

GOAL 3:

Develop science-based options for informed management

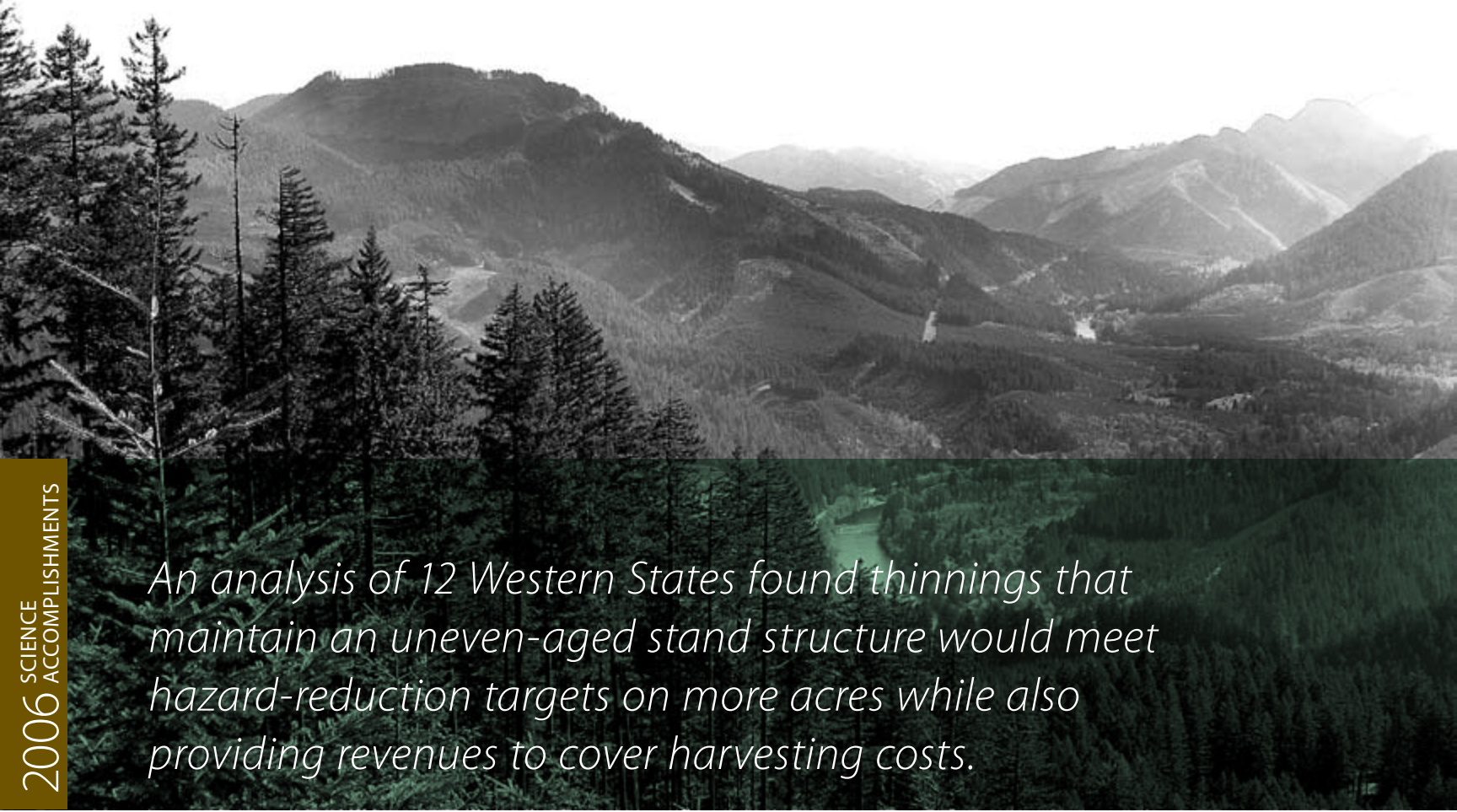
**KEY FINDINGS**

- An analysis of 12 Western States estimated that fuel reduction treatments on 23 million acres of timberland could generate 12 million oven-dry tons of biomass annually; the Western Governors Association used this analysis in developing a regional biomass energy program.
- Climate change may result in significant changes in California ecosystems, annual acres burned in the state, and biomass consumed.
- Climate change may lead to changed fire behavior in California's Sierra Nevada foothills, with the number of fast-spreading fires in grass and brush fuel types increasing several-fold.
- The California Fire Economics Simulator version 2 improves the analysis of initial attack resource needs, with more realistic assessment of initial-attack success under worse-than-average conditions.
- A software application using Ecosystem Management Decision Support was developed to help establish priorities for allocating the national budget for fuel treatment.
- The Fuel Characteristic Classification System was formally released in 2006 and is being used in national and forest-level applications.
- The BlueSky smoke modeling system shows promise for regional application, after evaluation of a Westwide field trial led to several improvements in BlueSky's accuracy.
- The Pacific Northwest is generally well positioned to continue as a world leader in wood production; challenges faced include forest fragmentation, parcelization, and increasing international competition.
- Specific changes could improve the performance of adaptive management in the Northwest Forest Plan.



ACCOMPLISHMENTS

- Certain highly productive soil types in Washington were found to be less sensitive to soil disturbance than previously thought and are suitable for intensive management.
- Seed zones for Douglas-fir were revised in light of new findings on cold-hardiness and frost adaptations in the species.
- Thinning and underplanting can promote the development of old-growth characteristics in young, Douglas-fir-dominated forests.
- Future demand for timber from Alaska national forests could range from 48 to 370 million board feet of logs annually, depending on the demand for lumber products and other factors.
- In southeast Alaska, streams in wetland-dominated watersheds have higher concentrations of dissolved organic carbon than streams in watersheds not dominated by wetlands.
- Public support for the management of rare and little-known species is more likely if scientists and managers clarify the rationale for and impacts of policies, are specific about the context for actions, outline specific actions to be taken, and identify when and where policies will be employed.
- If escaped Atlantic salmon establish breeding populations in Pacific Northwest streams, they could pose a significant threat to native salmon.
- Juvenile and adult coho salmon benefit from habitat in intermittent streams in the Oregon Coast Range, with these streams more important than previously thought.
- An improved model better identifies the sites in western Oregon most likely to be sources of debris flows and landslides, analyzes the likelihood of these events reaching fishbearing streams, and estimates the amount of wood that would be carried into the stream channel.



An analysis of 12 Western States found thinnings that maintain an uneven-aged stand structure would meet hazard-reduction targets on more acres while also providing revenues to cover harvesting costs.

Westwide fuel reduction could generate 12 million tons of biomass annually

AN ANALYSIS OF 12 Western States estimated that fuel reduction treatments on 23 million acres of timberland could generate 12 million oven-dry tons of biomass annually, about 25 percent of current roundwood removals in those states. The study analyzed the timberland acres currently at high risk for stand-replacement fire and used a treatment scenario

of 0.5 million acres per year. The analysis found thinnings that maintain an **uneven-aged** stand structure would meet hazard-reduction targets on more acres while simultaneously providing revenues to cover harvest costs, than would thinnings that maintain an **even-aged** structure.

The Western Governors Association (WGA) used the biomass analysis in their January 2006 report, "Clean and Diversified Energy Initiative: Biomass Task Force Report." In June 2006 the WGA adopted a policy resolution, based on the report's recommendations, to develop an additional 30,000 megawatts of clean energy by 2015. The Western Regional Biomass Energy Program, part of the WGA clean energy initiative, promotes the increased use of bioenergy and biobased products through the conversion of biomass residuals from forest health projects and commercial agriculture.



Tom Iraci

Twelve million tons of biomass could be generated annually from Western forests at high fire risk because of overstocking and insect outbreaks.

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

Small-scale power plants not profitable in southern Oregon forests at current electricity prices

SMALL TREES AND other low-value wood are being thinned from western forests to reduce fuels and fire hazard, but the work is expensive. Scientists examined the economic feasibility of using portable, small-scale power plants such as the BioMax to generate electricity from low-value wood at forest landings in southern Oregon. The BioMax gasification plant, manufactured by the Community Power Corporation of Littleton, Colorado, uses biomass such as forest thinnings to produce power. It could be used at forest landings, eliminating the cost of hauling wood to a centrally located processing plant.

The analysis found, however, that at current electricity prices in Oregon, and assuming a 23-percent pre-tax nominal return on invested capital, it would not be economical to operate either a 100-kilowatt or 1,000-kilowatt gasification plant at a forest landing without a subsidy or tax credit, even if fuel were delivered at no cost. Such subsidies would only make sense if the unmerchantable wood otherwise had to be disposed of at a higher cost. If it were possible to sell merchantable logs removed in the forest health treatments for an average of \$175 per thousand board feet, in addition to generating power from low-value wood, then most acres on gentle slopes in southern Oregon could be treated and provide net operating surpluses. Most treatments on steep slopes would still have operating deficits.

The analysis found that for all 15 Western States, power generation from biomass could potentially produce 2 to 14 billion kilowatt-hours of electricity annually, if merchantable timber is sold separately.

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

Partner: USDA Forest Service Forest Products Laboratory

More information: General Technical Report FPL-GTR-157. *Fuel to Burn: Economics of Converting Forest Thinnings to Energy Using BioMax in Southern Oregon.* http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr157.pdf

Merchantable trees, not small-diameter wood, drive the economic feasibility of fuel treatment options in southern Oregon

THE ECONOMICS OF proposed fuel-reduction projects are critical for getting the work done. Fuel treatments in Western States can potentially yield large amounts of woody biomass, which typically has low commercial value. Forest Inventory and Analysis (FIA) BioSum is a tool that can be used to assess the financial feasibility of fuel treatments, showing where “hot spots” of biomass supply are and the kinds of materials, both submerchantable and merchantable, that could be reasonably expected to flow from landscape-scale fuel treatments.

FIA BioSum was used to assess fuel treatment options for a 22-million-acre forested landscape that includes parts of northern California, southwest Oregon, and eastern slopes of the Cascade Range in both states, an area dominated by high fire hazard. The analysis found that under the most aggressive scenarios, enough biomass would be produced to supply four 50-megawatt power plants for decades. Under the most conservative scenarios (for example, treatment minimizes merchantable yield and only treats acres that could generate a positive net revenue despite this constraint), biomass supply would be far more limited. The merchantable wood from



The FIA BioSum analytical tool found that in southern Oregon, the merchantable trees would yield 90 percent of the total value recovered in fuel reduction projects.

John Laurence

GOAL ACCOMPLISHMENTS

treatments would yield 90 percent of the total value recovered, and scenarios that minimized merchantable yield fared poorly on a net revenue basis.

Thus, centralized, biomass electricity generation does offer an outlet for the small-diameter wood but does not drive feasibility—that role is played by the larger, merchantable trees removed in fuel treatments. FIA BioSum offers objective analysis of biomass options, allowing policymakers, managers, communities, and investors to discuss the outcomes and tradeoffs of policy choices.

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

More information: Science Update 7. *Reducing Fire Hazard: Balancing Costs and Outcomes.* <http://www.fs.fed.us/pnw/pubs/science-update-7.pdf>

Cofiring biomass and coal in Fairbanks area is technically feasible, but supply is insufficient

WORK IS UNDERWAY to reduce fuel loads and create defensible space around buildings on about 5,000 acres in the Fairbanks North Star Borough, which is Alaska’s second-largest metropolitan area with a borough population of about 86,000 people. Scientists examined the feasibility of mixing the woody biomass with coal in the area’s power plants. The potential benefits of cofiring coal and wood include improved

air quality, reduced greenhouse gas emissions, and local employment opportunities. The analysis found, however, that the biomass from defensible-space work would not be enough to replace 10 percent of the coal required by the area's four electric power plants. Long-term cofiring operations would require additional biomass sources, which could possibly come from logging slash, sawmill wastes, and municipal wastes. Although cofiring biomass and coal at all four power plants is not a viable near-term option, short-term tests could be tried at a single plant. Important issues for cofiring include wood chip uniformity and quality, fuel mixing procedures, transportation and wood chip processing costs, infrastructure requirements, and long-term biomass supply. Natural resource managers and power plant managers from the borough can use the feasibility study in their planning.

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Partner: USDA Forest Service, State and Private Forestry, Alaska Region

More information: Research Note PNW-RN-551. *Wood and Coal Cofiring in Interior Alaska: Utilizing Woody Biomass From Wildland Defensible-Space Fire Treatments and Other Sources*. http://www.fs.fed.us/pnw/pubs/pnw_rn551.pdf

Climate change may cause significant changes in California ecosystems

THE POTENTIAL EFFECTS of climate change on California ecosystems were analyzed with the dynamic vegetation model MC1, by using three updated climate change scenarios. Results showed that climate change may cause extensive changes in ecosystems, carbon cycles, and fire seasons throughout the state. Alpine ecosystems may be greatly reduced from their current area. Shrublands and woodlands may become forests under the wetter scenario, or grasslands under the two dry scenarios.

The annual area burned in California increased under all three scenarios, ranging from 9 to 15 percent above the

historical norm by the end of the 21st century. Under the wetter scenario, in which more vegetation would grow, annual biomass burned was projected to be about 18 percent greater than the historical norm. Even with more biomass burning, enough vegetation would grow under the wetter scenario that California would become a carbon sink (more carbon stored than released) of about 354 million tons total, by the end of the 21st century. Under the drier scenarios, in which less vegetation would grow, annual biomass burned was projected to be slightly less than the historical norm, and California would become a carbon source, losing carbon to the atmosphere.

The MC1 study was part of the California Energy Commission's Public Interest Energy Research program, and it was part of the first biennial report on the potential effects of global warming on the California economy. The full report was a multi-institution collaboration. Currently, the Station's lead scientist on this research serves on a panel advising the governor of California on climate change.

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Partners: California Energy Commission, Scripps Oceanographic Institute

More information: Science Findings 75. *Climate Change and California: Potential Implications for Vegetation, Carbon, and Fire*. <http://www.fs.fed.us/pnw/science/scifi75.pdf>.

Climate change may result in more fast-spreading fires in California's Sierra Nevada foothills

CALIFORNIA HAS DIVERSE climates and ecosystems, ranging from snow-capped Mount Whitney to Death Valley, and coastal redwoods to Sonoran desert. Scientists worked across several disciplines to understand how climate change's effects on rain, snow, wind, and vegetation may change fire behavior in different regions of California, and how that in turn affects the need for firefighting resources.

The scientists found that climate change's effects on fire behavior will differ for California's diverse regions. In the Sierra Nevada foothills, where grass and brush fuel types dominate, the number of fast-spreading fires is projected to increase several-fold. The number of large fires is also projected to rise in the Santa Clara region around San Francisco Bay. Very little change in fire behavior is expected on California's wetter, forested northern coast. Regions where fire spread and intensity are predicted to increase the most—grasslands, chaparral, and oak woodlands—are the same areas where California's population, already at 36 million, is growing the fastest.

The study found, however, that 10- to 20-percent increases of initial attack forces would compensate for climate-related



Tom Iraci

Climate change may cause extensive change in California ecosystems, including grasslands, shrublands, forests, and alpine meadows.

Scientists worked across several disciplines to understand how climate change's effects on rain, snow, wind, and vegetation may change fire behavior in different regions of California.

Tom Iraci

changes in weather and fire behavior. (Climate change would likely cause changes in vegetation and hence, fuels, also; these factors were not part of this study.) Study results were used in the California Energy Commission's Governor's Science Report, which is the scientific base for the state's climate change action plan.

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Partners: ATMOS Research and Consulting; Lawrence Berkeley National Laboratory, Center for Isotope Geochemistry; Universidad Rey Juan Carlos; University of California Berkeley

More information: Science Findings 74. *Fanning the Flames: Climate Change Stacks Odds Against Fire Suppression*. <http://www.fs.fed.us/pnw/science/scifi74.pdf>.

The California Department of Forestry (CDF) used CFES2 to analyze initial attack effectiveness under a range of current and potential future scenarios in the central Sierra Nevada foothills. One significant finding was that if wildland firefighting resources are diverted to protecting homes and other buildings, more wildland fires escape initial attack. If local fire departments can handle structure protection needs during wildland fires, the CFES2 analysis found statistically significant drops in escaped wildland fires, owing to faster initiation of fire containment work such as building fireline. The CDF has been using CFES2 for several years, and other states (for example, Montana) and agencies (Bureau of Land Management) are now adopting or evaluating the system.

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Partners: California Department of Forestry; University of California Berkeley

More information: The manual and software are publicly available at <http://jfried.tullyfried.net/programs/cfes/cfes2.htm>

New approach to initial attack needs has more realistic treatment of extreme conditions

WILDLAND FIREFIGHTING AGENCIES have long sought analytical tools that can help them determine initial attack resource needs. The California Fire Economics Simulator version 2 (CFES2) provides a more realistic treatment of issues such as firefighting tactics, dispatch policies, fire behavior, and fireline production rates. Previous simulators evaluated scenarios based on average conditions, and thus failed to represent clustered fire starts such as lightning storms, arson, or severe fire weather. With CFES2, analysts can easily predict the outcomes for worse-than-average conditions—for example, assessing initial attack effectiveness in the 1-out-of-10-years worst case.



Tom Iraci

A new analytical tool helps wildland firefighting agencies determine initial attack resource needs for worse-than-average conditions.

Decision-support technology aids decisions on allocation of national budget for fuel treatment

FUNDING PRIORITIES to address the emerging threat of intense wildfires throughout the United States are largely determined from scientific data provided by fire management personnel. A software application was developed with the Ecosystem Management Decision Support (EMDS) system to evaluate wildfire potential, and establish priorities for fuel treatments over broad landscapes. Logic is used to evaluate wildfire potential in terms of forest cover conditions derived from LANDFIRE data, fire behavior characteristics derived from advanced fire models, and climate variables derived from the USDC National Oceanic and Atmospheric Administration. The application also has a simple example of how additional logistical considerations, such as proximity to populated areas, can easily be factored into the decision process. The application was developed for one U.S. Geological Survey map zone but is easily extendable to the entire Nation. Importantly, it effectively demonstrates how decision-support systems can deliver rational, transparent solutions that are readily usable by senior managers for complex strategic problems.

The project team is now adapting the application to support the national budget allocation process for fuels treatment for both the USDA Forest Service and the USDI Bureau of Land Management. Oversight agencies such as the Government Accounting Office are examining the application for possible use in the interagency Fire Planning Analysis program.

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

Partner: USDA Forest Service, Rocky Mountain Research Station

More information: General Technical Report PNW-GTR-688. *Decision Support for Forest Fuel Evaluation and Fuel Treatment Planning*. Proceedings of the IUFRO Conference on sustainable forestry in theory and practice.



The Fuel Characteristic Classification System (FCCS) is based on years of research into fuel types and fuel consumption.

Managing Disturbance Regimes Program

Fuel classification tool is used in a national inventory of fire emissions

THE FUEL CHARACTERISTIC Classification System (FCCS) enables land managers, prescribed fire regulators, and scientists to classify fuelbeds by their capacity to consume fuels and carry fire and to create customized fuelbeds when needed. The FCCS system was formally released in 2006 with a user's manual and tutorial (<http://www.fs.fed.us/pnw/fera/fccs/>). Using remotely sensed data, scientists classified the fuelbeds of the coterminous United States into the 115 FCCS fuel types at a 0.6-mile resolution. The data-rich fuels map can be used for fire-effects modeling at the regional to national scale, including air quality modeling to meet national standards under the Clean Air Act and Regional Haze Rule. The Environmental Protection Agency is using FCCS outputs in a national inventory of wildland fire emissions.

The FCCS is also being used at regional and forest-level scales. In the Pacific Northwest, scientists and managers have classified fuelbeds on the Okanogan-Wenatchee National



Dave Peter

Forest at an 82-foot resolution, to be used in forest planning and fire-effects modeling. Similar work is underway in the Deschutes National Forest and eastern Oregon. The FCCS has been taught at 3 regional fuels workshops and 12 regional and national training sessions and is being taught at the University of Idaho.

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

Partners: Alaska Fire Service; Carolina Environmental Program; Joint Fire Sciences Program; National Center for Atmospheric Research; National Fire Plan; The Nature Conservancy; USDA Forest Service, Pacific Northwest Region and Wenatchee-Okanogan National Forests; USDC National Oceanic and Atmospheric Administration, Fisheries Service; USDI Bureau of Land Management, National Park Service, and Fish and Wildlife Service; U.S. Environmental Protection Agency; University of Washington; Washington State University; Western Regional Air Partnership

Accuracy of BlueSky smoke forecasting system improves

THE BLUESKY smoke modeling system forecasts smoke concentrations and trajectories, including the cumulative effects of smoke from multiple wildfires or prescribed fires, long-distance smoke movements, and smoke movement over a 24- to 48-hour period. Its forecasts are turned into easy-to-read maps through the rapid access information system (RAINS), a modification of an Environmental Protection Agency (EPA) product. The BlueSkyRAINS West demonstration project was a Westwide field trial conducted by the USDA Forest Service, EPA, and the Department of the Interior. Eleven Western States were included: Washington, Oregon, California, Idaho, Nevada, Montana, Wyoming, Utah, Colorado, Arizona, and New Mexico.

Results showed where BlueSky needed to improve, and changes made in response have improved BlueSky's accuracy. Other progress from the field trial included development of the first Westwide smoke weather forecast, better understanding of user needs in smoke forecasting, and close interagency cooperation through the regional fire consortia. Through the demonstration project and a smaller field trial in the Southeast, scientists tested BlueSky's accuracy on two large wildfires in the West and four prescribed burns in Southeastern ecosystem types. Overall, BlueSky shows promise for regional use as a smoke forecasting and air quality planning tool. The regional use and refinement of BlueSky will continue through the regional fire consortia, with potential for eventual use as a national, interagency tool for air quality planning.

Contact: Sim Larkin, larkin@fs.fed.us, Managing Disturbance Regimes Program

Partners: Joint Fire Science Program; Sonoma Technologies; USDA Forest Service, Northern and Pacific Northwest Regions, Rocky Mountain Research Station; U.S. Department of the Interior; U.S. Environmental Protection Agency

More information: Science Update 14. *A Clear Picture of Smoke: BlueSky Smoke Forecasting*. <http://www.fs.fed.us/pnw/pubs/science-update-14.pdf>.

NEW TOOL

FIRE SCENARIO BUILDER (FSB)

Description: Statistical models such as the Fire Scenario Builder (FSB) can predict annual or seasonal averages of fire extent at scales from watersheds to ecoregions, but both fire forecasting and estimation of fire effects—such as smoke production, carbon release, and air-quality reduction—require daily or hourly time steps to be useful. The FSB uses a simultaneous weighting of known influences on fire occurrence to create mapped distributions of fire probabilities, including both the likelihood of a fire occurring and the probabilistic distribution of fire sizes. The FSB model then produces daily, weekly, or monthly estimates of fire-occurrence probability and fire sizes.

Outcomes: The FSB provides a realistic means for simulating future fire probabilistically at time scales relevant for air-quality and ecosystem-dynamics modeling. It is currently being used with the BlueSky smoke modeling framework, and provides necessary inputs to run current fuel consumption and emission production models such as Consume 3.0 and the Fire Emissions Production Simulator.

How to get it: Contact Don McKenzie, donaldmckenzie@fs.fed.us, Managing Disturbance Regimes Program

Methodology helps predict how fuel treatments affect wildfire risk

IN THE WESTERN United States, many models and a wealth of literature are available to help land managers classify a landscape's wildfire risk. Few frameworks and tools exist, however, for helping managers measure how fuel treatments actually affect wildfire risk.

Scientists developed a methodology that applies quantitative and probabilistic risk assessments to wildfire risk management and fuels treatment planning. They tested this methodology on a large wildland-urban interface in eastern Oregon by using several hypothetical scenarios. Initial results suggest that the risk of probable loss from wildfire decreases as fuel treatment area increases. By simulating fuel treatment scenarios and evaluating their performance, this framework will help federal land managers identify the tradeoffs between different fuel treatment approaches.

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

Partners: USDA Forest Service, Deschutes, Wallowa Whitman, and Umatilla National Forests; Pacific Southwest Region; Rocky Mountain Research Station



Tom Iraci

NEW TOOLS

NATIONALLY CONSISTENT SMOKE AND FIRE WEATHER PREDICTIONS

Description: Station scientists are working with the regional Fire Consortia for the Advanced Modeling of Meteorology and Smoke (FCAMMS) on developing nationally consistent smoke and fire weather predictions.

Outcomes: A more consistent national interface is now available for products used in smoke and fire weather predictions. The predictions themselves are still research tools, under further testing and refinement to become operational tools.

How to get it: See the Web site at <http://www.fs.fed.us/fcamms/>.

PNW Research Station contact: Sim Larkin, larkin@fs.fed.us, Managing Disturbance Regimes Program

Partners: Montana/Idaho Airshed Group; Nez Perce, Quinault, and Colville Tribes; National Oceanic and Atmospheric Administration; Northwest Airquest Consortium; Northwest Regional Modeling Consortium; Oregon Department of Forestry; University of Washington; USDA Forest Service, Rocky Mountain, Southern, North Central, and Pacific Southwest Research Stations, and Pacific Northwest and Northern Regions; USDI Bureau of Land Management; U.S. Environmental Protection Agency; Washington Departments of Ecology and Natural Resources; Washington State University.

NEAR-REAL-TIME GRIDDED CLIMATE DATA

Description: Seasonal fire risk forecasts require updated, gridded climate data to get the best results from fire risk and vegetation models. A new system now delivers monthly, spatially gridded climate data for the coterminous United States by using the PRISM model. Data are included on precipitation, maximum temperature, minimum temperature, and vapor pressure (dew point). The data sets are created 1 to 2 weeks after the end of each month. A comprehensive Web site allows public download of all data sets, metadata, reports, and papers, and also includes a data alerts forum and many other services.

Outcomes: Products are fine-scale (2.5-mile) and coarse (31-mile) grids covering the coterminous United States. The data sets provide over 110 years of climate data, from January 1895 to the month just ended, and they are important inputs to the Forest Service's wildfire risk assessment and prediction system. These data sets are now providing valuable data to other user groups, including the U.S. Drought Monitor, the National Weather Service, the USDA Natural Resources Conservation Service, and state and regional climate offices across the country. The Web site averages about 7,500 hits each month on the home page, and at least 5,000 climate grid downloads each month.

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Partners: Desert Research Institute, Western Regional Climate Center; Oregon State University, Spatial Climate Analysis Service

Specific symptoms of fire-caused damage to ponderosa pine during prescribed burns can be used to assess the probability of individual tree mortality

MANAGERS OF PONDEROSA pine stands have been using prescribed burns in spring, as well as in fall, to increase their window of opportunity for conducting burns. This study demonstrated that for stands in the southern Blue Mountains of Oregon, the percentage of ponderosa pine mortality was higher after fall prescribed burns than after burns conducted in the spring, but that the mortality was caused by specific damage done to individual trees that was not related to the season. An easy-to-use model has been developed that will allow managers to predict the probability of mortality given five or even two easily measured, specific damage symptoms.



Tom Iraci

An easy-to-use model helps managers predict which fire-damaged ponderosa pines will die in coming years and which pines will survive.

Forest managers responsible for ponderosa pine stands in the southern Blue Mountains of Oregon can be less concerned that season alone limits their opportunity for conducting prescribed burns. The tree mortality model, when refined and validated, will provide managers a practical means of predicting postfire tree mortality and thereby improve the basis for both pre- and postfire management of fuels and vegetation. Additional data and development are needed to validate the model and to define the usable geographic range of this tool and extend its use to other sites.

Contact: Walter G. Thies, wthies@fs.fed.us, Managing Disturbance Regimes Program

Partners: USDA Forest Service, Malheur National Forest and Pacific Northwest Region, Forest Health Protection

Surprising relation found between tree thinning and bark beetle outbreaks

USING THE FOREST Vegetation Simulator (FVS) system, 60 years of fuel management treatments were modeled on a 16 000-hectare wildland-urban interface landscape in northeastern Oregon to predict how thinning treatments

could affect wildfire behavior and the susceptibility of forests to a future bark beetle outbreak. As hypothesized, projected wildfire behavior was significantly moderated by thinning, although substantial acreages required repeated thinning to meet and maintain long-term forest restoration goals. Thinning treatments favored bark beetle host species resulting in more and larger diameter host trees. When an outbreak was simulated at year 30, substantially higher mortality from bark beetles was predicted for the thinning scenario.

Wildland fire and bark beetle outbreaks are generally considered the most important disturbance factors in dry coniferous forests of the West. Federal land management agencies have adopted forest restoration strategies that call for thinning, reintroduction of natural and prescribed fire, and fuel reduction over wide areas in the Western United States. Although most agree that these activities have beneficial effects in terms of moderating wildfire, the effects on bark beetle dynamics and potential for widespread beetle-caused tree mortality are less clear, in part because the tools to analyze the problem are not well developed. This work resulted in a modeling framework that can be used to integrate the long-term potential impacts of bark beetles and other natural disturbance factors into landscape planning for wildfire risk and fuel treatments.

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

Partners: Forest Health Technology Enterprise Team (Fort Collins, CO); USDA Forest Service, Rocky Mountain Research Station

NEW TOOL

PONDEROSA PINE DELAYED-MORTALITY MODEL

Description: A predictive tool was developed that uses easy-to-measure features—such as the percentage of crown scorch and height of scorch on the trunk—that can assist managers in determining the probability of survival for fire-damaged ponderosa pines. The tool will be most effective in areas similar to Oregon's southern Blue Mountains, where it was developed.

Outcomes: Marking crews are doing additional field testing of the model. The model should be useful in planning management after prescribed burns in ponderosa pine stands.

How to get it: A field-usable graph of the two-factor model is presented in the PNW Science Findings 81, available at <http://www.fs.fed.us/pnw/science/scifi81.pdf>. The full model is presented in *International Journal of Wildland Fire* 15(1): 19–29.

PNW Research Station contact: Walter G. Thies, wthies@fs.fed.us, Managing Disturbance Regimes Program

In the Pacific Northwest, more timber is growing than is being cut; under current policies and investment levels, private forest lands should be able to maintain recent harvest levels.

Tom Iraci

Verbenone is effective only as short-term deterrent in bark beetle attack

MOUNTAIN PINE BEETLE is one of the most aggressive bark beetles in North America, attacking healthy green host trees. Severe outbreaks often kill most large, dominant lodgepole pine over large areas. A 5-year study in central Idaho found that verbenone, a commonly used bark beetle antiaggregant, lost its effectiveness for protecting trees after 2 years. Verbenone deterred mountain pine beetle for the first 2 years, but in the third year beetle attack was nearly equal between treated and control plots, in the fourth year beetle attack was higher in the verbenone-treated plots, and in the fifth year beetle attack was similar between treated and control plots again.

The change in beetle response after 2 years may be a result of the large numbers of beetles built up with fewer green, large trees to attack. Although verbenone alone appears not to be

a long-term solution during a sustained pine beetle outbreak, it deterred mass attack for 2 years, a delay long enough for managers to use other tactics against a mountain pine beetle outbreak.

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Partner: USDA Forest Service, Intermountain Region

NEW TOOL

MODEL OF BARK BEETLE PRESSURE FOR PINE FORESTS IN MEXICO

Description: Bark beetles are significant causes of mortality for many of the pine species in Mexico, and forest managers have asked for a tool that will help them predict the potential for bark beetle outbreaks. An index of beetle pressure was devised that provides a broad-scale indicator of the potential for bark beetle impacts on pine forests in Mexico.

Outcomes: The beetle pressure index will help managers assess risks and plan mitigation.

How to get it: Contact Alan A. Ager, aager@fs.fed.us, Western Wildland Environmental Threat Assessment Center

Partners: Comision Nacional Forestal de Mexico; Instituto Politecnico Nacional, Escuela Nacional de Ciencias Biologicas



Managing Disturbance Regimes Program

Verbenone deterred bark beetle attack for 2 years, but then lost its effectiveness as large numbers of beetles built up with fewer green trees to attack.

Pacific Northwest well positioned to continue as world leader in wood production

THE PACIFIC NORTHWEST is well positioned to continue as a world leader in wood production, with its location on the Pacific Rim and its existing infrastructure of mills and transportation systems. Overall, in the region more timber is growing than is being cut, and under current policies and investment levels, private forest lands should be able to maintain recent harvest levels. Tree species such as red alder are becoming more valuable and help diversify the portfolio of forest products from the region.

However, challenges are faced. The amount of forest land in the Pacific Northwest is decreasing, with most losses to residential and other development, not to clearing for agriculture. The region's population is expected to continue growing faster than the national average, and thus loss of forest land is likely to continue. Low-elevation forests west of the Cascade Range crest, which are some of the most productive forests in the world, are the forest lands most often converted to other uses. Along with the effects on timber production, forest fragmentation and parcelization also reduce wildlife habitat and can be a problem for biodiversity conservation. Growing international competition for wood products and relatively stable prices for Douglas-fir are additional concerns.



These and other findings were presented at a conference attended by state forest land managers, family forest landowners, nongovernmental organization members, timber investment management organizations, Native American tribal officials, and private forest industry representatives. Also, a partnership among Oregon State University Extension, the Oregon Small Woodlands Association, and the Oregon Forest Resource Institute produced an online forest directory that helps forest owners, log buyers, and wood products manufacturers connect with each other. The Web site is <http://www.orforestdirectory.com>.

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Partners: Oregon Small Woodlands Association; Oregon State University, College of Forestry; University of Washington, College of Forest Resources; Western Forestry and Conservation Association

More information: Science Findings 84. *Knock on Wood: Is Wood Production Sustainable in the Pacific Northwest?* <http://www.fs.fed.us/pnw/science/scifi84.pdf>.



Aquatic and Land Interactions Program

More timber is growing than is being cut in the Pacific Northwest, but some low-elevation forests are being converted to residential and other developed uses.

Changes identified that could make adaptive management more successful

ADAPTIVE MANAGEMENT, or learning while implementing policies, is a central strategy for implementing the Northwest Forest Plan because it is well suited for situations with high levels of uncertainty, limited knowledge, and unpredictability. However, the concept of adaptive management remains primarily an ideal rather than a demonstrated reality. A systematic evaluation of adaptive management, including literature review, interviews with resource managers and scientists, and a survey of over 400 involved citizens, documented people's experiences with adaptive approaches and identified what helped and what blocked adaptive approaches.

The study identified changes needed to improve the performance of adaptive management in the Northwest Forest Plan:

- A closer alignment of adaptive management with organizational goals
- A demonstrated organizational commitment and will to act adaptively
- Increased capacity (skills, resources)
- Clear, shared language
- Agreement on expectations, both within and outside the management organizations
- A reasonable likelihood of continuity to allow the process a fair chance to succeed
- Clear performance benchmarks
- Formal and explicit documentation protocols

Effective use of adaptive management has the potential to improve management of the region's forests and secure

adequate protection for a range of public values and uses, including endangered species, old growth, commodity production, and community resiliency.

Contact: Bernard Bormann, bbormann@fs.fed.us, Ecosystem Processes Program, for George Stankey (retired), Human and Natural Resources Interactions Program

More information: Research Paper PNW-RP-567. *Learning to Manage a Complex Ecosystem: Adaptive Management and the Northwest Forest Plan.* http://www.fs.fed.us/pnw/pubs/pnw_rp567.pdf.

Some western Washington soils more resilient to harvest effects than previously thought

FOREST HARVESTS CAN affect soils in two ways—by removing nutrients and by altering soil properties through the movement of heavy equipment across the site. Preventing losses in site productivity requires knowledge of how to design harvesting practices for individual sites.



Tom Iraci

Research in second-growth forests is testing management options for uneven-age stands, soil protection, and other goals.

Scientists studied the impacts of normal harvest-related tree removal and compaction on highly productive soils in the Fall River long-term study site in the Coast Range of Washington State. They found that these soils are so rich in nitrogen—a nutrient critical to plant growth—the removal of tree boles, branches, and needles during harvest had only negligible effects on the total amount of nitrogen available. This small reduction would be unlikely to influence future plant growth. In an experimental compaction treatment, scientists also found that, although the physical characteristics of the soils were altered, subsequent tree growth was not affected.

Results from this study are being used to reclassify this and similar soil types to a less sensitive category. This reclassification will reduce current restrictions on harvesting equipment and should demonstrate to managers that these soils are

NEW TOOL

ARCFUELS

Description: ArcFuels is a library of macros embedded in the ArcGIS system. It provides better linkages among models commonly used in planning fuel treatments. These macros simplify the analysis and visualization of forest management scenarios' effects on potential fire behavior at the stand and landscape scales.

Outcome: Field units are using ArcFuels to design landscape projects for fuels management and forest restoration.

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

Partner: USDA Forest Service, Rocky Mountain Research Station

suitable for intensive management, including high biomass removal levels. Managers also are removing plants that compete with the crop trees, based on another finding from the study, that this action will result in increased soil water content and tree growth.

Contact: Constance Harrington, charrington@fs.fed.us, Resource Management and Productivity Program

Partners: University of Washington, Weyerhaeuser Company

More information: General Technical Report PNW-GTR-691. *The Fall River Long-Term Site Productivity Study in Coastal Washington: Site Characteristics, Methods, and Biomass and Carbon and Nitrogen Stores Before and After Harvest.*

Seedling growth can be increased when competition is reduced

THE EARLY GROWTH of conifers is affected by intense competition from overstory trees and understory vegetation. Scientists compared the seedling growth rate of three common conifer species—Douglas-fir, western hemlock, and western redcedar—in plots with different levels of over- and understory competition in Washington's Capitol State Forest.

Five years after the seedlings were planted, scientists noted dramatic differences. In plots with no overstory competition, the stems of seedlings were, on average, four to eight times the size of those in plots with high levels of overstory competition. When understory competition was compared, stems in plots without understory competition were two to four times those in plots with high levels of understory competition. For Douglas-fir, responses to removal of understory competition were even greater if overstory trees were absent. The benefits of no competition came with a price: redcedar seedlings were more visible and, thus, browsed by deer as competing vegetation was removed.

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

Partner: Washington State Department of Natural Resources

The adoption of the Northwest Forest Plan in 1994 shifted the management of forests from a focus on timber production to a broader concern with the entire range of ecosystem services.

Tom Iraci

After thinning, growth of understory trees is constrained by other factors

IN THE PACIFIC Northwest, forestry practices are shifting from even-age to uneven-age stand management that involves partial thinning. Scientists found that after thinning, intended to reduce shade on understory trees and thereby increase their growth, other factors can still constrain tree growth.

The study compared growth of western hemlock and Douglas-fir saplings in adjacent mixed stands, one of which was thinned to partially remove shade limiting their growth. Although absolute height growth of shade-tolerant western hemlock was greater than that of shade-intolerant Douglas-fir in both stands, the relative height growth after thinning versus before thinning was twice as great in Douglas-fir. Initially, tree growth after thinning was constrained by photosynthetic capacity until the trees were able to replace shade-adapted needles with sun-adapted needles that could fuel more growth. In Douglas-fir, response after thinning was further constrained by the efficiency with which roots and stems supply the leaves with water. These results should be useful to silviculturists developing thinning treatments to maintain Douglas-fir in uneven-aged stands.

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

Partner: Oregon State University

🔑 Cold-hardiness and frost adaptations are key traits in Douglas-fir genetic fitness

FORESTERS LONG AGO established seed zones for Douglas-fir, recognizing that genetic adaptation to environmental conditions affected tree survival. In new work on genetic variation among Douglas-fir populations in western Oregon and Washington, scientists studied adaptive traits such as growth and cold-hardiness. They found the greatest



Tom Iraci

Douglas-fir seed zones were revised, based on findings that cold-hardiness and frost adaptations are key traits in Douglas-fir genetic fitness.

population differentiation among traits for cold-hardiness and bud-set and emergence. This differentiation was strongly related to an area's elevation and cold-season temperature. Variation in bud-burst and partitioning was related to latitude and summer drought.

Results from this study—which demonstrated the overriding importance of winter temperatures and frost dates to Douglas-fir's environmental adaptation—were used during a recent revision of Douglas-fir seed and breeding zones. Samples taken from trees in the experiment will be used in another study to determine the specific genes responsible for adaptive variation in Douglas-fir.

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

Partners: Northwest Tree Improvement Cooperative; Oregon Department of Forestry; Oregon State University; University of California Davis; USDA Forest Service, Pacific Northwest Region; USDI Bureau of Land Management



For young forests, thinning and underplanting may promote old-growth features

THROUGHOUT THE PACIFIC Northwest, portions of federal land are being managed to promote the development of habitat for the threatened northern spotted owl and other species associated with old-growth forests. For hundreds of thousands of acres in the region's Coast Range, this involves converting young forests to more complex structures.

In 1992, Station scientists began a study to evaluate whether the development of old-growth characteristics in young, Douglas-fir-dominated forests could be promoted through thinning and underplanting. Thinning, especially, is increasingly used by managers to increase diversity in forest structure. Scientists found that Douglas-fir and western hemlock seedlings underplanted in thinned stands grew, but the same species underplanted in unthinned stands frequently died. Seedlings in the thinned stands also grew taller and were more vigorous than surviving seedlings in unthinned stands. Shrubs initially decreased after thinning, but recovered to prethinning levels in 5 years.

Managers on the Siuslaw National Forest have used these results to create a local version of the Forest Vegetation Simulator, a program that simulates forest growth and yield under a variety of conditions.

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

Partners: Oregon State University; USDA Forest Service, Siuslaw National Forest

Database provides reference data on old-growth characteristics

ACCELERATING THE DEVELOPMENT of old-growth, or late-successional, characteristics in young forests through management techniques often is complicated by the lack of clear structural targets. Clear and specific guidelines for stand structure have not been available for managers.

Scientists created a database to provide managers with the structural targets they need. The database features information gathered from over 16,000 acres of old-growth forest in western Oregon, consisting of measurements of all conifers greater than 1 foot in diameter on nearly 600 forest sites. The database provides managers with an estimate of the total number of trees per acre in this vast and structurally varied area as well as the diameter classes of 13 species.

Using the database, managers can find old-growth stands close to the young stands they are managing and use the complexity and structure of the old forest as a guide. The database is especially useful to managers working to implement the Northwest Forest Plan.

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

Partners: USDI Bureau of Land Management and Geological Survey, Forest and Rangeland Ecosystem Science Center

More information: BLM Late-Successional and Old-Growth Conifer Data Series. <http://fresc.usgs.gov/ArclMS/Website/lsog/viewer.htm>

Large-scale management experiments yield new knowledge about effectiveness of silvicultural treatments

THE ADOPTION OF the Northwest Forest Plan in 1994 shifted the management of west-side federal forests from a focus on timber production to a broader concern with the entire range of ecosystem services. Scientists and managers initiated large-scale management experiments (LSMEs) to test innovative silvicultural treatments designed to meet the new goals. These experiments are planned to be long term, typically over 20 to 200 years, and are at a broad scale highly relevant to management decisionmaking. But, because LSMEs typically have been conducted independently, the results of their long-term monitoring of ecological, environmental, and social responses to silvicultural treatments are difficult to synthesize.

To summarize early results, Station scientists compiled data from 14 LSMEs underway in western Oregon and Washington. The summarized data conclusively demonstrated

that it is, in fact, feasible to implement a wide range of alternative silvicultural treatments designed to promote ecosystem services in the Pacific Northwest—something that was not commonly thought possible a decade ago. The comprehensive summary defines the body of knowledge from these studies and will be published in an upcoming General Technical Report.

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

Partners: Oregon State University; University of Washington; USDA Forest Service, Pacific Northwest Region; USDI Bureau of Land Management, Oregon; U.S. Department of Defense, Fort Lewis Military Reservation; Washington Department of Natural Resources



Tom Iraci

Large-scale silvicultural studies across the Pacific Northwest have yielded new findings only a few years into the 20- to 200-year research plans.

Estimates of timber demand from Alaska national forests updated

FROM 1990 THROUGH 2004, harvests from Alaska national forests declined by 92 percent as a result of changes in the Alaska forest sector, markets for Alaska products, and conditions faced by Alaska's competitors. With the cancellation of the long-term contracts and the closure of the two southeast Alaska pulp mills, demand for Alaska national forest timber now depends on domestic and export markets for sawn wood and the ability to export manufacturing residues and lower-grade logs.

The Alaska Wood Utilization Research and Development Center analyzed four alternative futures for Alaska's forest sector and estimated the resulting demand for timber from Alaska national forests. All the scenarios assume there will be a timber sale program on the Tongass National Forest. The limited lumber production scenario estimated timber demand from Alaska national forests at 48 million board feet (MMBF) annually. In the expanded lumber scenario, Alaska regains market share of Pacific Rim shipments comparable to the state's levels in the 1990s, with demand estimated at

143 MMBF annually. In the medium and high integrated industry scenarios, new uses develop for low-grade wood, and facilities are built to meet the increased demand. In the high scenario, estimated timber demand from Alaska national forests reaches 370 MMBF annually. The Forest Service Alaska Region is using this report as they update the Tongass Land Management Plan of 1997.

Contact: Allen Brackley, abrackley@fs.fed.us, Human and Natural Resources Interactions Program

More information: General Technical Report PNW-GTR-677. *Timber Products Output and Timber Harvests in Alaska: Projections for 2005–25*. http://www.fs.fed.us/pnw/pubs/pnw_gtr677.pdf

In southeast Alaska, adaptive management of young stands can provide ecological, social benefits

THE 17-MILLION-ACRE Tongass is the largest national forest in the country. Scientists are partners with managers in the Tongass-Wide Young-Growth Studies. To date, the group of studies has demonstrated that a combination of thinning, pruning, and mixed conifer-red alder stands can improve not only wood production from young stands, but ecological services, such as wildlife habitat and biodiversity.

Thinning, pruning, and other techniques for improving young stands form the basis of the Tongass and The Nature Conservancy's endeavor to develop a restoration economy in southeast Alaska. These findings also are being used as part of a multiagency initiative to improve deer habitat on Prince of Wales Island and, thus, increase sport and subsistence hunting opportunities and support a healthy population of predators, such as wolves and bears.

Contact: Michael H. McClellan, mmcclellan@fs.fed.us, Resource Management and Productivity Program

Partners: State of Alaska, Department of Fish and Game; The Nature Conservancy; USDA Forest Service, Tongass National Forest



Updated estimates of Alaska timber demand are being used in Tongass National Forest plan revisions.

In southeast Alaska's temperate rain forests, scientists found that wetlands play a major role in transferring carbon and other nutrients from the soil to streams.

Tom Iraci

Wetlands provide carbon to streams in southeast Alaska

AS THEIR NAME IMPLIES, wetlands are a transitional habitat type between terrestrial and aquatic ecosystems. In southeast Alaska's temperate rainforests, scientists found that wetlands play a major role in transferring carbon and other nutrients from the soil to streams.

In studies conducted in the Tongass National Forest, scientists found higher concentrations of dissolved organic carbon in streams flowing in wetland-dominated watersheds than in non-wetland-dominated watersheds. Dissolved organic carbon, known as DOC, is created when organic matter, like plants, decays and releases carbon and other nutrients into the soil, where it then seeps into nearby bodies of water. By detecting greater concentrations of DOC in wetland-dominated watersheds, scientists confirmed that wetlands play an important role in transferring carbon from the soil to water, where it is used by plants and microscopic organisms.

This important wetland function was used by the state of Alaska as evidence that the city and borough of Juneau's Coastal Zone Management Program complied with the state's requirement that wetlands exerting a significant influence on surface and coastal waters be protected.

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

Partners: University of Alaska, Southeast; USDA Forest Service, Tongass National Forest

Diverse native plant mixes best at preventing invasive plant infestations

NATIVE PLANT SEED mixes are used to restore the diversity of plant communities and thwart the growth of invasive species. Scientists studied how well eight species of native grasses and forbs established and grew in Fort Hoskins Historical Park. The 140-acre park in Oregon's Willamette Valley is managed with the primary goal of restoring its once-dominant oak forests, now threatened.



Nan Vance

Research led to recommended mixes of native plant seeds for success in restoring native ecosystems.

Scientists also evaluated 18 grass and forb species sown on a 23,000-acre burned area on the Deschutes National Forest. They found that the native species differed in their rate of germination on the harsh site. They determined that to include the range of natural variability and ensure maximum resistance to invasives, the best reseeding operations would use mixes of a variety of native plants with different growth rates and life forms. Twelve of the tested species are now being grown for seed evaluation at Lucky Peak Nursery in Boise, Idaho.

These findings have been shared with agency land managers, nursery personnel, county park managers, and the International Park Managers Association. The findings are important for successful restoration and management of oak savannas and dry ponderosa forests.

Contact: Nan C. Vance, nvance@fs.fed.us, Resource Management and Productivity Program

Partners: (Director of Rangeland Management) Benton County Natural Areas and Parks; Lucky Peak Nursery; Oregon State University Seed Laboratory; Shoulder to Shoulder Farms; USDA Forest Service, Deschutes National Forest, Sisters Ranger District; USDA Natural Resources Conservation Service, Plant Materials Center



Bridgett Naylor

Native grasslands with less disturbance are more resilient and less likely to be dominated by invasive plants.

Specific steps build public support for conservation of rare, little-known species

SPECIES CONSERVATION policies must have public support, along with being biologically sound and cost effective, if they are to succeed. Although conservation of species like wolves and spotted owls has been controversial, at least a sizable segment of the public supports the policies. However, few people have opinions on rare, little-known species such as the warty jumping-slug or a rare fungus, yet federal laws and policies require agencies to conserve these and many more rare, little-known species.

Social science studies have found that specific steps can build public support for the management of rare and little-known species. The first step is to clarify the rationale behind policies. Rare species management competes with urgent needs such as health and education; thus management actions that can be linked with public concerns such as healthy ecosystems are more likely to be found acceptable. Specific information on the context for action and specific actions planned can improve public understanding and begin discussions that lead to creative solutions protecting other values, gaining wider public support. A commitment to monitoring and adaptive management is not only a sound management practice but may also result in people being more willing to try new options. The challenge of building and sustaining public support for conservation of little-known species requires time and thought, but without it, the best scientific plans can fail.

Contacts: Linda Kruger, lkruger@fs.fed.us, Human and Natural Resources Interactions Program, for George Stankey, retired; Bruce Shindler, bruce.shindler@oregonstate.edu, Oregon State University, Department of Forest Resources

Partners: Oregon State University, Department of Forest Resources; USDI Bureau of Land Management

Past land use and a lack of native plant seeds lead to invasive plant domination in bunchgrass ecosystems

SCIENTISTS FOUND THAT specific factors strongly influenced which bunchgrass ecosystems are dominated by invasive plants. Grasslands that were heavily disturbed in the past (abandoned cultivated fields) had the greatest density and dominance of invasive plants. Adjacent grassland communities that were not previously tilled were still dominated by native, perennial bunchgrass species and had very low numbers of invasive plants. Invasive-dominated sites also appeared to be limited in native seeds, with less than 1 percent of the soil seed bank composed of native species and less than 0.001 percent composed of native perennials.

These findings suggest what ecological mechanisms have damaged the resilience of native grasslands, important information needed to develop long-term, efficient, and cost-effective approaches to control invasive plants and restore native plant communities.

Contact: Catherine Parks, cparks01@fs.fed.us, Managing Disturbance Regimes Program

Partners: Oregon State University, The Nature Conservancy, Oregon Department of Fish and Wildlife, Willowa Resources

Fuel treatment effects on wildlife synthesized

SCIENTISTS AT THE Pacific Northwest and Rocky Mountain Research Stations synthesized available information on the effects of fuel treatments on terrestrial wildlife and invertebrates in dry coniferous forests in the West. A few general relationships emerged despite the difficulties in



generalizing across a wide variety of studies and significant knowledge gaps. In general, fire-dependent species, species preferring open habitats, and those associated with early-successional vegetation or that consume seeds and fruit appear to benefit from fuel reduction activities. In contrast, species that prefer closed-canopy forests or dense understory, and those closely associated with habitat elements removed or consumed by fuel reductions, will likely be negatively affected. Some habitat loss may persist for only a few months or years, such as understory vegetation and litter that recover quickly. Loss of large-diameter snags and down wood—important habitat elements for many wildlife and invertebrate species—may take decades to recover and thus represent important habitat elements to conserve during fuel treatments. Treatments on a small percentage of the landscape will have less effect on wildlife and invertebrate populations than treatments covering a large percentage of the landscape.

This synthesis should be helpful to fuel planners, fire managers, and National Environmental Policy Act specialists. Until some of the knowledge gaps are filled, an overall approach using prudence and conservation may be most appropriate. Management activities that retain habitat structures such as snags, down wood, and refugia of untreated stands may increase habitat diversity and benefit the greatest number of species in the long run.

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

Partner: USDA Forest Service, Rocky Mountain Research Station

Study helping to improve success of postfire restoration

LARGE WILDFIRES CAN disrupt a forest in many ways, from altering its productivity to reducing its habitat quality. After a wildfire, one goal of forest managers often is ecosystem restoration, where planting and other silvicultural practices are used to encourage forest recovery. In the Timbered Rock Stand Development and Fuels Study, scientists are studying different postfire restoration treatments and their effects, including effects on fuels.

To date, they have learned that planting location, not planting density or the removal of competing vegetation, is a greater determinant of how well planted conifers grow. The initial growth of planted conifers differed substantially among species. The amount of naturally regenerated conifers and hardwoods differed widely among the study sites, and some species were more closely associated with specific restoration treatments. As the forests in the study sites develop, scientists will study differences in plant communities and potential fire risk resulting from the restoration treatments. Findings should be helpful to land managers in planning postfire activities.

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

Partners: Oregon State University; USDI Bureau of Land Management, Butte Falls Resource Area, Medford District

Molecular methods characterize the impact of burn severity and postfire salvage logging operations on soil microbial communities

MORE STAND-REPLACING wildfires are occurring in Western forests, prompting evaluation of the effects of postfire treatments on ecosystem recovery. Intense fire and compaction are leading causes of soil degradation, and soil microbes are critical to maintaining forest resiliency after fire for cycling nutrients and contributing to tree establishment and survival.

Scientists used a molecular technique of genetic analysis to isolate microbial DNA directly from soil after fires, taking their first sample as soon as they could safely enter burned areas. Samples were taken again after postfire logging treatments. The scientists detected 18 dominant fungal species in soil immediately after a fire. Six species were detected at all sample times including in severely burned soils. One species was found immediately after the fire was extinguished and before any rain fell; scientists continued to find that species throughout the year and on each site. One more species was also detected during the first spring after the fire. These findings provide land managers with estimates of the effects of severe fire and soil compaction on belowground microbial health, information useful in designing postfire recovery treatments.

Contact: Jane E. Smith, jsmith01@fs.fed.us, Ecosystem Processes Program
Partners: Oregon State University; USDA Forest Service, Deschutes and Willamette National Forests

Panel ensures plans for protecting Columbia River Basin's fish and wildlife are scientifically sound

THE POWERFUL COLUMBIA RIVER is ideal both for species of fish and wildlife and for hydroelectric activities. In Washington, where much of the state's electric power is derived from the river, the Northwest Power and Conservation Council created subbasin plans for main segments and tributaries of the river that outline measures for protecting and managing fish and wildlife populations affected by hydroelectric facilities.



Jim Hughes



Tom Iraci

Severe wildfires can damage soils, affecting soil properties and forest recovery for years after the fire.

In 2006, a Station scientist, along with fellow members of the Independent Scientific Review Panel, conducted a scientific peer review of more than 600 of these plans and project proposals to ensure their soundness. The panel's review found that many of the plans did not reflect current scientific knowledge in the field of ecological restoration. By offering suggestions on how the proposals and plans could be improved, the panel is helping to improve the likelihood that the \$150 million worth of projects outlined by the plans—among the largest ecological restoration programs in the Nation—are successful.

Contact: Pete Bisson, pbisson@fs.fed.us, Aquatic and Land Interactions Program
Partners: Columbia River Basin Indian tribes, Northwest Power and Conservation Council, USDC National Oceanic and Atmospheric Administration, Fisheries Service



Atlantic salmon could become invasive in Pacific Northwest if they establish breeding populations

COMMERCIAL SALMON FARMS are common along the north Pacific coast, especially in British Columbia. Although they contribute to the coastal economy, they also regularly introduce nonnative salmon to the region's ecosystems. Each year, hundreds of the Atlantic salmon raised at these farms escape from their hatcheries and pens and end up in the rivers of Washington and British Columbia.

Station scientists examined the risk of these Atlantic salmon becoming an invasive species in the region. They found that, so far, the escaped fish have been able to reproduce only in a few streams on Vancouver Island, which limits their ability to become invasive. However, if Atlantic salmon adapt to the region's watersheds and establish successful breeding populations, they could pose a significant threat to native salmon. Especially at risk would be native salmon populations in Puget Sound streams, the Straits of Juan de Fuca and Georgia, and the rivers of southeastern Alaska.

Juvenile coho salmon that spent winter in intermittent streams had higher survival rates and were larger than fish reared in the mainstem stream.

Bob Szaro

These findings can be used by managers and fishery biologists with Washington's and Alaska's national forests and tribes and by others who conduct routine stream surveys and manage the region's waters.

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

Partners: Canada Department of Fisheries and Oceans; University of Washington; USDC National Oceanic and Atmospheric Administration, Fisheries Service; Washington Department of Fish and Wildlife

Large numbers of fish and presence of hatchery-raised salmon reduce steelhead foraging

SCIENTISTS CONTINUED their study of the effects of hatchery-raised salmon on wild salmonid (steelhead and salmon) foraging in streams of the interior Columbia River basin. They found that wild steelhead trout foraged less intensively when they fed alongside hatchery-raised coho salmon. Steelhead trout foraging also was inhibited by the number of foraging fish present. Group size reduced foraging rates for these trout as well as for wild chinook salmon.

These findings are being used to inform decisions about introducing hatchery-raised salmon to supplement seasonal runs. They also are helping to predict what effects invasive fish species, like the Atlantic salmon, might have on native fish, especially sensitive species like steelhead trout and chinook salmon.

Contact: Karl M. Polivka, kpolivka@fs.fed.us, Aquatic and Land Interactions Program

Partners: USDA Forest Service, Okanogan-Wenatchee National Forest; USDC National Oceanic and Atmospheric Administration, Fisheries Service; Washington Department of Fish and Wildlife; Yakama Nation

Scientists identify landscape characteristics that influence salmon habitat features

TO DETERMINE THE influence landscape characteristics exert on the development of salmon habitat, scientists surveyed stream segments in the Elk River in southwest Oregon. They found that the depth and volume of pools in the stream segments, features important to juvenile salmon, were more strongly related to the amount of land area draining into the stream than to type of forest management. In contrast, the average density of large wood in the pools was at least partially an indicator of forest management. (Large wood is a key salmon habitat component.) The amount of large wood in the streams increased with the size of the trees in the surrounding forest.

The identification of specific landscape characteristics that may affect salmon habitat is critical to forest planning and habitat restoration activities. The Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan is using approaches developed by the scientists to reduce monitoring costs. When landscape characteristics can be linked to habitat conditions, as this study has shown, fewer field studies are needed.

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

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

NEW TOOL

ICWATER: INCIDENT COMMAND TOOL FOR PROTECTING DRINKING WATER

Description: The ICWater tool provides incident commanders with key information rapidly, enabling them to evaluate the risks to the public when drinking water sources are contaminated by terrorist attacks or accidental spills and to direct effective action by first responders. ICWater can be used by Forest Service incident commanders as well as incident commanders from many other federal, state, and local agencies. The Pacific Northwest Research Station led a consortium in developing this tool, because over 3,000 towns and cities across the country depend on drinking water that flows from national forest land. The final tool covers drinking water sources on all lands in the 50 states regardless of ownership.

Outcomes: Hazardous materials teams from the states of Oregon and Washington and at the federal level are using ICWater. The tool was available for all 50 states at the end of 2006. ICWater has been adopted by the Department of Defense, and an agreement is in place for them to distribute the tool and provide training.

How to get it: For information on ICWater, see: <http://eh2o.saic.com/ICWATER/> or contact Doug Ryan, dryan01@fs.fed.us, Aquatic and Land Interactions Program. Registration for distribution to government agencies is at ACECenter (https://acecenter.cntr.dtra.mil/acecenter/_login.cfm).

Partners: Defense Threat Reduction Agency, Federal Emergency Management Agency, Science Applications International Corporation, Technical Support Working Group (interagency), USDC National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency

Coho salmon benefit from intermittent streams

DURING THE DRY summer months, some streams in the region stop flowing and become isolated pools disconnected from their source. These streams flow again during fall, when precipitation increases. Scientists found that these intermittent streams are important habitat for coho salmon in the Oregon Coast Range.

The standing pools left in these streams offer high-quality habitat and abundant food resources to fish, such as coho salmon. Juvenile coho salmon survived in these pools during summer and returned to the mainstem when fall rains increased waterflow. Juvenile fish that spent winter in these streams had higher survival rates and were larger than fish reared in the mainstem, owing to the habitat conditions and food intermittent streams provided. Adult coho salmon, too, benefit from intermittent streams. Ten to twenty percent of the adult fish that spawned in the study area did so in intermittent streams.

Results from this study are providing management and regulatory agencies with a basis for developing practices and policies that promote intermittent streams. Knowledge of the importance of these streams also may help establish criteria for prioritizing culvert replacements.

Contact: Bruce Hansen, bhansen@fs.fed.us, Aquatic and Land Interactions Program

Partners: Oregon Department of Fish and Wildlife, Oregon State University, USDI Bureau of Land Management, U.S. Environmental Protection Agency



Aquatic and Land Interactions Program

The average density of large wood in stream pools, important for salmon habitat, is related to the percentage of large wood in the surrounding forest.

Improved model better identifies likely sources of landslides

THE IMPACT OF LANDSLIDES on fish has long been a source of debate. Some regard them as undesirable disturbances, whereas others point to recent studies that show landslides' deposition of wood and sediment in streams as potentially improving fish habitat. Scientists enhanced a model that both identifies probable sites where landslides may begin and assesses their likelihood to reach fish-bearing streams. The western Oregon model now allows users to estimate the amount of wood a landslide may introduce into a stream based on vegetation conditions surrounding the stream channel.

This model allows managers to determine which sites have the greatest potential for introducing materials into fish-bearing streams. With this knowledge, managers can tailor activities to reduce the negative effects of landslides and promote their potential positive effects for streams and fish.

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

Partners: Earth Systems Institute; USDI Bureau of Land Management, Oregon State Office

People's sense of place has implications for recreation management

“SENSE OF PLACE” is generally understood as the way people feel about particular places and the meanings that those places hold. A new synthesis of research on sense of place in recreation and tourism explains the concept's implications for management of public lands. Understanding people's attachments to place may help managers understand stewardship behaviors, sources of disagreements between groups, and people's attitudes about the environment. For example, people with strong attachments to place often react intensely to ecological changes, especially when those changes are perceived to be negative, as was the case with the large wildfires in Yellowstone National Park in 1988. Conflicts—for instance, differences between newcomers and long-term residents—often occur because places hold different meanings for people according to their cultural, racial, and religious backgrounds.

Sense of place can influence community viability and economy. For example, the town of Estes Park, Colorado, known as the gateway to Rocky Mountain National Park, chose to turn down an opportunity to make substantial money from a tourism venture, because townspeople felt the venture threatened their sense of place. Overall, the sense of place research can help managers in their relations with the public and help managers anticipate how people will react to management proposals.

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Partner: University of Idaho, College of Natural Resources

More information: General Technical Report PNW-GTR-660. *Sense of Place in Natural Resource Recreation and Tourism: An Evaluation and Assessment of Research Findings*. http://www.fs.fed.us/pnw/publications/pubs/pnw_gtr660.pdf



Tom Iraci

People's different reasons for loving a place can lead to disagreements about how an area should be managed.

Pacific golden chanterelle recovers 6 years after light stand thinning

THE COMMERCIAL HARVEST of wild edible mushrooms is a multimillion dollar industry in the Pacific Northwest. The Pacific golden chanterelle is one of the fungal species more highly valued, not only by commercial harvesters, but also by the general public. This chanterelle species is most productive in young Douglas-fir stands 20 to 60 years of age.

A major concern by managers and the public has been the effects of forest thinning on this valuable resource. As part of an integrated, replicated young-stand thinning study in the central Cascade Range of Oregon, scientists monitored the productivity of the Pacific golden chanterelle after both light and heavy thinning. The mushroom's productivity significantly declined for the first 4 years in all thinning treatments. However, by year 6, the mushroom's productivity had nearly recovered to control levels in the light thinning treatment. Productivity remained far below control level in the heavy thinning treatment. This finding can provide guidelines for integrating edible mushroom management with other forest management goals.

Contact: Randy Molina, rmolin@fs.fed.us, Ecosystem Processes Program

Partners: Willamette National Forest, Oregon State University, Cascade Center for Ecosystem Management

Think-tank group works on bringing landscape science into forest planning

STATION SCIENTISTS HOSTED a think-tank group on questions of integrating landscape ecology and modeling research with the landscape analysis and planning that managers do, from the project level to forest plan revisions. The Suttle Lake, Oregon, workshop included scientists from multiple disciplines, resource specialists from the Forest Service Pacific Northwest Region, and specialists from the Washington Office Inventory and Monitoring Institute. The workshop enhanced understanding of applied and basic research methods that could be used for midscale landscape assessments. Station scientists and regional staff developed stronger working relationships. They will continue working together on bringing landscape science into forest planning.

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

Partner: USDA Forest Service, Pacific Northwest Region

NEW TOOL

LANDSCAPE AGE-CLASS DYNAMICS SIMULATOR (LADS 4.4)

Description: The LADS 4.4 model is a landscape tool useful for long-term, broad-scale assessments of historical and future fire regimes and their effects on forests. The new upgrade incorporates the dynamics of three fire regimes (stand replacement, mixed severity, nonlethal).

Outcomes: The LADS 4.4 model can be used to understand the historical range of variability in forest structures and changing age-class patterns and to simulate the possible outcomes of forest management and climate-change scenarios. It can be applied at the scale of a late-successional reserve, a national forest, and also for regional assessments. This complex model is run by researchers using input from managers.

How to get it: Contact Rebecca Kennedy, rebecca.kennedy@fs.fed.us, Ecosystem Processes Program

Stand structure attributes of east-side old-growth ponderosa pine forests in central Oregon and northern California can be used to guide and evaluate treatments

LOW-ELEVATION PONDEROSA pine forests east of the Cascade Range crest in Oregon and northern California have changed substantially in the last 100 years. To develop a set of old-growth reference conditions for managers, Station scientists studied the age, size structure, and spatial patterns of old-growth ponderosa pine forests at three protected study areas. The oldest trees were 618 years old and stands were multi-aged. Density of old-growth ponderosa pine in the upper canopy averaged 20 trees per acre with average diameter of 24 inches at breast height. Large dead ponderosa pines were common at all three study areas, averaging 4 per acre. The most common spatial pattern of upper canopy trees was a clumped distribution. Density of downed logs was 19 logs per acre, and most logs were decomposing, suggesting that they had been down for many years.

Managers can use these reference conditions as a guide in projects to restore ecological integrity of ponderosa pine forests (including frequent surface fires) and projects to develop late-successional and old-growth characteristics. The reference conditions are used by Lassen National Forest and Klamath, Modoc, and Yahooskin Tribes (Klamath Tribes) in northern California and southern Oregon to guide development of a management plan for the nearly 700,000-acre Klamath Reservation Forest.

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

Partners: USDA Forest Service, Deschutes National Forest and Pacific Southwest Research Station

Multistory forests on the east side would be vulnerable to wildfires and insect outbreaks

OVER THE PAST century, many dry forests on the eastern slopes of the Cascade Range have developed into dense, multistoried forest, which historically was less common than it is today. The multistoried forest has become habitat for spotted owls, a threatened species, and thus presents a conundrum. Dense forests on drier sites are susceptible to fire and insect outbreaks, and if the forest burns, owl habitat and much more may be lost. Thus managers are faced with balancing the need for multistory habitat with the sustainability of those habitats and the fire risks they pose.

With these issues in mind, management scenarios were studied for a 650,000-acre subbasin of the upper Deschutes River in central Oregon. Integrated landscape modeling was done on four alternatives: (1) no management on federal lands except fire suppression; (2) develop multistory large and very large trees in federal forests to increase spotted owl habitat; (3) manage federal forests to achieve historical conditions, to the extent possible; and (4) a combination of 2 and 3. All scenarios include active fuel treatment on private lands. Initial results show that managing for extensive areas of dense, multistory old forests in the upper Deschutes subbasin, and likely in similar east-side forests, would be a chancy proposition, and amounts of multistory old forest would fluctuate widely over time owing to wildfire and insect outbreaks. The modeling also showed how the scenarios would affect wildlife habitat and yields of forest products.

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

Partners: Joint Fire Science Program; Oregon Department of Forestry; USDA Forest Service, Pacific Northwest Region



Pockets of insect-killed trees become fuel jackpots for wildfires, in dense, east-side forests.

GOAL 4:

Communicate science findings and enhance their application



KEY FINDINGS

- New book, *Alaska's Changing Boreal Forest*, is a synthesis of 20 years of research on ecosystem processes in Alaska's boreal forest biome.
- A series of general technical reports presented key monitoring findings and syntheses of scientific information from the Northwest Forest Plan 10-year review.
- A forest threats conference began a synthesis of scientific information on forest environmental threats, the first step in an online encyclopedia on that topic.
- New information from the Joint Fire Science Program, a partnership of six federal organizations, is getting to the field faster through improved science delivery programs.
- A conference delivered tools and information to managers on managing for biodiversity.
- New online resources have been added on FishXing, riparian roads, and watershed restoration, making this information widely available.
- A user-friendly software program and tutorial help people understand, visualize, and process data generated by LIDAR, an airborne laser scanning technology.
- The Station added really-simple syndication to its Web site, allowing visitors to customize the information they receive.
- Landscape models and data from the Interagency Mapping and Assessment Project (IMAP) are being used in forest planning by the Oregon Department of Forestry and the USDA Forest Service Pacific Northwest Region.



ACCOMPLISHMENTS

New book provides synthesis of the ecology of Alaska's boreal ecosystems

BOREAL FORESTS ARE the second most extensive land biome in the world. Found in northern latitudes, such as Alaska's vast interior, they are the focus of research conducted by the Station as part of the Bonanza Creek Long Term Ecological Research program, established in 1987.

This year, Oxford University Press published *Alaska's Changing Boreal Forest*, a book synthesizing the findings of Station scientists and their colleagues. The book, part of a

Long-Term Ecological Research Network series, summarizes the wide range of scientific work conducted on boreal topics as diverse as climate and soils, vegetation and wildlife, and aquatic systems and human uses. It is the first such comprehensive synthesis of the ecology of Alaska's boreal forest ecosystems.

The book serves as a primary reference for scientists and land managers, helping them understand what is known of Alaska's boreal forests and how the forests might be affected by climate change in the future.

Contact: Thomas A. Hanley, thanley@fs.fed.us, Ecosystem Processes Program

Partners: National Science Foundation; University of Alaska Fairbanks

More information: *Alaska's Changing Boreal Forest*, Oxford University Press

Science support provided to Alaska Region of Forest Service

THE STATION IS providing science support to federal land use planning in Alaska. This support includes the development of new products, consultations on key topics, and science reviews for the Tongass Forest Plan Amendment. Progress to date includes completion of a new timber demand analysis for the Tongass National Forest and consultations. Station scientists' involvement is to promote use of the best available science in revising land use plans.

Contact: Sandy Boyce, daboyce@fs.fed.us, Station Director's Office

Partner: USDA Forest Service, Alaska Region



John Laurence

A new book on Alaska's boreal forests includes science on soils, permafrost, and carbon cycles, as well as on people, wildlife, water, and plants.

A series of reports present a synthesis of key findings and monitoring results from the first 10 years of the Northwest Forest Plan.

Tom Iraci

Station supports Forest Service regional planning activities in Oregon and Washington

THE STATION PROVIDES science support to federal land use planning by developing new products, synthesizing findings, and providing consultations and scientific reviews. Recently, a four-level science consistency review process the Station developed jointly with the Pacific Northwest Region was incorporated into the Forest Service Handbook. The review process ensures that key components of land use plans are scientifically reviewed and consistent with the best available science. Two land use plan components—the selection of aquatic focal species and the draft aquatic and riparian conservation strategy—were reviewed by using the process.

Scientists have consulted on the development of a regional process for terrestrial species sustainability, which will be incorporated into land use plans. Also, scientists organized a workshop for managers on current Station research related to tree mortality and are working with managers to refine, evaluate, and apply tree mortality rating systems within the Pacific Northwest.

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

Partner: USDA Forest Service, Pacific Northwest Region



Adaptive management and monitoring processes improved for Northwest Forest Plan

THE NORTHWEST FOREST PLAN (the Plan) pioneered efforts to make adaptive management a standard practice in forest management. Because it includes a built-in learning process, adaptive management is ideal for addressing the uncertainties inherent in management strategies. A 10-year review revealed that, in spite of its benefits, adaptive management did not meet these high expectations during the Plan's first decade. A team of Station scientists and Pacific Northwest Region specialists are evaluating how adaptive management might be improved and how the Plan's monitoring program might be refined.

To date, the team has developed a framework for a regional adaptive management process and created a set of priority questions that will help focus monitoring and research. The team also created a process for reporting regional adaptive management accomplishments, which will highlight new information for managers' consideration. Forest Service and Bureau of Land Management managers plan to use these tools to improve their adaptive management and regional monitoring programs across the region.

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

Partner: USDA Forest Service, Pacific Northwest Region

Northwest Forest Plan 10-year review publications available

KEY FINDINGS AND monitoring results from the first 10 years of the Northwest Forest Plan were presented at a major conference in April 2005, sponsored by the PNW Research Station, Pacific Northwest Region, Bureau of Land Management, and other partners. Central themes were to evaluate the success of the Plan in achieving its objectives over the last 10 years and to review relevant new scientific information. Scientists presented key monitoring findings and syntheses of scientific information on topics such as old-growth forests, watersheds, spotted owls, marbled murrelets, other threatened and endangered species, aquatic conservation, socioeconomic changes, and adaptive management.

Since that conference, a series of general technical reports have been published through the PNW Research Station. These reports present a synthesis of all the 10-year monitoring and research results. The collection of reports includes a series of status and trends reports, a synthesis of all regional monitoring and research results, a report on interagency information management, and a summary report. Publications to date include:

Buttolph, L.P.; Kay, W.; Charnley, S. [et al.]. 2006. Northwest Forest Plan—the first 10 years (1994–2003): Socioeconomic monitoring of Olympic National Forest and three local communities. Gen. Tech. Rep. PNW-GTR-679.

Charnley, S., tech. coord. 2006. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Gen. Tech. Rep. PNW-GTR-649. 6 vols.

Donoghue, E.; Sutton, L. 2006. Community socioeconomic information system: making socioeconomic data available at the community level. [CD-ROM.] Gen. Tech. Rep. PNW-GTR-672.

Gallo, K.; Lanigan, S.H.; Eldred, P. [et al.]. 2005. Northwest Forest Plan—the first 10 years (1994–2003): preliminary assessment of the condition of watersheds. Gen. Tech. Rep. PNW-GTR-647.

Haynes, R.W.; Bormann, B.T.; Lee, D.C.; Martin, J.R., tech eds. 2006. Northwest Forest Plan—the first 10 years (1994–2003): synthesis of monitoring and research results. Gen. Tech. Rep. PNW-GTR-651.

Huff, M.H.; Raphael, M.G.; Miller, S.L. [et al.], tech. coords. 2006. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650.

Lint, J., tech. coord. 2005. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648.

McLain, R.J.; Tobe, L.; Charnley, S. [et al.]. 2006. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring of Coos Bay District and three local communities. Gen. Tech. Rep. PNW-GTR-675.

Moseley, C. 2006. Northwest Forest Plan—the first 10 years (1994–2003): procurement contracting in the affected counties of the Northwest Forest Plan: 12 years of change. Gen. Tech. Rep. PNW-GTR-661.

Moeur, M.; Spies, T.A.; Hemstrom, M. [et al.]. 2005. Northwest Forest Plan—the first 10 years (1994–2003): status and trend of late-successional and old-growth forest. Gen. Tech. Rep. PNW-GTR-646.

Contact: Frank Vanni, fvanni@fs.fed.us, Communications and Applications Program

Partner: USDA Forest Service, Pacific Northwest Region

More information: Find reports at <http://www.fs.fed.us/pnw/pubs/>

Science reviews, consultations improve science credibility of BLM's planning process

SEVERAL STATION SCIENTISTS are assisting the Bureau of Land Management (BLM) with its western Oregon plan revision project, which will amend land use plans for six western Oregon and Washington BLM districts. Scientists are providing crucial information defining the state of science for topics such as community resiliency, landscape dynamics, streamflow, aquatic habitat management, and young stand management. They also are participating in public meetings, consultations, and science reviews. Their involvement should provide managers and others with an understanding of current scientific knowledge and promote use of the best available science in BLM's plan revisions.

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

Partner: USDI Bureau of Land Management, Oregon State Office



Stream survey crews and many other field crews helped monitor the status and trends of natural resources under the Northwest Forest Plan.

Forest threats conference fosters much-needed dialogue between researchers, managers

MANY ENVIRONMENTAL THREATS face the Nation's forests and rangelands, including invasive species, uncharacteristic fire, and disease. Because these threats often cross ownership and administrative boundaries, collaborative solutions offer the best chance of their management and control. In July, more than 170 researchers and managers from the United States, Canada, and Mexico attended "Advances in Threat Assessment and Their Application to Forest and Rangeland Management," a conference on applying risk assessment information to management and policy issues. The 3-day conference, held in Boulder, Colorado, featured more than 100 oral and poster presentations on topics ranging from severe weather, to risk mapping, to wildland arson. Many past scientific conferences have addressed threats individually, but few examined their interactions, as this conference did.

Nearly 50 of the synthesis and case study papers presented will form the initial content of the *Encyclopedia of Forest Environmental Threats*, the newest of six online encyclopedias in the Forest Encyclopedia Network. The encyclopedia, which will officially be launched in May 2007, will provide researchers, managers, and policymakers with the scientific knowledge they need about environmental threats to their objectives. For more information, visit <http://www.threats.forestencyclopedia.net>.

Contact: Jerry Beatty, jbeatty@fs.fed.us, Western Wildland Environmental Threat Assessment Center

Partners: Cooperative State Research, Education, and Extension Service; Southern Forest Research Partnership; Southern Regional Extension Forestry; USDA Forest Service, Southern Research Station, Eastern Forest Environmental Threat Assessment Center

New fire science information gets to field faster through new delivery programs

THE JOINT FIRE SCIENCE Program (JFSP), a partnership of six federal wildland fire and research organizations, has completed over 300 research projects in the past decade, including better infrared technology for airborne thermal mapping, online fuel photo series, community fire preparedness, improved fire weather and fire risk forecasting, and smoke management. New science-delivery projects are getting the wealth of new information and tools to the field faster. The first product was concise summaries of individual JFSP-funded research projects, with emphasis on management implications. Syntheses of all research on a particular topic, such as invasive species, are underway. Information can be packaged to meet the different needs of managers, decision-makers, and policymakers.

Over 300 principal investigators from the research projects responded to a survey on the science delivery process. Over 95 percent of respondents viewed field collaboration as an important source of ideas, as well as being personally and professionally rewarding. The new science-delivery program is being shared with other fire research clearinghouses, including FRAMES and the Wildland Fire Lessons Learned Center.

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

Partner: Joint Fire Science Program

More information: <http://jfsp.nifc.gov/news/index.htm>



Tom Iraci
Fire science supports firefighting operations through new tools such as improved fire weather and fire behavior forecasts.

Consumer's guide synthesis assists with planning fuel and vegetation treatments

LAND MANAGERS ARE FACED with a wide variety of analytical and decision-support tools for fuel and vegetation treatments. Station scientists created a General Technical Report that serves as a "consumer's guide," providing a state-of-science summary of tools for managing vegetation and fuels. The guide includes tools' analyst and data requirements, scale (stand, landscape, etc.), linkages to other tools, and outputs. It also offers streamlined tables that allow managers to quickly identify tools that could be applied to their situation. The guide, developed at the request of land managers, enables managers and technical specialists to choose tools appropriate to their specific needs.

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

Partners: USDA Forest Service, Pacific Northwest Region; USDI Bureau of Land Management, Oregon State Office

More information: General Technical Report PNW-GTR-690. *Analytical and Decision Support for Managing Vegetation and Fuels: A Consumer's Guide*.



Natural fuels photo series now online

THE DIGITAL FUELS Photo Series is a Web-based project that provides the Natural Fuels Photo Series data in electronic form. The site includes data from all 11 volumes, with 31 photo series and 323 sites, all in database form for easy search and downloading. The online photo series has additional information not in the published volumes; also, some data have been rearranged and terminology has been standardized. The Digital Fuels Photo Series Web site is being used by land managers who already rely on the fuels photo series field guides.

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

Partners: Joint Fire Science Program, National Fire Plan, University of Washington

How to get it: <http://depts.washington.edu/nwfire/dps/>

Online tutorials are available for fire and fuel management tools

THE NATURAL FUELS Photo Series, Fuel Characteristic Classification System (FCCS), Consume 3.0, and Fire Emissions Production System (FEPS) have become important tools in fire and fuels management. A set of online tutorials, instructor's guides, and student workbooks help land managers and others learn how to use the tools, appropriate applications for each tool, and technical background on the four tools. The tutorials have step-by-step instructions for learning the tools and case studies showing applications of the tools in the boreal, southern, and western regions of the United States.

Each case study also shows how the four land management tools can be used in combination with one another. Entry-level people can use these tutorials to quickly learn the four tools, and experienced users can become advanced users.

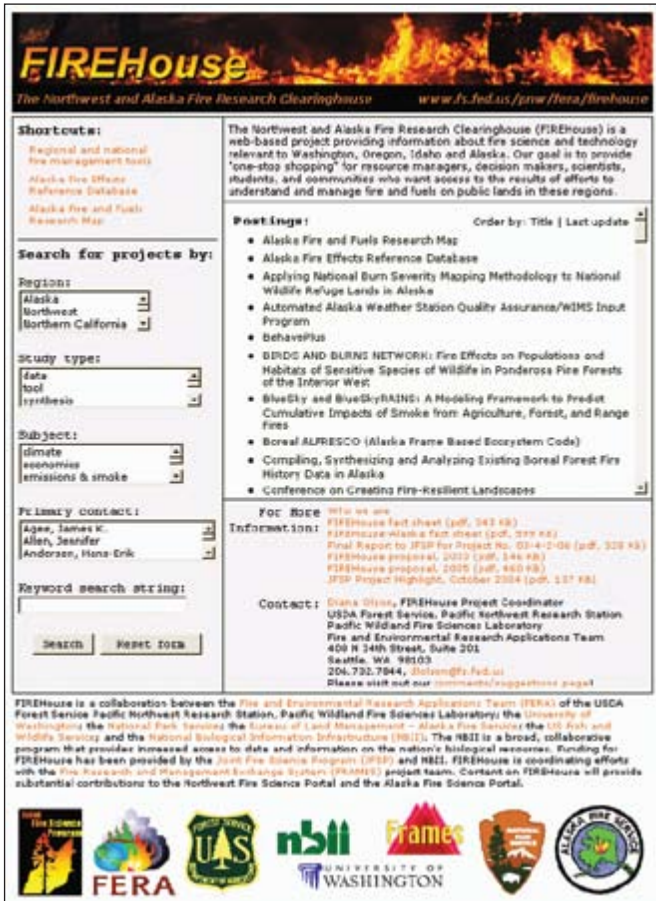
Contact: Don McKenzie, donaids@fs.fed.us, Managing Disturbance Regimes Program

Partners: Alaska Fire Service; Carolina Environmental Program; Joint Fire Science Program; National Center for Atmospheric Research; National Fire Plan; University of Washington; USDA Forest Service, Pacific Northwest Region; USDC National Oceanic and Atmospheric Administration, Fisheries Service; USDI National Park Service; U.S. Environmental Protection Agency; Washington State University; Western Regional Air Partnership

How to get it: <http://www.fs.fed.us/pnw/fera/products/tutorials/>

FIREHouse: The Northwest and Alaska Fire Research Clearinghouse

FIRE RESEARCH INFORMATION is not always easily accessible. FIREHouse now helps get fire research findings out to resource managers, decisionmakers, and the general public. The user-friendly Web site provides information about fire science and technology relevant to Washington, Oregon, Idaho, and Alaska. For each project posted, FIREHouse provides searchable access to (1) project and tool descriptions, contact information, and links; (2) online publications; (3) proposals and study plans; and (4) metadata. Many projects also include an educational component explaining important findings. FIREHouse also offers server space and Web and database support for researchers who choose to post their primary data on FIREHouse.



The FIREHouse Web site provides information about fire science and technology relevant to Alaska, Idaho, Oregon, and Washington.

Managing Disturbance Regimes Program

Two additional online products are relevant to Alaska: (1) the Alaska Fire and Fuels Research Map, an interactive map displaying information about fire and fuels research plots in Alaska, and (2) the Alaska Fire Effects Reference Database, a searchable database of fire research publications, as well as unpublished agency reports.

Contact: Diana L. Olson, dolson@fs.fed.us, Managing Disturbance Regimes Program

Partners: Fire Research and Management Exchange System (FRAMES); Joint Fire Science Program; USDI Bureau of Land Management Alaska Fire Service, Fish and Wildlife Service, and National Park Service; University of Washington; USGS National Biological Information Infrastructure (NBII).

How to get it: <http://www.fs.fed.us/pnw/fera/firehouse/>

DVD and companion guide on communication strategies for fire management

A NEW DVD is available titled “Communication Strategies for Fire Management: Creating Effective Citizen-Agency Partnerships.” The companion guide is titled “A Practical Guide to Citizen-Agency Partnerships: Public Outreach Strategies for Fire and Fuel Management.” These products convey findings from research funded by the National Fire Plan and Joint Fire Science Program. They were developed to help land managers work with citizens on community fire and fuel reduction strategies.

The DVD uses real, on-the-ground examples of fire and fuel management, highlighting effective public outreach programs

and featuring agency personnel responsible for their success. It examines essential attributes for developing partnerships, initiating an outreach program, or improving an existing program. The supplemental guide gives viewers hands-on materials for planning and action and also provides indepth commentary.

So far, over 600 copies have been distributed to fire management and outreach personnel at every level of government in the United States as well as citizen groups. Copies have also been requested by forest agencies in Canada, Australia, New Zealand, Spain, and Russia.

Contact: Linda Kruger, lkruger@fs.fed.us, for George Stankey, retired; Human and Natural Resources Interactions Program

Partners: National Fire Plan; Oregon State University; USDA Forest Service, Deschutes National Forest and Northern Research Station; USDI Bureau of Land Management, Medford District, and National Park Service, Sequoia-Kings Canyon National Parks

How to get it: Copies of the DVD are available from Bruce Shindler, bruce.shindler@oregonstate.edu, Oregon State University, Department of Forest Resources

Symposium delivers new science on biodiversity conservation to wildlife biologists

BIODIVERSITY CONSERVATION is a relatively new field and one that has been limited both by a lack of knowledge of ecological systems and the inherent complexity of land management. Station scientists presented the current science on biodiversity conservation to Pacific Northwest wildlife biologists at a symposium at Oregon State University. Eight review articles on the key biodiversity topics discussed at the symposium—such as forestry practices, invasive species, and habitat modeling techniques—were published as a special issue of *Northwestern Naturalist*. The special issue has been distributed locally to the more than 200 symposium attendees and internationally, such as to natural resource specialists in New Zealand, Southeast Asia, and Argentina.

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

Partners: Defenders of Wildlife; Oregon State University, Institute for Natural Resources; U.S. Geological Survey, Biological Resources Division.

Biodiversity conference delivers tools to managers

A BIODIVERSITY INITIATIVE delivered existing tools and information to about 150 managers from the private sector and state and federal agencies at its June 2006 conference on “Managing for Biodiversity.” Over 40 presentations gave a synthesis of current knowledge related to managing for biodiversity in Pacific Northwest forests. Topics included social and economic considerations of biodiversity management, the effects of invasive species on biodiversity, wildlife and plant responses to silvicultural practices and natural disturbances, sensitive species management, and management of special habitats such as wetlands, riparian areas, and oak savannas.

Although some single-species conservation and monitoring programs are well developed, the monitoring of overall biodiversity remains challenging. What do single-species data tell us about overall biodiversity? What else do we measure? How does project-level measurement scale up to a regional picture? The biodiversity initiative helped Oregon and Washington state natural resource agencies, which have federal mandates and funds to develop monitoring strategies for their wildlife conservation programs, develop a regional vision and framework for monitoring biodiversity. The states are now taking the lead on development of regional programs to monitor biodiversity. The private sector, state agencies, and their federal counterparts are now sharing resources related to monitoring biodiversity. Finally, the initiative team is working with partners to meet another pressing need identified by managers, the development of a Web portal that is a central clearinghouse for biodiversity information and resources.

Contact: Randy Molina, rmolina@fs.fed.us, Focused Science Delivery Program

Partners: Defenders of Wildlife; Institute for Natural Resources, Oregon State University; National Council for Air and Stream Improvement; The Campbell Group; The Nature Conservancy; Oregon Department of Fish and Wildlife; USDI Bureau of Land Management, Oregon State Office and Regional Office, Fish and Wildlife Service, National Park Service; Washington Department of Fish and Wildlife; Washington Department of Natural Resources Natural Heritage Program

More information: General Technical Report PNW-GTR-670. *The Pacific Northwest Research Station's Biodiversity Initiative: Collaborating for Biodiversity Management*. http://www.fs.fed.us/pnw/pubs/pnw_gtr670.pdf



G. Kramer

A key challenge in biodiversity monitoring is figuring out what data on individual species, such as the greater sage-grouse, tell us about regional biodiversity.



Tom Iraci

A new field guide on Pacific Northwest amphibians includes new science findings as well as identification information.

New field guide contributes to growing body of knowledge about amphibians

OVER THE LAST 15 years, scientists have made tremendous progress in understanding the status and biology of amphibians. In places like the Pacific Northwest—where more than half of the region's amphibians have restricted distributions and are at potential risk from natural and human causes—this knowledge base is essential to managing these enigmatic creatures.

To contribute to the growing body of amphibian species knowledge, scientists authored *Amphibians of the Pacific Northwest*, published by the Seattle Audubon Society. The book features a field guide of species accounts, with full-color photographs, as well as text covering topics such as amphibian habitats, taxonomy, and population declines. The book compiles information from numerous experts, drawing upon literature and personal experiences, to synthesize current understanding of the region's frogs and salamanders.

Amphibians of the Pacific Northwest appeals to a broad readership—from the general public and students, to professional biologists and naturalists. Copies of the book have been used extensively and distributed to numerous agencies, nonprofit groups, and universities throughout the region, including the partners listed below.

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

Partners: Biolinx Environmental Research Limited; Camosun College (Victoria, British Columbia); Central Washington University; E. Wind Consulting; King County Department of Natural Resources (Washington State); Oregon Department of Fish and Wildlife; Oregon State University; Qesta Engineering; Rana Resources; Seattle Audubon Society; Society for Northwestern Vertebrate Biology; Spokane Falls Community College; University of California at Berkeley; University of California at Davis; University of California at Santa Cruz; University of Wisconsin; USDA Forest Service, Southwestern and Pacific Northwest Regions; USDI Geological Survey, Biological Resources Division; Washington Department of Fish and Wildlife; Washington Department of Natural Resources, Washington Natural Heritage Program; Washington Department of Transportation; Western Washington University



Management guide is now available for the mountain lady's slipper

A NEW GUIDE PROVIDES comprehensive information and assessments for managing the mountain lady's slipper, a sensitive species in the Intermountain Region and listed in Wyoming. The guide's full title is "*Cypripedium montanum* Douglas ex Lindley (Mountain lady's-slipper): A Technical Conservation Assessment." It is used by managers in the Intermountain Region and other regions also where this species is found. The guide can be accessed at <http://www.fs.fed.us/r2/projects/scp/>.

The Forest Service is using a Web page on lady's-slipper orchids to publicize the agency's Celebrating Wildflowers Program. "Meet the Ladies: The *Cypripedium* orchids" introduces the public to this genus of orchids and to the broader biodiversity of plants and their management on National Forest System lands. The Web page is at <http://www.fs.fed.us/wildflowers/beauty/cypripedium/>.

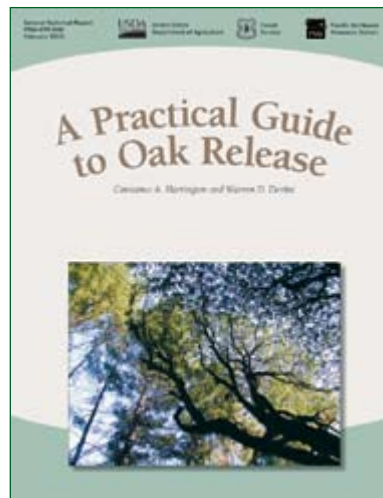
Contact: Nan Vance, nvance@fs.fed.us, Resource Management and Productivity Program

Partners: USDA Forest Service, Rocky Mountain Region and Washington Office

Guide helps landowners, managers restore oak communities

COMMUNITIES OF OREGON white oak were once common in the Pacific Northwest's lowlands. Today, however, close to 95 percent of those present in the early 1800s have been lost. Decades of fire suppression following European settlement in the region have resulted in the loss of nearly all of the region's oak communities. Historically, periodic fires cleared the lowlands of conifers that overtop—and shade out—oaks, which are tolerant of fire, but die in shade.

Many of the few remaining oak communities are on private land, and, until now, resource professionals had no single tool to help landowners manage their oak stands. Scientists developed *A Practical Guide to Oak Release* to fill this gap. In clear language, the guide describes the process of conducting oak release operations, which eliminate conifer competition, the greatest threat facing today's oaks.



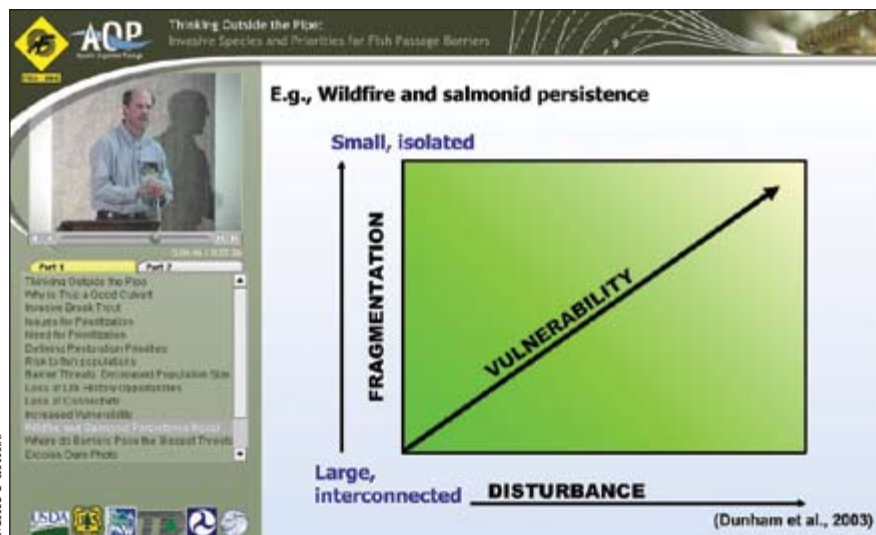
This guide helps landowners restore Oregon white oak savannas and woodlands by releasing the oak from overtopping conifers.

Written in a question-and-answer format and richly illustrated with full-color photographs, the guide is in high demand, with more than 1,000 copies distributed in the first few months after its publication. The guide is being used by the Natural Resources Conservation Service, county extension offices in Washington and Oregon, the Oregon Department of Forestry, Benton County Parks, The Nature Conservancy, and private consultants.

Contact: Constance Harrington, charrington@fs.fed.us, Resource Management and Productivity Program

Partner: U.S. Army, Fort Lewis Military Reservation

More information: General Technical Report PNW-GTR-666. *A Practical Guide to Oak Release*. http://www.fs.fed.us/pnw/pubs/pnw_gtr666.pdf



FishXing 3.0 includes online presentations from experts, along with a detailed user manual and a growing number of case studies.

Online resources for FishXing, riparian roads, and watershed restoration

FISHXING 3.0 (pronounced “fish crossing”) has become widely used by engineers, hydrologists, and fish biologists to evaluate and design culverts for fish passage. An extensive learning system was added this past year, including a detailed user manual that is essentially a textbook on culvert hydraulics and fish locomotion. The online presentations and lectures, called PEPs (portable electronic presentations), have been expanded; they cover fish passage and closely related topics. The collection of case studies is growing. FishXing 3.0 can be accessed at <http://www.stream.fs.fed.us/fishxing>.

A short course on “Riparian Roads and Restoration” was produced as a PEP, with partner San Dimas Technology and Development Center. The course was distributed on CD-ROMs and is available online at <http://www.fsl.orst.edu/geowater/RRR/>. Another online group of presentations explains how science and technology were applied to watershed restoration securing key salmon habitat areas in the Upper Sacramento River system. This collection can be viewed at <http://www.fs.fed.us/psw/topics/water/calFed/>. The online and CD-ROM presentations are vital tools for distributing new science and science applications in a time when training budgets are constrained.

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Partners: CalFed; Federal Highway Administration; USDA Forest Service, Lassen National Forest, San Dimas Technology Development Center, Stream Technology Systems Center, and Washington Office

Multimedia Web presentation on “The Geomorphic Response of Rivers to Dams and Dam Removal”

AT A TIME WHEN dam relicensing, management, and possible removal are hot topics, this multimedia presentation makes sought-after information easily available. A 63-minute multimedia presentation on the Web summarizes the geomorphic response of rivers to dams and dam removals. Three windows

show simultaneously the scientist lecturing on the topic, his accompanying graphics, and a list of headings for navigation. This presentation is part of the persistent electronic presentation (PEP) series on the FishXing Web site. It introduces managers, resource professionals, and the general public to tradeoffs associated with small dam management and removal, presents concepts related to the geomorphic effects of dams and dam removal, and explores lessons learned from case histories.

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How to get it: Access this presentation and other PEPs at the FishXing Web site: <http://www.stream.fs.fed.us/fishxing/V3publicbeta/PEPs.html>

Review summarizes literature on hydrologic impacts of forestry

FORESTRY OPERATIONS—through forest harvest or road building, for example—can change streamflow from forested watersheds. Although this potential is generally acknowledged, the extent of forestry’s impacts on hydrology is the subject of ongoing, vigorous debate, evidenced by a vast and, often contradictory, body of literature.

Scientists synthesized the available literature into one easily accessible resource—an article published in the *Journal of the*



Scientists study the way water moves through soil and down hillslopes, working to answer questions about forestry’s effects on streamflow.

Aquatic and Land Interactions Program

American Water Resources Association. The article documents the current state of knowledge, reports effects of forest harvest practices that show consistent results across many studies, and highlights significant gaps in knowledge that future research could address.

This extensive review is of interest and use to land managers charged with conducting forestry operations around aquatic ecosystems.

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Partner: University of British Columbia

Synthesis of science on forest roads gives managers up-to-date knowledge

RECENT SCIENTIFIC INFORMATION on forest roads was synthesized and presented to 200 state and federal agency resource managers from the Pacific Northwest, California, and Idaho. The conference, held in Eugene, Oregon, presented the newest information on the ecological effects roads have on terrestrial and aquatic ecosystems; explanation of how roads have physical, biological, and economic influences on forests beyond the immediately obvious effects; social and economic costs and benefits of roads; and ways that roads can contribute to management objectives. The multidisciplinary synthesis of information should be useful to managers as they deal with the often-controversial issue of forest roads.

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Partner: Western Forestry and Conservation Association

Fact sheets spread the word about new findings in forestry science

EVEN THE BEST and most interesting forestry research can end up on a one-way street to publication in scientific journal outlets, missing the chance to tell its story to a broader audience. To get new information out to people who can use it, science writers have collaborated with scientists to condense and simplify their research and create colorful, engaging fact sheets. These 1- to 2-page briefing sheets provide a summary of significant findings in an easy-to-read format, as well as references and contact information for the researcher. They cover topics in landscape analysis, environmental assessment, and fire economics.

These fact sheets have been proven successful at generating interest in ongoing PNW Research Station studies, as well as for outreach and education. For example, the fact sheets have been handed out at conferences and meetings and used for briefing a congressional committee. They have been requested by the media, the California state legislature, Web-based knowledge portals, private citizens, and policymakers.

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Methods shared for linking the national LANDFIRE project to midscale landscape analysis

THE INTERAGENCY MAPPING and Assessment Project (IMAP) landscape models and methods developed by PNW Research Station are being used in forest planning by the Oregon Department of Forestry and the USDA Forest Service Pacific Northwest Region. The IMAP models are mid-scale refinements of the national LANDFIRE, a wildland fire, ecosystem, and fuel mapping project that will generate consistent, comprehensive, landscape-scale maps and data describing vegetation, fire, and fuel characteristics across the United States.

At the LANDFIRE Rapid Assessment Rollout conference, Station scientists explained how the IMAP methods are being used in the Pacific Northwest to meet landscape analysis needs at forest planning and finer scales. They also discussed how these methods could be used in other regions in forest plan revisions. Conference attendees were from other Forest Service regions and research stations. Station scientists are also developing a business model for using the Vegetation Development Dynamics Model as a nationally supported planning tool for national forests.

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Airborne laser scanning software and tutorial available on the Web

LIDAR (LIGHT DETECTION and ranging) is a sophisticated remote-sensing technology that uses airborne laser scanning to produce three-dimensional point clouds representing forests and landscapes. Scientists developed a user-friendly software program and tutorial to help users better understand, visualize, and process their LIDAR data.

The program, known as FUSION, displays and processes LIDAR data, allowing users to interactively explore large data sets. Key to using the software is an online tutorial and installation guide, produced in collaboration with the USDA



Forest Service's Remote Sensing Applications Center. The tutorial features a sample LIDAR data set, which enables users to explore the characteristics of LIDAR data and process data to produce information describing vegetation attributes for large land areas and individual trees. Users also learn how to integrate LIDAR data with more traditional remote-sensing technologies, such as aerial photographs, topographic maps, and satellite images.

FUSION has been used to analyze terrain and vegetation conditions by the Idaho Panhandle, Rogue River-Siskiyou, and Siuslaw National Forests; researchers at the University of Washington and Mississippi State and Oregon State Universities; and many other federal, state, and private agencies.

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Partners: Joint Fire Sciences Program; University of Washington, Precision Forestry Cooperative

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

Process outlined for achieving effective integrated research programs

ECOSYSTEM MANAGEMENT, stewardship, forest health—all these concepts call for integrated resource management, and integrated research to provide holistic solutions to management issues. However, many well-intentioned efforts at integrated research have failed to break out of traditional disciplines.

A new report outlines a three-phase approach to framing integrated research questions, discusses barriers and solutions, and recommends an approach for monitoring progress in integrated research. Problem framing is the most important and perhaps most difficult phase; it has a profound effect on outcomes. An integrated research approach requires clear definition of the problems, teams committed to mutual learning and team approaches, and a willingness to be adaptive to change as situations change. Barriers that block progress can occur at individual, team, and institutional levels. Monitoring of research progress should assess relationships, processes, and outcomes.

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More information: General Technical Report PNW-GTR-678. *Integrated Research in Natural Resources: The Key Role of Problem Framing*. http://www.fs.fed.us/pnw/pubs/pnw_gtr678.pdf



Station launches RSS feeds, putting visitors in control of information they receive

THE STATION'S WEB SITE—which received more than 30,000 hits in 2006—is an important source of information for resource managers, media, researchers, policymakers, and the public. For the convenience of Web visitors, the Station began offering them the ability to customize the information they receive.

In July, the Station made its popular content available by using a technology known as really-simple syndication (RSS). The RSS automatically sends selected feeds of Station information to subscribers when new content is available. This means users can access customized information from the Station without actually visiting the Station's Web site. Whenever a new event announcement, news release, or publication is published to the Web, subscribers automatically receive a posting of the document along with a summary and access to a full-text version of the document. Feeds are collected by, and viewed in, software programs known as readers, which are available for free download from the Web. To subscribe to a feed, users need only click its link.

The Station's RSS feeds put visitors in control of how much information they receive from the Station. For more information and a complete listing of available feeds, visit <http://www.fs.fed.us/pnw/RSS/>.

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Edna Mo

At this year's Inner City Youth Institute, middle school students saw a Station research biologist call in spotted owls.

Inner City Youth Institute Summer Camp

THE STATION PROVIDED support to the Inner City Youth Institute (ICYI), a program that encourages underrepresented youths to pursue higher education and careers in the natural resource and environment fields. The ICYI sponsors ecology clubs in inner-city middle and high schools and a summer camp program for middle school students, held in Corvallis, Oregon. This summer the ICYI sponsored its 8th natural resources camp at Oregon State University. Twenty-six middle school students from inner city Portland, Oregon, engaged in a week of intense natural resource education while living in a college environment. Activities included day trips to Alsea Falls and Finley Wildlife Refuge and an

evening hike to Mary's Peak. Station scientists were actively involved in the camp. The highlight of this year's camp was being guided by PNW scientist Eric Forsman through the old-growth stands in McDonald Dunn Forest, where the students saw three spotted owls called in by Eric.

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Partners: Audubon Society of Portland; Oregon State University; USDA Forest Service, Pacific Northwest Region; USDI Bureau of Land Management



Bob Szaro

The Oregon Department of Forestry is using models tested in a central Oregon landscape analysis for their assessment of all Oregon forests.

Interagency landscape models are being used in state and federal forest planning

THE INTERAGENCY MAPPING and Assessment Project (IMAP) pools scientific expertise, landscape models, and data in support of improved forest planning for state and federal agencies. Landscape models are most useful when all landowners contribute data, and, in turn, all landowners can benefit by using the improved models to analyze management possibilities. Using IMAP, landowners with different objectives—whether it be maintaining old growth, reducing fire risk, or producing timber—can translate their ideas and goals into landscape models and understand how different scenarios might play out over time and large areas.

After a successful pilot, the central Oregon landscape analysis, the Oregon Department of Forestry is now using IMAP for their 2010 assessment of all 28 million acres of forest in the state and the resulting Forestry Program for Oregon. The IMAP models and data are also being used for most national forest plan revisions in the Pacific Northwest Region (13 national forests and 5 other areas such as national grasslands in Oregon, and 3 national forests west of the Cascade Range crest in Washington) and for monitoring under the Northwest Forest Plan. The IMAP models can also be used to study other issues such as fire and fuel risk, conversion of wildlands to developed areas, carbon storage, and wildlife habitats.

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Partners: Oregon Department of Forestry; The Nature Conservancy in Oregon; USDA Forest Service, Pacific Northwest Region; USDI Bureau of Land Management, Regional Office