2002 Science Accomplishments

of the Pacific Northwest Research Station

Contents

March 2003

Vision and Mission

We are highly sought for our scientific leadership and impartial knowledge.

Our mission is to generate and communicate scientific knowledge that helps people understand and make informed choices about people, natural resources, and the environment.

Station Director's Message

Thomas M. Quigley

Citizens of many interests seek to understand forests and their many values. Land managers need know-how as they implement public policy or accomplish private or tribal goals for forests. Policymakers require comprehensive yet readily understandable information on forest-related issues. In 2002, we renewed our dedication to our varied customers as we implemented a new strategic plan developed with their help.

We conduct research to help form basic knowledge. For example this year we found, contrary to popular belief, most summer flow out of the high Cascade Range does not come from annual snowmelt but from groundwater that emerges as springs. Our description of this water geology provides context for calculating water budgets and allocation among many important uses.

Our forest and inventory analysis accelerated in the past several years to provide up-to-date information for all ownerships. In 2002, one finding, for example, shows that Oregon's land use program appears successful at containing urban expansion within areas zoned for development. We find in Oregon that although many acres moved in and out of forested status over the last 70 years, the total amount of forest land has changed little.

In response to national and regional fire issues from increasing fire risk, which brought about the National Fire Plan, the Station's overall program in fire research has increased from about $2 million in 1999 to about $12 million in 2002. Findings about fire produced in 2002 include:

- A new fire risk model makes 3- to 12-month forecasts of fire risks for the United States. The model correctly predicted the fire susceptibility in the Southwest early in the 2002 fire season and the severe fires in the Pacific Northwest later in the season. The accuracy of the forecast this year validated the model.
- Fire risk is highly variable across regions and changes over time. Scientific information from federal lands in the interior Columbia River basin shows the probability that a wildfire will be a stand-replacement fire has more than doubled because of fire exclusion, timber harvest, livestock grazing, and introduction of exotic species.
- Fires could increase in extent and severity throughout the interior West under global warming. Increased precipitation from warming could cause forests to expand and increase in density. Ignitions would spike during dry years.

To enhance the application of our research, we communicate and develop information. This year, *PNW Science Update* was launched as a quarterly publication to succinctly describe scientific information that contributes to natural resource and environmental issues.

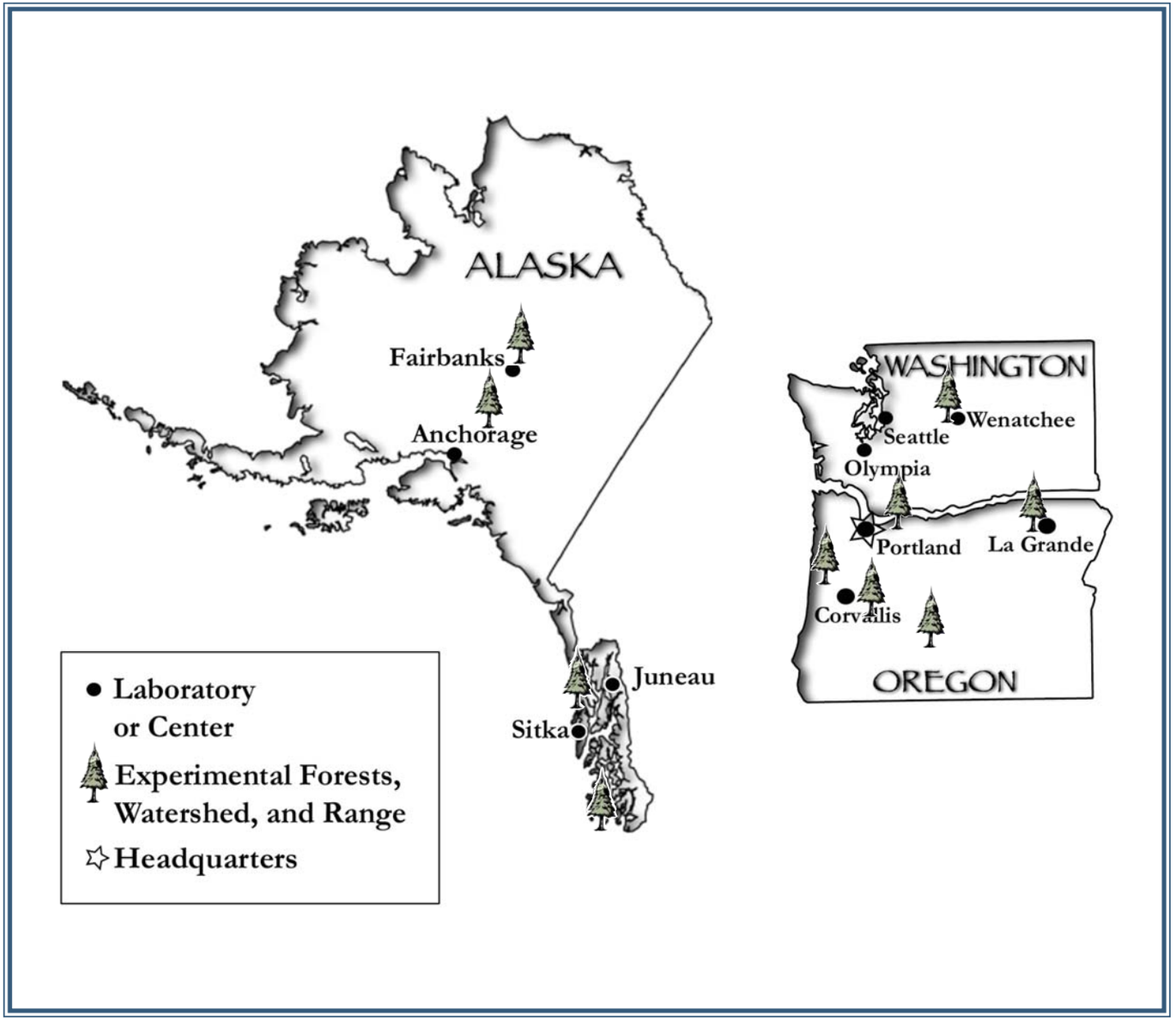
The Station works closely with public and private land managers. For example, as part of an industry research effort called Agenda 2020, we started four studies in 2002 including the effects of soil and climate on long-term productivity of Douglas-fir. Other studies from the 5-year partnership have begun to yield information such as early findings on soil compaction that could help reduce harvest costs yet protect forest sustainability. This regional effort is a prototype for Forest Service Research and Development as it sponsors the Sustainable Forestry component of Agenda 2020 across the country.

As the new Director of the Pacific Northwest Research Station, I am pleased with the Station's accomplishments. These accomplishments are the result of work by dedicated Station employees and research partners. I appreciate the hard work and commitment to science information and products that will make a difference.

THOMAS M. QUIGLEY
Station Director

PNW Research Station: The Setting

- 10 laboratories in Alaska, Oregon, and Washington
- 10 active experimental areas (watershed, range, and experimental forests)
- Research also conducted in more than 20 research natural areas (RNAs)
- Headquarters in Portland, Oregon
- PNW is 1 of 6 research stations in the U.S. Department of Agriculture, Forest Service
- 522 employees (279 permanent, 243 temporary)



Goal Accomplishments

Goal 1: Develop a Fundamental Understanding of Ecological, Social, and Economic Systems and Their Interactions

Key Findings:

- Fires could increase in extent and severity throughout the interior West under global warming. Increased precipitation from warming would cause forests to expand and increase in density. Ignitions would spike during dry years.
- Climate-change scenarios indicate that in the forest sector, those who own and grow trees would be most at risk to lose income. The forest sector as a whole was found to have adjustment mechanisms that mitigate climate-change effects.
- The dynamics of fuel moisture influence the flammability of forest floor duff. Data from Florida longleaf pine forests are helping unlock the complex duff moisture dynamics of boreal forest systems in Alaska.
- Historical fire regimes differed among areas in western Oregon and Washington. Over the past 600 years, fires tended to be more frequent, less severe, and smaller in dryer, warmer areas of the region, such as the Willamette Valley foothills and southern Cascade Range.
- Although public acceptance is necessary for public resource management decisions, public judgments are almost always provisional.
- The geology of source water helps determine stream temperatures. High Cascades streams are very cold all summer long because they originate from deep groundwater stored for decades, not from annual snowmelt.
- A new model identifies habitat patches for large carnivore species such as grizzly bear, wolf, lynx, and wolverine; and evaluates the landscape characteristics that influence the movement of large carnivores among those habitat patches in Washington.
- Geomorphic surface types influence the amphibians in headwater basins in unmanaged forest stands. Within the riparian zone, the slopes closest to the streams are hotspots for biological diversity in the central Coast Range of Oregon.
- After wildfires in eastern Washington forests, more cavities occurred in ponderosa pine and Douglas-fir than in other tree species. Ponderosa pine and Douglas-fir snags were most likely to have cavities if they had large diameters, moderate heights, and broken tops; were in a "soft decay" condition; and were located in burns that occurred more than 20 years ago.
- In hardwood bottomland forests on alluvial flood plains of the lower Mississippi River, small forest openings may enhance bird and small mammal diversity.
- Red alder is associated with higher levels of nitrate, a crucial nutrient for algae, in streams. However, not all streams with high alder coverage had high nitrate concentrations, suggesting that other factors also regulate nutrient levels.

Accomplishments

Fires in the interior West could increase under global warming

In the initial stages of global warming, precipitation is likely to increase and cause forests to expand and their density to increase throughout most of the interior West. These resulting forests would have more fuel than today's forests, and fires likely would increase in extent and severity. Ignitions would spike in dry years. Carbon storage may increase with the forest expansion. As temperatures increase further, however, forest expansion and carbon storage would decline, and drought stress and severe fires would counter increases in net primary productivity.

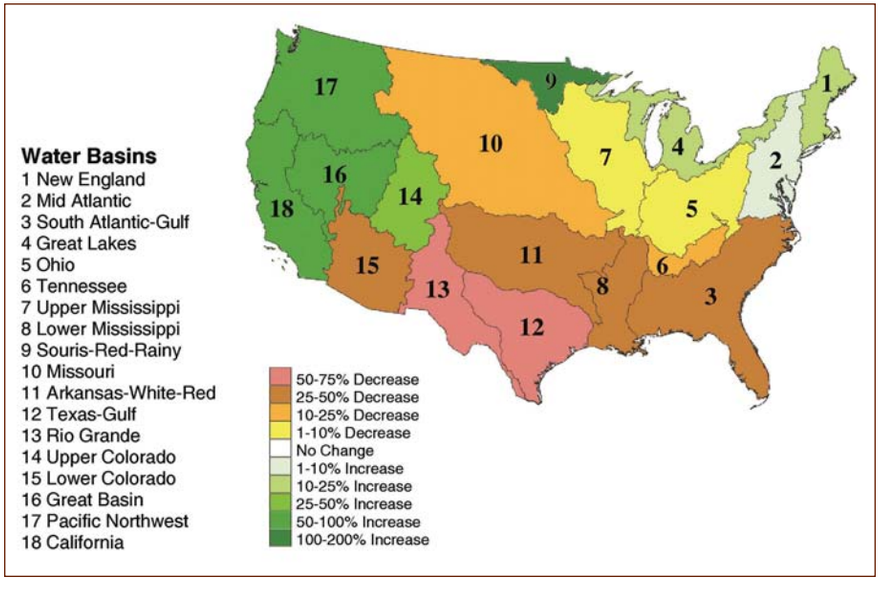
Increased precipitation and snowmelt earlier than occurs currently could increase flooding in many parts of the West. Runoff could increase from 50 to 100 percent over most of the Pacific Northwest, California, and the Great Basin.

In the Southeast, forests would expand in moderate warming scenarios. In more severe warming scenarios, forests would decline as catastrophic fires turned forests into savannas. Over the entire Eastern United States, surface runoff could range from a slight decrease to a decline of more than 50 percent. In seven future climate scenarios, the Mississippi drainage averages a 20-percent decline in runoff.

Contact: Ron Neilson, rneilson@fs.fed.us, Managing Disturbance Regimes Program
More information: Science Findings 44, May 2002. *Is Carbon Storage Enough? Can Plants Adapt? New Questions in Climate Change Research.* www.fs.fed.us/pnw/sciencef/scifi44.pdf.

Computer models analyze how climate affects tree regeneration, forest productivity, and fire

Climate and fire are driving factors in the forest health and productivity of eastern Oregon and Washington. Climatic variability is complicated by the area's mountain, steppe, and canyon topography, and its mosaic of forests and other vegetation types. Fire and its effects are largely controlled by the amount and type of fuels available and weather-related influences while fires are burning.



Global warming would likely change runoff for major water basins in the United States. Map shows the average percentage of change in runoff across seven general circulation models for major water basins.

Scientists have analyzed the relationships over the past few decades among climate variations, management actions, ecological changes, and fuel bed changes in eastern Oregon and Washington. This analysis enables scientists to develop computer models that make projections about how effective various management options might be. The models analyze the complex conditions that enhance or limit tree regeneration, forest productivity, and disturbances such as fire.

Contact: Sam Sandberg, dsandberg@fs.fed.us, Managing Disturbance Regimes Program
Partners: USDA Forest Service Pacific Northwest Region, University of Washington, National Oceanic and Atmospheric Administration, Washington Department of Ecology

Tundra plant communities responded rapidly to climate warming, potentially decreasing biodiversity and altering carbon storage capacity.

Forest sector has adjustment mechanisms to mitigate economic effects of climate change

If global climate change affects forests, the biological responses will in turn have economic effects. As part of a national assessment of climate change, scientists evaluated the potential forest-related economic effects of four possible climate change scenarios.

The 100-year projections show increased forest growth and thus more wood, a change of benefit to consumers but not to those who own and grow trees. In fact, those who own and grow trees would be most at risk to lose income under the four scenarios because increased yields would cause the price for trees to go down, decreasing revenue to landowners.

The forest sector as a whole was found to have adjustment mechanisms that will mitigate the economic effects of climate change. These mechanisms include adjustments of forest land prices, interregional migration of wood products manufacturing, overall growth in wood products use as wood is substituted for other materials in some products, and substitution of pulpwood products for sawtimber in some uses. Finally, forest landowners are projected to change their management practices, including the intensity of forest management and stand rotation age. Harvest patterns also are projected to change, with harvest volume shifting among owners and regions.

Contact: Ralph Alig, ralig@fs.fed.us, Human and Natural Resources Interactions Program
Partners: Oregon State University, Texas A&M University

Tundra plant communities change under experimental and natural climate warming

In northern Alaska, the composition of tundra plant communities changed when the communities were exposed to climate warming. Station scientists led a group of international partners in research on more than 10 sites around the circumpolar Arctic, including northern Canada, Greenland, northern Scandinavia, and northern Asia. Alpine areas in Colorado and Tibet also were included. The combined data showed that communities experimentally warmed about 4 degrees Fahrenheit had a clear and significant shift to increased woodiness and decreased moss and lichen cover that was detectable after only 4 to 6 years. Some moss and lichen species were lost, and no new species were gained in any category. Rare species became more rare, and some woody species became more common. Many scientists hypothesized that nutrient limitations would suppress the ability of these tundra ecosystems to respond to warming, but that limitation was apparent only in the first few years. The change is particularly significant because these ecosystems sequester large amounts of carbon, and shifts in plant communities will change the nature of that sequestration.

Perhaps even more significant, some control plots showed similar changes in plant communities in regions where the growing season temperatures in fact have increased. In all cases, whether the warming was experimental or natural, biodiversity decreased dramatically with warming. The results make a compelling argument that tundra plant communities respond rapidly to environmental change, potentially decreasing biodiversity and altering carbon storage capacity.

Contact: Marilyn Walker, mdwalker@fs.fed.us, Ecosystem Processes Program
Partner: University of Alaska at Fairbanks

Marginal populations of southeast Alaska trees are possible indicators of climate change

Trees at the margins of their species range are potentially early indicators of climate change. For all tree species studied in southeast Alaska, tree distribution was associated more closely with topographic slope than with site aspect. This distribution reflects

the general geomorphology of southeast Alaska, in that most species have core populations at low elevations and marginal populations at higher elevations with steeper slopes. In addition, in southeast Alaska, solar radiation is diffuse during much of the growing season, so that no aspect receives much of an advantage in terms of light availability or temperature. Results varied for individual species.

Contact: Bill van Hees, bvanhees@fs.fed.us, Forest Inventory and Analysis Program
Partner: Leeds University

Dynamics of fuels and fires were studied from boreal to tropical forests

Forest floor duff is an important fuelbed component, yet its contribution to fire behavior is not well understood. Scientists are studying fuel moisture dynamics of duff in the longleaf pine forests of Florida, a simple system hydrologically, and this information is helping them unlock the extremely complex moisture dynamics of boreal forest systems in Alaska.

In eastern Oregon, scientists set up a project to measure the effectiveness of prescribed fire in treating fuels and restoring ecosystems changed by past fire suppression. The research team is monitoring atmospheric conditions, ground and surface fuel moisture dynamics, fire physics especially in the poorly understood smoldering stage, biomass consumption, and production of smoke and pollutants, before, during, and after prescribed fires. The results will be combined with similar experiments in other ecosystems ranging from tropical to boreal forests, and the information will help understanding of fire dynamics in all ecosystems.

Contact: Sam Sandberg, dsandberg@fs.fed.us, Managing Disturbance Regimes Program

Historical fire regimes differed among areas in western Oregon and Washington

Scientists have completed two syntheses of landscape-scale fire history studies done in 10 areas in western Oregon and Washington. The results show that

USDA Forest Service

Roger Ottmar collects fire physics data in Baker City watershed, eastern Oregon.

historical fire patterns differed widely from the southern Cascade Range in Oregon, to the northern Cascade Range in Washington. Over the past 600 years, fires tended to be more frequent, less severe, and smaller in dryer, warmer areas of the region, such as the Willamette Valley foothills and southern Cascade Range. In the central Coast Range of Oregon and the northern Cascade Range, fires were less frequent but more severe and larger.

Extensive fires occurred throughout the region during the 1500s and 1800s. During other centuries—the 1600s, 1700s, and 1900s—fires were less extensive regionally. This pattern is believed to be the result of climatic variations up until the 1800s. In the second half of the 1800s, European-American settlers were at least partly responsible for the roughly doubled number of acres burned. But in

Even management decisions and actions that are supported by sound science will ultimately fail if social acceptance is lacking.

Tom Iraci

These remnants of old-growth forest in mature forest are the result of historical fire regimes.

the 1900s, people worked to suppress fires, and the average area burned was low in historical terms, even though the 1900s were generally a warm, dry climate period.

The geographic pattern of fire regimes reveals the broad outline of historical forest disturbance. Local landforms also influence fire regimes, suggesting that simple rules for forest management, such as fixed-width stream buffers, create unnatural landscape patterns. Even though no single regime serves as a reference condition for management options, historical fire patterns can be useful for designing coarse-filter approaches to species protection in areas of active management.

Contact: Fred Swanson, fswanson@fs.fed.us, Ecosystem Processes Program
More information: Science Findings 46, September 2002. *When the Forest Burns: Making Sense of Fire History.* www.fs.fed.us./pnw/sciencef/scifi46.pdf.

People's judgments about forest practices are provisional

Even when people find forest practices acceptable, their judgments are almost always provisional, never absolute or final. Scientists evaluated the current state of knowledge regarding the factors that shape, sustain, and alter public judgments about the acceptability of various forest management conditions and practices. People form judgments through a complex of factors, with technical and scientific information only one of these.

Scientists have found that people's judgments and their durability are affected by people's level of trust in managers, their personal experiences with place, their ideas about what "natural" is, the degree of risk seen in management actions, and people's reliance on their values or experiential knowledge in addition to scientific knowledge.

The research suggests that even management decisions and actions that are supported by sound science will ultimately fail if social acceptance is lacking. However, the research also identifies strategies to gain public acceptance. Suggested strategies include (1) treat social acceptability as a process rather than an end product, (2) develop organizational capacity to respond to public concerns, (3) approach trust-building as the central long-term goal of effective public process, (4) provide leadership to develop a shared understanding of forest conditions and practices, and (5) focus on the larger context within which forest landscapes are managed, including uncertainties and risks.

Contact: George H. Stankey, ghstankey@fs.fed.us, Human and Natural Resources Interactions Program
Partners: Oregon State University, Utah State University

USDA Forest Service

Civilian Conservation Corps (CCC) firefighting crew, on what is now the Gifford Pinchot National Forest. The CCC was integrated from 1933 to 1935 and segregated from 1935 to 1942, when the CCC was disbanded.

Diverse people view environmental issues differently

Social scientists found that people of color had environmental experiences different from those of middle and working class white people during the 19th and 20th centuries in the United States. The white experience is better known. Some middle class white people left cities to focus attention on outdoor explorations, wilderness, and wildlife issues. Their interests led to the 20th-century environmental movement, which focused on wilderness preservation, wildlife and habitat protection, and outdoor recreation issues, turning to pollution issues in the 1960s. Other middle class and working white people took on an urban environmental agenda focused on parks, open spaces, public health, sanitation, worker rights, pollution abatement, and housing reform.

People of color, however, were driven off their land, corralled on reservations, and worked as low-wage laborers. They developed an environmental justice agenda that linked racism and oppression to worker health and safety issues, the struggle for human rights and self-determination, limited access to resources, loss of or denial of land ownership, and disproportionate impacts of environmental hazards. Not surprisingly, then, diverse people view various environmental issues very differently.

Contacts for different race, class, and gender perspectives: Ellen Donoghue, edonoghue@fs.fed.us, Human and Natural Resources Interactions Program
Partner: University of Michigan

High Cascades streams originate from deep groundwater

Contrary to popular belief, most summer streamflow out of the high Cascade Range does not come from annual snowmelt. The high Cascade Range is a vast hydrologic sponge that stores many decades worth of water as deep groundwater. This water emerges from springs along both the east and west sides of the Cascade crest, fed by very large regional aquifers flowing through the young volcanic rock. These springs and streams have very cold water all summer long

Tom Iraci

Deep groundwater emerges in large springs in the Cascade Range, such as here at Jack Creek, Metolius basin, Oregon.

Gordon Grant

Cougar Reservoir, South Fork of the McKenzie River, Oregon, during drawdown for salmon-related dam improvements in summer 2002.

and discharge rates that are fairly stable compared to streams originating from annual snowmelt. Even during drought years, streams and rivers fed by deep groundwater flow at virtually constant rates. The water in these high Cascades streams fell as rain or snow as long ago as 30 to 40 years.

On the west slope of the Cascade Range in the H.J. Andrews Experimental Forest, some streams are much colder than other streams all summer long. The cold streams have greater discharge than their watershed could supply from annual precipitation and have water with a higher phosphorus content than recent precipitation. These clues indicate that the water source for these cold streams is likely deep groundwater. The water source for the other streams is most likely annual precipitation and snowmelt.

This research provides a context for calculating water budgets and allocations, establishing stream temperature standards, and interpreting the effects of land use and climate change on water resources in western Oregon.

Contacts: Sherri Johnson, sherrijohnson@fs.fed.us and Gordon Grant, ggrant@fs.fed.us, Ecosystem Processes Program

For more information: Science Findings 49, December 2002. *Geology as Destiny: Cold Waters Run Deep in Western Oregon.* www.fs.fed.us/pnw/sciencef/scifi49.pdf.

Turbidity "hotspots" affect municipal drinking water sources

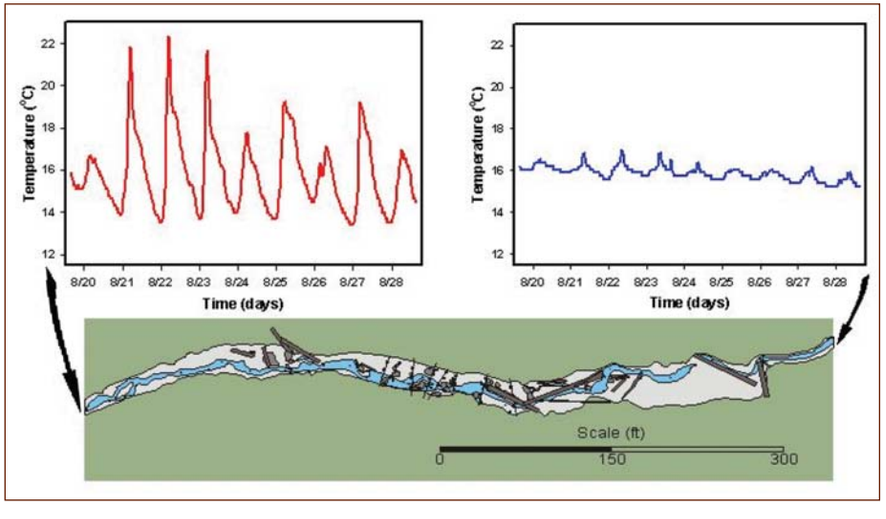
Many forested watersheds in the Pacific Northwest are sources of high-quality municipal drinking water. Scientists have found that the underlying geology of watersheds affects water quality from those basins. In western Oregon mountain watersheds, certain clays cause persistent turbidity and thus affect water quality. These clays are concentrated in distinct landforms and zones within western Oregon mountain watersheds. The "hotspots" deliver high concentrations of turbidity-causing clays into streams and rivers during major storms, but deliver little clay between storms. If activities such as road construction and timber harvest occur near these turbidity hotspots, they may increase the potential for high turbidity downstream. Further, reservoirs in these watersheds concentrate the clays, and reservoir management, including drawdowns and dam removals, may cause high-turbidity spikes downstream. The turbidity spikes can be problems for municipal water suppliers and aquatic resources.

Scientists can identify these turbidity hotspots with analysis of the watershed's clay mineralogy, landform mapping, and geographic information system analysis. This information can help land managers evaluate risks attached to forest land use and reservoir management.

Contact for turbidity and drinking water: Gordon Grant, ggrant@fs.fed.us, Ecosystem Processes Program

Subsurface water flows reduce water temperature fluctuation in streams

Water flows below the surface in a mountain stream as well as above ground. The subsurface, or hyporheic, water enters and leaves a mountain stream many times. In a small mountain stream in western Oregon, water temperature had a daily range of 16 degrees Fahrenheit in a stream reach where water flowed in an unshaded channel scoured to bedrock and no hyporheic exchange occurred. But after water flowed 980 feet through a reach with an extensive hyporheic zone, the daily range in stream temperature was less than 4 degrees. The average daily temperature was identical in both locations; the range differed.



Stream temperature data, H.J. Andrews Experimental Forest, Oregon. Over these 8 days, stream water temperature averaged 60.5 °F at both sites, despite large differences in daily temperature range.

Temperature oscillations were highly correlated to the travel times of water flowing from the stream to experimental wells that measured subsurface water, suggesting that heat exchange with hyporheic sediment and water mixing dampened the temperature oscillations. Subsurface water flow has the potential to dampen daily temperature fluctuations in stream water or to create thermal refugia. With better knowledge about the mechanisms that control stream temperatures, managers have a stronger scientific basis for setting forest practice rules.

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

Scott Gende

Brown bear catches pink salmon in Alaska.

Salmon and other anadromous fish influence the productivity of freshwater ecosystems

Salmon are a major food source for predators such as Alaska brown bears. A new study shows that when brown bears fish for spawning salmon, they preferentially kill salmon that are highest in lipid content, which are the fish that have been in the stream for the fewest number of days. The bears also prefer to eat the body parts with the highest lipid density, such as the salmon skin, brain, and in females, the roe (eggs).

Social hierarchy (dominance) played a major role in the brown bears' choice of fishing place, success rate while fishing, time available for fishing, and distance that salmon were transported from the stream. The dominant bears were always big, regardless of sex or reproductive status (i.e., presence of cubs with a sow).

It's been known for some years that salmon deliver valuable nutrients from marine ecosystems into freshwater and terrestrial ecosystems, in the form of salmon carcasses and eggs. Previous studies have identified distinctive marine isotopes of nitrogen and carbon present in returning salmon and then traced these isotopes through freshwater and riparian food webs.

New research documents the influence of these marine nutrients on productivity and biodiversity in freshwater ecosystems. The research was done primarily in Alaska, including the Copper River Delta, Chilkat River drainage near Haines, and Margaret River drainage near Ketchikan. Current projects are underway near Juneau, Alaska, and also in the Clackamas and Sandy basins of the Columbia River basin, with Mount Hood National Forest as partner. Scientists used isotopes to trace the nutrient flow from the returns of wild runs and, in some cases, hatchery salmon carcasses placed in watersheds. Scientists found that this marine subsidy substantially influences stream and riparian food webs and elevates freshwater productivity. All levels of the food web, including microscopic animals, invertebrates, and fish, respond to marine nutrients with increased growth, production, densities, biomass, or lipid reserves. Resource managers are using the results in their management decisions about salmon escapement levels, fish ladder construction, and nutrient restoration to streams.

Other anadromous fish besides salmon are also important as food and nutrient sources. Eulachon runs are short-lived but intense, and can sustain large numbers of predators for a short time. For one eulachon run at Berner's Bay, Alaska, an average of over 40,000 gulls, 250 Steller sea lions, and 600 bald eagles fed on the run every day.

Contact for brown bear feeding and eulachon studies: Scott M. Gende, sgende@fs.fed.us, Aquatic and Land Interactions Program
Contact for marine-derived biomass in food webs: Mark S. Wipfli, mwipfli@fs.fed.us; Gordon H. Reeves, greeves@fs.fed.us; and Richard T. Edwards, rtedwards@fs.fed.us; Aquatic and Land Interactions Program

Stream reaches on private lands have the most intrinsic potential for coho salmon habitat

In the Oregon Coast Range, stream reaches with the highest potential for coho and chinook salmon habitat occurred on private agricultural and non-industrial forested lands, whereas those for steelhead and cutthroat trout habitat occurred farther upstream, often on forested lands under public ownership.

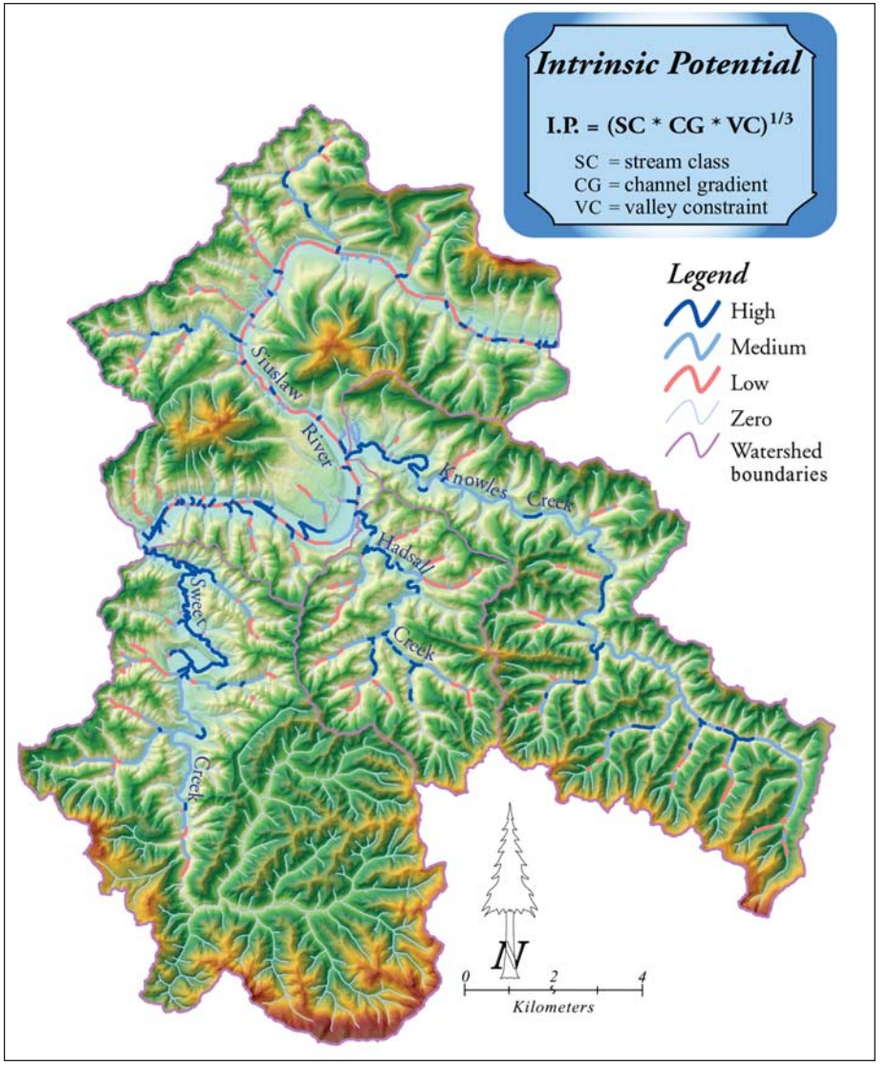
An evaluation was done as part of the coastal landscape analysis and modeling study (CLAMS). Streams, delineated with a newly derived model, differed in their potential for developing high-quality habitat.

Results can be used in regional prioritization strategies to characterize watersheds based on their potential to develop high-quality habitat and their past management influences. Land managers could use results to identify good candidates for conservation (high potential and low past management influence), restoration (high potential but high past management influence), or intensive management (low potential). Managers also could use the modeled stream networks to delineate riparian areas and evaluate the probability of debris-flow transport and deposition.

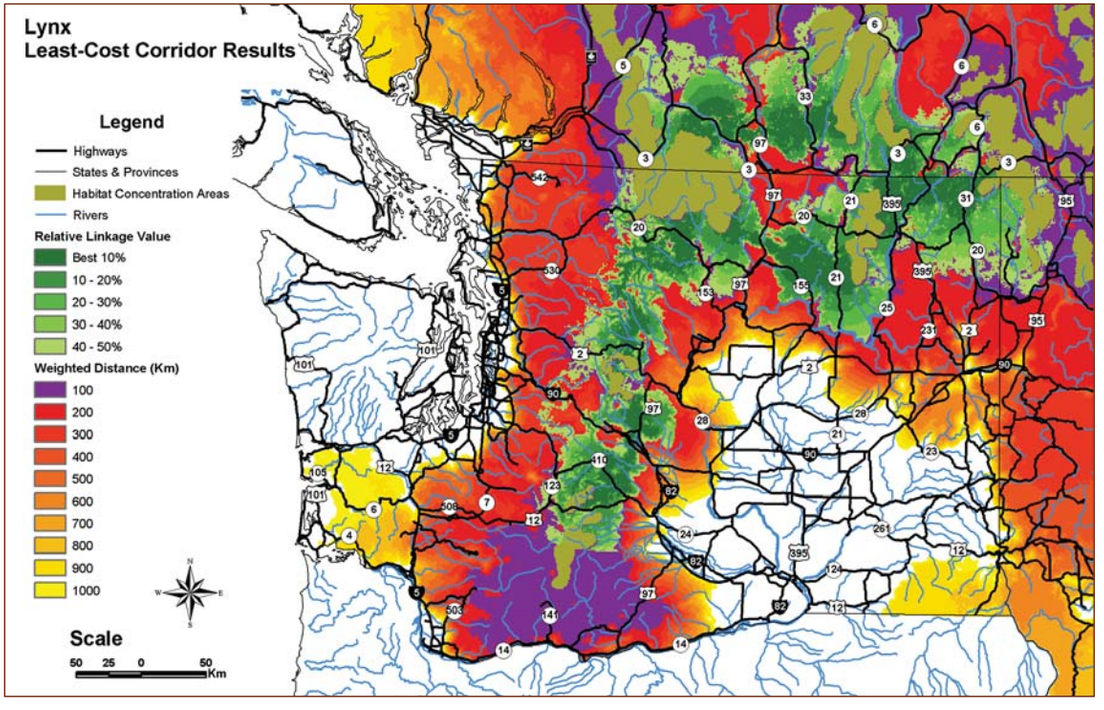
Contact: Kelly Burnett, kburnett@fs.fed.us, Aquatic and Land Interactions Program

Regional model assesses landscape permeability for large carnivores in Washington

In the Pacific Northwest, threatened and endangered large carnivores exist in small populations in fragmented habitats. Recent recovery plans for these animals emphasize the importance of habitat connectivity among these fragmented habitats. Scientists conducted a regional assessment of landscape permeability for grizzly bears, wolves, lynx, and wolverines in Washington, southern British Columbia, and adjacent portions of Idaho. Scientists developed models that identified five patches of large carnivore habitat in Washington and adjacent portions of British Columbia.



Intrinsic potential of stream reaches to develop high-quality habitat for salmon and trout for an area in the Oregon Coast Range.



Landscape permeability for lynx in Washington and adjacent areas of British Columbia and Idaho.

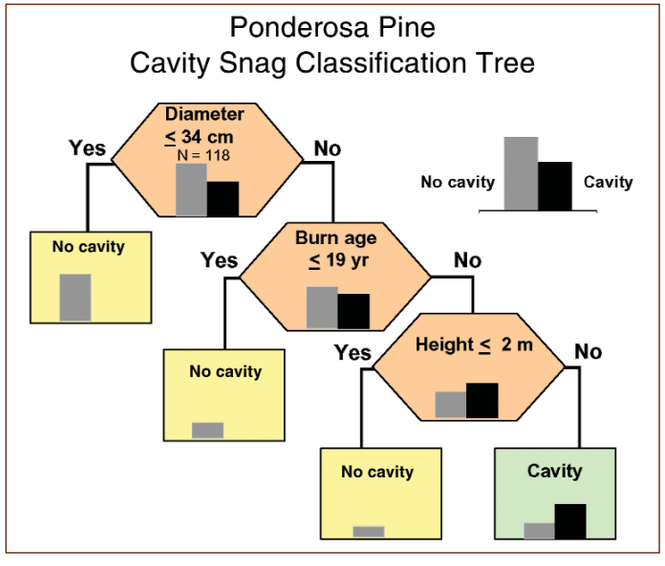
Landscape permeability—or characteristics that influence the movement of large carnivores—is critical for their conservation and recovery. Characteristics include the distribution of roads, human population density, land cover type, and topography. The scientists evaluated these characteristics in the four areas between the patches of habitat. The resulting maps will be useful in guiding field surveys and will contribute to regional recovery planning for threatened and endangered carnivores.

Contact: Peter Singleton, psingleton@fs.fed.us, Managing Disturbance Regimes Program
Partners: Okanogan and Wenatchee National Forests, Washington State Department of Transportation

Identified factors predict cavity development in snags after wildfires

Snags are vital wildlife habitats in forests. In 26 burned areas in eastern Washington, more cavities occurred in ponderosa pine and Douglas-fir than in other tree species. Few or no cavities were found in subalpine fir and lodgepole pine snags.

Ponderosa pine and Douglas-fir snags were most likely to have cavities if they had large diameters, moderate heights, and broken tops; were in a "soft decay" condition; and were located in burns that had occurred more than 20 years ago. Classification models developed to predict cavity occurrence were 88 to 97 percent accurate when tested on other burned areas.



Classification model predicts cavity occurrence in ponderosa pine snags.

The study suggests that to maintain or restore snags after fires, managers could target defective trees in nearby green forests to provide immediate postfire snag habitat, retain those trees for the short term, and retain large snags in the burned area for long-term snag habitat.

Contact: John Lehmkuhl, jlehmkuhl@fs.fed.us, Managing Disturbance Regimes Program
Partners: Okanogan and Wenatchee National Forests

West-side pileated woodpeckers choose snags and live trees equally

The pileated woodpecker is a keystone species in Pacific Northwest forests. The large woodpeckers fill a role as ecological engineers as they excavate nest and roost cavities in trees. These cavities are later used by a wide array of species, including the common merganser, silver-haired bat, fisher, and American marten.

Guidelines for pileated woodpecker management were based on research done on the east side of the Cascade Range. In the first major research study done on pileated woodpeckers west of the Cascade crest, the researchers are finding that

Catherine M. Raley

Male pileated woodpecker wears "backpack" radio transmitter, in first major west-side research on the species.

west-side pileated woodpeckers have behaviors significantly different from those on the east side.

East of the Cascade crest, the birds create cavities mostly in snags. But in the coastal forests of western Washington, pileated woodpeckers nest equally in both snags and live trees with dead tops. In western Washington, 48 percent of the nests found were in live trees with dead tops, compared to less than 1 percent in northeastern Oregon, and 19 percent in western Montana.

If forest managers provide habitat conditions that maintain pileated woodpeckers, other species are likely to benefit as well.

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

Off-road recreation affects elk and mule deer movements

At the Starkey Experimental Forest and Range in northeast Oregon, scientists studied how elk and mule deer responded to people engaged in off-road recreation. For a controlled experiment, scientists established a series of off-road transects designed to mimic a typical network of off-road trails on a national forest. People ran the transects on all-terrain vehicles (ATVs), mountain bikes, horseback, and on foot, as experimental treatments.

The animals' responses were measured in terms of how far the elk and deer moved and how much energy they expended before, during, and after the off-road recreational activities on each transect. Eventually, the results will be used in energy budget models to assess the overall effects of each off-road activity on the survival and reproductive potential of deer and elk.

Contacts: Marty Vavra, mvavra@fs.fed.us; Mike Wisdom, mwisdom@fs.fed.us, Managing Disturbance Regimes
Partners: Oregon Department of Fish and Wildlife, Oregon Department of Parks and Recreation, Rocky Mountain Elk Foundation, Wallowa-Whitman National Forest, USDA Forest Service Pacific Northwest Region

Fish may be better indicators of site-scale stream conditions; amphibians may be better indicators of landscape-scale riparian and upland features.

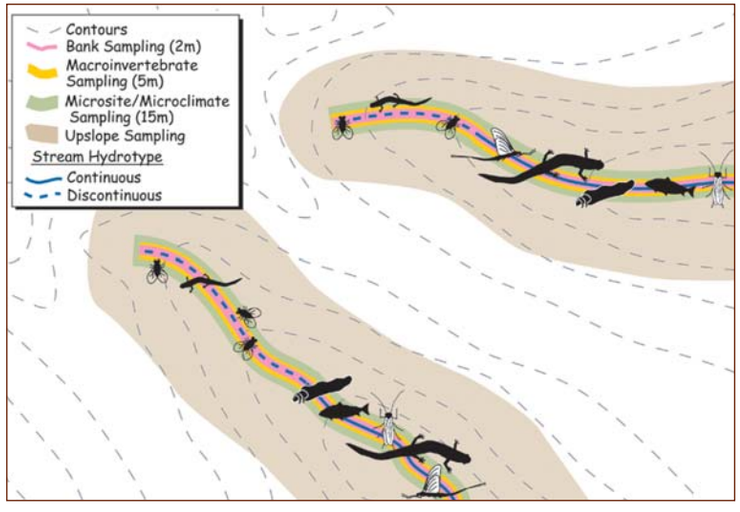
Small forest openings enhance biodiversity in hardwood bottomland forests in the South

Old-growth, hardwood bottomland forests are important wildlife habitat in the Southern United States and contribute substantial biological diversity to the landscape. New studies completed with cooperators from the South have provided several insights into the wildlife ecology of old-growth hardwood bottomland forests in alluvial flood plains of the lower Mississippi River.

Forest openings create habitat patches with plants that attract animals like white-tailed deer, which benefit from forest edges, and swamp rabbits. Although white-tailed deer substantially influence forest vegetation structure and composition, neither deer nor swamp rabbit grazing affected the regeneration of hardwood seedlings or the biological diversity of regenerating plant communities in wind-throw canopy gaps. Because perennial inundation is a major factor affecting plant communities, small changes in local topography may be more important than herbivory in influencing the dynamics of regenerating plant communities.

When compared to second-growth forests, old-growth bottomland forests had a greater richness of species and greater diversity of songbirds. Small mammals were both more abundant and more diverse in old-growth forest than in second-growth forest. Forest openings smaller than 0.6 acres and composing less than 25 percent of the total forest area may enhance breeding bird diversity and habitat for small mammal communities in mature hardwood bottomland forest. The study results have already been incorporated into the USDA Forest Service Southeast Region's "best management practices" and, specifically, are being used by the Delta National Forest in Mississippi.

Contact: Winston P. Smith, wsmith02@fs.fed.us, Aquatic and Land Interactions Program



Habitats and fauna are distributed in predictable patterns along the length of streams and in riparian zones. Inner gorges have the highest amphibian and arthropod diversity

Amphibian diversity in headwater streams is related to specific habitat elements

In the central Coast Range of Oregon, plants and amphibians are distinctly associated with specific landscape features in unmanaged forest stands. In particular, the first slopes up from streams, known as the "inner gorge" areas, are hotspots for biological diversity. The upper edge of the inner gorge is demarcated by a change in slope. The inner gorge is a biodiversity hotspot in managed forests as well, with distinctive habitat conditions and a greater diversity of amphibian and arthropod species. Habitats and animals also are distributed in predictable patterns along the length of the stream channel from zero-order basins (ephemeral systems, headwater catchment areas, and upstream sections of first-order streams) to downstream channels.

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