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Pacific Northwest Research Station

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Pacific Northwest Research Station Publications

The following publications may be ordered by using the form on the inside back cover. Circle the code number for the publication. These publications are available for download at <http://www.fs.fed.us/pnw/publications/complete-list.shtml>.

Atmosphere

07-080

Joyce, L.; Haynes, R.; White, R.; Barbour, R.J., tech. coords.

2007. Bringing climate change into natural resource management: proceedings of a workshop. Gen. Tech. Rep. PNW-GTR-706. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 150 p.

These are the proceedings of the 2005 workshop titled "Implications of bringing climate into natural resource management in the Western United States." This workshop was an attempt to further the dialogue among scientists, land managers, landowners, interested stakeholders, and the public about how individuals are addressing climate change in natural resource management. Discussions illustrated the complexity of global climate change and the need for managers to consider how the impacts of climate change will unfold across regional and local landscapes. The workshop offered examples of how managers are already responding to those aspects of global climate change that they can see or perceive. While no comprehensive solutions emerged, there was an appreciation that policy complexity may exceed the science complexity but that eventually the accumulation of local actions will shape the future.

Keywords: Climate change, forest and range management.

<http://www.treesearch.fs.fed.us/pubs/27014>

Bibliographies

07-181

Pacific Northwest Research Station.

2007. Recent publications of the Pacific Northwest Research Station, third quarter 2006.

Keywords: Bibliographies (forestry).

<http://www.fs.fed.us/pnw/pubs/3q06.pdf>

Economics

06-512

Kline, J.D.

2007. Defining an economics research program to describe and evaluate ecosystem services. Gen. Tech. Rep. PNW-GTR-700. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p.

Balancing society's multiple and sometimes competing objectives regarding forests calls for information describing the direct and indirect benefits resulting from forest policy and management, whether to address wildfire, loss of open space, unmanaged recreation, ecosystem restoration, or other objectives. The USDA Forest Service recently has proposed the concept of ecosystem services as a framework for (1) describing the many benefits provided by public and private forests, (2), evaluating the effects of policy and management decisions involving public and private forest lands, and (3) advocating the use of economic and market-based incentives to protect private forest lands from development. The concept extends traditional economic theory regarding multiple forest benefits and the use of economic incentives to enhance their provision, by emphasizing ecosystems as an organizing structure for benefits. Although the emphasis on ecosystems is new, challenges in evaluating ecosystem services are similar to those long faced by economists tasked with evaluating forest benefits: (1) defining a typology of ecosystem services, (2) describing and measuring ecosystem services units or outputs, and (3) describing and measuring ecosystem services per unit of values or social weights. Progress within the Forest Service in applying the ecosystem services concept to forest policy and management will depend on knowing what information will suffice, working across disciplines, deciding on appropriate analytical frameworks, defining the appropriate role of economic and market-based incentives, and adequately funding economics research.

Keywords: Public goods, nonmarket values, economic analysis, forests and society.

<http://www.treesearch.fs.fed.us/pubs/25265>

Fire

06-089

Johnson, M.C.; Peterson, D.L.; Raymond, C.L.

2007. Guide to fuel treatments in dry forests of the Western United States: assessing forest structure and fire hazard. Gen. Tech. Rep. PNW-GTR-686. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 322 p.

This guide analyzes a range of fuel and vegetation treatments for representative dry forest stands in the Western United States. Five silvicultural options are considered in combination with three surface fuel treatments, resulting in a range of alternative treatments for each representative stand. The Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS) was used to calculate the immediate effects of treatments on surface fuels, fire hazard, potential fire behavior, and forest structure (including visualizations). The fuel treatment scenarios presented here can be used by resource managers to examine alternatives for National Environmental Policy Act documents and other applications that require scientifically based information to quantify the effects of modifying forest structure and surface fuels.

Keywords: Dry forest, FFE-FVS, fire, fire behavior, fire hazard, fuel treatments, silviculture.

<http://www.treesearch.fs.fed.us/pubs/27293>

06-278

Peterson, D.L.; Evers, L.; Gravenmier, R.A.; Eberhardt, E.

2007. Analytical and decision support for managing vegetation and fuels: a consumer guide. Gen. Tech. Rep. PNW-GTR-690. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 151 p.

Current efforts to improve the scientific basis for fire management on public lands will benefit from more efficient transfer of technical information and tools that support planning, implementation, and effectiveness of vegetation and hazardous fuel treatments. The technical scope, complexity, and relevant spatial scale of analytical and decision support tools differ considerably, which provides a challenge to resource managers and other users who want to select tools appropriate for a particular application. This publication provides a state-of-science summary of tools currently available for management of vegetation and fuels. Detailed summaries include a description of each tool, location where it can be obtained, relevant spatial scale, level of user knowledge required, data requirements, model outputs, application in fuel treatments, linkage to other tools, and availability of training and support. Streamlined

summaries in tabular format allow users to rapidly identify those tools that could potentially be applied to a specific management need. In addition, an interdisciplinary team process is described that facilitates application of tools and decisionmaking at different spatial scales.

Keywords: Decision support, fire management, fuel treatment, hazardous fuel.

<http://www.treesearch.fs.fed.us/pubs/25953>

Forest Management

06-315

Donoghue, E.M.; Sutton, N.L.; Haynes, R.W.

2007. Considering communities in forest management planning in western Oregon. Gen. Tech. Rep. PNW-GTR-693. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 95 p.

A recurrent theme in the development of U.S. forest policies has been the assertion of strong positive relations among communities, economies, and natural resource management. Now as a new round of federal land management planning is getting underway, questions are being raised about the strength of that assertion and how to view communities following a decade of reduced federal harvests. This report examines these questions considering the 433 communities in six Bureau of Land Management districts in western Oregon. It discusses the ways that forest-based communities have been considered in the context of federal forest management planning, and it summarizes information on socioeconomic conditions and trends for communities in western Oregon.

Keywords: Communities, land management planning, socioeconomic well-being.

<http://www.treesearch.fs.fed.us/pubs/26189>

06-093

Geier, M.G.

2007. Necessary work: discovering old forests, new outlooks, and community on the H.J. Andrews Experimental Forest, 1948-2000. Gen. Tech. Rep. PNW-GTR-687. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 357 p.

This historical account of the Andrews Forest and the researchers and land managers working there since its establishment in 1948 is based on over 40 interviews with individuals and groups. An initial period dominated by a small number of Forest Service scientists was followed by growing numbers of researchers from the agency, Oregon State University, and other institutions working in close

partnership with staff of the Willamette National Forest. Together they have made important advances in ecosystem science and management.

Keywords: LTER, IBP, watersheds, Andrews Forest, adaptive management.

<http://www.treesearch.fs.fed.us/pubs/27292>

06-453

Haynes, R.W.; Adams, D.M.; Alig, R.J.; Ince, P.J.; Mills, J.R.; Zhou, X.

2007. The 2005 RPA timber assessment update. Gen. Tech. Rep. PNW-GTR-699. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 212 p.

This update reports changes in the Nation's timber resource since the Analysis of the Timber Situation in the United States was completed in 2003. Prospective trends in demands for and supplies of timber, and the factors that affect these trends are examined. These trends include changes in the U.S. economy, increased salvage of British Columbia beetle-killed timber, and a stronger U.S. dollar. Other prospective trends that might alter the future timber situation are discussed including changes in U.S. timberland area, reductions in southern pine plantation establishment, impacts of climate change on forest productivity, increased restoration thinning on Western public lands, and the impact of programs to increase carbon sequestration through afforestation. Various management implications such as the influence of prices on forest management, concerns about changes in forest area, the emerging open space issue, forests as a set of commons, seeking to find greater compatibility in forest management, and the stewardship agenda are discussed.

Keywords: RPA assessments, timber projections, supply, demand, management alternatives, resource trends.

<http://www.treesearch.fs.fed.us/pubs/26905>

07-058

Rapp, V.A.; Sands, Y.; Wilson, C.; Sullivan, L.

2007. 2006 Science accomplishments of the Pacific Northwest Research Station. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 80 p.

The Pacific Northwest Research Station conducts research at 11 laboratories and centers in Alaska, Oregon, and Washington, and at many sites throughout the three states. This publication summarizes research findings, products, accomplishments, and outcomes for fiscal year 2006. All research is organized underneath the Station's four goals: (1) develop a fundamental understanding of ecological,

social, and economic systems and their interactions, (2) assess the status and trends of ecosystems and natural resources and their uses, (3) develop science-based options for informed management, and (4) communicate science findings and enhance their application. The report also includes information on finances, workforce, honors, and awards.

Keywords: PNW Research Station, accomplishments, 2006 science findings, outcomes, science-based options.

<http://www.fs.fed.us/pnw/pubs/2006-science-accomp/index.shtml>

06-516

Rojas, T.D.

2007. National forest economic clusters: A new model for assessing national-forest-based natural resources products and services Gen. Tech. Rep. PNW-GTR-703. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 40 p.

National forest lands encompass numerous rural and urban communities. The urban and rural communities within or near national forest lands include a wide variety of historical traditions and cultural values that affect their process of economic development. National-forest-based urban and rural communities participate in numerous economic sectors including nontraded industries, resource-dependent traded industries, and non-resource-dependent traded industries. These communities represent microeconomic environments. Cluster theory provides an explicit framework to examine the microeconomic relationships between national forests and their embedded and neighboring communities. Implementation of economic cluster initiatives in national-forest-based communities could improve their overall social well-being through increased competitive advantage based on innovation and higher productivity. This paper proposes establishing an Economic Clusters research team within the Forest Service. This team would dedicate its efforts to the analysis and improvement of the determinants of competitive advantage affecting national-forest-based communities.

Keywords: National-forest-based communities, economic cluster theory, innovation, productivity, competitiveness.

<http://www.treesearch.fs.fed.us/pubs/26230>

Landscape Ecology

07-137

Thompson, J.; Wisdom, M.; Rowland, M.

2007. Sagebrush in Western North America: habitats and species in jeopardy. Science Findings 91. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p.

Sagebrush habitats are declining rapidly across western North America, with over 350 associated plant and animal species at risk of local or regional extirpation. The sagebrush ecosystem is one of the largest in the United States, and it is vulnerable to a litany of threats. Chief among them is invasion of cheatgrass into the understory, followed by high-severity fires that cheatgrass promotes. The expansion of pinyon juniper woodlands into sagebrush habitat and other human impacts, such as overgrazing by livestock and energy development, are also major sources of concern.

Keywords: Sagebrush ecosystems, overgrazing, Great Basin.

<http://www.treesearch.fs.fed.us/pubs/26613>

Land Use

07-015

Kline, J.D.; Azuma, D.L.

2007. Evaluating forest land development effects on private forestry in eastern Oregon. Res. Pap. PNW-RP-572. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 18 p.

Research suggests that forest land development can reduce the productivity of remaining forest land because private forest owners reduce their investments in forest management. We developed empirical models describing forest stocking, thinning, harvest, and postharvest tree planting in eastern Oregon, as functions of stand and site characteristics, ownership, and building densities. The models are based on USDA Forest Service Forest Inventory and Analysis data gathered in eastern Oregon in 1987 and 1998, and data describing building densities gathered by the Oregon Department of Forestry from aerial photographs taken over the same period. We used the models to examine the potential effects of population growth and development, as described by increasing building densities, on the likelihood that private forest owners maintain forest stocking, precommercially thin, harvest, and plant trees following harvest. Empirical results suggest that population growth and development have had no measurable effect on these

activities in eastern Oregon during the period examined. Any development effects on private forest management and investment so far are likely to be fairly localized.

Keywords: Wildland-urban interface, nonindustrial private forest owners, urbanization.

<http://www.treesearch.fs.fed.us/pubs/26619>

06-460

Plantinga, A.J.; Alig, R.J.; Eichman, H.; Lewis, D.J.

2007. Linking land-use projections and forest fragmentation analysis. Res. Pap. PNW-RP-570. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Station. 41 p.

An econometric model of private land-use decisions is used to project land use to 2030 for each county in the continental United States. On a national scale, forest area is projected to increase by 18.8 million acres. Urban area is projected to increase by 68 million acres, and cropland, pasture, rangeland, and Conservation Reserve Program land is projected to decline in area. Regional econometric models are needed to better represent region-specific economic relationships. County-level models of forest fragmentation indices are estimated for the Western United States. The core forest model is found to perform better than the model of like adjacencies for forest land. A spatially detailed analysis of forest fragmentation in Polk County, Oregon, reveals that forests become more fragmented even though forest area increases. By linking the land-use projection and forest fragmentation models, we project increases in the average county shares of core forest in 8 of the 11 Western States. The average like adjacency measure increases in six of the states. The aggregate and spatially detailed fragmentation methods are compared by projecting the fragmentation indices to 2022 for Polk County, Oregon. Considerable differences in the results were produced with the two methods, especially in the case of the like adjacency metric.

Keywords: Land use, forest-land area, forest fragmentation, spatial analysis.

<http://www.treesearch.fs.fed.us/pubs/26191>

07-152

Thompson, J.; Wondzell, S.; Bisson, P.; Hemstrom, M.A.

2007. Simulating the consequences of land management. Science Findings 92. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p.

How do you project the effects of management decisions made today on future conditions of riparian forests, stream habitat, and fish abundance in the streams and rivers of the

interior Columbia Basin? Researchers at PNW Research Station have developed some novel analytical tools to help answer this question. Their work is part of the Interior Northwest Landscape Analysis System (INLAS).

Keywords: INLAS, stream dynamics, ecosystem management.

<http://www.treesearch.fs.fed.us/pubs/26960>

Monitoring

07-026

Raphael, M.G.; Baldwin, J.; Falxa, G.A.; Huff, M.H.; Lance, M.; Miller, S.L.; Pearson, S.F.; Ralph, C.J.; Strong, C.; Thompson, C.

2007. Regional population monitoring of the marbled murrelet: field and analytical methods. Gen. Tech. Rep. PNW-GTR-716. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

The marbled murrelet (*Brachyramphus marmoratus*) ranges from Alaska to California and is listed under the Endangered Species Act as a threatened species in Washington, Oregon, and California. Marbled murrelet recovery depends, in large part, on conservation and restoration of breeding habitat on federally managed lands. A major objective of the Northwest Forest Plan (the Plan) is to conserve and restore nesting habitat that will sustain a viable marbled murrelet population. Under the Plan, monitoring is an essential component and is designed to help managers understand the degree to which the Plan is meeting this objective. This report describes methods used to assess the status and trend of marbled murrelet populations under the Plan.

Keywords: *Brachyramphus marmoratus*, distance sampling, line transect, marbled murrelet, Northwest Forest Plan, population monitoring.

<http://www.treesearch.fs.fed.us/pubs/27320>

07-005

Thompson, J.; Cohen, W.

2006. Monitoring forests from space: quantifying forest change by using satellite data. Science Findings 89. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p.

Scientists at the Laboratory for Applications in Remote Sensing in Ecology (LARSE) have pioneered several applications for mapping forest disturbances using Landsat satellite data. One such advancement is a mathematical transformation of multiple bands of Landsat data into one value that is most associated with clearcut style of forest disturbance. LARSE scientists used the “Disturbance

Index” to delineate every clearcut harvest completed in western Oregon and Washington and northern California from 1972 to 2004. This map revealed several differences in the patterns of harvest on public and private lands over the past three decades.

Keywords: LARSE, remote sensing, mapping, disturbance and recovery.

<http://www.treesearch.fs.fed.us/pubs/25135>

Mycology

07-007

Pilz, D.; McLain, R.; Alexander, S.; Villarreal-Ruiz, L.; Berch, S.; Wurtz, T.L.; Parks, C.G.; McFarlane, E.; Baker, B.; Molina, R.; Smith, J.E.

2007. Ecology and management of morels harvested from the forests of western North America. Gen. Tech. Rep. PNW-GTR-710. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 161 p.

Morels are prized edible mushrooms that fruit, sometimes prolifically, in many forest types throughout western North America. They are collected for personal consumption and commercially harvested as valuable special (nontimber) forest products. Large gaps remain, however, in our knowledge about their taxonomy, biology, ecology, cultivation, safety, and how to manage forests and harvesting activities to conserve morel populations and ensure sustainable crops. This publication provides forest managers, policymakers, mycologists, and mushroom harvesters with a synthesis of current knowledge regarding these issues, regional summaries of morel harvesting and management, and a comprehensive review of the literature.

Keywords: Morchella, morel mushrooms, forest management, special forest products, nontimber forest products.

<http://www.treesearch.fs.fed.us/pubs/26906>

Range Management

07-008

Hall, F.C.

2007. Variation in shrub and herb cover and production on ungrazed pine and sagebrush sites in eastern Oregon: a 27-year photomonitoring study. Gen. Tech. Rep. PNW-GTR-704 Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 44 p.

Fluctuations in herb and shrub canopy cover and total herbage production on August 1st were estimated over 27 years by photomonitoring and sampling. The purpose

was to appraise cover and production for characterizing range condition guides. Both varied by about a 2.4-fold difference. Clearly, canopy cover and production are poor parameters for characterizing “good range condition.” Abundance of seedheads on bunchgrasses is commonly used to characterize good range health. But they were not produced about half the time. Good range condition implies maximum competition which is apparently not synonymous with maximum vigor and abundant seedheads. Color of herbaceous vegetation on August 1st varied from cured light brown to rather vibrant green reflecting rather major seasonal differences in plant phenology.

Keywords: Range condition, flowering, canopy cover, herbage production, bunchgrass, yearly variability.

<http://www.treesearch.fs.fed.us/pubs/26630>

Recreation

06-451

McCool, S.F.; Clark, R.N.; Stankey, G.H.

2007. An assessment of frameworks useful for public land recreation planning. Gen. Tech Rep. PNW-GTR-705. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 125 p.

Public land managers are confronted with an ever-growing and diversifying set of demands for providing recreation opportunities. Several frameworks exist for providing recreation opportunities on public lands. These include the Recreation Opportunity Spectrum, Limits of Acceptable Change, Visitor Experience and Resource Protection, Visitor Impact Management, and Benefits-Based Management. The report traces the development of each framework, describes the fundamental premises and concepts used within them, and provides an assessment of the experience with their use.

Keywords: Recreation frameworks, planning, ROS, LAC, VERP, VIM, BBM.

<http://www.treesearch.fs.fed.us/pubs/26955>

Remote Sensing

07-019

Thompson, J.; Raphael, M.G.

2007. The secret life of marbled murrelets: monitoring populations and habitats. Science Findings 90. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p.

The marbled murrelet is a small diving seabird that occupies coastal waters from Alaska to central California. Populations have been declining for decades as the amount

of nesting habitat has been reduced through logging. The murrelet was listed under the Endangered Species Act in 1992. Two years later, Pacific Northwest federal forests were brought under the management of the Northwest Forest Plan, which identified the conservation of marbled murrelet nesting habitat as a primary objective. Scientists at the PNW Research Station have recently completed a 10-year review of the plan’s effectiveness at meeting its goals for the murrelet.

Keywords: Marbled murrelets, habitat.

<http://www.treesearch.fs.fed.us/pubs/25866>

Resource Inventory

06-298

Gray, A.N.; Fried, J.S.; Christensen, G.; Potts, L.

2006. Timber resource statistics for forest land in eastern Washington, January 2002. Resour. Bull. PNW-RB-251. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p.

This report summarizes timber resource statistics for the 20 counties in eastern Washington. The inventory sampled all private and public lands except those administered by the National Forest System in 2001, and those that were reserved from management for wood products. Area information for parks and other reserves was obtained directly from the organizations managing these areas. Statistical tables provide estimates of land area, timber volume, growth, mortality, and harvest for eastern Washington as a whole. Estimated area of forest on nonnational forest land was 4.9 million acres, and net volume of growing stock on timberland was 8.7 billion cubic feet. Estimated annual growth on non-national forest timberland from 1990 to 2001 was 203 million cubic feet; average annual mortality was 84 million cubic feet; average annual harvest was 288 million cubic feet.

Key Words: Forest inventory, statistics (forest), land area, land use change, timber volume, eastern Washington.

<http://www.treesearch.fs.fed.us/pubs/25134>

Silviculture

06-513

Miller, R.E.; Anderson, H.W.; Reukema, D.L.; Max, T.A.

2007. Growth of bear-damaged trees in a mixed plantation of Douglas-fir and red alder. Res. Pap. PNW-RP-571. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 29 p.

Incidence and effects of tree damage by black bear (*Ursus americanus altifrontalis*) in a 50-year-old, coast Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*) plantation are described. Bears girdled or partially girdled 35 dominant or codominant Douglas-fir trees per acre, but only in that portion of the plantation that had been interplanted at age 4 with red alder (*Alnus rubra* Bong). No red alder were damaged. Bears damaged Douglas-fir in this stand on at least four occasions between 1929 (planting) and 1991. Fully girdled Douglas-fir (six per acre in 1976) died within 2 to 14 years. Of the 29 per acre partially girdled trees, 17 percent died in the 16 years of observation, compared to 9 percent of nondamaged trees. Cross-sectional growth of surviving damaged trees exceeded that of matched, nondamaged trees by about 30 percent at three heights on the bole: 6 ft, 4.5 ft, and immediately above the damaged area. Death of six large Douglas-fir trees per acre reduced live stand volume of this species for about 6 years after bear damage until growth of the remaining trees compensated for the volume lost to mortality. Confirmation of the stimulating effects of bear damage on subsequent tree growth is needed at other locations.

Key Words: Black bear, *Ursus americanus altifrontalis*, bear damage, Douglas-fir, tree growth, tree mortality.

<http://www.treesearch.fs.fed.us/pubs/25924>

Soil

06-293

Ares, A.; Terry, T.A.; Piatek, K.B.; Harrison, R.B.; Miller, R.E.; Flaming, B.L.; Licata, C.W.; Strahm, B.D.; Harrington, C.A.; Meade, R.; Anderson, H.W.; Brodie, L.C.; Kraft, J.M.

2007. 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. Gen. Tech. Rep. PNW-GTR-691. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 85 p.

The Fall River research site in coastal Washington is an affiliate installation of the North American Long-Term Soil Productivity (LTSP) network. Overall goals of the

Fall River study are to assess effects of biomass removals, soil compaction, tillage, and vegetation control on site properties and growth of planted Douglas-fir (*Pseudotsuga menziesii*). In this report, we describe site conditions, pre-harvest stand characteristics, experimental design, sampling methods, biomass, and C and N stores before and after imposing biomass-removal treatments. Biomass-removal treatments included removal of commercial bole (BO), bole to 5-cm top diameter, total tree, and total tree plus all legacy woody debris.

Keywords: Sustainable forestry, biomass, C and N stores, organic matter retention, soil physical properties, andisols, vegetation, climate.

<http://www.treesearch.fs.fed.us/pubs/25956>

Wildlife

07-142

Harrington, T.B.; Nicholas, G.E., tech. eds.

2007. Managing for wildlife habitat in westside production forests. Gen. Tech. Rep. PNW-GTR-695. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 135 p.

On October 18, 2006, a workshop was held in Vancouver, WA, with the title "Managing for wildlife habitat in westside production forests." The purpose of the workshop was to provide prescriptions and guidelines for people who manage west-side forests (those west of the Cascade Mountains' crest) primarily for wood production, but because of mandate or personal preference, want to integrate wildlife values. The audience included over 150 professionals from forest industry, consulting firms, and public and tribal forest and wildlife management agencies. This proceedings includes 10 papers based on oral presentations at the workshop plus a synthesis paper summarizing workshop themes, discussions, and related information. Topics include a history of wildlife management research in the Pacific Northwest, elements of habitat and how to manage for them, the challenges of appropriately implementing ecosystem management, and economic implications to private forestland owners.

Keywords: Wildlife habitat, old-forest structure, thinning, coarse woody debris, wildlife trees, management regimes, economic analysis.

<http://www.treesearch.fs.fed.us/pubs/26190>

Wood Utilization

06-515

Nicholls, D.L.; Stiefel, M.C.

2007. Market opportunities for kitchen cabinets made from Alaska hardwoods: a synthesis and review of recent research. Gen. Tech. Rep. PNW-GTR-702. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 28 p.

The kitchen cabinet industry has shown significant growth recently, with expanding residential markets, new cabinet styles, and larger kitchens. This industry represents an opportunity for small Alaska wood producers to create high-value secondary products. In response to recent trends in kitchen cabinet manufacturing and the need to identify opportunities for underutilized species, the Alaska Wood Utilization Research and Development Center has conducted numerous studies evaluating consumer preferences for Alaska's primary hardwoods—Alaska birch (*Betula papyrifera* var. *humilis* (Reg.) Fern & Raup) and red alder (*Alnus rubra* Bong.). These studies explored consumer preferences under a range of marketing parameters, cabinet appearances, and regional market locations. This paper summarizes these studies and offers insights into the potential market for Alaska's hardwoods as secondary wood products such as kitchen cabinets.

Keywords: Alaska, hardwoods, red alder, paper birch, kitchen cabinets, consumer preference studies, willingness to pay.

<http://www.treesearch.fs.fed.us/pubs/26616>

07-056

Nicholls, D.L.; Brackley, A.M.; Stiefel, M.C.

2007. Alaska Wood Tides [Newsletter]. No. 6. Sitka, AK: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Alaska Wood utilization Research and Development Center. 4 p.

This issue features an article by Dave Nicholls on recent biomass developments in Alaska and provides research updates, an events calendar, and lists of current and upcoming publications.

Keywords: Biomass, wood energy, sawmill.

<http://www.fs.fed.us/pnw/sitka/publications/wood-tides/no6.pdf>

Publications Available Elsewhere

The following publications are available through interlibrary loan, by writing to the locations indicated, or by using the form indicated. Many journal articles are available on our Web site at <http://www.fs.fed.us/pnw/publications/nonstation.shtml>.

Aquatic/Riparian Systems

Larson, D.W.; Sweet, J.; Petersen R.R.; Crisafulli, C.M.

2006. Posteruptive response of phytoplankton and zooplankton communities in Spirit Lake, Mount St. Helens, Washington. *Lake and Reservoir Management*. 22(4): 273–292.

The 1980 eruption provided a rare opportunity to study lake response and recovery following volcanic disturbance. During the eruption, and for several months after, plankton populations experienced deleterious conditions and were virtually eliminated. During the next 2 years, plankton communities comprised only a few opportunistic species whose combined abundance was low. By 1983, phytoplankton abundance and species diversity had greatly increased. The reestablishment of the zooplankton was underway in 1983, as indicated by the presence of numerous taxa. By 1986, the plankton communities began to resemble those found in subalpine lakes in the Cascades. The rapid recovery of Spirit Lake demonstrated the resiliency of plankton.

Keywords: Spirit Lake, Mount St. Helens, phytoplankton, zooplankton, disturbance ecology.

(see Olympia Lab order form.)

Atmosphere

Case, M.J.; Peterson, D.L.

2007. Growth-climate relations of lodgepole pine in the North Cascades National Park, Washington. *Northwest Science*. 81(1): 62–74.

Information about the sensitivity of lodgepole pine to climate will allow forest managers to maximize growth, better understand how carbon sequestration changes over time, and better model and predict future ecosystem responses to climate change. Projected increases in summer temperatures will likely cause greater soil moisture stress in many forested ecosystems. The potential of extended drought periods over decades may significantly alter spatial patterns of productivity, thus impacting carbon storage. The productivity of lodgepole pine likely will decrease at

sites with shallow, excessively drained soils, south- and west-facing aspects, and steep slopes, but increase at high-elevation sites.

Keywords: Tree growth, carbon sequestration, climate change, lodgepole pine, North Cascade Range.

(see PWFSL order form.)

Botany

Domec, J.C.; Gartner, B.L.; Meinzer, F.C.

2006. Bordered pit structure and function determine spatial patterns of air-seeding thresholds in xylem of Douglas-fir (*Pseudotsuga menziesii*; Pinaceae) trees. *American Journal of Botany*. 93(11): 1588–1600.

We sought to determine whether as predicted by the air-seeding hypothesis, xylem hydraulic function is linked directly to bordered pit functioning in Douglas-fir trees. From roots to branches, margo resistivity increased because of a decrease in margo pore size and pit membrane diameter. Linkages between pit structure, resistance to embolism, and hydraulic conductivity were explained by the fraction of the tracheid radial wall represented by pits. Decreasing pit membrane flexibility and increasing porosity make conduits more prone to air-seeding but enhanced conductivity.

Keywords: Hydraulic architecture, tracheids, xylem vulnerability.

(see Corvallis Lab order form.)

Ecosystem Structure and Function

Warren, J.M.; Meinzer, F.C.; Brooks, J.R.;

Domec, J.-C., Coulombe, R.

2006. Hydraulic redistribution of soil water in two old-growth coniferous forests: quantifying patterns and controls. *New Phytologist*. 173: 753–765.

We incorporated soil/plant biophysical properties into a simple model to predict seasonal trajectories of hydraulic redistribution (HR). We measured soil water content, water potential root conductivity, and climate across multiple years in two old-growth coniferous forests. The HR variability within sites (0 to 0.5 mm d⁻¹) was linked to spatial patterns of roots, soil moisture and climate.

The HR seasonally accounted for up to 9 percent of daily water use, peaking at 0.16 mm d^{-1} (ponderosa pine) or 0.30 mm d^{-1} (Douglas-fir), then declining as modeled pathway conductance dropped with increasing root cavitation. Patterns of HR were attributed to variability in water potential gradients and conductivity within the root system.

Key words: Douglas-fir (*Pseudotsuga menziesii*), hydraulic lift, hydraulic redistribution, ponderosa pine (*Pinus ponderosa*), root conductivity, soil water content, water potential.

(see Corvallis lab order form.)

Fire

Hessburg, P.F.

2006. Creating landscapes within landscapes: reintroducing fire in fire prone landscapes. In: Proceedings of the 3rd International Fire Ecology and Management Congress. San Diego, CA: Association of Fire Ecology: 1–3.

Inland northwest dry mixed-conifer forests are burning with uncharacteristic severity, frequency, and spatial scale. In response, there now is well-defined policy on public lands to actively manage affected forests and reduce the threat of wildfires to people and property. The need for restoration is motivated by desire to actively manage future fire behavior, and to increase the flow of fiber from public lands. Regardless of political persuasion, many agree there is legitimate need to reduce the threat of severe wildfire, and that methods for achieving the goal of threat reduction differ by forest type, land ownership, and at varying spatial scales. Here we: (1) emphasize stand-level principles from fire ecology that are associated with improving the fire resistance of fire-prone landscapes; (2) discuss the chief effects of treatments that are based on these principles; (3) discuss advantages of treatments to managers; (4) discuss advantages/disadvantages of stand-level treatments to native biota; and (5) provide two additional principles that incorporate fine- and meso-scale landscape considerations.

Keywords: Wildfire, conifer forests, stand-level treatments.

(see Wenatchee Lab order form.)

Hessburg, P.F.; Reynolds, K.M.; Keane, R.E.; Salter, R.B.

2006. A multi-scale decision support system for evaluating wildland fire hazard and prioritizing treatments. In: Proceedings of the 3rd International Fire Ecology and Management Congress. San Diego, CA: Association of Fire Ecology: 1–3.

Wildland fuels have accumulated in Western U.S. forests for the past 70 years owing to 20th-century human settlement and management activities, and a shifting climate. As demonstrated by recent wildland fires, added fuels foster

intense wildfires that are difficult to contain and control. We present a prototype decision-support system (DSS) for evaluating wildfire hazard and prioritizing subwatersheds for vegetation and fuels treatment. The DSS consists of logic and decision models. We evaluate hazard in the logic model as a function of three primary topics: fire vulnerability, wildfire severity, and risk of ignition. Primary topics have secondary topics under which data are evaluated. The logic model shows the state of each evaluated landscape with respect to fire hazard. In the decision model, we place the fire hazard summary conditions of each evaluated landscape in the context of the amount of associated wildland-urban interface (WUI). The logic and decision models are executed in Ecological Management Decision Support, a DSS that operates in ArcGIS. We show that a decision criterion, such as relationship to wildland-urban interface, can significantly influence the outcome of a decision to determine treatment priorities. We demonstrate use of the system with an example from the Rocky Mountain region in Utah, a planning area of about 4.8 million ha.

Keywords: Wildland fuels management, wildland-urban interface.

(see Wenatchee Lab order form.)

Johnson, M.C.; Peterson, D.L.; Raymond, C.L.

2007. Managing forest structure and fire hazard—a tool for planners. *Journal of Forestry*. 105(2): 77–83.

Fire planners and other resource managers need to examine a range of potential fuel and vegetation treatments to select options that will lead to desired outcomes for fire hazard and natural resource conditions. A new approach to this issue integrates concepts and tools from silviculture and fuel science to quantify outcomes for a large number of treatment options in dry forest stands in the Western United States. Five silvicultural options (thinning from below to 50 trees per acre [tpa], 100, 200, and 300 tpa; or no thinning) are considered in combination with three surface fuel treatments (pile and burn, prescribed fire, or no treatment), resulting in a range of alternative treatments for each representative stand. The Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS) was used to calculate (1) immediate effects of treatments on surface fuels, fire hazard, potential fire behavior, and forest structure (including visualizations); and (2) a 50-year time series of treatment effects at 10-year increments. These fuel treatment scenarios can be used as a starting point for examining alternatives for National Environmental Policy Act documents and other applications that require scientifically based information to quantify the effects of modifying forest structure and surface fuels. Forest managers also can develop customized treatments for specific locations

and resource objectives. Scenarios and output can be used to inform ecological, economic, and sociological evaluations of the effects of fuel and vegetation treatments.

Keywords: Fire management, forest thinning; Forest Vegetation Simulator; fuel treatment, silviculture.

(see PWFSL order form.)

Forest Management

Liang, J.; Buongiorno, J.; Monserud, R.A.

2006. Bootstrap simulation and response surface optimization of management regimes for Douglas-fir/western hemlock stands. *Forest Science*. 52(5): 579–594.

A method was proposed to simulate forest stand growth, timber prices, and interest rates, by distribution-free bootstrapping, and then optimize management controls for economic and ecological objectives by response surface analysis. The method was applied to Douglas-fir/western hemlock stands to predict the effects on economic and ecological objectives of management alternatives defined by the cutting cycle, C , the residual stand basal area, B , the diameter of the largest tree, D , and the ratio, q , of the number of trees in adjacent diameter classes. The effects were described with response surfaces, which were used to determine the best combinations of B , q , and C for each management criterion. Adjusting B , q , and C could control for 97 to 99 percent of the variability in the expected value of species diversity, size diversity, percentage of peeler logs, and basal area, and for 80 to 90 percent of the variability in land expectation value and annual production. Economic and ecologic criteria were generally most sensitive to the q ratio, the residual basal area, and the cutting cycle. Annual production was negatively correlated with tree size diversity and wood quality. There was no apparent conflict between stand diversity and wood quality.

Keywords: Economics, stand growth, wood quality, tree diversity, stochastic.

(see Portland Lab order form.)

Liang, J.; Buongiorno, J.; Monserud, R.A.; Kruger, E.L.; Zhou, M

2007. Effects of diversity of tree species and size on forest basal area growth, recruitment, and mortality. *Forest Ecology and Management*. 243: 116–127.

The objective of this study was to determine the relationship, or lack thereof, between growth and diversity of tree species and size in conifer stands of western North America. Growth was measured by net basal area growth and its components: survivor growth, recruitment, and mortality. The analysis used inventory data from permanent plots in the Douglas-fir/western hemlock forest type in Oregon and Washington, and in the mixed-conifer forest

type in California. The methods consisted of generalized least square regression with spatial autocorrelation, controlling for the effect of other stand characteristics. Other things being equal, in the two forest types under study, there was a strong positive relationship between net basal area growth and tree-species diversity. This effect was associated with higher recruitment in stands of higher tree-species diversity. Neither mortality nor growth of survivors was related to tree-species diversity. The relationship between growth and tree-size diversity was less clear. For Douglas-fir/western hemlock, net basal area growth was negatively correlated with tree-size diversity, essentially because recruitment was lower on plots of high tree-size diversity. For mixed conifers, net basal area growth tended also to be lower in plots of high tree-size diversity, but this was mostly because mortality was higher in plots of higher tree-size diversity.

Keywords: Species diversity; size diversity; forest growth; recruitment; mortality; spatial autocorrelation

(see Portland Lab order form.)

Reynolds, K.M.

2006. EMDS 3.0: A modeling framework for coping with complexity in environmental assessment and planning. *Science in China: Series E Technological Sciences*. 49(1): 63–75.

EMDS 3.0 is implemented as an ArcMap® extension and integrates the logic engine of NetWeaver® to perform landscape evaluations, and the decision modeling engine of Criterium DecisionPlus® for evaluating management priorities. Key features of the system's evaluation component include abilities to (1) reason about large, abstract, multifaceted ecosystem management problems, (2) perform useful evaluations with incomplete information, (3) evaluate the influence of missing information, and (4) determine priorities for missing information. A key feature of the planning component is the ability to determine priorities for management activities, taking into account not only ecosystem condition, but also criteria that account for the feasibility and efficacy of potential management actions. Both components include powerful and intuitive diagnostic features that facilitate communicating the explanation of modeling results to a broad audience.

Keywords: Natural resources, modeling, assessment, analysis, planning, software, ecosystem management.

(see Corvallis lab order form.)

Reynolds, K.M.; Schmoldt, D.L.

2006. Computer-aided decision making. In: Shao, G.; Reynolds, K.M., eds. Computer applications in sustainable forest management: including perspectives on collaboration and integration. New York: Springer-Verlag: 143–169. Chapter 8.

Several major classes of software technologies have been used in decisionmaking for forest management applications over the past few decades. These computer-based technologies include mathematical programming, expert systems, network models, multi-criteria decisionmaking, and integrated systems. Each technology possesses unique advantages and disadvantages, and has been applied differentially to decisionmaking in forestry. Several example decision-support systems highlight the incorporation of these various technologies for vastly different management problems. Likely future development trends for decision-support technologies over the next few decades include Internet implementations, agent-based applications, increased social science components, and participatory decisionmaking.

Keywords: Decision support, decisionmaking, optimization, expert systems, networks, multi-criteria decision models, integrated systems.

(see Corvallis lab order form.)

Genetics

Johnson, G.R.; Berrang, P.C.

2007. Seed shatter dates of antelope bitterbrush in Oregon. Rangeland Ecology and Management. 60(1): 99–103.

Seed shatter dates for antelope bitterbrush were estimated from collections at 192 sites in Oregon and surrounding states. Shatter date was strongly correlated to elevation, and an equation that included elevation, latitude, longitude, and longitude squared explained 79 percent of the variation in seed shatter dates. This information can assist those needing to schedule seed collection activities at multiple locations.

Keywords: Purshia tridentata, seed collection, seed maturation

(see Corvallis lab order form.)

Johnson, G.R.; Gartner, B.L.

2006. Genetic variation in basic density and modulus of elasticity of coastal Douglas-fir. Tree Genetics and Genomes. 3: 25–33.

Douglas-fir trees from 39 open-pollinated families at four test locations were assessed to estimate heritability of modulus of elasticity (MOE) and basic density. Heritability estimates of MOE (across-site $h^2 = 0.55$) were larger than those for total height (0.15) and diameter at breast

height (DBH; 0.29), and similar to those for density (0.59). Negative genetic correlations were found for MOE with height ($r_A = -0.30$) and DBH ($r_A = -0.51$). Negative genetic correlations were found for MOE with height ($r = -0.30$) and DBH ($r = -0.51$). The partial correlations of height with MOE and density, while holding DBH constant, were positive. Taper [DBH/9 (height – 1.4)] was found to be negatively associated with MOE.

Keywords: MOE, density, heritability, genetic correlation.
(see Corvallis Lab order form.)

Geomorphology and Hydrology

Jefferson, A.; Grant, G.; Rose, T.

2006. Influence of volcanic history on groundwater patterns on the west slope of the Oregon High Cascades. Water Resources Research. 42(W12411): 1–15.

Spring systems on the west slope of the Oregon High Cascades exhibit complex relationships among modern topography, lava flow geometries, and groundwater flow patterns. Seven cold springs were continuously monitored for discharge and temperature in the 2004 water year, and they were periodically sampled for $\delta^{18}\text{O}$, δD , tritium, and dissolved noble gases. Anomalously high unit discharges suggest that topographically defined watersheds may not correspond to aquifer boundaries, and oxygen isotope data reveal that mean recharge elevations for the springs are coincident with extensive Holocene lava fields. The $^3\text{He}/^4\text{He}$ ratios in most of the springs are close to atmospheric, implying shallow flow paths, and aquifer thicknesses are estimated to be 30 to 140 m. Estimates using $^3\text{He}/^3\text{He}$ data with exponential and gamma distributions yield mean transit times of 3 to 14 years. Recharge areas and flow paths are likely controlled by the geographic extent of lava flows, and some groundwater may cross the Cascade crest.

Keywords: Springs, volcanic aquifers, isotopes, recharge areas, transit time, Oregon Cascades.

(see Corvallis Lab order form.)

Landscape Ecology

Barrett, T.M.; Zuuring, H.R.; Christopher, T.

2006. Interpretation of forest characteristics from computer-generated images. Landscape and Urban Planning. 80(4): 396–403.

The need for effective communication in the management and planning of forested landscapes has led to a substantial increase in the use of visual information. Using forest plots from California, Oregon, and Washington, and a survey

of 183 natural resource professionals in these states, we examined the use of computer-generated images to convey information about forest characteristics. Age and density (basal area (BA)) were underestimated for large, old, dense forest and overestimated for small, young, open forest. While accuracy of responses for density, tree size, and age of forest plot images was low, the ordering of such images by these attributes did correspond to the actual forest plot characteristics. Alterations to the standard image were made for three of the forest plots, including alterations for the area depicted, the incorporation of understory vegetation and fallen trees, the addition of a truck, and regular and clumpy individual tree spacing. Image alterations did affect some mean responses for tree size, density, fire hazard, vertical stratification, and forest age. Results show managers and planners may need to exercise caution and supplement images with additional information to avoid miscommunication about the nature of current and projected forest landscapes.

Keywords: Computer visualization, decision-support systems, vegetation modeling, public communication.

(see Portland Lab order form.)

Peter, D.H.; Shebitz, D.

2006. Historic anthropogenically maintained bear grass savannas of the southeastern Olympic Peninsula. *Restoration Ecology*. 14(4): 605–615.

A little-known fire-maintained anthropogenic ecosystem in the southeastern Olympic Peninsula of Washington is documented. Owing to cessation of burning, most of these areas have succeeded to forest. We present cultural, historical, and ecological data to describe the structure and function of this ecosystem. We believe that native peoples maintained this system for the provision of culturally important plants and animals through repeated burning. The overstory was dominated by Douglas-fir and the understory by beargrass. Shade-intolerant prairie species persist where openings have been maintained but not in surrounding forests. These findings suggest that frequent application of fire would be necessary to restore this ecosystem.

Keywords: Anthropogenic ecosystem, beargrass, fire, Olympic Peninsula, prairie, savanna, succession, Xerophyllum tenax.

(see Olympia lab order form.)

Land Use

Alig, R.; White, E.

2007. Projections of forestland and developed land areas in western Washington. *Western Journal of Applied Forestry*. 22(1): 29–35.

Between 1990 and 2000, nonfederal timberland areas in western Washington declined by 5 percent, in contrast to a 3 percent reduction for the 1980-90 period. Most of this reduction is attributed to the conversion of timberland to other land uses, especially urban and other developed uses. In areas such as the Puget Sound region, population densities have more than doubled over the last 40 years. Further expansion in urban and developed areas is expected, with timberland a major source for development. We project an 8-percent reduction over 30 years in forest land area in western Washington. At the same time, urban and other developed areas are projected to roughly double, driven by increases in population and personal income levels. Increased demand for land for residential and other developed uses puts upward pressure on land values, increasing opportunity cost of retaining land in forests and raising the question of what will become of some forests and associated forest resources, such as water and wildlife, if forest owners find it too costly to manage the forest.

Keywords: Population, land values, land allocation, deforestation, socioeconomic drivers, forest benefits.

(see Corvallis order form.)

Kline, J.D.

2006. Keeping land in forest. In: *Forests, carbon and climate change: a synthesis of science findings*. Corvallis, OR: Oregon Forest Resources Institute: 93–116. Chapter 6.

Advancing forest carbon sequestration goals in Oregon will depend on understanding the factors that influence forestland development and its effects on carbon sequestration, what trends and projections imply about future forest-land loss, and what policies may be appropriate, effective, and socially acceptable for addressing those effects. This chapter draws upon a large body of research conducted in Oregon and elsewhere to describe forest-land development causes and trends, what they imply about future forest-land development in Oregon, what the potential effects might be for carbon sequestration, and what might be done about it.

Keywords: Land use and policy, open space preservation, forest values, planning.

(see Corvallis Lab order form.)

Monitoring

Nyberg, J.B.; Marcot, B.G.; Sulyma, R.

2006. Using bayesian belief networks in adaptive management. *Canadian Journal of Forest Research*. 36(12): 3104–3116.

Bayesian belief and decision networks are relatively new modeling methods that are especially well suited to adaptive-management applications, but they appear not to have been widely used in adaptive management to date. Bayesian belief networks (BBNs) can serve many purposes for practioners of adaptive management, from illustrating system relations conceptually to calculating joint probabilities of decision options and predicting outcomes of management policies. We describe the nature and capabilities of BBNs, discuss their applications to various steps in the adaptive-management process, and provide a case example of adaptive management of forests and terrestrial lichens in north-central British Columbia.

Keywords: Bayesian belief networks, monitoring, adaptive management, caribou modeling.

(see Portland lab order form.)

Mount St. Helens

Allen, M.F.; Crisafulli, C.M.; Morris, S.J.; Egerton-Warburton, L.M.; MacMahon, J.A.; Trappe J.M.

2005. Mycorrhizae and Mount St. Helens: story of a symbiosis. In: Dale, V.H.; Swanson, F.J.; Crisafulli, C.M., eds. *Ecological responses to the 1980 eruption of Mount St. Helens*. New York: Springer: 221–231. Chapter 15.

The 1980 eruptions of Mount St. Helens destroyed or buried most fungi and plants over a 600 km area. The reestablishment of mycorrhizae is an intergral part of vegetation development across this disturbed landscape. We assessed the invasion of arbuscular (AM) and endomycorrhiza (EM) in tephra-fall, blowdown and pyroclastic flow volcanic disturbance zones from 1980–2000. Establishment of AM was largely regulated by animals and focused on patches of vegetation sought by large grazers and rodents. For EM, wind was a dominant vector initially, but dispersal was dependent on patches of plants or physical features to create turbulence and to concentrate spores. Within a decade following the eruptions, mycorrhizae were well established in the tephra-fall and blowdown zones. Within two decades, mycorrhizae established in the sterilized pyroclastic flow zone. Most elements are now present for forest development.

Keywords: Mount St. Helens, fungi, mycorrhizae, succession, mammals.

(see Olympia Lab order form.)

Crisafulli, C.M.; MacMahon, J.A.; Parmenter, R.R.

2005. Small-mammal survival and colonization on the Mount St. Helens volcano: 1980–2002. In: Dale, V.H.; Swanson, F.J.; Crisafulli, C.M., eds. *Ecological responses to the 1980 eruption of Mount St. Helens*. New York: Springer: 199–218. Chapter 14.

We observed the initial effects of the 1980 eruption on small mammals (those species the size of squirrels and smaller) and their subsequent long-term responses. Our goals were (1) to compare predisturbance community composition to the evolving, postdisturbance communities; (2) to document differences, if any, in community assembly in different portions of the complex disturbance mosaic created by the eruption; (3) to study a variety of sites; (4) to document species-specific responses to the altered and reconstituting environment; and (5) to discuss observations in relation to general successional theory and to the findings of plant ecologists studying the volcano. We found that patterns of mammal colonization and assemblage did not fit any one existing model of succession.

Keywords: Mount St. Helens, small mammals.

(see Olympia Lab order form.)

Crisafulli, C.M.; Swanson, F.J.; Dale, V.H.

2005. Overview of ecological responses to the eruption of Mount St. Helens: 1980–2005. In: Dale, V.H.; Swanson, F.J.; Crisafulli, C.M., eds. *Ecological responses to the 1980 eruption of Mount St. Helens*. New York: Springer: 287–299. Chapter 20.

The sensational 1980 eruption of Mount St. Helens and the subsequent ecological responses is the most thoroughly studied volcanic eruption in the world. Change will be the primary theme in the dynamic Mount St. Helens landscape during the coming decades. The extent and pace of this change will be influenced by the highly variable and complex processes of ecological succession and influenced by landscape position, topography, climate, and further biotic, human, and geophysical forces.

Keywords: Mount St. Helens, ecological responses.

(see Olympia Lab order form.)

Crisafulli, C.M.; Tripp, L.S.; Hawkins, C.P.; MacMahon, J.A.

2005. Amphibian responses to the 1980 eruption of Mount St. Helens. In: Dale, V.H.; Swanson, F.J.; Crisafulli, C.M., eds. *Ecological responses to the 1980 eruption of Mount St. Helens*. New York: Springer: 183–197. Chapter 13.

The 1980 eruption of Mount St. Helens created an opportunity to examine the initial responses of an amphibian assemblage to a diverse array of volcanic disturbances and to describe patterns of species colonization in areas that

were influenced by the eruption. The following questions were studied: (1) Did amphibians survive the eruption? (2) If so, what factors aided survival? (3) Did survivors persist in the new landscape? (4) If areas were defaunated, what was the rate and pattern of recolonization? and (5) What biotic interactions developed between amphibians and other species, and what were some potential implications of these interactions for colonization and amphibian populations? We found that amphibian responses to the eruption differed considerably by species but even more importantly by the general habitat type associated with each species.

Keywords: Mount St. Helens, amphibians.

(see Olympia Lab order form.)

Parmenter, R.R.; Crisafulli, C.M.; Korbe, N.; Parsons, G.; Edgar, M.; MacMahon, J.A.

2005. Posteruption arthropod succession on the Mount St. Helens volcano: the ground-dwelling beetle fauna (*Coleoptera*). In: Dale, V.H.; Swanson, F.J.; Crisafulli, C.M., eds. Ecological responses to the 1980 eruption of Mount St. Helens. New York: Springer: 139–150. Chapter 10.

The 1980 eruptions of Mount St. Helens created a complex mosaic of disturbance types over a 600 km² area. From 1980 through 2000 we monitored beetle species relative abundance and faunal composition of assemblages at undisturbed reference sites and in areas subjected to tephra-fall, blowdown and pyroclastic flow volcanic disturbance. We collected 27,074 beetles representing 39 families and 279 species. Five families made up 64 percent of all species collected. Patterns of beetle recolonization and succession were consistent with predicted patterns from relay succession theory, with individual species being sequentially replaced through time as each site's environmental characteristics changed. The beetle assemblages exhibited predictable patterns of similarity, with the least similar assemblages being at opposite ends of the disturbance gradient.

Keywords: Mount St. Helens, disturbance, arthropods, beetles, succession.

(see Olympia lab order form.)

Mycology

Ammarellou, A.; Trappe, J.M.; Molina, R.

2007. A first ascomycete genus (*Picoa* sp.) record for the fungi flora of Iran. *Pakistan Journal of Biological Sciences*. 10(10): 1772.

In this reasearch, according to macroscopic and microscopic characteristics, *Picoa* sp., a member of Ascomycota, was recorded for the first time in Iran.

Keywords: Ascomycete, Picoa sp. Iranian mycoflora.

(see Corvallis order form.)

Dunham, S.M.; O'Dell, T.E.; Molina, R.

2006. Forest stand age and the occurrence of chanterelle (*Cantharellus*) species in Oregon's central Cascade Mountains. *Mycological Research* 110: 1433–1440.

We describe watershed-scale habitat associations of three *Cantharellus* species with respect to stand age. We found stand age to be a good predictor of the distribution of *C. subalbidus* and *C. formosus*, but only marginally useful for predicting the occurrence of *C. cascadenis*. Understanding habitat associations is useful for managers to sustain these valuable forest fungi, two species of which are commercially harvested as edible fungi.

Keywords: Mycorrhizal fungi, population biology, mushrooms.

(see Portland Lab order form.)

Luoma, D.L.; Stockdale, C.A.; Molina, R.; Eberhart, J.L.

2006. The spatial influence of *Pseudotsuga menziesii* retention trees on ectomycorrhiza diversity. *Canadian Journal of Research Forestry*. 36: 2561–2573.

This study examines the effect of retained green trees on diversity of mycorrhizal fungi after stand harvest. A significant reduction of mycorrhizal root type richness resulted from the harvest treatment. Samples taken under tree crowns showed no significant decline in the mean number of mycorrhiza types per soil core. In areas well removed from retention trees, there was a 50-percent decline in the number mycorrhizal types per soil core. Soil cores taken just outside the dripline and in open areas exhibited a shift in mycorrhizal community structure. Retention trees can act as important refugia for mycorrhizal fungi and thus affect seedling establishment and function in developing forests after harvest.

Keywords: Root density, soil microbial ecology, ecosystem function.

(see Corvallis Lab order form.)

Trappe, J.M.; Castellano, M.A.

2007. *Clavulina lilliputiana*, a diminutive new species from Tasmania. *Australasian Mycologist*. 25(3): 87–89.

Clavulina lilliputiana, found growing in troops on a road bank in Tasmania, differs from other species of the genus by its combination of very small size (mostly < 1 cm tall), unbranched but often lobed form, cerebriform surface, and basidia up to 100 µm long.

Keywords: Mycology, taxonomy, biodiversity.

(see Corvallis lab order form.)

Plant Ecology

Bucci, S.J.; Scholz, F.G.; Goldstein, G.; Meinzer, F.C.; Franco, A.C.; Campanello, P.I.; Villalobos-Vega, R.; Bustamante, M.; Miralles-Wilhelm, F.

2006. Nutrient availability constrains the hydraulic architecture and water relations of savannah trees. *Plant, Cell and Environment*. 29(12): 2153–2167.

Several plant functional traits were studied in five dominant woody savanna species in a Brazilian savanna to determine whether removal of nutrient limitations has an effect on carbon allocation, water relations, and hydraulic architecture. Four treatments consisting of a control, and nitrogen (N), phosphorus (P), and N plus P additions were maintained for 5 years. Nitrogen fertilization significantly altered several components of hydraulic architecture. In addition, long-term N and N plus P fertilization caused midday leaf water potential to decline significantly by a mean of 0.6 MPa across all species. Decreases in leaf water potential appeared to be almost entirely compensated by increases in xylem resistance to embolism.

Keywords: Fertilization effects, hydraulic conductivity, xylem embolism.

(see Corvallis Lab order form.)

Peterson, D.W.; Reich, P.B.; Wrage, K.J.

2007. Plant functional group responses to fire frequency and tree canopy cover gradients in oak savannas and woodlands. *Journal of Vegetation Science*. 18(1): 3–12.

We measured plant functional group cover and tree canopy cover on permanent plots within a long-term prescribed fire frequency experiment and used hierarchical linear modeling to assess plant functional group responses to fire frequency and tree canopy cover. Understory woody plant cover was highest in unburned woodlands and was negatively correlated with fire frequency. C4-grass cover was positively correlated with fire frequency and negatively correlated with tree canopy cover. C3-grass cover was highest at 40-percent tree canopy cover on unburned sites and at 60-percent tree canopy cover on frequently burned sites. Total forb cover was maximized at fire frequencies of 4 to 7 fires per decade, but was not significantly influenced by tree canopy cover. Cover of nitrogen-fixing forbs was highest in shaded areas, particularly on frequently burned sites, while combined cover of all other forbs was negatively correlated with tree canopy cover. Conclusions: the relative influences of fire frequency and tree canopy cover

on understory plant functional group cover differs among plant functional groups, but both play a significant role in structuring savanna and woodland understory vegetation.

Keywords: Cedar Creek Natural History Area, disturbance ecology, fire ecology, forb, grass, prescribed fire, savanna restoration, woody plant.

(see Wenatchee lab order form.)

Scholz, F.G.; Bucci, S.J.; Goldstein, G.; Meinzer, F.C.; Franco, A.C.; Miralles-Wilhelm, F.

2007. Removal of nutrient limitations by long-term fertilization decreases nocturnal water loss in savanna trees. *Tree Physiology*. 27: 551–559. <http://heronpublishing.com/tree/summaries/volume27/a27-551.html>. June 23, 2006.

Under certain environmental conditions, nocturnal transpiration can be relatively high in temperate and tropical woody species. In nutrient-poor systems such as the Brazilian Cerrado, nocturnal transpiration may enhance delivery of nutrients to roots. We compared nocturnal transpiration of three dominant Cerrado tree species growing in unfertilized plots and plots to which nitrogen (N) and phosphorus (P) had been added twice yearly from 1998 to 2005. The results were consistent with the idea that enhancing nutrient uptake by allowing additional transpiration to occur at night when evaporative demand is lower may avoid excessive dehydration associated with increased stomatal opening during the day when evaporative demand is high.

Keywords: Leaf water potential, soil N and P, stomatal conductance, transpiration, tropical savanna.

(see Corvallis order form.)

Woodruff, D.R.; McCulloh, K.A.; Warren, J.M.; Meinzer, F.C.; Gartner, B.L.

2007. Impacts of tree height on leaf hydraulic architecture and stomatal control in Douglas-fir. *Plant, Cell and Environment*. 30: 559–569.

We investigated the mechanisms involved in the regulation of stomatal closure in Douglas-fir and evaluated the potential compensatory adjustments in response to increasing tree height. Stomatal closure was initiated at values of leaf water potential corresponding to nearly complete loss of leaf hydraulic conductance. Cryogenic scanning electron microscopic images showed that relative abundance of embolized tracheids in the central vein increased with increasing leaf water stress. Leaf embolism appeared to

be coupled to changes in stomatal conductance and may perform a vital function in stomatal regulation of plant water status and water transport in conifers.

Keywords: Leaf hydraulic conductance, stomatal conductance, growth limitation, water stress, *Pseudotsuga menziesii*.

(see Corvallis lab order form.)

Range Management

Vavra, M.; Brown, J.

2006. Rangeland research: strategies for providing sustainability and stewardship to the rangelands of the world. *Society for Range Management*. 28(6): 7–14.

During the last 30 years, a revolution has been in progress in the scientific discipline that provides tools to manage and assess rangelands. Rangeland research has undergone considerable change and continues to evolve, exploring new and exciting approaches to how rangelands function and how they might be managed. Just as North America has changed from a rural to a predominantly urban society, as economic and social conditions improve, the rest of the world can be expected to follow suit. As a result, values and needs of global societies will change markedly. Instead of valuing rangelands as places where important life-sustaining commodities such as meat, wool, and lumber are produced, people will view rangelands for other goods and values we loosely call amenities. Commodities will still be produced, but as benefits to sustainable management that also provides amenities and ecosystem services such as healthy watersheds. As a result of these changes, rangeland management and the sciences that direct it have changed, and will change even more so in the future. Rangeland research, its supporting institutions and funding sources, need to adapt to serve this new, evolving vision of rangelands.

Keywords: Research, range management, range ecology, grazing, biodiversity.

(see La Grande lab order form.)

Regional Assessments

Bormann, B.T.; Haynes, R.W.; Martin, J.R.

2007. Adaptive management of forest ecosystems: did some rubber hit the road? *Bioscience*. 57(2): 186–191.

Although many scientists recommend adaptive management for large forest tracts, there is little evidence that its use has been effective at this scale. One exception is the 10-million-hectare Northwest Forest Plan, which explicitly included adaptive management in its design. Evidence from 10 years of implementing the plan suggests that formalizing adaptive steps and committing to monitoring worked better

than allocating land to adaptive management areas. Clearly, some of the problems in implementing any new strategy should have been expected and probably would have been avoided if the plan had called for even more focused feedback. But decisions made after monitoring results were analyzed have led to new management priorities, including new approaches to adaptive management. These decisions suggest that one adaptive management loop has been completed. A continued commitment to learning about and adapting practices and institutions will most likely be needed to improve performance in the future.

Keywords: Adaptive management, forest assessment, regional monitoring, interpretive steps, synthesis.

(see Corvallis order form.)

Remote Sensing

Schroeder, T.A.; Cohen, W.B.; Yang, Z.

2007. Patterns of forest regrowth following clearcutting in western Oregon as determined from a Landsat time-series. *Forest Ecology and Management* 243: 259–273.

The rate at which forest vegetation re-establishes dominance after clearcut harvesting can impact many ecological processes, such as erosion/sedimentation, nutrient and water cycling, carbon storage potential, wildlife habitat, and trophic interactions. Although knowing a forest stand's current state of succession is useful, a clearer understanding of the impact forest harvesting has on the aforementioned ecological processes can be achieved with a more dynamic characterization of the successional process. To more fully model the continuous nature of forest regrowth following clearcut harvesting, we extrapolated tree cover data collected by the U.S. Forest Service Pacific Northwest Forest Inventory and Analysis program to a cross-normalized Landsat time-series using a date-invariant regression modeling approach.

Keywords: Landsat TM, secondary succession.

(see Corvallis order form.)

Song, C.; Schroeder T.; Cohen, W.B.

2007. Predicting temperate conifer forest successional stage distributions with multitemporal Landsat Thematic Mapper imagery. *Remote Sensing of Environment*. 106: 228–237.

Recently (2002), Song and others coupled the ZELIG and GORT models to simulate the succession trajectory for a typical young stand (<50 years) in the H.J. Andrews Experimental Forest. In this study, we extend the simulation of forest succession into old-growth stage accounting for the gradual change in canopy spectral properties, and use a large number of FIA plots as well as plots identified in the field to validate the successional trajectory. With

the stand age-class information from the FIA plots, we develop statistical models to understand the importance of multitemporal Landsat TM imagery in mapping forest successional stages.

Keywords: Succession, ecosystem modeling, Landsat TM. (see Corvallis order form.)

Resource Inventory

Barrett, T.M.

2006. Optimizing efficiency of height modeling for extensive forest inventories. *Canadian Journal of Forest Research* 36(9): 2259–2269.

Although critical to monitoring forest ecosystems, inventories are expensive. This paper presents a generalizable method for using an integer programming model to examine tradeoffs between cost and estimation error for alternative measurement strategies in forest inventories. The method is applied to an example problem of choosing alternative height-modeling strategies for 1,389 plots inventoried by field crews traveling within an 82.5- × 106-ha region of the west coast of North America during one field season. In the first part of the application, nonlinear regional height models were constructed for 38 common species by using a development data set of 137,374 measured tree heights, with root mean square error varying from 6.7 to 2.1 m. In the second part of the application, alternative measurement strategies were examined using a minimal cost objective subject to constraints on travel time and estimation error. Reduced travel time for field crews can be a significant portion of the cost savings from modeling tree heights. The optimization model was used to identify a height-modeling strategy that, given assumptions made, resulted in less than 10 percent of maximum average plot volume error, more than 33 percent of potential measurement cost savings, and small bias for estimates of regional volume and associated sampling error (0.1 percent and 0.4 percent, respectively).

Keywords: Optimization modeling, inventory planning, economic efficiency.

(see Portland Lab order form.)

Donnegan, J.A.

2007. Detection monitoring—analysis and interpretation of forest health data in the U.S. In: *Proceedings of International symposium on forest health monitoring: 2007*. Korea Forest Conservation Movement. Seoul, Korea. 117–152.

The Korean Forest Conservation Movement invited inventory specialists to describe the current protocols used to assess forest health in other nations. This paper is a

summary of the work that FIA authors have produced and the protocols they use to assess forest health in the United States.

Keywords: Palau, biomass, damage, FIA, forest inventory, volume, land cover.

(see Portland Lab order form.)

Silviculture

Busby, P.E.; Adler, P.; Warren, T.L.; Swanson, F.J.

2006. Fates of live trees retained in forest cutting units, western Cascade Range, Oregon. *Canadian Journal of Forest Research*. 36: 2550–2560.

To assess the fate of live trees retained in dispersed patterns across cutting units in the western Cascade Range of Oregon, we conducted repeat surveys (1993 and 2001) of sites cut as early as 1983. Our objectives in this study are to (1) survey survival and mortality of trees retained at the time of harvest, (2) describe temporal patterns of windthrow and other causes of mortality, (3) explore the relationship between site conditions and tree mortality, (4) consider a simple projection of the future fate of the retained live trees, and (5) comment on the long-term management of retained live trees.

Keywords: Timber harvesting, thinning, ecosystem management, AMA, green tree retention, blowdown.

(see Corvallis order form.)

Chan, S.S.; Larson, D.J.; Maas-Hebner, K.G.;

Emmingham, W.H.; Johnston, S.R.;

Mikowski, D.A.

2006. Overstory and understory development in thinned and underplanted Oregon Coast Range Douglas-fir stands. *Canadian Journal of Forest Research*. 36: 2696–2711.

This study examined thinning effects on overstory and understory development for 8 years after treatment. Three 30- to 33-year-old Oregon Coast Range plantations were partitioned into four overstory treatments: (1) unthinned (~550 trees/ha) (2) light thin (~250 trees/ha), (3) moderate thin (~150 trees/ha), and (4) heavy thin (~75 trees/ha). Two understory treatments were implemented within each overstory treatment: (1) underplanted with Douglas-fir and western hemlock and (2) not underplanted. Overstory trees responded to thinning through increased stem growth, crown expansion, and extended longevity of lower branches. Thinned overstory canopies began to close rapidly the third year after thinning, decreasing skylight by approximately 2 percent per year. Skylight in unthinned stands increased slightly owing to senescence of lower limbs and competitive mortality from self-thinning. Eight years after thinning, skylight in light thinned stands was

nearly the same as that of unthinned stands, and skylight in moderate thinned stands was close to values found in lightly thinned stands just after thinning. All underplanted conifers in unthinned stands died, while 8th year survival in thinned stands averaged 88 percent. Thinning to low densities and underplanting has the potential to accelerate development of multilayered stands, an important characteristic of old-growth forests.

Keywords: Thinning, percent skylight, canopy cover, live-crown ratio, artificial regeneration, natural regeneration, underplanting, western hemlock.

(see Corvallis Lab order form.)

Devine, W.D.; Harrington, C.A.

2006. Changes in Oregon white oak (*Quercus garryana* Dougl. ex Hook) following release from overtopping conifers. *Trees*. 20: 747–756.

Oregon white oak woodlands and savannas in the Puget Sound Region have been dramatically reduced in area owing in part to the invasion and eventual dominance of Douglas-fir in oak stands after Native American burning practices ended. We initiated a study in 2001 to examine the response of overtopped oaks to three types of release (full, partial, control) from Douglas-fir. Full and partial release treatments increased oaks' stem growth and acorn production and resulted in the formation of new branches. Our findings indicate that these overtopped oaks are capable of recovery, even after an extended period of suppression.

Keywords: *Quercus garryana*, *Oregon white oak*, *acorn production*, *epicormic branching*, *release*.

(see Olympia Lab order form.)

Harrington, T.B.

2006. Five-year growth responses of Douglas-fir, western hemlock, and western redcedar seedlings to manipulated levels of overstory and understory competition.

Canadian Journal of Forest Research. 36(10): 2439–2453.

Douglas-fir, western hemlock, and western redcedar seedlings were planted in 2001 within clearcuts, shelterwoods, or thinned stands of second-growth Douglas-fir. Understory vegetation was left untreated or removed to provide areas of vegetation control (AVC) of 0, 50, or 100 percent of seedling growing space. Third-year stem volume of seedlings growing in clearcuts was greater than in thinned stands but did not exceed that in shelterwoods (for redcedar) unless AVC was 50 percent or greater (for Douglas-fir) or 100 percent (for hemlock). Results indicate that competition in thinned stands severely limits seedling growth, competition in shelterwoods limits or prevents

growth increases after vegetation control, and understory vegetation in clearcuts is just as competitive as shelterwood trees and understory vegetation combined.

Keywords: *Conifer regeneration*, *competition*, *overstory density*, *vegetation control*.

(see Olympia lab order form.)

Littell, J.S.; Peterson, D.L.

2005. A method for estimating vulnerability of Douglas-fir growth to climate change in the Northwestern U.S. *The Forestry Chronicle*. 81(3): 369–374.

Borrowing from landscape ecology, atmospheric science, and integrated assessment, we aim to understand the complex interactions that determine productivity in montane forests and utilize such relationships to forecast montane forest vulnerability under global climate change. Specifically, we identify relationships for precipitation and temperature that govern the spatiotemporal variability in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) growth by seeking similarities in patterns of growth/climate models across a significant portion of the climatological range of the species. In the 21st century and beyond, sustainable forestry will depend on successful adaptation to the impacts of climate change and climate variability on forest structure and function. The combination of these foci will allow improved prediction of the fate of montane forests over a wide range of biogeoclimatic conditions in western North America and thus allow improved management strategies for adapting to climate change. We describe a multidisciplinary strategy for analyzing growth variability as a function of climate over a broad range of local-to-regional influences and demonstrate the efficacy of this sampling method in defining regional gradients of growth-limiting factors.

Keywords: *Douglas-fir*, *Pseudotsuga menziesii*, *climate variability*, *climate impacts*, *mechanism-response*, *tree rings*, *growth-climate relationships*.

(see PWFSL order form.)

Poage, N.J.; Marshall, D.D.; McClellan, M.H.

2007. Maximum stand-density index of 40 western hemlock-Sitka spruce stands in southeast Alaska. *Western Journal of Applied Forestry*. 22(2): 99–104.

Reineke's (1933) maximum stand-density index (SDI_{max}) was determined for 40 unthinned, fully stocked, even-aged, hemlock-spruce stands in southeast Alaska. The mean SDI_{max} of the stands was 619. None of the stand or site factors examined accounted for more than 30 percent of the variability observed in SDI_{max} . Although the spruce proportion (Pspruce) of most stands increased over time

and the hemlock proportion (Phemlock) of most stands decreased over time, SDI_{max} was not related to Pspruce, Phemlock, or change over time in Pspruce or Phemlock.

Keywords: Alaska, *Picea sitchensis*, stand-density index, self-thinning, *Tsuga heterophylla*.

(see Portland lab order form.)

Social Sciences

Fried, J.S.; Gatzliolis, D.; Gilless, J.K.; Vogt, C.; Winter, G.

Changing beliefs and building trust at the wildland/urban interface. *Fire Management Today*. 66(3): 51–54.

We developed and tested a nationally applicable survey instrument to evaluate public acceptance of fuel treatment. Testing the survey with three fuel treatment approaches in three states revealed striking regional differences in fire-related experiences, beliefs, attitudes, and acceptance as well as some common factors that influence acceptance. If education induces more homeowners to believe that prescribed burning doesn't lead to more uncontrollable fires, doesn't have terrible consequences for scenic beauty, and does reduce firefighting costs, attitudes will be more positive and acceptance increased. A lack of trust in those doing the treatments can torpedo the chances of achieving fuel management acceptance.

Keywords: Public acceptance, fuel treatments, hazard reduction.

(see Portland Lab order form.)

Soil

Parker, R.T.; Maguire, D.A.; Marshall, D.D.; Cochran, P.

2007. Ponderosa pine growth response to soil strength in the volcanic ash soils of central Oregon. *Western Journal of Applied Forestry*. 22(2): 134–141.

Mechanical harvesting and associated logging activities have the capacity to compact soil across large portions of harvest units. Two thinning treatments (felled only versus felled and skidded) in 70- to 80-year-old ponderosa pine stands were replicated at three sites with volcanic soils in central Oregon. Growth in diameter, height, and volume of residual trees were related to degree of soil compaction, measured as soil strength with a recording penetrometer. Felled and skidded plots had significantly higher soil strength values than felled-only plots (42 percent). Tree

diameter, height, and volume periodic annual increment declined significantly as average soil strength values increased above undisturbed conditions.

Keywords: Site productivity, tree growth, ponderosa pine, compaction, volcanic ash, bulk density.

(see Olympia lab order form)

Threatened, Endangered, Sensitive Species

Raley, C.M.; Aubry, K.B.

2006. Foraging ecology of pileated woodpeckers in coastal forests of Washington. *The Journal of Wildlife Management*. 70(5): 1266–1275.

Providing habitat for pileated woodpeckers in the Pacific Northwest has been a key component of forest management strategies for over 20 years. We investigated the diet of pileated woodpeckers, and selection by birds of both individual structure and site characteristics for foraging. Birds foraged almost exclusively in closed-canopy habitats and selected relatively tall, large-diameter snags in early to moderate stages of decay. Sites used for foraging had greater densities of large snags (>51 cm d.b.h. and >7.4 m tall) than sites that were not used. Contrary to previous studies, this study found logs were rarely used for foraging. In coastal forests, logs appeared to be too cool and wet to support carpenter ants, which were the primary prey of pileated woodpeckers.

Keywords: Carpenter ant, *Dryocopus pileatus*, foraging, forest management, habitat selection, log, Pacific Northwest, pileated woodpecker, scat analysis, snag.

(see Olympia lab order form.)

Wildlife

Anthony, R.G.; Forsman, E.D.; Franklin, A.B.; Anderson, D.R.; Burnham, K.P.; White, G.C.; Schwarz, C.J.; Nichols, J.D.; Hines, J.E.; Olson, G.S.; Ackers, S.H.; Andrews, L.S.; Biswell, B.L.; Carlson, P.C.; Diller, L.V.; Dugger, K.M.; Fehring, K.E.; Fleming, T.L.; Gerhardt, R.P.; Gremel, S.A.; Gutierrez R.J.; Happe, P.J.; Herter, D.R.; Higley, J.M.; Horn, R.B.; Irwin, L.L.; Loschl, P.J.; Reid, J.A.; Sovern, S.G.

2006. Status and trends in demography of northern spotted owls, 1985–2003. *Wildlife Monographs*. 163(1): 1–48.
<http://www.wildlifejournals.org/perlserv/?request=get-toc&issn=0084-0173&volume=163&issue=1>. July 2006.

We summarized data from 14 long-term spotted owl demography studies in Oregon, Washington, and California

during the period 1985-2003. We concluded that populations of eight areas were declining, populations of four areas were stationary, and the population of one area was probably declining. One area did not have enough years of data to estimate the population growth rate. The estimated average rate of decline on eight federal monitoring areas was 2.5 percent per year. On the other study areas, the estimated average rate of decline was 6.6 percent per year. Population declines were most precipitous in Washington. We suggest that population declines are due to a variety of factors, including continued loss of habitat from logging on nonfederal lands, competition with barred owls, and loss of habitat from fires and parasites.

Keywords: Spotted owl, barred owl, demography, meta-analysis, population trends, survival, fecundity, mark-recapture, Oregon, Washington, California.

(see Corvallis order form.)

Crisafulli, C.M.

2005. Cascade torrent salamander. In: Jones, L.C.; Leonard, W.P.; Olson, D.H., eds. *Amphibians of the Pacific Northwest*. Seattle, Washington: Seattle Audubon Society: 58–62.

A field guide species account that includes information on the description, variation, reproductive biology, distribution, life history, natural history, and habitat of the Cascade torrent salamander.

Keywords: Cascade torrent salamander, Plethodon.

(see Olympia Lab order form.)

Crisafulli, C.M.

2005. Larch mountain salamander. In: Jones, L.C.; Leonard, W.P.; Olson, D.H., eds. *Amphibians of the Pacific Northwest*. Seattle, Washington: Seattle Audubon Society: 132–135.

A field guide species account that includes information on the description, variation, reproductive biology, distribution, life history, natural history, and habitat of the Larch Mountain salamander.

Keywords: Larch Mountain salamander, Plethodon.

(see Olympia Lab order form.)

Forsman, E.D.; Otto, I.

2006. Healed fractures and other abnormalities in bones of small mammals. *Northwestern Naturalist* 87: 143–146.

We identified forty-six healed fractures and six skeletal deformities in a sample of 19,972 small mammals in pellets of spotted owls (*Strix occidentalis*) in Oregon. Most healed fractures (98 percent) were in arboreal or scansorial mammals. Our data clearly indicate that arboreal voles, squirrels, and woodrats occasionally survive after suffering severe fractures in falls or other trauma. However, our

observations almost certainly underestimate the frequency of occurrence of broken bones in small mammals because most individuals that suffer serious fractures probably do not survive.

Keywords: Injuries, accidents, fractures, small mammals, tree voles, flying squirrel, woodrats, chipmunks.

(see Corvallis Lab order form.)

Marcot, B.G.

2006. Characterizing species at risk. I: Modeling rare species under the Northwest Forest Plan. *Ecology and Society* 11(2):10. <http://www.ecologyandsociety.org/vol11/iss2/art10/>.

The Northwest Forest Plan in the Pacific Northwest, United States, includes directives for survey and site protection of hundreds of rare species across many taxonomic classes. To help direct survey activities, prioritize sites, and survey stand conditions for conservation of these species, I developed Bayesian belief network (BBN) models of habitat relationships and multiple stressors predicting presence of 12 rare species, and I present an example of predicting presence and absence of a rare fungus. The BBN models are developed along a rigorous process of expert judgment, peer review, reconciliation, accuracy testing, and incremental updating with known site data and validation data. Management implications of prediction errors are discussed.

Keywords: Bayesian belief networks, Bridgeoporus nobilissimus, model validation, Northwest Forest Plan, rare species models, Pacific Northwest.

(see Portland lab order form.)

Marcot, B.G.; Hohenlohe, P.A.; Morey, S.; Holmes, R.; Molina, R.; Turley, M.C.; Huff, M.H.; Laurence, J.A.

2006. Characterizing species at risk. II: Using Bayesian belief networks as decision support tools to determine species conservation categories under the Northwest Forest Plan. *Ecology and Society*. 11(2):12. <http://www.ecologyandsociety.org/vol11/iss2/art12/>.

We developed decision-aiding models as Bayesian belief networks (BBNs) that represented evaluation guidelines used to determine the appropriate conservation of hundreds of potentially rare species on federally-administered lands in the Pacific Northwest United States. The models were used in a structured assessment and paneling procedure as part of an adaptive management process that evaluated new scientific information under the Northwest Forest Plan. The models helped resource managers and specialists to

evaluate complicated and at times conflicting conservation guidelines and to reduce bias and uncertainty in evaluating the scientific data.

Keywords: Bayesian belief networks, decision models, expert panels, risk analysis, Northwest Forest Plan, species conservation.

(see Portland lab order form.)

Marcot, B.G.; O’Neil, T.A.; Nyberg, J.B.; MacKinnon, A.; Paquet, P.J.; Johnson, D.H.

2006. Analyzing key ecological functions for transboundary subbasin assessments. In: Slaughter, C.W.; Berg, N., eds. *Watersheds across boundaries: science, sustainability, security*. Proceedings of the ninth biennial watershed management council conference. Water Resources Center Report 107. Riverside, CA: University of California: 37–50.

We present an evaluation of the ecological roles (“key ecological functions” or KEFs) of 618 wildlife species as one facet of subbasin assessment in the Columbia River Basin (CRB) of USA and Canada. Using a wildlife-habitat relationships database (IBIS) and GIS, we have mapped KEFs as levels of functional redundancy (numbers of species with particular KEF categories) that may occur within subbasins and subwatersheds historically and at present. Natural levels of functional redundancy are presumed to be desirable for contributing to resilient ecosystems. Our “functional analyses” complement analyses of habitats and species, and serve to inform on the degree to which wildlife communities are “fully functional” and how that functionality can be influenced by changes in habitats. The focus of the paper is on the use of KEFs but we also have provided, for the first time, the analysis in a transboundary CRB context by merging data on the U.S. and Canada. The analysis depicts historical, current, and changes in functional redundancy for selected KEF categories; total functional richness (number of KEF categories performed by all wildlife species in an area); and functional diversity (functional richness weighted by functional redundancy). The maps denote parts of the subbasin that are strong or deficient in specific ecological functions. Land managers could use the maps to guide restoration or conservation priorities for ecological functions of fish and wildlife.

Keywords: Key ecological functions, functional redundancy, Columbia River Basin, subbasin assessment.

(see Portland lab order form.)

Marcot, B.G.; Steventon, J.D.; Sutherland, G.D.; McCann, R.K.

2006. Guidelines for developing and updating Bayesian belief networks applied to ecological modeling and conservation. *Canadian Journal of Forest Research*. 36: 3063–3074.

We provide practical guidelines for developing, testing, and revising Bayesian belief networks (BBNs). Primary steps in this process include creating influence diagrams of the hypothesized “causal web” of key factors affecting a species or ecological outcome of interest; developing a first, alpha-level BBN model from the influence diagram; revising the model after expert review; testing and calibrating the model with case files to create a beta-level model; and updating the model structure and conditional probabilities with new validation data, creating the final-application gamma-level model. We illustrate and discuss these steps with an empirically based BBN model of factors influencing probability of capture of northern flying squirrels (*Glaucomys sabrinus* (Shaw)).

Keywords: Bayesian belief networks, model development, modeling guidelines, northern flying squirrel.

(see Portland lab order form.)

McCann, R.K.; Marcot, B.G.; Ellis, R.

2006. Bayesian belief networks: applications in ecology and natural resource management. *Canadian Journal of Forest Research*. 36(12): 3053–3062.

We review the use of Bayesian belief networks (BBNs) in natural resource management and ecology. We suggest that BBNs are useful tools for representing expert knowledge of a system, evaluating potential effects of alternative management decisions, and communicating to nonexperts about resource decision issues. BBNs can be used effectively to represent uncertainty in understanding and variability in system response, and the influence of uncertainty and variability on utilities associated with resource decisions in a risk management framework. BBN tools also lend themselves well to an adaptive-management framework by posing testable management hypotheses and incorporating new knowledge to evaluate existing management guidelines.

Keywords: Bayesian belief networks, natural resource modeling, resource management problems.

(see Portland lab order form.)

McIntyre, A.P.; Schmitz, R.A.; Crisafulli, C.M.

2006. Associations of the Van Dyke's salamander (*Plethodon vandykei*) with geomorphic conditions in headwall seeps of the Cascade Range, Washington State. *Journal of Herpetology*. 40(3): 309–322.

We explored the association between Van Dyke's salamander (*Plethodon vandykei*) and hydrologic condition, geomorphology, and vegetation structure in headwall seeps in the Cascade Range of Washington State. We modeled occurrence of *P. vandykei* at three site scales: between seeps, within seeps, and between microhabitat sites. We ranked a priori models using Bayesian information criterion (BIC). Using logistic regression, with presence and absence as the response, we found best approximating models for the occurrence of *P. vandykei* at the three site scales is predicted by hydrological and geological habitat characteristics.

Keywords: Van Dyke's salamander, amphibian, *Plethodon*, headwall seeps, ecological modelling.

(see Olympia lab order form.)

McIver, J.D.; Ottmar, R.

2006. Fuel mass and stand structure after post-fire logging of a severely burned ponderosa pine forest in northeastern Oregon. *Forest Ecology and Management*. 238(1-3): 268–279.

Stand structure and downed woody fuel mass were measured in four replicate units for each of three treatments (unlogged control, commercial harvest, and fuel reduction harvest) following the 1996 Summit Wildfire in northeastern Oregon. Commercial and fuel-reduction harvest resulted in a significant decrease in tree density and tree basal areas. The total downed woody fuel mass significantly increased as compared to the unlogged controls. Model projections of the fuel bed using the Forest Vegetation Simulator indicated the significant difference in downed fuel loading between the unlogged and logged units would remain for approximately 15 years. However, as stand collapse became progressively greater in year 25 and 50, the unlogged units downed woody fuel mass became two to three times higher than the logged units.

Keywords: Salvage logging; re-burn hypothesis; restoration.

(see La Grande lab order form.)

McKenzie, D.; O'Neill, S.M.; Larkin, N.; Norheim, R.A.

2006. Integrating models to predict regional haze from wildland fire. *Ecological Modelling*. 199: 278–288.

Visibility impairment from regional haze is a significant problem throughout the continental United States. A substantial portion of regional haze is produced by smoke from

prescribed and wildland fires. Here we describe the integration of four simulation models, an array of GIS raster layers, and a set of algorithms for fire-danger calculations into a modeling framework for simulating regional-scale smoke dispersion. We focus on a representative fire season (2003) in the Northwestern USA, on a 12-km domain, and track the simulated dispersion and concentration of PM_{2.5} over the course of the season. Simulated visibility reductions over national parks and wilderness areas are within the ranges of measured values at selected monitoring sites, although the magnitudes of peak events are underestimated because these include inputs other than fire.

Keywords: Regional haze, integrated models, fire regimes, fire emissions, smoke dispersion.

(see PWFSL order form.)

Meinzer, F.C.; Warren, J.M.; Brooks, J.R.

2007. Species-specific partitioning of soil water resources in an old-growth Douglas-fir/western hemlock forest. *Tree Physiology*. 27: 871–880.

We studied seasonal courses of soil water utilization in a 450-year-old *Pseudotsuga menziesii*/*Tsuga heterophylla* forest. Mean root area in the upper 60 cm of soil was significantly greater in the vicinity of *T. heterophylla* trees. However, seasonal water extraction on a root area basis was significantly greater near *P. menziesii* trees at all depths between 20 and 60 cm, leading to significantly lower water storage in the upper 60 cm of soil near *P. menziesii* trees at the end of the summer dry season. The results provide information on functional traits relevant for understanding the ecological distributions of the two species and have implications for spatial variability of processes such as soil respiration and nutrient cycling.

Key words: *Pseudotsuga menziesii*, root distribution, sap flow, transpiration, *Tsuga heterophylla*.

(see Corvallis lab order form.)

Pearl, C.A.; Bull, E.L.; Green, D.E.; Bowerman, J.; Adams, M.J.; Hyatt, A.; Wentz, W.H.

2007. Occurrence of the amphibian pathogen *Batrachochytrium dendrobatidis* in the Pacific Northwest. *Journal of Herpetology*. 41(1): 145–149.

Chytridiomycosis (infection by the fungus *Batrachochytrium dendrobatidis*) is an emerging pathogen of amphibians that is associated with declines in at least four continents. We report results of disease screens from 271 field-sampled amphibians from Oregon and Washington. Chytridiomycosis was detected on 5 of 7 species and from 31 percent of all snappers, including sensitive species western toad (*Bufo boreas*), northern red-legged frog (*Rana aurora*), and Oregon spotted frog (*R. pretiosa*). We also detected chytridiomycosis in nonnative bullfrogs

(*R. catesbeiana*) in western and central Oregon. Further research into the origin, virulence, transmissibility, and interactions with other stressors is needed to gauge its potential impact on northwestern amphibians.

Keywords: Amphibian, Batrachochytrium dendrobatidis, bullfrog, Chytridiomycosis, diseases, Oregon, pathogen.
(see La Grande lab order form.)

Wood Utilization

Renninger, H.J.; Gartner, B.L.; Meinzer, F.C.

2006. Effects of release from suppression on wood functional characteristics in young Douglas-fir and western hemlock. Canadian Journal of Forest Research. 36(8): 2038–2046.

We assessed differences in growth ring width, specific conductivity (Ks), tracheid dimensions, moisture content, and wood density in suppressed Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) trees and trees released from suppression. Growth ring width was 370 percent higher for Douglas-fir and 300 percent higher for western hemlock trees released from suppression, and Ks was 182 percent higher for Douglas-fir and 42 percent higher for western hemlock trees released from suppression. Earlywood width was approximately four times greater. Tracheids were 25 percent wider and 11 percent longer in released Douglas-fir trees. Wood density decreased by 21 percent in Douglas-fir trees and by 11 percent in western hemlock trees released from suppression.

Keywords: Hydraulic conductivity, thinning, wood anatomy, wood density.

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