USGS
science for a changing world

Understanding Our Changing Forests

The increasing demands placed on Pacific Northwest forests, coupled with the changing nature of these forests, challenge public agencies and private landowners responsible for their management. Unbiased scientific understanding, like that provided by the U.S. Geological Survey's (USGS) Forest and Rangeland Ecosystem Science Center, remains at the heart of successful management. With a long history of conducting forest science and long-term relationships with forest managers, this center is capable of conducting research on forest disturbances, forests as habitats for fish and wildlife, ecological monitoring, watersheds, and landscape change and cumulative effects. Information from this research supports decisions associated with forest planning and management.

Forests are economically important to the Pacific Northwest

- Idaho's wood and paper industries account for nearly one-fifth of all labor income generated in the state and more than one-tenth of the state's total employment.
- Washington's forestry and wood products manufacturing sectors pay out over $2 billion in wages and generate $16 billion in business revenue.
- Oregon's forest sector generates over $12 billion directly and nearly $10 billion more through indirect effects. Forests are responsible for at least 25% of the employment base in 60% of the state's counties.

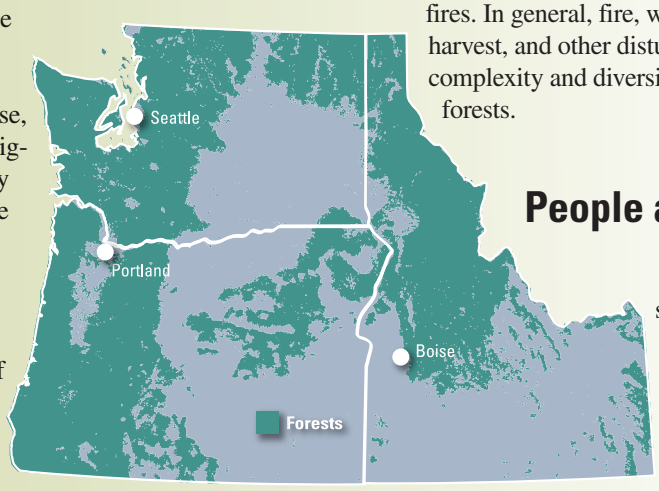
For millennia, inhabitants of the Pacific Northwest were attracted by the wealth of natural resources in the region, including forests, fisheries, rivers, and fertile soils. The forests of the region were then and continue today to be among the most productive, diverse, and spectacular in the world. These forests serve as a significant economic engine even as the regional economy diversifies. In Oregon and Washington, forests generate over $28 billion directly and almost as much through indirect effects. They also are home for the region's iconic species, such as Douglas-fir, Pacific salmon, northern spotted owl, and Roosevelt elk, and provide numerous other ecological values. The vast majority of these forests are on public lands, challenging agencies entrusted with their stewardship to use science for responsible and responsive management.

Forest Ecology

Forests vary by location in the Pacific Northwest. Plentiful rainfall west of the Cascade Mountains contributes to the development of old-growth forests that contain large conifer trees, smaller trees and shrubs, dead wood, and other forms of structural complexity. Some tree species live more than 1,000 years and grow hundreds of feet tall. The greatest forest biological diversity in the region is associated with these old forests, including the federally listed marbled murrelet, northern spotted owl, and coho salmon. East of the Cascade Mountains conditions tend to be drier, the subregion is larger, and a wider array of forest types occur. Douglas-fir and true firs dominate some sites, but lodgepole pine and ponderosa pine are more common. Some forests, especially those dominated by pine, have an open character because of frequent, low-intensity fires. In general, fire, windstorms, timber harvest, and other disturbances change the complexity and diversity of all of these forests.

Forests characterize the Pacific Northwest

- 75 million acres of forests in Idaho, Oregon, and Washington
- 67% of forests are on public land
- Over 100 inches of rainfall in some locations
- More conifer species than anywhere else in the world
- Contains old-growth forests that can produce three times the biomass of tropical rain forests
- Long-lived trees, including Douglas-fir, which can survive more than 1,200 years
- Home to over 450 species of amphibians, reptiles, birds, mammals, and fish



People and Forests

People are significant factors associated with forest change, and their influence will increase as the human population

grows. The number of people in the states of Oregon, Washington, Idaho, and the Canadian province of British Columbia is projected to climb from 14.3 million recorded in 2000 to possibly 39 million by 2050. Housing this increase will put great demands on forests for building materials. In addition, people will need land for their homes and businesses and will place increased demands on forests for clean water, space for recreation, and perhaps a place to store carbon to mitigate climate change. Society will challenge public and private forest managers to support sound economies, as well as provide environmental goods and services. Scientific understanding will remain integral to successful management.

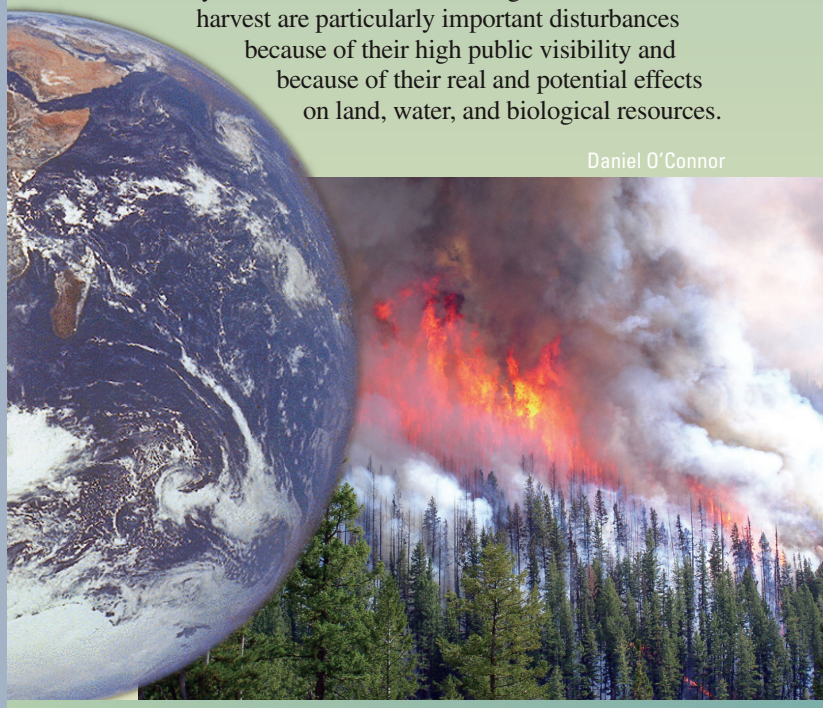
David Wieprecht

Forest Science Program

In 2000, the National Academy of Sciences provided Congress with basic information describing environmental issues in Pacific Northwest forest management: sustain viable populations of indigenous species, maintain properly functioning ecological processes, meet human needs for forest commodities, and satisfy cultural and aesthetic values. These issues are still relevant today. The forest science program at the Forest and Rangeland Ecosystem Science Center explicitly addresses the issues associated with forest ecology and indirectly addresses those associated with human needs for forest commodities and other values. Our science is complementary and builds on a long history of conducting forest science and an equally long history of agency relationships. The research is conducted under the umbrella of five different themes: disturbance, habitats, landscape change and cumulative effects, monitoring, and watersheds, which are outlined in the following pages.

Forest Disturbances as Agents of Change

Many forces shape forests, such as climate, fire, windstorms, earthquakes, landslides, invasive species, insects, and pathogens. Sometimes these forces, or disturbances, are catastrophic and significantly alter the landscape. They often are natural, but management can influence their likelihood and degree of effects. For example, years of fire suppression have increased the frequency and severity of some fires. Climate change, fire, and timber harvest are particularly important disturbances because of their high public visibility and because of their real and potential effects on land, water, and biological resources.



Daniel O'Connor

Research Topics

- Carbon storage & climate change
- Fire-fuels treatments
- Fire ecology
- Post-fire restoration
- Disturbance ecology
- Invasive-species ecology
- Effects of contaminants
- Disturbance & nutrient cycles

The Carbon Treasure Chest

Pacific Northwest forests are a treasure chest of carbon. In vegetation, downed logs, and soils, these forests can store more carbon per area than any other ecosystem on Earth. Carbon uptake and storage by forests is important for mitigating climate change because it slows the accumulation of atmospheric carbon dioxide, a greenhouse gas. We are studying how carbon dynamics in these forests are influenced by climate. Our research combines field studies, experimental manipulations, and computer models to predict how carbon storage will respond to projected climate change. As carbon storage becomes more important to national policymakers and businesses interested in offsetting the release of greenhouse gases, scientific understanding of climate's influence on carbon storage potential in the region's forests will continue to grow in value.

Biscuit Fire Reveals Multiple Effects

In 2002, the western United States experienced the most extensive wildland fire season in the past 50 years. The Biscuit Fire was the largest fire in Oregon in the past century and the costliest ever for the state. It encompassed more than 450,000 acres, put 15,000 homeowners on evacuation notice, changed habitat for fish and wildlife, and cost over $150 million to fight. Such fires have heightened awareness of the need for research both before and after fires occur.

Landscape Change and Cumulative Effects

The Pacific Northwest covers over 150 billion acres, a large area in which to understand change and predict outcomes of disturbance. Federally managed forests have already experienced significant regional change as the result of individual decisions to suppress fires, harvest timber, build roads, or other actions. Cumulative effects of management actions over broad areas are especially difficult to assess in a patchwork of federal land, wilderness areas, and privately owned industrial forests. Landscape studies illuminate patterns of disturbance and cumulative effects of land use at watershed and regional scales, which are necessary for effective planning and management.

Research Topics

- Cumulative impacts
- Decision support
- Landscape assessments
- Spatial modeling
- Remote sensing
- Climate change

Forests as Habitat for Wildlife, Fish, and Plants

Forests of the Pacific Northwest are home to over 450 species of amphibians, reptiles, birds, mammals, and fish, thousands of plant species, and tens of thousands of invertebrate species. Some of these species are extremely widespread and resilient; others are rare and highly sensitive to change. In addition, forest species vary in the types of forests they inhabit and the stages of forest growth that meet their needs for food, cover, water, and space. In fact, habitat conditions are the prime determinants of the number of species present and the number of individuals within a population. Understanding changes in forest structure and function due to natural disturbances or management activities and their potential effects on forest species will help address conservation objectives.

Matt Lee

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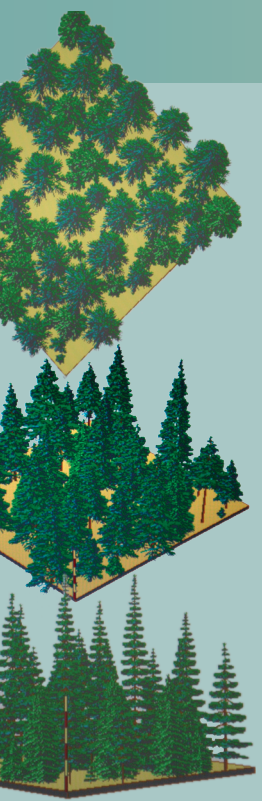
Research Topics

- Species recovery
- Habitat & species management
- Population assessments
- Habitat restoration
- Multi-species conservation
- Integrated silviculture & wildlife habitat



Exploring the Space-Time Continuum

The Bureau of Land Management is revising the Resource Management Plan for its lands in western Oregon and Washington. One critical step is the development and evaluation of management alternatives. To assist their process, we have developed modeling tools to assess how natural disturbances and possible management actions interact within a landscape. For example, how can repeated harvest over multiple decades and large areas affect forest vegetation or change the likelihood of catastrophic fire? Our tools demonstrate some of the effects of management options in a multi-use, fire-prone watershed spanning public and private lands. These "scenarios" are a basis for creative thinking and problem solving, and have been adopted by the agency in planning.

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Owls Barred from Own Territory

The barred owl is moving from the eastern United States into the range of the spotted owl. Although they are close relatives, the barred owl is bigger and more aggressive than the spotted owl. Barred owls, not habitat loss, now are considered the number-one threat to spotted owls. In some cases, barred owls displace resident spotted owls; in others, the two species interbreed to create hybrids. Northern spotted owls are a threatened subspecies under the U.S. Endangered Species Act, but hybrids are not. It is critical to be able to differentiate them, and we have developed genetic techniques that distinguish spotted owls, barred owls, and hybrid birds. We also are investigating the overlap of the two species' home ranges, comparing their diets, and documenting behavioral interactions to improve understanding of spotted owl declines and to develop management actions to reduce the barred owl threat.

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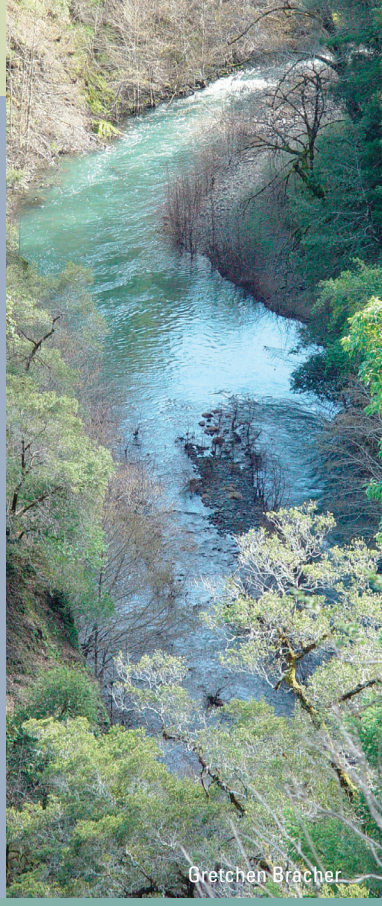
Ecological Monitoring

Ecological monitoring is a critical component of contemporary forest management. Much as landscape studies provide an important perspective across large areas of land, systematic monitoring provides the information to evaluate influences of forest management through periods of time. Monitoring research and technical assistance do not necessarily involve data collection. Rather they examine the scientific underpinnings of different approaches to monitoring, and the relationships of indicators to forest biodiversity and to important forest functions, for example, nutrient cycling, water storage, or carbon storage. In addition, monitoring research examines relationships among management influences and long-term forest change to help inform modifications of management practices in the process called "adaptive management."

Watershed Science

A watershed is a specific land area that drains water into a river system or other body of water. The health of a watershed is a principal measure of how we live on the land. That health includes considerations of the surface water, ground water, vegetation and land as a whole system that produces clear, clean sustainable flows of water, and thus supports water supply, aquatic habitat, and healthy forests. Forest practices have the potential to influence watershed health, and there are best-management practices intended to safeguard water quality and biological objectives for fish and other aquatic life.



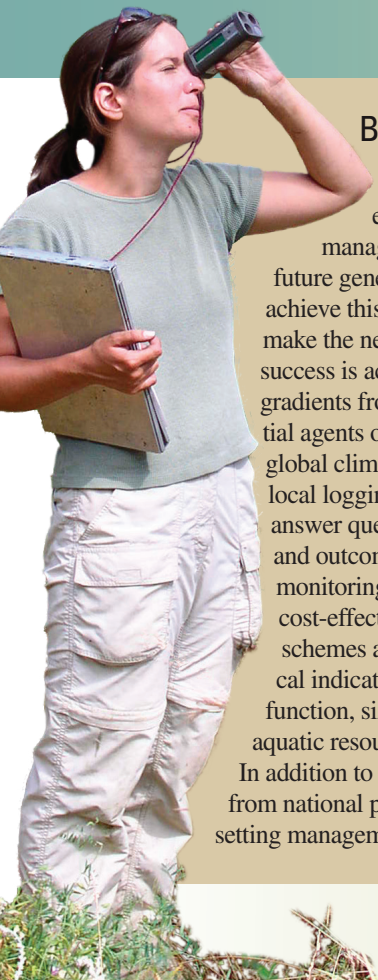
Gretchen Bracher

Research Topics

- Population surveys
- Sample design
- Data analysis
- Methods development & testing
- Information synthesis
- Monitoring management outcomes

Research Topics

- Watershed health
- Ecological connections
- Water quality & quantity
- Habitat restoration
- Fish ecology
- Streamside ecology



Building a Barometer

In the Pacific Northwest, people expect forests in national parks to be managed to leave them "unimpaired for future generations." What does management to achieve this goal look like, and how do managers make the necessary measurements to know when success is achieved? After all, forests in parks span gradients from shorelines to timberline, and potential agents of change are variable, for example global climate change, regional air pollution, and local logging in adjacent forests. We are helping answer questions about management approaches and outcomes using long-term ecological monitoring. With park staff, we are developing a cost-effective, statistically defensible sampling schemes and protocols for measuring ecological indicators of forest structure, composition, function, size and frequency of disturbance events, aquatic resources, and selected wildlife species. In addition to guiding park staff, monitoring results from national parks will establish benchmarks for setting management goals for harvested forests.

Pearls of Watershed Wisdom

Silent sentinels, western pearl shell mussels lie almost unnoticed for more than 100 years in the sand and gravel of streams. Their hard shells document growth similar to tree rings, archiving long-term information that we may be able to decipher. Forests influence streams, and both forests and streams respond to local and regional climate changes. We hope to use information from mussels, trees, and other long-lived organisms to better understand historical climates and the responses of different species in terrestrial and aquatic ecosystems. We are most interested in how water temperature and stream flows can be predicted from the growth of mussels. Mirroring the interconnections of watersheds, lessons from the past may have important implications for a changing future.

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