments did not significantly reduce fire hazard over the long term. This suggests that more aggressive treatments or repeated application of treatments may be needed to reduce fuels and create more sustainable forest structure.

The study did find a difference between fuel treatments and the residual forest stands. Burning and burning plus thinning treatments increased the proportion of dead trees, whereas the proportion of dead trees declined or remained constant in thinned and control units. Most new tree mortality occurred within 2 years of treatment and was attributed to bark beetles. Bark beetle-caused tree mortality, although low overall, was greatest in the burning plus thinning treatment.

This study was part of the national Fire and Fire Surrogate study, which is assessing fuel reduction techniques, economics associated with different treatments, wildfire behavior, and forest health and forest restoration efforts, along with other issues and methods for integrating these results into decision-support tools.

Contact: Andrew Youngblood, ayoungblood@fs.fed.us, Managing Disturbance Regimes Program

Partners: Joint Fire Science Program

Steve Wondzell

A field crew checks a silt fence to evaluate erosion at a study plot on the Umatilla National Forest.

Prescribed fire has little effect on erosion in the absence of major storms after treatment

Prescribed fire is often proposed as a treatment for restoring forest health and reducing long-term risk of wildfires. It is generally assumed that wildfires and wildfire-related erosion pose greater threats to water quality and fish habitat than prescribed fires. This study in the Blue Mountains of northeastern Oregon and southeastern Washington was designed to quantify background erosion rates and to examine the effects of prescribed fire on hillslope erosion and stream sedimentation. Preliminary analyses indicated that erosion rates were significantly related to aspect and amount of bare ground but were not significantly influenced by prescribed fire. Vegetative ground cover grew back quickly in the years following fire. Consequently, the window of time during which treated areas are at risk of accelerated erosion following prescribed fire appears to be relatively short.

Data from this study have been used to help calibrate the WEPP model for background erosion rates and the effects of prescribed fire

on hillslope erosion for volcanic-ash-derived soils. The data and WEPP model also contributed to analysis on erosion and sedimentation for the School Fire salvage logging environmental impact statement and subsequent litigation.

Contact: Steve Wondzell, swondzell@fs.fed.us, Aquatic and Land Interactions Program

Partners: USDA Forest Service Umatilla National Forest, Rocky Mountain Research Station, and Moscow Forestry Sciences Laboratory

Fertilization after severe wildfires can accelerate the development of plant cover and help reduce soil erosion hazards

Slope stabilization treatments often are applied after high-severity wildfires to reduce soil erosion, protect water quality, and reduce risks to human life and property resulting from landslides. The effectiveness of many common slope stabilization treatments remains in question, however, and high costs limit the extent to which some popular treatments, like aerial mulching, can be used. In a study of seeding and fertilization treatment effects following the 2004 Pot Peak Fire near Chelan, Washington, scientists found that fertilizing with nitrogen and sulfur increased plant cover significantly during the first two growing seasons following the severe wildfire. Fertilization alone was more effective than seeding alone; however, spreading fertilizer and yarrow seeds, a native forb, produced the greatest increase in plant cover.

If further studies can establish the consistency of these results, fertilization can provide a viable alternative to seeding or mulching as a slope stabilization treatment. Fertilizer is widely available and relatively inexpensive to purchase and apply, and carries low risk of introducing exotic plant species into severely disturbed landscapes. Ongoing studies will help us better understand possible secondary effects (good or bad) of fertilization on vegetation composition and succession.

Contact: Dave W. Peterson, davepeterson@fs.fed.us, Managing Disturbance Regimes Program

Partners: USDA Forest Service Okanogan-Wenatchee National Forest, University of Washington

Dave W. Peterson

A study after the 2004 Pot Peak Fire near Chelan, Washington, found that fertilization accelerated plant regrowth.

NEW TOOL

SMARTFIRE

Description: Fire information is available from ground-based reporting systems, satellite fire detections, incident command teams, and other sources, each of which has its strengths and weaknesses. The Satellite Mapping Automatic Reanalysis Tool for Fire Incident Reconciliation (SMARTFIRE) is a new tool for integrating and reconciling all sources of fire information. By selectively weighting the different sources based on their inherent strengths, SMARTFIRE creates a single fire database that contains the most complete and best possible information. SMARTFIRE currently reconciles ground-based reports such as the incident command system reports and those from prescribed burn systems with satellite-based fire detections made available through the National Oceanic and Atmospheric Administration Hazard Mapping System. SMARTFIRE output is available on a daily, real-time basis.

Outcomes: The Environmental Protection Agency is examining SMARTFIRE for use in its national emissions inventory. When SMARTFIRE is used with the BlueSky smoke modeling framework, BlueSky appears to better predict surface smoke concentrations. The National Weather Service will be evaluating SMARTFIRE for use in National Air Quality forecasts.

How to get it: Contact Sim Larkin, larkin@fs.fed.us, Managing Disturbance Regimes Program

New model improves estimation of wood quality and fire risk

The size, location, and condition of knots are important factors in determining wood quality. Although individual tree stand simulation models have been used for almost 30 years, very little research has been done on modeling crown dynamics in individual trees or knots formed by the branches. Without detailed information on crown dynamics, it is difficult to improve predictions of wood quality in these simulation models. A second need for this information is its use in determining the probability of crown torching in fire-risk models.

To meet these needs, scientists developed a dynamic crown model that is general enough to fit into the major stand simulation models used in the Northwest. This model can provide key information for both wood quality and fire-risk modules under a variety of management alternatives.

Contact: Robert A. Monserud, rmonserud@fs.fed.us, Human and Natural Resources Interactions Program

Partner: Oregon State University

Fuel reduction treatments affect elk and mule deer differently

Manipulation of forest habitat via mechanical thinning or prescribed fire for fuels reduction has become increasingly common across western North America. This study evaluated seasonal and spatial responses of North American elk and mule deer to thinning and burning of true fir and Douglas-fir stands that contained high levels of dead fuel. Results indicated that although elk altered their home

Frank Vanni

Elk at Starkey Experimental Forest and Range.

range to include areas that had been treated, they did not use the treated area within their home range more than untreated areas. Seasonal and multiple environmental factors such as distance to roads, steeper slopes, and topographical complexity also contributed to home range establishment. It appears that manipulating forest habitat with prescribed fire may be of greater benefit to elk than mule deer where these species are found in the same area. Therefore, maintaining a mixture of burned and unburned habitat may provide better long-term foraging opportunities for both species than burning a large proportion of a landscape. This research will help forest managers plan fuel reduction projects in the future to ensure that habitat values for elk and mule deer are maintained or enhanced.

Contact: John Kie, kiejohn@isu.edu, Marty Vavra, mvavra@fs.fed.us, Managing Disturbance Regimes Program

Partners: Joint Fire Science Program, University of Idaho, Rocky Mountain Elk Foundation, Idaho State University

Vegetation maps facilitate modeling of fire risk to owl habitat and risk of gypsy moth outbreak

Station scientists identified the need for geospatial vegetation data that could be used to model interactions between potentially severe disturbances such as wildfire and insect outbreaks and their impacts on resource values. Therefore, they used a mapping method that links forest plot data with satellite imagery to produce a series of vegetation maps at 30-meter resolution for central, eastern, and southern Oregon; Washington; and northern California. These maps provide detailed information on the distribution of vegetation and stand composition, which allowed scientists to model the risk of fire to existing spotted owl habitat and identify areas at risk of gypsy moth outbreaks. This information enables land managers to focus related management efforts in areas where they will be most effective.

Contact: Jerome S. Beatty, jbeatty@fs.fed.us, Western Wildlands Environmental Threat Assessment Center

Partners: Landscape Ecology, Modeling, Mapping, and Analysis Team, Oregon State University; USDA Forest Service Remote Sensing Application Center

Fuel treatments can protect spotted owl habitat

Natural disturbances such as wildfire are a growing threat to the habitat of many rare wildlife species. Although fuel treatments and other management activities can reduce wildfire impacts, designing effective treatment strategies on large complex landscapes is challenging. Scientists are developing a new wildfire risk assessment framework for measuring the performance of alternative fuel treatment strategies using formal risk science. The framework can be applied to wildlife habitat and other resource values at risk to find fuel management strategies that best meet habitat conservation goals.

In a case study on the Deschutes National Forest, the risk analysis indicated that strategic fuel treatments on 10 percent of the project area, excluding habitat

Tom Iraci

Northern spotted owl.

Left: Mack Creek old growth, H.J. Andrews Experimental Forest, Oregon. Photo by Tom Iraci.

NEW TOOL

Guidelines for developing and updating Bayesian network models

Description: Bayesian network models are based on Bayesian statistics and allow the user to model events in terms of probabilities of different outcomes. A Station scientist and his colleagues have developed, published, and implemented practical guidelines for creating, evaluating, validating, and updating Bayesian network models.

Outcomes: The Oregon Department of Forestry has asked for help in developing Bayesian network models to determine the overall efficacy of their forest management in terms of ecological, social, and economic outcomes. Washington Department of Fish and Wildlife has asked for guidance in developing wildlife habitat prediction models for groups of wildlife species; U.S. Fish and Wildlife Service is using the Bayesian network approach to model decisions about listing species as threatened or endangered; and U.S. Geological Survey used this research to build comprehensive models of probable relationships between polar bear populations, amount of arctic sea ice, and global climate change.

How to get it:

Marcot, B.G.; Steventon, J.D.; Sutherland, G.D.; McCann, R.K. 2006. Guidelines for developing and updating Bayesian belief networks applied to ecological modeling and conservation. Canadian Journal of Forest Research. 36: 3063–3074.

Marcot, B.G. 2006. Characterizing species at risk I: modeling rare species under the Northwest Forest Plan. Ecology and Society. 11(2): 10. http://www.ecologyandsociety.org/vol11/iss2/art10/.

Contact Bruce Marcot, bmarcot@fs.fed.us, Ecosystem Processes Program

of the northern spotted owl, reduced the probability of owl habitat loss from fire by almost 30 percent, compared to no treatment. Results from the risk assessment were used to support the preferred alternative in the final environmental impact statement for the Five Buttes Interface project. This work paves the way for future wildfire risk analysis to support fuel treatment projects. The risk assessment framework can be applied elsewhere to quantify potential benefits of wildland fires and to study social and ecological issues related to wildfire impacts.

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

Partner: USDA Forest Service Rocky Mountain Research Station

Outcome: Deschutes National Forest uses new risk assessment framework to assess probability of lost owl habitat from wildfire with or without fuel treatment projects.

Forest structure limits populations of flying squirrels, primary prey of spotted owl

Northern flying squirrels are a central part of the spotted owl-squirrel-fungi-tree linkage and are, thus, thought to be important to the long-term ecological health of the region's forests. To study the impact forest management practices can have on this nocturnal rodent, scientists collected data from live trapping, radio-tracking studies, and vegetation surveys in western Washington from 1991 to 2006. These data were added to a three-dimensional computer model.

Scientists found a positive association between high squirrel densities and complex interactions among forest structural components that appear to make squirrels less vulnerable to predation. Removal of structure, either through

natural or human-induced processes, reduced squirrel populations.

Models such as the one developed in this project help provide a quantitative basis for forest management designed to promote habitat for species of concern, such as the northern spotted owl.

Contact: Todd M. Wilson, twilson@fs.fed.us, Ecosystem Processes Program

Partners: U.S. Army, Fort Lewis; USDA Forest Service Olympic National Forest

Insect-induced tree mortality and loss of canopy closure not necessarily detrimental to pileated woodpeckers

The pileated woodpecker is a species of conservation concern and an indicator of mature- and old-forest habitat conditions in the Pacific Northwest. Effects of natural and human-caused disturbance on density of nesting pairs, reproductive success, and traditional home ranges were compared over 30 years in two areas and over 15 years in five additional areas. Harvesting, particularly regeneration cuts, which lead to the development of new stands, and loss of dead trees and logs were detrimental to the woodpecker. In one area, density of nesting pairs decreased after extensive timber harvests eliminated most of the stands of mature and old-growth grand fir and reduced the density of nest and roost trees and foraging substrate since 1990. Density of nesting pairs, reproductive success, and home range location remained fairly consistent over 30 years in a second area with extensive tree mortality resulting from insect outbreaks but without regeneration harvests. The woodpeckers had greater reproductive success between 2003 and 2005 in areas where less harvest had occurred and where there were more closed-canopy stands within their home ranges.

Given the USDA-USDI 2001 National Fire Plan, the Healthy Forest Restoration Act of 2003, and management emphasis on fuel management and forest restoration, large areas have or will be subject to fuel reduction activities. Findings from this long-term study will be useful to wildlife biologists and resource managers as they manage for multiple goals.

Contact: Evelyn Bull, ebull@fs.fed.us, Managing Disturbance Regimes Program

Partners: USDA Forest Service Pacific Northwest Region; University of Idaho

NEW TOOL

Image-driven screening aid for identifying common and selected exotic species of wood-boring buprestid beetles

Description: Wood-boring buprestid beetles (e.g., emerald ash borer) can have significant ecological and economic impacts on forest resources. This identification aid includes more than 20 of the most common PNW buprestid species and selected exotic species. This image-driven key was developed in PowerPoint, a format that is widely available. This screening aid enables non-entomologists to sort up to 95 percent of specimens collected in surveys or studies. This relieves the limited number of taxonomic experts from conducting time-consuming coarse sorts and instead enables them to concentrate on target species.

Outcomes: This project supports the Forest Service's Early Detection/Rapid Response effort in providing taxonomic keys for prescreening collections. Similar support will be provided for various state surveys, such as the National Exotic Woodborer and Bark Beetle Survey conducted by the Cooperative Agricultural Pest Survey program.

How to get it:

Contact Christine G. Niwa, cniwa@fs.fed.us, Managing Disturbance Regimes Program

New tools help translate planning directives into management projects

Forest managers want to know if their management activities are having the intended result or creating the desired condition. It is difficult, however to conduct broad-scale, multidisciplinary evaluations of management practices. Scientists developed the Interior Northwest Landscape Analysis System (INLAS) project to address this challenge. INLAS provides intermediate-scale assessments that can help translate broad-scale planning directives into specific management projects.

Miles Hemstrom

The Interior Northwest Landscape Analysis System (INLAS) was applied to management scenarios in the Blue Mountains in northeastern Oregon to determine if management activities were creating the desired results.

The INLAS tools were applied to management scenarios in the Blue Mountains of northeast Oregon. Several key findings emerged from these simulations: (1) fire suppression alone does not produce abundant large tree structure; (2) maintaining abundant large-tree multistoried structure in cool, moist forests is likely to be difficult because of wildfire and insect outbreaks; and (3) both active fuel treatment and passive management scenarios increased the proportion of large-tree single-story forests in dry forest conditions.

Some INLAS tools have been used in other assessments, and some INLAS case studies have been integrated into Forest Service planning tools for vegetation, wildlife habitat, and wildfire. INLAS case studies also have been incorporated with nationwide training programs for the Fireshed Assessment process, and the Interagency Mapping and Assessment Project.

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

Partners: Oregon State University, University of Georgia, USDA Forest Service Pacific Northwest Region and Rocky Mountain Research Station, USDI National Park Service, Oregon Department of Forestry

NEW TOOL

Gradient Nearest Neighbor maps of forest vegetation for the state of Oregon

Description: Detailed maps of forest composition and structure for research and management applications, including landscape scenario analysis; forest policy analysis; land management and conservation planning; and risk assessment for fire, insects, disease, and climate change.

Outcomes: Used in a wide variety of analyses, such as the Interagency Mapping and Analysis Project (IMAP), Effectiveness Monitoring for the Late-Successional Forests under the Northwest Forest Plan, National Forest Plan revision, forest health risk assessment, dead wood habitat assessment using DecAID.

How to get it: Download maps, accuracy assessment, metadata, and other information from http://www.fsl.orst.edu/lemma/, under the link for the GNNPac project, or contact Janet Ohmann, johmann@fs.fed.us, Ecosystem Processes Program

2.5-acre forest aggregates retained during harvest provide conditions suitable for species maintenance

Leaving aggregates of undisturbed forest after timber harvest to serve as refugia for sensitive species is a practice increasingly considered by forest managers. The success of these plots as refugia lies in their ability to maintain the same environmental conditions found in mature, intact forest.

Scientists compared conditions inside 2.5-acre plots to those in adjacent harvested areas and to larger tracts of undisturbed forest. After measuring microclimatic variables such as light availability and temperature, they determined that 2.5-acre aggregates are sufficiently large to contain areas with light, temperature, and soil moisture that are comparable to those in undisturbed forest. These areas, they found, would be suitable for the short-term persistence of forest-dependent species.

Current retention standards in the Northwest Forest Plan allow for retention of forest aggregates as small as 0.5 acre. These results suggest that microclimatic conditions in aggregates this small would be severely compromised. Findings from this study can be used to develop retention guidelines that better meet management objectives.

Contact: Troy Heithecker, theithecker@fs.fed.us, Resource Management and Productivity Program

Partners: Oregon State University; University of Oregon; University of Washington; USDA Forest Service, Gifford Pinchot and Umpqua National Forests and Pacific Northwest Region; Washington State Department of Natural Resources

Snag density declines with timber harvest and human access

Many wildlife species depend on snags (standing dead trees) for habitat. Research suggests, however, that snag density is lower in areas of intensive timber harvest and where humans have access to cut firewood. Scientists evaluated these potential relations by sampling stands with different levels of timber harvest and access in national forests in the Northwestern United States. Stands with no history of timber harvest had 3 times as many snags as in stands selectively harvested, and 19 times as many snags as in stands that had been completely harvested. Stands not adjacent to roads had three times as many snags compared to stands adjacent to roads.

Evelyn Bull

Snags are important habitat to a variety of wildlife. Scientists found fewer snags in areas readily accessed by humans.

This information is being used by national forests in eastern Oregon, eastern Washington, Idaho, and western Montana as part of forest planning, revisions, amendments, and environmental assessments and impact statements to help mitigate past snag loss and to improve snag retention during management activities.

Contact: Michael Wisdom, mwisdom@fs.fed.us, Managing Disturbance Regimes Program

Partners: Wildlife Consulting, Inc.; USDA Forest Service Washington office

Outcome: National forests are revising management to improve snag retention.

Recreation is emerging as a key management issue

More people are recreating on public land, and the range of activities they are engaging in is expanding. This increasing diversity of both people and activities has highlighted the need to reevaluate planning methods and tools and to assess the role of recreation within the Forest Service's planning and administrative processes. To address this, scientists systematically compared the premise, development, strengths, and weaknesses of the major recreation planning frameworks used by land management agencies. Conceptual needs for

meeting future recreation goals were presented at the National Workshop on Recreation Research and Management.

Scientists have shared their findings about the effectiveness of different planning methods and ways to incorporate ecosystem management principles in the selection and use of planning tools at the Outdoor Recreation Short Course for Mid Career Professionals in Logan, Utah, and the Continuing Education for Ecosystem Management Short Course in Flagstaff, Arizona. Results were also presented to the Dixie National Forest Travel Management Taskforce and at the Science Forum for the Grand Staircase-Escalante National Monument. For 2008, scientists have been invited to share these findings with the Forest Management Teams for the Mount Baker-Snoqualmie and Olympic National Forests, and the Forest Service's Interregional Ecosystem Management Coordinating Group.

Contact: Dale Blahna, dblahna@fs.fed.us, Human and Natural Resources Interactions Program

Partners: University of Montana, Department of Society and Conservation; Utah State University, Department of Environment and Society and Department of Sociology, Social Work, and Anthropology

People form relationships with the land during nature-based recreation

Understanding how and why people become attached to certain places can help land management agencies anticipate how people will react to management proposals. Scientists found that tourists, as well as seasonal and year-round residents identified natural areas where they recreated as special places. Working with this conception of recreation as a place-making and a community activity, scientists developed a matrix that provides analytical tools for integrating theories of place and community. The matrix helps integrate exploration across categories of place (physical setting, interactions and behaviors, meanings and evaluations) and community (local ecology, local society, and community action). The matrix was conceived as an aid for crafting land-use policy that will be better understood, easier to implement, and more successfully involve the public, particularly in volunteer programs.

Contact: Linda E. Kruger, lkruger@fs.fed.us, Human and Natural Resources Interactions Program

Partner: Pennsylvania State University

Sara Jovan

Field crew members drill each other on identification of lichens.

David Nicholls

Home show attendees preferred wood panels with knots, distinct grains, and contrasting colors.

Consumers prefer decorative wood products with character

Traditionally, wood products were valued for their high strength, clear grain, consistent color, and lack of knots. Deviations from this were considered imperfections and thus given a lower grade and sold for a lower price. Continuing research on hardwood utilization indicates that when it comes to lumber for furniture and paneling, consumers often prefer lumber with character. In surveys conducted at home shows, respondents consistently preferred cabinets and panels with knots, distinct grain, and contrasting colors in the heartwood and sapwood.

Understanding consumer preference allows small lumber producers to increase their profit margins by converting lower grade lumber to value-added products, such as paneling, to sell to local markets and wholesalers.

Contact: David L. Nicholls, dnicholls@fs.fed.us, Human and Natural Resources Interactions Program

Partners: University of Alaska Cooperative State Research, Education, and Extension Service Forest Products Program

Scientists explore feasibility of using wood for power generation

Woody residues from timber harvest, hazardous fuel removal, and wood products manufacturing can be used to generate electricity. The question is, when is it economically feasible in a given location? Scientists examined the feasibility of using woody biofuels for direct-combustion electrical or thermal power applications at several different scales: large-scale electrical power generation at stand-alone facilities, co-generation to produce steam and electrical power, and smaller scale thermal heating projects at government facilities and schools. They found that for such a project to be economically feasible, the source of wood had to be very close to the power-generating facility, harvesting costs had to be very low, which is not often the case with hazardous fuel removal, and the costs of building and maintaining the generating facility had to be low. The most promising use for woody biofuels currently appears to be in smaller scale projects such as generating heat for schools.

David Nicholls

Woody residues, such as these from a mill in Alaska, can be used to generate electricity.

As the country looks to develop alternative fuel sources, the information generated from studies like these plays an invaluable role in helping bioenergy projects find an appropriate niche.

Contact: David L. Nicholls, dnicholls@fs.fed.us, Human and Natural Resources Interactions Program

Partners: The Sitka Wood Utilization Center

Oval logs produce more lumber than round logs of same volume

Over the years sawmillers have, by trial and error, determined the best way to cut logs to produce the most useable lumber. For oval-shaped logs, primary sawing along the longer axis has generally been accepted as the "correct" method. Scientists verified this by applying a series of sawing simulations to five replicate groups of oval logs, modeled from measurements of 52 western hemlock logs. Using

Sawing simulations revealed the optimal log orientation for producing lumber.

AUTOSAW, the log models were sawn in a series of simulations that altered log orientation and elliptical representations. Scientists found oval logs tended to produce more lumber than round logs when rotated to their optimal orientation. In fact, the more oval the log, the greater the amount of lumber it yielded, compared to a round log of the same volume.

This information indicates the oval logs should not be downgraded as other literature has suggested. These finding were published in the Forest Products Journal and presented to the Timber Measurements Society.

Contact: Robert A. Monserud, rmonserud@fs.fed.us, Human and Natural Resources Interactions Program

Partners: New Zealand Forest Research Institute (Scion and Ensis)

Left: Photo by Charlie Crisafulli.

Regional Agenda2020 partnership is strengthening forest products industry

Agenda2020 is a national partnership committed to sustainable forestry and its application in the United States. Funded by the Forest Service and the American Forest and Paper Association, the partnership fosters research exploring numerous high-priority areas, including soil and tree productivity, molecular biology, and biotechnology. The Forest Service's western research stations and area universities are among the partnership's many members.

In 2007, the Station's Regional Agenda2020 members successfully completed a dozen projects that explore long-term site productivity, genetics, and tool development. Results and technologies from the Agenda2020 partnership are being used by the forest products industry to sustainably manage for wood production and maintain competitive strength in a global market. More broadly, results from Agenda2020's work are helping the country to reduce its dependency on fossil fuels, increase carbon sequestration, promote sustainable development in rural communities, and increase the global competitiveness of the forest products industry.

Contact: Charley Peterson, cepeterson@fs.fed.us, Resource Management and Productivity Program

Partners: American Forest and Paper Association, National Council on Air and Stream Improvement, Oregon State University, University of Idaho, University of Washington

Native Douglas-fir will be poorly adapted to climates expected by end of 21st century

Climates are expected to warm considerably over the next century, suggesting that today's plant populations will not be adapted to future conditions.

Scientists studied the potential risk of maladaption of native Douglas-fir by comparing populations grown together and looking at the relationship of population variation in adaptive

traits and the environments of seed sources. They found the risk to be large for most adaptive traits relative to the risk associated with transfers within current seed zones, particularly for the more drastic climate change scenarios. Uncertainty remains, however, with respect to specific climate projections and appropriate timeframes to consider for adaptive responses.

Management options to prepare for a warming but uncertain future climate include increasing within-stand diversity by planting mixtures of local seeds and seeds from lower elevations or farther south.

Contact: Brad St. Clair, bstclair@fs.fed.us, Resource Management and Productivity Program

Partner: Oregon State University

Understanding why Alaska yellow-cedar is declining leads to conservation strategy

The decline of yellow-cedar in southeast Alaska illustrates how a minor shift in climate can have serious and unanticipated consequences on forest ecosystems. As scientists better understand the cause of the decline, they are developing a conservation strategy for this economically and culturally valuable species. Cumulative research is revealing that spring freezing injury induced by a warming climate and reduced protective snow is the cause of the widespread yellow-cedar mortality. This knowledge, combined with assessment of decline at several spatial scales, is leading to a strategy that involves partitioning the landscape into areas that are favorable and unfavorable for yellow-cedar, harvesting some of the dead forests, and actively regenerating cedar in areas suitable for long-term cedar viability.

This strategy may eventually be implemented by Forest Service and other land managers in southeastern Alaska and adjacent areas of British Columbia to conserve and manage yellow-cedar in the context of climate-induced mortality.

Contacts: Paul Hennon, phennon@fs.fed.us, Managing Disturbance Regimes Program; David D'Amore, ddamore@fs.fed.us, Resource Management and Productivity Program

Partners: British Columbia Forest Service; USDA Forest Service Tongass National Forest, Forest Products Laboratory, and Northern Research Station; University of Vermont; University of Alaska Fairbanks; The Nature Conservancy;

More information: *Science Findings* No. 93 (May 2007), The Mysterious Demise of an Ice Age Relic: Exposing the Cause of Yellow-Cedar Decline, http://www.fs.fed.us/pnw/sciencef/scifi93.pdf

Outcome: Research leads to strategy for managing for Alaska yellow-cedar in a changing climate.

David D'Amore

Standing dead yellow-cedar interspersed with healthy western hemlock are a common sight on low-elevation hillslopes in southeast Alaska.

Headwater streams contribute wood to fish-bearing streams

Large wood in streams creates desirable habitat for salmon. Its presence slows water and creates pools, which give fish places to rest and hide. Forest management within a watershed can affect the size and amount of wood that eventually ends up in a fish-bearing stream. The question is, at what spatial scale within a watershed can landscape features best explain habitat features in fish-bearing streams? In southwestern Oregon, scientists found that an intermediate spatial scale, which included headwater streams draining directly into surveyed fish-bearing streams, best explained the presence of large wood in fish-bearing streams.

These findings will help managers decide where management within a watershed will most effectively contribute to desirable stream habitat. This multiscale approach is being explored to reduce monitoring costs and target field monitoring locations as part of the Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan.

Contact: Kelly Burnett, kmburnett@fs.fed.us, Aquatic and Land Interactions Program

Partners: Aquatic and Riparian Effectiveness Monitoring Program (a partnership of federal land management agencies); Oregon State University; USDA Forest Service Pacific Northwest Region; USDI Bureau of Land Management Oregon State Office

Alex Foster

Large wood in streams helps create desirable habitat for salmon.

Buffers along headwater streams protect amphibians and invertebrates from effects of upslope timber harvests

Headwater streams have an ecology distinct from larger streams within the watershed. They also contribute critical nutrients to fish-bearing streams farther downstream. Retention of vegetation in streamside buffer zones can minimize the effects of forest management activities on the stream. Although the establishment of riparian buffer zones has been a required forestry practice for more than a decade, the benefits of different riparian buffer widths for headwater wildlife and habitats were relatively untested. In particular, the relation between buffer widths necessary to maintain headwater wildlife with different forestry activities was unknown.

Scientists conducted several studies in northwest Oregon to address these issues. At study sites from near Mount Hood in the Cascade Range to near Coos Bay in the Coast Range, they characterized headwater amphibian communities and found that riparian buffers as narrow as 20 feet retained amphibian diversity and habitat when upland forests were thinned. Another study near Sweet Home, Oregon, found that a 98-foot buffer protected riparian invertebrate communities from the impacts of a clearcut forest harvest. This information helps forest managers develop management plans that protect wildlife diversity and habitat while also managing timber resources.

Contact: Deanna H. Olson, dedeolson@fs.fed.us, Aquatic and Land Interactions Program

Partners: USDI Bureau of Land Management, USDA Forest Service Siuslaw and Willamette National Forests, Oregon State University, Oregon Headwaters Research Cooperative

Sara Jovan

Hall's lung lichen (Lobaria hallii).

NEW TOOL

Sediment and wood delivery from headwater streams model

Description: This model for western Oregon predicts the likelihood of a debris torrent in a given headwater stream reaching a fish-bearing stream. It also estimates the amount of wood that will be delivered to the channel.

Outcomes: The model allows for the development and evaluation of options for managing headwater streams within a given watershed or across a large area and for evaluating the potential cumulative impact of forest management. The model is being used extensively by the Bureau of Land Management in Oregon to develop and evaluate options for their revised land management plan.

How to get it: Contact Kelly Burnett, kmburnett@fs.fed.us, Aquatic and Land Interactions Program

Alex Foster

Amphibians and invertebrates benefit from riparian buffers after upslope timber harvests.

Continuous riparian buffers protect aquatic life better than variable-width buffers

Riparian trees and shrubs play an important role in aquatic ecosystems. Stream-side vegetation within a riparian zone shades the stream, while fallen branches and leaf litter provide structure and nutrients in the immediate vicinity and farther downstream. In this study, scientists found that aquatic life in headwater streams of the Washington Coast Range appeared better protected by continuous, fixed-width riparian buffers than by either intermittent, variable-width buffers or no buffers. The quantity and composition of organic litterfall was strongly influenced by the amount of riparian forest retained with fixed-width buffers providing the greater amounts of organic matter, but temperature changes were detected only in streams with no buffers. Fewer mollusks and millipedes were found after timber harvest, especially at sites without springs or seeps, regardless of the type of buffer provided.

Contact: Pete Bisson, pbisson@fs.fed.us, Aquatic and Land Interactions Program

Partners: Washington Department of Natural Resources, Washington Department of Ecology, University of Washington

Outcome: Buffer information is being used by the Washington Department of Natural Resources to prescribe headwater stream protection requirements in its 50-year habitat conservation plan for managing headwater streams.

Alex Foster

Millipede.

Tom Iraci

Maybeso Experimental Forest, Alaska.

Stream buffers conserve diversity of forest mammals

The ability to gauge the response of forest-floor wildlife to changes in streamside habitat is critical to determining the efficacy of aquatic conservation strategies. These strategies often involve the creation of buffers—natural areas surrounding streams that protect them and their inhabitants from the effects of land management activities.

To study the effectiveness of buffers in conserving small mammals, scientists compared capture rates of mammal species along streams before and after the creation of buffers. They found that species diversity increased in streams with buffers and was greatest within 3 years of creation. Scientists also noted that capture rates tended to vary greatly among the streams, meaning very large effects would be needed to detect differences following disturbance.

This research supports efforts to develop a long-term stream conservation strategy as part of the Washington Department of Natural Resources' habitat conservation plan and to support the agency's adaptive management strategy.

Contact: M.G. Raphael, mraphael@fs.fed.us, and R.J. Wilk, rwilk@fs.fed.us, Ecosystem Processes Program

Partner: Washington Department of Natural Resources

Synthesis of research on amphibians provides alternative management approaches

Forty-seven species of amphibians live in the Pacific Northwest and spend some portion of their life in riparian areas. Streams create microclimates of cool, moist air that permeates upslope to warmer, drier areas. These microclimates appear particularly important to amphibians that breed in streams but can disperse hundreds of yards into upland forests, if the habitat is present.

A synthesis of recent studies on amphibians and microclimates associated with headwater streams suggests a two-pronged management approach for forested headwaters in the Pacific Northwest. One is a conservative approach designed to provide maximum benefits to targeted amphibians potentially at risk, whereas the other is for landscapes where timber harvest is a priority. Key to both of these approaches is providing connected avenues of trees both along streams and across ridgelines to other headwaters. Aggregated and dispersed retention of trees along channels and upslope to provide dispersal habitat for amphibians may effectively retain these unique taxa and the habitat and microclimates they require.

Contact: Deanna H. Olson, dedeolson@fs.fed.us, Aquatic and Land Interactions Program

Partners: USDI Bureau of Land Management, Pacific Rivers Council, USDA Forest Service Siuslaw National Forest and Pacific Southwest Research Station

New tools enhance FishXing software

FishXing helps engineers**,** hydrologists, and fish biologists design and evaluate culverts that fish and other aquatic organisms can pass through safely. In 2007, scientists created several new tools to further enhance the usability of the software. One of these tools is a 300-page help manual. It is built into the software and includes a comprehensive synthesis of the literature on fish performance vs. culvert hydraulics.

A third new tool is a comprehensive, interactive online guide to field techniques for collecting data of inventory and assessment of culverts. These learning resources widen the FishXing user base, and help to ensure it is used as intended.

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

Partners: San Dimas Technology and Development Center and the Federal Highway Administration

More information: Visit http://stream.fs.fed.us/fishxing/

Peter Bisson

Cutthroat trout and Chinook salmon.

Organized in table format, the help manual allows users to select the literature that best fits their situation. Internet search engines give priority ranking to the help manual for many of the key terms included in its index; this results in extensive online traffic from users around the world.

The FishXing Web site now includes 29 case studies that facilitate advanced training for Aquatic Organism Passage design and construction. The case studies demonstrate the application of accepted design techniques for passage of fish and other aquatic organisms, ways to approach challenging site constraints, lessons learned, and pitfalls to avoid. The case studies highlight successful solutions as well as techniques that did not work as expected. Another 20 case studies are in the works.

Maps and expansion models aid weed management

Noxious, invasive weeds can sicken livestock, contaminate agricultural exports, and out-compete native vegetation. Crook County in central Oregon is particularly susceptible to invasive weeds because of its location, climate, and land uses, including multiple off-highway recreational attractions. Effective weed management requires land management agencies to coordinate their efforts across the affected, and potentially affected, landscape.

Before this project, federal, state, and local agencies in Crook and surrounding counties were independently monitoring and combating the spread of noxious weeds, but a commonly accessible source for noxious weed data did not exist. To remedy this, Station scientists and collaborators established contacts within the

Terry Shaw

Noxious weeds can contaminate agricultural products and sicken livestock. Scientists helped Crook County, Oregon, control the spread by developing maps and models that identify vulnerable areas.

various agencies and mapped the location of the top 15 invasive weeds. Models that project the probable expansion of the weeds were also developed and validated, enabling land managers to focus weed management efforts in areas where spread is most likely.

Contact: Charles (Terry) Shaw, cgshaw@fs.fed.us, Western Wildlands Environmental Threat Assessment Center

Partners: Crook County, Oregon Geographic Information Systems Office

Outcome: Study helps coordinate noxious weed management in Crook County.

National Environmental Policy Act process on way to becoming more efficient

Administering the National Environmental Policy Act (NEPA) is one of the most demanding and publicly visible functions of the Forest Service. As part of the NEPA for the 21st Century Initiative, nine studies examined how the NEPA process could be administered more efficiently within the agency. Some findings from these studies indicate that (1) passionate leaders who encourage stakeholder participation are common elements of success, (2) there is more within-region variation than between-region variation in NEPA processes, (3) multiple federal agencies value having a dedicated interdisciplinary team and a staff writer, and (4) certain activities would be amenable to outsourcing.

Regional planning staff, line officers, and national-level NEPA program staff helped develop the initial research questions addressed in the nine studies to ensure that the findings and resulting recommendations would meet the information needs of on-the-ground NEPA practitioners. Elements of these studies are being used by National Forest System staff to consider alternative organizational structures and management processes for conducting NEPA activities.

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

Partners: USDA Forest Service Ecosystem Management Coordination, Washington office; Virginia Tech University; State University of New York at Buffalo; University of California at Berkeley; Indiana University; Oregon State University; Society of American Foresters

Outcome: National Forest System is considering alternative processes for administering NEPA more efficiently.

NEW TOOL

Stand Visualization Add-in for Excel™

Description: This is a user-friendly interface program for the Stand Visualization System (SVS). It streamlines the process of creating forest images to depict dwarf mistletoe infections in live trees and a range of mortality structures including uprooted, broken, or standing dead trees.

Outcomes: Stand images that can be used to illustrate or communicate forest health scenarios or management treatment scenarios.

How to get it: Visit http://silvae.cfr.washington.edu/stnadviz-addin/

Continue to Part 3


Return to Part 2

GOAL 4: Communicate science findings and enhance their application

KEY FINDINGS

- *New framework used to guide monitoring associated with the Northwest Forest Plan and report related science findings in an annual interagency report.*
- *Station scientists provide information and modeling tools that assist Pacific Northwest Region forest plan revisions.*
- *Station scientists complete six scientific reviews for the Tongass Forest Plan Amendment.*
- *An informed public is more likely to accept fire and fuel management strategies, and interactive learning is an effective format for communicating information.*
- *Clients want to know more about markets for ecosystem services and identify the need to clarify role of federal agencies.*
- *New science delivery strategy puts fire science information in the hands of users, and further informational needs are identified.*
- *First reference book about silviculture and ecology of western forests examines management within an ecosystem context.*

Left: Alder stand in southeast Alaska. Photo by Tom Iraci.
Above: Ecologists discuss research findings at Mount St. Helens. Photo by Charlie Crisafulli.

Framework is developed to guide monitoring and report science findings

The Regional Interagency Executive Committee (RIEC) identified adaptive management as a priority following the Northwest Forest Plan conference in 2005. To facilitate adaptive management, the RIEC developed a framework consisting of 16 priority questions to guide regional monitoring and collaborative research investments over the next 10 years. The Station compiled key findings for all the research agencies involved in the Northwest Forest Plan for the first annual report using this new framework.

The RIEC will review the adaptive management strategy annually to determine if changes in management policies, standards and guides, or priority questions are warranted. Forest Service and Bureau of Land Management managers will use the annual report findings to better implement adaptive management and regional monitoring efforts across the region.

Contact: Becky Gravenmier, bgravenmier@fs.fed.us, Station Director's Office

Partners: USDA Forest Service Pacific Northwest Region

Tom Iraci

Homer Demonstration Forest, Alaska.

Station continues its science support in regional planning efforts

The Station participates in Forest Service land-use planning efforts and provides science support by developing new products, synthesizing findings, and providing consultations and scientific reviews. Scientists helped develop regional sustainability models for aquatic species that will be used in forest plan revisions in the Pacific Northwest Region of the Forest Service. These models and other tools will be useful to other regions as they revise their forest plans. Station scientists also consulted with managers about recent postfire forest management research findings and management implications for the Pacific Northwest and Pacific Southwest Regions and the Bureau of Land Management (BLM) in Oregon. Key science findings were provided to the regions, and a summary of recent and forthcoming publications was placed on the Station Web site for easy access by forest and BLM units.

Contact: Becky Gravenmier, bgravenmier@fs.fed.us, Station Director's Office

Partners: USDA Forest Service, Pacific Northwest and Pacific Southwest Regions

Station provides scientific reviews for Alaska Region of Forest Service

The Station provides science support to the Tongass Forest Plan Amendment process. This year, scientists completed six scientific reviews of key components of the forest plan including the conservation strategy, timber demand, climate change, young-growth management, vegetation models, and ecosystem services. These reviews help ensure that the best available science is used in the plan revision process.

Contact: Becky Gravenmier, bgravenmier@fs.fed.us, Station Director's Office

Partners: USDA Forest Service, Alaska Region

Roger Ottmar

Participants at a Station-led fuels workshop in Ohio learn how to classify forest fuels.

People respond positively to interactive communication about fire and fuel management

Public acceptance is key to the success of many fire and fuel management strategies, and acceptance is more likely to evolve from an informed public. Scientists conducted several studies on communication strategies for fire and fuel management programs. They found that outreach programs that engaged citizens as active participants rather than passive recipients were most effective. This finding is consistent with theories on adult learning. A second study found that fire agencies need to further develop their capacity to respond to the public's concerns. The third study found that direct, frequent interactions between scientists and managers are an effective way to communicate findings, observations, and questions, but that few opportunities for this type of dialog exist.

These findings suggest that interactive methods are better able to incorporate the participants' experiences with real-world problems. These experiences include attachment to special places, perceptions of uncertainty and risk, and community concerns. A workshop is being planned to share these findings with managers and to jointly develop processes that will reduce communication barriers between scientists and managers.

Contact: Lee K. Cerveny, lcerveny@fs.fed.us or Linda E. Kruger, lkruger@fs.fed.us, Human and Natural Resources Interactions Program

Partners: Oregon State University, (jointly funded with Joint Fire Science Program, National Fire Plan, and USDA Forest Service Northern Research Station), University of Washington

Clients share thoughts about markets for ecosystem services

"Ecosystem services" are the benefits people obtain from ecosystems, such as food and forest products, as well as an array of traditionally nonmarketable services provided by nature, such as clean air, clean water, and carbon storage. When forest or agricultural land is converted to more developed uses, many of these services are lost or significantly reduced. As the U.S. population increases, so will demand for these ecosystem services, while the availability of land and natural systems that produce these services will likely be diminished. This realization has created interest in finding incentives to encourage private landowners to include production of ecosystem services in their resource management plans.

At a workshop in January 2007, forest industry, public agencies, conservation groups, and family-forest owners discussed concerns, barriers, regulations, and incentives related to market-based valuation systems for ecosystem services. This was followed by focused client meetings where clients identified key research needs. Several common themes were expressed: (1) clients believe well-structured regulations are crucial to the success of developing ecosystem service markets, (2) clients are insecure about market uncertainties, (3) clients would be better served if the efforts of multiple agencies were integrated across broad geographic areas, and (4) clients are very interested in carbon markets. Discussions also included the appropriate role of federal land management agencies in providing ecosystem services and their assistance to develop markets for these services.

Contact: Robert Deal, rdeal@fs.fed.us, Focused Science Delivery Program

Online watershed seminars offer new format for scientists to share expertise

This new seminar series on watershed sciences allows hydrologists, biologists, ecologists, and others in the watershed-fisheries community of practice to efficiently share key information throughout the year. Topics for 2007 included the effects of forest management on water yield and quality in three experimental forests, modeling biological responses to physical stream changes, and a synthesis of emerging research on the effects of fire and fuel management on fish. Each seminar had about 50 participants. By participating in interactive seminars online, participants avoid the travel costs associated with traditional conferences and symposia, and less travel means fewer carbon emissions. The seminars have been

Charlie Crisafulli

Scientists gather to discuss recent findings in ecological research at Mount St. Helens.

converted to portable electronic presentations for on-demand viewing. More seminars are planned for 2008.

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

Partners: USDA Forest Service National Forest System and State and Private Forestry

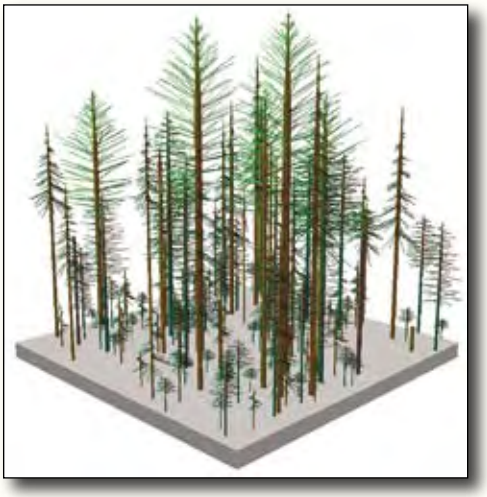
More information: Visit http://stream.fs.fed.us/wss/

Fire science information is now more accessible

Over the past decade, the federal Joint Fire Science Program has generated a substantial volume of new knowledge, methods, and tools related to fire and fuel management. Until recently, however, there was no organized system for introducing and delivering these products to managers, regulators, decisionmakers, and policymakers. To address this need, scientists developed a science delivery strategy and implementation plan designed to move away from the current ad hoc method of science delivery and application to a more systematic process. A range of written products designed to meet the communication needs of various audiences is now available on the Joint Fire Science Web site: http://www.firescience.gov/.

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

Partners: Joint Fire Science Program



Graphic images created from forest inventory data are increasingly used to depict different forest types.

NEW TOOL

A Consumer Guide to Vegetation and Fuels Management Tools

Function: This publication provides a state-of-science summary of tools currently available for management of vegetation and fuels. Detailed summaries include a description of each tool, where it can be obtained, relevant spatial scale, level of user knowledge required, data requirements, model outputs, application in fuel treatments, linkage to other tools, and availability of training and support. Streamlined summaries in tabular format allow users to rapidly identify those tools that could potentially be applied to a specific management need. In addition, an interdisciplinary team process is described that facilitates application of tools and decisionmaking at different spatial scales.

Outcomes: This guide is currently being used by the Joint Fire Science Program and Carnegie-Mellon University as the basis for a national review of fire modeling tools produced by federal agencies. It is also being used by the U.S. Geological Survey as a source document for information on fire models within their fire research program.

How to Get It: General Technical Report PNW-GTR-690. A Consumer Guide to Vegetation and Fuels Management Tools. Available at http://www.fs.fed.us/pnw/pubs/pnw_gtr690.pdf or contact David L. Peterson, peterson@fs.fed.us, Managing Disturbance Regimes Program

Improved computer-generated images of forested landscapes facilitate better communication

Computer-generated images that illustrate different conditions in forest stands facilitate discussion about prospective management treatments. These images are based on forest inventory data and are used to convey information such as forest age, density, stand size, vertical layering, and fire hazard. Before this study, little research had been done to determine the accuracy of interpretations of forest attributes from computer-generated images. Based on the response of 183 forestry professionals in California, Oregon, and Washington, several factors were identified, that when altered, affected observer perception of forest conditions based on the image. For example, including

more visual information, such as groundcover, changed the observer's perception of tree size, age, and stand density.

A new nationally consistent forest inventory system has been implemented for 43 states, providing a wealth of inventory measurements that can be used to create images of the diverse forest types found across the United States. Improved computer-generated images provide scientists and managers with another way to communicate and involve the public in forest planning discussions.

Contact: Tara M. Barrett, tbarrett@fs.fed.us, Forest Inventory and Analysis Program

Partner: University of Montana

Proceedings highlights insights on the transfer of forest science knowledge and technology

An ongoing challenge for forest science organizations around the world is disseminating information and innovations in ways that facilitate their implementation. A conference in 2005, sponsored in part by the Station and the International Union of Forest Research Organizations, addressed this topic. The proceedings resulting from the conference includes papers by people who work in extension services, natural resource specialists, scientists, and technology transfer specialists. A major theme is the concept of technology transfer as a two-way channel between researchers and users. The collection of papers examines knowledge and technology transfer theories, methods, and case studies that cover digital media, engagement of users and communication specialists in the full cycle of research, integrated forestry applications, Internet-based systems, science writing, training, video conferencing, and Web-based encyclopedias.

Contact: Cynthia Miner, clminer@fs.fed.us, Communications and Application Program

More information: General Technical Report PNW-GTR-726. Proceedings: International Conference on Transfer of Forest Science Knowledge and Technology. http://www.fs.fed.us/pnw/pubs/pnw_gtr726.pdf

Scientists characterize east-side old-growth forests

When land management agencies are charged with managing for and maintaining "old-growth forest conditions," it helps to have an agreed-upon definition of the term. The Washington Department of Natural Resources (DNR) is required by the state legislature to do just that, so Station scientists and staff from state agencies are developing definitions of old-growth forest for several forest environments east of the Cascade Crest ranging from very dry to cool and moist. The development of these definitions is part of a larger examination of how DNR manages forested lands to meet legislative requirements.

Sara Jovan

*Cup lichen (*Cladonia *sp.)*

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

Partners: University of Washington, Washington Department of Fish and Wildlife, Washington Department of Natural Resources

Station expertise helps combat illegal logging worldwide

Illegal logging threatens sustainable forest management around the world. One method for thwarting this activity is to establish a chain of custody that tracks logs and wood products from the forests where they are harvested through their final sale to the consumer. The Forest Service's International Programs Office

Left: Hikers at Breitenbush Hot Springs, Oregon. Photo by Tom Iraci.

Robert Szaro

Tillamook State Forest, Oregon.

asked a Station scientist, recognized as a world authority on the subject, to develop training materials on log tracking systems to assist officials in Russia and Columbia combat illegal logging. The scientist was also invited to Jakarta, Indonesia, to help plan a training program for implementing that country's new legal standard for harvested timber.

Contact: Dennis Dykstra, ddykstra@fs.fed.us, Human and Natural Resources Interactions Program

Partners: USDA Forest Service International Forestry; Food and Agricultural Organization, Center for International Forestry Research

Outcome: Officials in Russia, Columbia, and Indonesia receive training to establish log tracking systems.

New book provides international perspective on sustainable forestry management

Sustainable Forestry *Management and Wood Production in a Global Economy*, published by Haworth Press, is a compilation of international studies and strategies for sustainable forest management in a global economy. A Station scientist edited the volume and several others contributed chapters. Topics included the influence of forest products markets on sustainable forestry in the United States, the development of conservation reserves and changes in forest policy in Australia, the challenges associated with even-aged plantations of conifer species in Scotland, illegal logging and the economic challenges of forest management in Central America, and similarities and differences in sustainable forest management criteria and indicators and their role for sustainable forestry in the Pacific Rim region. Forest researchers and practitioners around the world seeking to manage forests on a continual basis will find this book useful.

Contact: Robert Deal, rdeal@fs.fed.us, Focused Science Delivery Program

New reference book examines forest management within an ecosystem context

Modern silviculture is more than just a collection of methods for cultivating forests. Through carefully designed prescriptions, today's foresters use silviculture to implement specific management objectives, such as improving forest health, reducing wildfire hazard, and creating wildlife habitat.

A team of scientists from the Station and Oregon State University have written the first comprehensive reference book on

Station scientists write first comprehensive textbook on silviculture and ecology of Western U.S. forests.

silviculture for the Western United States. Using an ecosystem framework as a basis for silviculture, the book includes chapters on ecology of shrubs and hardwoods, methods for regenerating forests, measurement of stand density, and use of controlled fire. The book synthesizes 40 years of forestry research and cites over 900 references as well as the authors'

John Laurence

Ecologists visit a bog near Juneau, Alaska, to collaborate on development of regional ecosystem models.

research and management experiences. Written with forest practitioners, policymakers, and students in mind, the book provides a practical understanding of the science and application of silviculture.

The book serves as a primary reference for land managers, scientists, and students interested in using silvicultural treatments to improve forest health, produce forest products, manage wildlife habitat, and accomplish other forestry objectives. Already, the book is being used as part of silviculture courses at Oregon State University and the University of California, Berkeley.

Contact: Timothy B. Harrington, tharrington@fs.fed.us, Resource Management and Productivity Program

Partner: Oregon State University

More information: Tappeiner, J.C., II; Maguire, D.A.; Harrington, T.B. 2007. Silviculture and ecology of Western U.S. forests. Corvallis, OR: Oregon State University Press.

Comprehensive synthesis chronicles silvicultural research and management in the Douglas-fir region

Over the last century, silvicultural practices in the Douglas-fir region evolved through a combination of formal research, observation, practical experience, and changing economic and social factors. These practices have had a great influence not only on the present characteristics of the Pacific Northwest's forests, but the economic well-being of the region. This long history is unknown to most of the public, and much of it is unfamiliar even to many natural resource specialists.

In a new publication, Station scientists trace the history of silvicultural research's contributions to the evolution of forest practices. Special attention is given to the large body of information developed in the first half of the 20th century that is becoming increasingly unfamiliar to both operational foresters and—perhaps, more importantly—to those engaged in forestry research. Current trends in silviculture and silviculture-related research also are emphasized.

This publication provides forest researchers and managers with access to results from older silviculture research that are difficult to find. Many of these studies have relevance to newer silviculture regimes being proposed and implemented to address multiple resource objectives.

Contact: Robert O. Curtis, rcurtis@fs.fed.us, PNW emeritus scientist, Resource Management and Productivity Program

More information: PNW-GTR-696. Silvicultural research and the evolution of forest practices in the Douglas-fir region. http://www.fs.fed.us/pnw/publications/pnw_gtr696/

Starkey Experimental Forest and Range.

PNW's experimental forests and ranges embody rich history of work valuable to science, management

The Pacific Northwest's 11 experimental forests and ranges are part of a national network of long-term research sites whose rich legacies are today helping to address contemporary natural resource issues.

Studies of the histories of two leading experimental forests in the Pacific Northwest reveal a wealth of contributions toward the understanding of the natural resource systems and the importance of strong working relations among Station scientists, land managers, and university partners. Historical accounts document and interpret the histories of the Wind River Experimental Forest and the H.J. Andrews Experimental Forest, based on archival and oral history research methods. These histories reveal the importance of management systems that balance a strong commitment to long-term studies with attention to the issues of the day.

These historical accounts provide information on how successful management of research facilities can lead to important advances in ecosystem science and natural resource management.

Contact: Sarah Greene, sgreene@fs.fed.us, Ecosystem Processes Program

Partners: Oregon State University, Western Oregon University

More information:

Herring, M.; Greene, S. 2007. Forest of time: a century of science at Wind River Experimental Forest. Oregon State University Press. 188 p.

PNW-GTR-687. Necessary work: discovering old forests, new outlooks, and community on the H.J. Andrews Experimental Forest, 1948–2000. http://www.fs.fed.us/pnw/publications/gtr687/.

Second edition of *Alaska Trees and Shrubs* is published

New techniques and procedures have been developed for plant taxonomy in the 25 years since the first edition of *Alaska Trees and Shrubs* was published. Several Alaska shrubs have been renamed, and others are now categorized in new or different genera. Additionally, the geographic range of Alaska vegetation is better known, and gaps in range maps have been filled, especially in western and southwestern Alaska and the Wrangell-St. Elias region. This updated information is included in the second edition of this reference book published by Snowy Owl Books and is now available for scientific, academic, and general public use.

Contact: Willem van Hees, bvanhees@fs.fed.us, Forest Inventory and Analysis Program

Partners: USDA Forest Service State and Private Forestry, Alaska Region, and Bonanza Creek Long-Term Ecological Research Program; USDI National Park Service

Left: Old-growth trees, Olympic National Forest, Washington. Photo by Tom Iraci.

PNW scientists contribute to special issue of *Forest Science* and help reveal value of headwater streams to downstream resources and watershed condition

In the past, headwater streams—those closest to the water's source—have received considerably less attention than larger fish-bearing streams. Recent research, however, has highlighted the importance of headwater streams to downstream aquatic resources and overall watershed condition.

Station scientists are playing a major role in developing original research and research syntheses that address several high-priority research needs and information gaps surrounding headwater streams. Studies have focused on the basic ecology, biology, and physical attributes of riparian systems and processes as well as the influences of management practices and policy on the provision of riparian services from headwater streams.

This body of work has been captured in a recent special issue of *Forest Science* that focuses on the science and management of forest headwater streams. Of 21 papers included in the issue of this peer-reviewed journal, at least 12 have direct connections to the Station—through authorship by Station scientists or collaborators receiving Station funding.

This volume will be useful to managers and policymakers responsible for developing management practices and riparian reserve guidelines and to the development of watershed assessments and restoration or conservation plans.

Contact: Paul D. Anderson, pdanderson@fs.fed.us, Resource Management and Productivity Program

Partners: National Council for Air and Stream Improvement, Oregon Headwaters Research Cooperative, USDI Bureau of Land Management, Weyerhaeuser Company

More information: Science and management of forest headwater streams (Special issue). Forest Science. 53(2): April 2007.

Sara Jovan

*British felt lichen (*Peltigera britannica).

Second edition of media guide published

This year, the Station published the second edition of its media guide, *Sources and Science: A Guide to Experts at the Pacific Northwest Research Station.* The publication was updated to feature profiles of 62 Station scientists and is designed to help journalists and others identify expert sources and learn more about the work the Station conducts. Other highlights of the revised edition include a glossary, which defines common forestry and natural resource terms, and an expanded subject index.

Contact: Sherri Richardson Dodge, srichardsondodge@fs.fed.us, Communications and Applications Program

More information: *Sources and science: a guide to experts at the Pacific Northwest Research Station.* http://www.fs.fed.us/pnw/pubs/sources-science07.pdf

Conference lays groundwork for establishment of Pacific Northwest Invasive Plant Council

Invasive plant species threaten many of the Pacific Northwest's terrestrial and aquatic ecosystems by outcompeting native species, degrading wildlife habitat, and altering basic

ecosystem functions. To address these concerns and set the groundwork for collaboration, Station scientists hosted a conference in Seattle titled "Meeting the Challenge: Invasive Plants in Pacific Northwest Ecosystems." Nearly 60 papers and posters were presented during the 2-day event, which attracted 180 professionals from public and private organizations responsible for monitoring, studying, or managing invasive plants.

Lisa Scott

*Although beautiful to the untrained eye, invasive species such as this orange hawkweed (*Hieracium aurantiacum *L.) threaten many of the Pacific Northwest's terrestrial and aquatic ecosystems by outcompeting native species.*

In addition to exploring the latest developments in invasive plant research and fostering dialog, the conference also stimulated a scoping process that is currently underway to establish a Pacific Northwest Invasive Plant Council. Similar organizations in other regions of the country have been extremely effective at coordinating early detection and rapid response efforts, as well as educating land managers on prevention and control tactics for invasive plants.

Contact: Timothy B. Harrington, tharrington@fs.fed.us, Resource Management and Productivity Program

Partners: Montana State University, The Nature Conservancy, University of Washington

More information: PNW-GTR-694. Meeting the challenge: invasive plants in Pacific Northwest ecosystems. http://www.fs.fed.us/pnw/pubs/pnw_gtr694.pdf

Scientists provide international leadership on value of long-term studies in a sustainable world

Station scientists have worked closely with the International Union of Forest Research Organizations (IUFRO) in holding three major symposia.

These symposia, held in Europe; Portland, Oregon; and Australia, demonstrated the value and relevance of long-term studies and included information generated from large-scale experiments that address joint production of wood and ecological and social values. Collectively, many of the variable-retention harvest and thinning options presented at the symposia are gaining wider use on federal lands in Alaska, the Western United States, and on crown lands in British Columbia.

Contact: Charley Peterson, cepeterson@fs.fed.us, Resource Management and Productivity Program

Partners: International Union of Forest Research Organizations; British Columbia Ministry of Forestry; Canadian Forest Service; Oregon State University; USDA Forest Service Alaska and Pacific Northwest Regions, Gifford Pinchot and Umpqua National Forests; University of Washington; U.S. Department of Defense; USDI Bureau of Land Management; Washington State Department of Natural Resources

Western Journal of Applied Forestry special issue highlights findings from Sustainable Wood Production Initiative

Key research findings from the Sustainable Wood Production Initiative (SWPI) focused on several important topics for sustaining wood production in the Pacific Northwest region, including sustainable timber supply and markets, sustainable land use, and sustainable forestry options. The research was conducted

WEB PAGE

Large-scale silvicultural experiments in western Oregon and Washington

Description: This Web page describes 12 large-scale silvicultural experiments in western Oregon and Washington. Because these experiments are being conducted at the scale of actual forestry treatments, rather than on smaller experimental plots, the inferences drawn from these experiments can be translated directly to management options.

Function: The Web page enhances communication and information exchange among scientists, cooperators, and other stakeholders interested in large-scale, operational silviculture studies in the Pacific Northwest.

How to get it: Visit http://www.fs.fed.us/pnw/research/lsse/

in response to the needs of an array of forest landowners who were solicited during the SWPI for their input. Selected findings include (1) market-based harvest projections of private lands suggest that harvests in western Oregon could be sustained at or above recent levels over the period through 2054; (2) urban and developed area is projected to roughly double over the next 30 years, putting pressure on land values; (3) in some cases, riparian harvest restrictions could preclude the thinning of overstocked stands, which, if completed, would enhance riparian fish habitat; and (4) the ecological benefit of forest certification, measured in terms of acres of old-forest structure, is minimal. These studies were written up as a special issue of the Western Journal of Applied Forestry.

Contact: Robert Deal, rdeal@fs.fed.us, Focused Science Delivery Program

More information: See Western Journal of Applied Forestry, Vol. 22.

Michael Wisdom

Singleleaf pinyon pine and mountain big sagebrush.

PNW Media Highlights

Attracting the most media attention in 2007 was a study that explored the effects of postfire forest management on future fire severity. Led by Station scientist Thomas Spies and published in Proceedings of the National Academy of Science, a highly regarded interdisciplinary journal, the study examined forested sites that burned most recently by the massive Biscuit Fire in 2002. The story was run by many print and radio outlets, including *The New York Times*, *Christian Science Monitor*, *Seattle Post-Intelligencer*, and Oregon Public Broadcasting. Outlets in Austria, the United Kingdom, and Australia also covered the story.

Also receiving attention was the capture and radio-collaring of a wolverine in north-central Washington by Station biologists Keith Aubry and Cathy Raley and their colleagues. The wolverine was the third to be captured as part of a study that began in 2006—the first to track the elusive species in the region. The *Wenatchee World* and *Methow Valley News* ran stories.

In response to a pending sawmill closure, reporters sought the expertise of Station economist Richard Haynes. Haynes was quoted about the health of Oregon's timber industry in stories that ran in The Oregonian and on the news sites of several regional television stations, including NBC affiliate KGW and CBS affiliate KOIN.

Bioclimatologist Ron Neilson was quoted in stories about a study that found a possible link between ocean temperatures and wildfires. Articles ran in several outlets, including The *Seattle Times*, *Seattle Post-Intelligencer*, and Discovery Channel News.

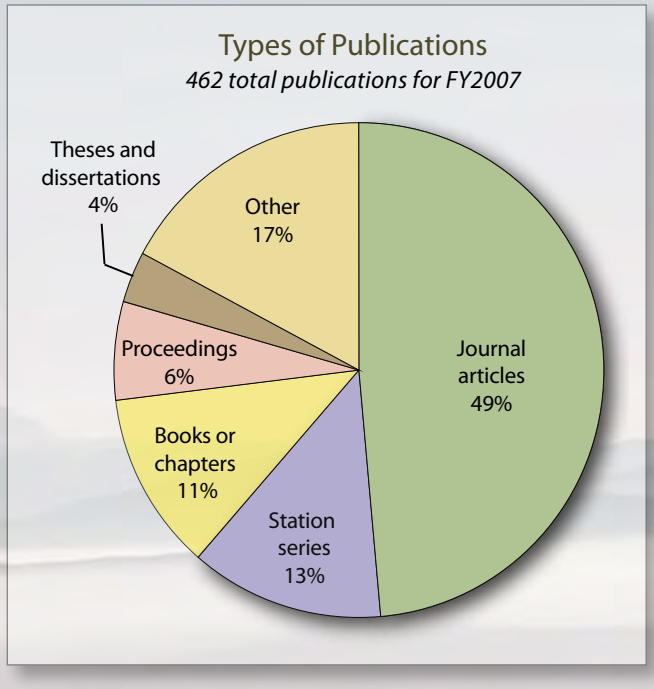
A study on the effects of recreation on elk and deer also received media attention. The *Casper Star-Tribune* (Wyoming) and *Billings Gazette* (Montana) were among the outlets that ran stories quoting Michael Wisdom, a wildlife biologist and the study's lead investigator.

Contact: Sherri Richardson Dodge, srichardsondodge@fs.fed.us, Communications and Applications Program

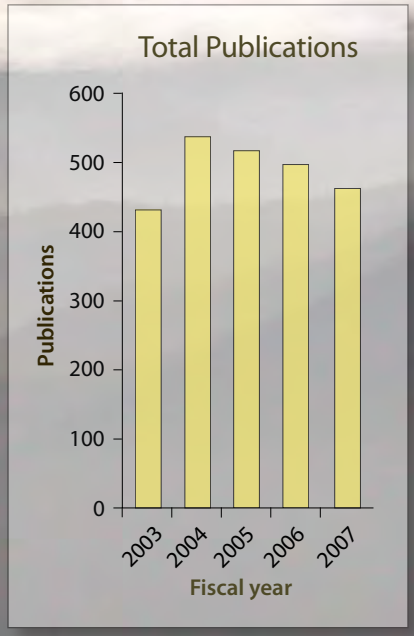
Publications

Types of Publications

Journal articles	225
Station Series	59
Books	53
Proceedings	30
Theses	16
Other	79



- 462 total publications. (Includes Station series publications, journal articles, proceedings, books or book chapters, theses and dissertations, and other publications.)
- 316,955 hardcopies of Station series publications distributed.
- 1,664 Station publications available online (via Station's Web site and Treesearch, http://www.treesearch.fs.fed.us).
- More than 19,000 journal article reprints distributed by scientists in response to requests.
- 10 issues of ***PNW Science Findings*** published; about 9,800 copies distributed each issue.
- 2 issues of ***PNW Science Update*** published; about 9,800 distributed each issue.
- 26 multimedia presentations produced.



Symposia, Workshops, and Tours

- 1,466 people participated in symposia and workshops
- 1,105 people went on field tours
- 4,460 people participated in conservation education activities

The PNW Research Station sponsors scientific and technical events each year, many with the help of partners, including universities, state and federal agencies, and nongovernmental organizations. Below is a description of some of these events.

BlueSky Stakeholders' Meeting. Twenty-seven researchers and users attended the annual meeting in Winthrop, Washington, to discuss new and future developments for the BlueSky smoke modeling framework.

Capitol Forest Research Tour. Scientists from the Silviculture and Forest Models Team met with managers and resource specialists from the Washington Department of Natural Resources to discuss results of the Silvicultural Options Study. Topics included methods for establishing understory conifers in mature forests and silvicultural systems for regenerating forests given different management constraints. Twenty-one people participated in this tour.

Colville Forest Measurement and Monitoring with LIDAR Workshop. At the request of the Colville National Forest and the Northeast Washington Forestry Coalition, PNW scientists presented results from LIDAR forest measurement research in a half-day workshop in Colville, Washington, for 40 attendees. Following the presentations, scientists demonstrated the PNW LIDAR Fusion software system to local, state, and federal resource specialists and managers.

Learning Events

Roger Ottmar

At workshops in California, Idaho, New Mexico, and Ohio, scientists from the PNW Managing Disturbance Regimes Program led participants through a series of exercises on the use of the Fuel Characteristics Classification System.

Dry Forest II. At this workshop in Wenatchee, Washington, 207 participants shared knowledge and experience gained through managing dry forests since the 2001 Dry Forest I workshop. They also discussed ways to translate this knowledge into treatment options so it can be included in management strategies.

Forest Growth and Timber Quality: Crown Models and Simulation Methods for Sustainable Forest Management. This 4-day conference in Portland, Oregon, focused on the relationship between forest management activities and timber quality. Special sessions focused on mechanistic crown modeling and on hybrid models within the context of wood quality and sustainable forest management. Seventy-five scientists from 20 countries participated.

Forest Inventory and Analysis (FIA) Client Meeting. At this annual meeting in Olympia, Washington, FIA updated 30 clients from Washington, Oregon, and California on its activities over the past year and shared research findings. Clients also presented results from their research based on FIA inventory data.

Fuel Treatment Planning and Wildfire Risk Assessment Workshops. This training on ArcFuels and other tools for fuel treatment planning and wildfire risk assessment was offered to fuel planning and management specialists at several workshops throughout the West. Participants included employees with Forest Service, Bureau of Land Management, Bureau of Indian Affairs, and The Nature Conservancy. There were about 45 attendees at the Region 5 workshop in Reno, Nevada, a combined 65 attendees at the two central Oregon workshops, 20 attendees at the Umatilla National Forest workshop, and 25 at the Klamath National Forest workshop.

GIS Day 2006. About 50 adults attended a seminar and poster session at Oregon State University about uses of GIS technology. GIS Day is a global event with the goal of educating millions of children and adults about how geography makes a difference in our lives.

GMWest Workshop. About 15 attendees from various state and federal agencies attended a workshop titled "A Risk Assessment System for Gypsy Moth" in Portland, Oregon.

Hardwood Silviculture Cooperative Annual Meeting. As part of the annual Hardwood Silviculture Cooperative Meeting in Olympia, Washington, PNW scientists conducted a tour of its oak research sites in the Olympia area for 15 private, state, and federal scientists and managers.

H.J. Andrews Experimental Forest. About 950 scientists, natural resource managers, public, students (K-16), and teachers participated in tours of the H.J. Andrews Experimental Forest. Participants were from around the world. Five writers spent a week at H.J. Andrews Experimental Forest, and 15 environmental philosophers spent a long weekend reflecting on their roles in shaping public thinking about the natural world.

Integrating Science and Experience in Silviculture Prescriptions. About 70 participants from federal agencies, nongovernmental organizations, and universities met in Vancouver, Washington, to present and discuss state-of-the-art silviculture projects. Practitioners and researchers established communication networks and identified limitations in existing knowledge and tools.

Leafy Spurge Insect Biocontrol Collection Days. About 40 participants met at the Shake Creek Guard Station on the Sawtooth National Forest for 3 days to collect two species of insects that are being used to control leafy spurge, an invasive weed.

Managing for Wildlife Habitat in West-Side Production Forests. About 150 participants attended this workshop in Vancouver, Washington. The workshop included a panel of 11 speakers from research, management, or policy backgrounds who shared prescriptions and guidelines for managing wildlife habitat in forests cultivated primarily for wood production. A proceedings publication from the workshop (PNW-GTR-695, http.//www.fs.fed.us/pnw/pubs/pnw_gtr695.pdf) summarizes each presentation and provides a synthesis of methods for integrating habitat management into existing silvicultural systems.

MIREN II. At this second workshop for the Mountain Invasion Research Network, 17 participants, including 10 international scientists, convened at the La Grande Forestry and Range Sciences Laboratory to discuss the research direction for the coming year. Participants also toured sites in the Wallowa Mountains to view ongoing plant invasions and to discuss invasive plant survey and monitoring techniques.

NEPA for the 21st Century study review workshop. At this workshop in Stevenson, Washington, principal investigators shared their preliminary findings on how the Forest Service conducts NEPA activities with 25 NEPA practitioners and decisionmakers. Participants provided feedback on these findings and contributed to a discussion about potential changes in the NEPA process.

Modeling Fire Behavior and Landscape Planning Workshop. About 30 employees with the U.S. Geological Survey attended this workshop in Denver, Colorado.

Oregon Remote Sensing Workshop and Training Session. The Oregon Remote Sensing Workshop, held at Oregon State University, introduced 125 people from local, state, regional, and tribal agencies to ways remote sensing imagery can be used and methods for sharing access to acquired imagery. About 30 people participated in a related training.

Portland Forest Measurement and Monitoring with LIDAR Workshop. At the request of the BLM, PNW scientists presented results from LIDAR forest measurement research in a half-day workshop in Portland, Oregon, for 45 attendees. Following the presentations, scientists demonstrated the PNW LIDAR Fusion software system to local, state, and federal resource specialists and managers.

Regional Fuel Workshops. Twenty-two participants in Moscow, Idaho, 20 in Portsmouth, Ohio, 15 in San Luis Obispo, California, and 15 in Albuquerque, New Mexico, partook in a 3-day course on how to use and train others to use the Fuel Characteristics Classification System (FCCS), Consume 2.0, the Natural Fuels Photo Series, and the Digital Photo Series. Scientists from the PNW Managing Disturbance Regimes Program led participants through a series of classroom and field exercises.

Starkey Experimental Forest and Range Tours. During six 1-day tours, 134 people learned about ongoing and past research activities and management of the experimental forest.

Roger Ottmar

A participant at the Southwest Regional Fuels Workshop practices her skills in the field.

John Laurence

Wrangell 2020. Envisioning Our Future. This 2-day workshop in Wrangell, Alaska, focused on cultivating community identity and identifying strengths and opportunities, as well as building capacity for achieving short- and long-term goals. The event included a visioning workshop attended by 30 local residents and a cultural exchange with 35 elementary students (coordinated with the Alaska Native Sisterhood). As part of the workshop, several local organizations and agencies developed vision statements.

Western Forest Climate Change Task Force Workshop. This workshop in Vancouver, Washington, brought together 16 researchers and managers from Oregon, Washington, and British Columbia to learn about climate change impacts on forest ecosystems and discuss the development of a multidisciplinary task force of forest managers, forest geneticists, tree breeders, silviculturists, and tree physiologists to evaluate potential genetic and silvicultural options for mitigating effects of climate change.

Western Stations Bark Beetle Workshop. At this inaugural workshop in Stevenson, Washington, participants developed regional priorities for bark beetle research, identified protocols and processes for inter-station research communication and collaboration, and established links with State and Private Forestry Forest Health Protection. About 15 scientists from the Pacific Northwest, Pacific Southwest, and Rocky Mountain Research Stations were joined by 12 partners from Forest Health Protection.

Westwide Workshop on Forests, Insects, Pathogens, and Climate Change. About 35 attendees gathered in Portland, Oregon, to discuss current tools used to assess and quantify climate change, insects and pathogens, and synergistic effects on natural resources and ecosystem services at scales relevant for forest management and planning.

Wildfire Risk Modeling Workshop. About 120 members of the Army National Guard attended this workshop as part of the National Environmental Coordinators Training in San Diego, California.

Conservation Education

Conservation education introduces children and adults to the natural world. By teaching classes and leading field trips, PNW Station scientists are sharing forest science with broader audiences.

Aquatic Ecology Monitoring Program. With the help of a Station scientist, students from Battle Ground High School, Washington, developed a multiyear field program. Students learned how to design and implement aquatic scientific studies through hands-on activities. About 120 high school students participated in this program each week over a 6-month period.

Aquatic Entomology Taxonomic Class. A Station scientist spoke about her profession and background to 16 undergraduate science students at Evergreen State College, Washington. Students also learned to identify aquatic insects.

Conservation Education Poster Distribution. The Station distributed about 2,000 posters related to Mount St. Helens, invasive species, fish, oak communities, and old-growth forests. Most of these posters are requested by teachers in the Pacific Northwest, but many posters also have been sent to teachers throughout the United States and overseas. Posters can be requested online at http.//www.fs.fed.us/pnw/kids/index.shtml.

Michelle Kinzel

Learning to use a compass at GIS Day in Corvallis, Oregon.

Corvallis Outdoor School. About 250 middle school students in Benton County, Oregon, learned about botany, pollination, the natural history of streams and riparian areas, soils, wildlife, and forestry. Station scientists helped develop the curriculum and served as instructors in both field and classroom sessions.

Dry Ice—Discovering CO_2. Seventy third-graders from the Liberty Elementary School District in Albany, Oregon, learned about carbon dioxide gas and its many uses.

Forest Camp. This outdoor learning event in Lebanon, Oregon, taught 250 sixth-graders about the web of life, a concept illustrating the links among biotic and abiotic elements of forest ecosystems. This camp also featured an added segment on the important role fungi play in forest ecosystems. Several Station scientists participated in the camp, which was hosted by the Siuslaw National Forest.

Forest Camp—Project Learning Tree. Fifth- and sixth-graders near Sweet Home, Oregon, also learned about forest ecology using the web of life curriculum. Several Station scientists each contributed 1 day of instruction for about 120 students.

GIS Day. About 450 sixth-grade students from Corvallis and Portland, Oregon, participated in this event at Oregon State University. Students saw demonstrations of geographic information systems (GIS) applications, participated in a global positioning systems hike around campus, and learned about using GIS technology for climate mapping.

Hands-On Experience With Science Series. A Station forester made 12 visits to Lincoln Elementary School in Olympia, Washington, to speak with 25 second- and third-graders about a variety of natural resource topics, including radio tracking, measuring trees, weather stations, plant reproduction, and graphing ecological data.

H.J. Andrews Experimental Forest Used by Students and Faculty. Classes from 10 universities and colleges used the Andrews facilities and forests in 2007 (University of Oregon, Willamette University, Evergreen State College, Lane Community College, University of Wisconsin-Platteville, Portland State University, Lewis & Clark College, Washington State-Vancouver, and Western Oregon University. The forest also hosted a professional development workshop on fire ecology for 20 community college faculty from around the United States.

Inner City Youth Institute. The Station continued its support of the Inner City Youth Institute (ICYI). The ICYI sponsors ecology clubs in inner city middle schools and high schools and a summer camp in Corvallis, Oregon, as away to encourage students to pursue higher education and careers in the natural resource and environmental fields. The ICYI is a collaborative effort between the Forest Service, Bureau of Land Management, Oregon State University, and Portland Public Schools. About 200 students participated in ICYI programs.

Kids in the Creek. About 150 biology students from Wenatchee High School, Washington, participated in hands-on watershed monitoring at a site in the Wenatchee River subbasin.

Launch Your Future: A Math and Science Career Fair. Station scientists spoke to 200 middle school students about math and science careers with the Forest Service at an event hosted by Intel in DuPont, Washington.

Northwest Science Expo. The Station sponsored the "Outstanding Forest Science" award that is given to a high school student and a middle school student at the Northwest Science Expo. This science fair for young scientists, engineers, and mathematicians was held at Portland State University, and Station scientists served as judges.

Oregon State University Extension Outdoor School. About 150 middle school students in Astoria, Oregon, attended classroom sessions on the ecology of riparian zones.

Petri Dish Experiment. By participating in an activity called "Growing fungi and bacteria from the dirt on our hands," 70 third-graders from Liberty Elementary School District in Albany, Oregon, learned about the scientific method. The children rubbed dirty hands on an agar petri plate and then clean hands on another to see what sort of fungus and bacteria would grow.

Salmon Steward Program. Over 2,000 people participated in interpretive field trips to various salmon spawning locations near Olympia, Washington. A Station scientist was on hand to explain the salmon life history to the general public.

Salmon Watch. About 200 grade and middle school students in Corvallis, Oregon, visited streams with spawning salmon to learn about stream and fish ecology.

South Sound Farm Forestry Association. In Tumwater, Washington, 20 tree farmers attended a presentation about current research in the Capital State Forest. The presentation was called "Response of several small, invertebrate and vertebrate species to different riparian buffers along headwater streams" and was hosted by the South Sound Farm Forestry Association.

Washington State Science and Engineering Fair. The Station sponsored the "Outstanding Forest Science Project Award," for high school students at the Washington State Science and Engineering Fair held at Olympic College, Bremerton. Station scientists also served as judges.

Wolftree. Station employees participated in ecology programs with Portland and Vancouver area middle and high schools. About 100 students were involved. The Station also contributed funds for supplies and equipment.

Nobel Peace Prize

Ralph Alig, an economist with the Human and Natural Resources Interaction Program, **Ron Neilson**, a research bioclimatologist, and **David L. Peterson**, a research biologist, both with the Managing Disturbance Regimes Program, were honored for their research related to climate change. The three Station scientists share the Nobel Prize with many other scientists worldwide who also have contributed to the Intergovernmental Panel on Climate Change and with former Vice President Al Gore.

Chief's Distinguished Science Award

Richard Haynes, program manager for the Human and Natural Resources Interactions Program, received the Chief's Distinguished Science Award. He was honored for his work on developing bioeconomic models for forest assessments and policy analyses.

Chief's Global Stewardship Award

Bruce Marcot, a wildlife biologist with the Ecosystem Processes Program, was honored for fostering conservation of wildlife and forest biodiversity through global projects and partnerships.

Chief's Excellence in Budget and Financial Accountability Award

Gail Hodgson, a budget analyst for the Station Director's Office, was awarded for her dedicated and proactive service to the Station in the area of budget and financial accountability.

Society for Technical Communication Awards

Charlie Crisafulli, an ecologist, and **Fred Swanson**, a research geologist, with the Aquatic and Land Interactions Program along with their colleague Virginia Dale received the Society's highest award for distinguished technical communication for their publication, *Ecological Responses to the 1980 Eruption of Mount St. Helens*. In the international competition, the book received a merit award. The Society for Technical Communication is the world's largest professional organization dedicated to technical communicators, with more than 18,000 members and 150 chapters.

The **Communications and Applications Program** also received a distinguished rating from the Society for Technical

Honors and Awards

Communication for its publication, *2005 Science Accomplishments of the Pacific Northwest Research Station*. Because of its success at the chapter level, the publication was entered in the Society's 2006–2007 International Technical Publications competition where it was rated as excellent.

Director's Award for FIA Excellence

Team leaders **Ray Koleser** and **Bob Rhoads** each received the director's award, while **Ken Winterberger**, forester, and **Sue Willits**, program manager, received honorable mentions for their outstanding efforts in advancing the Forest Inventory and Analysis Program. In particular, the four recipients were honored for their contributions to developing and publishing national field manuals over the past 10 years.

Society of American Foresters, Oregon Chapter

Robert Deal, research forester with the Focused Science Delivery Program, was named forester of the year by the Oregon chapter of the Society of American Foresters (SAF). He was recognized for his exceptional service to SAF as program chair of the Portland chapter, as co-chair at the 2005 tri-state meeting, and for his work on the national SAF Forest Science and Technology Board.

Wings Across the Americas

John Lehmkuhl, research wildlife biologist with the Managing Disturbance Regimes Program, received an international research and partnership award for his work with the Birds and Burns project, which examines fire effects on populations and habitat of cavity-nesting birds and songbirds in ponderosa pine forests in the interior Western United States.

Wagon Wheel Gap Award

Michael Furniss, a hydrologist with the Communications and Applications Program, received the 2006 Wagon Wheel Gap Award for excellence in hydrology. This award is named in honor of the first watershed experiments in the United States at the Wagon Wheel Gap Experimental Forest on the Rio Grande National Forest.

Photo by Frank Vanni.

Finances and Workforce

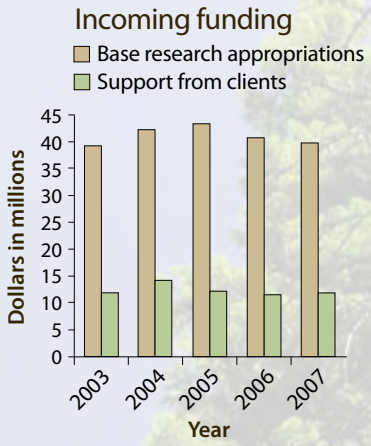
Two sources of funding support the work of the PNW Research Station: **federal appropriations**, which contribute the greatest percentage of funds; and **direct client support**, which comes rom organizations in need of scientific information.

2007 PNW Research Station finances and workforce, by the numbers:

Fiscal year 2007: October 1, 2006, to September 30, 2007

Incoming funding

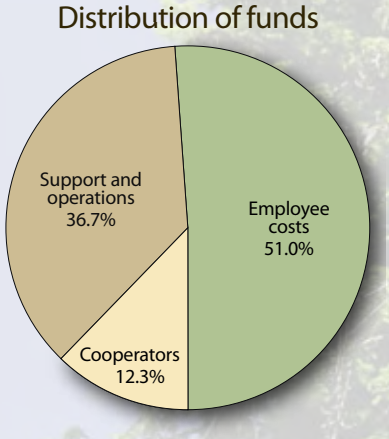
Base research appropriations: $39.9 million
Client support: $12.3 million
Total funding: $52.2 million



Distribution of funds

Permanent employee costs: ($26.6 million) — 51.0%
Support and operations: ($19.2 million) — 36.7%
Distributed to cooperators: ($6.5 million) — 12.3%

Of $6.5 million to cooperators, 90 percent went to educational institutions.

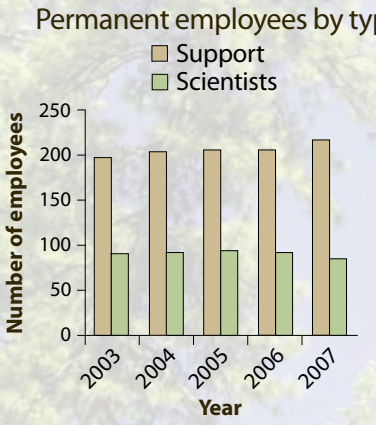


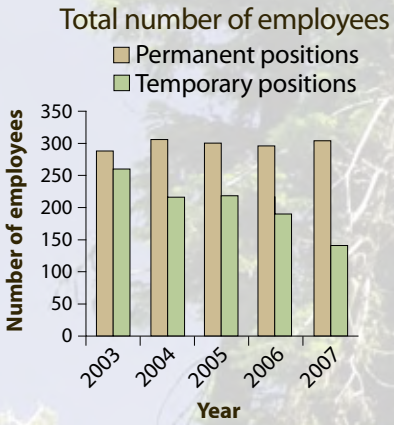
Workforce statistics:

Permanent workforce: 302 employees
Of the permanent workforce, 28 percent, or 85 employees, are scientists.

Temporary workforce: 141 employees

Total Station workforce: 443 employees





Research Context

Funding Partners for 2007

Cooperators Who Received Funding for Studies From the PNW Research Station

Educational Institutions
- Alaska Pacific University
- Duke University
- Eastern Oregon University
- Loyola University
- Michigan State University
- Oregon State University
- Southern Illinois University
- Southern Oregon University
- San Jose State University Foundation
- University of Alaska Anchorage
- University of Alaska Fairbanks
- University of Arizona
- University of California at Berkeley
- University of Georgia
- University of Idaho
- University of Illinois
- University of Maine
- University of Montana
- University of Oregon
- University of Washington
- University of Wyoming
- Virginia Polytechnic Institute and State College
- Virginia Tech University
- Washington State University
- West Virginia University
- Yale University

Other Federal Agencies
- National Academy of Sciences
- National Institute of Standards and Technology
- National Weather Service
- USDA Farm Service Agency
- USDA Natural Resources Conservation Service
- USDA Office of Assistant Secretary for Civil Rights
- USDI Bureau of Land Management, Alaska Fire Service
- USDI National Park Service
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

State Agencies
- Oregon Department of Agriculture
- Oregon Department of Forestry
- Texas Agricultural Experiment Station

Private Industry
- MacGregor-Bates, Inc.

County and Municipal Governments
- Crook County
- Fairbanks Economic Development Corporation
- Juneau Economic Development Council

Nongovernmental Organizations
- Earth Systems Institute
- Forest Research Institute of Baden-Wuerttenberg
- International Association of Wildland Fire
- Sustainable Northwest
- Washington Conservation Corps
- Western Forestry and Conservation Association

Foreign Institutes
- SCION (New Zealand Forest Research Institute)

Clients Who Provided Funding for Studies to the PNW Research Station

Educational Institutions
- California State University
- Montana State University
- University of Alaska Fairbanks
- University of Maryland
- University of Notre Dame

Other Federal Agencies
- Bonneville Power Administration
- National Aeronautics and Space Administration
- National Oceanic and Atmospheric Administration
  Fisheries Science Center
- USDA Agricultural Research Service
- USDC National Marine Fisheries Service
- USDI Bureau of Land Management
- USDI National Park Service
- U.S. Army, Fort Lewis
- U.S. Department of Energy
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

State Agencies
- Washington Department of Fish and Wildlife
- Washington Department of Natural Resources

County and Municipal Governments
- City of Seattle
- Eugene Water and Electric Board

Private Industry
- Portland General Electric
- Seattle City Light
- Sonoma Technology
- Tyler Contracting and General Services

Nongovernmental Organizations
- National Council for Air and Stream Improvement, Inc.
- Northwest Power and Conservation Council
- The Wolverine Foundation, Inc.

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Writers—Rhonda Mazza and Yasmeen Sands

Art direction and production management—Frank Vanni

Graphic design and layout—Keith Routman

Photography—see credit with each photo

All uncredited photos—U.S. Forest Service staff

The attached CD-ROM contains the following files:

- 2007 Science Accomplishments.
- PNW Research Program Reports.
- PNW Directory for Research Programs.
- 2007 PNW Research Station publications.

United States Department of Agriculture

Forest Service

Pacific Northwest Research Station

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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