United States
Department of
Agriculture

**Forest Service**

Pacific Northwest
Research Station

# Recent Publications of the Pacific Northwest Research Station, Second Quarter 2004

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The first section shows items published by the PNW Research Station. The second section shows publications available elsewhere. In each section, items are grouped alphabetically by author within categories.

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620 SW Main, Suite 400
P.O. Box 3890
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**Seattle**
Pacific Wildland Fire Sciences Laboratory
400 N 34th Street, Suite 201
Seattle, WA 98103

**Sitka**
Alaska Wood Utilization Research and
Development Center
204 Siginaka Way
Sitka, AK 99835-7316

**Wenatchee**
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1133 N Western Avenue
Wenatchee, WA 98801-1229

July 2004

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# Pacific Northwest Research Station Publications

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## Bibliographies

### 04-034

Pacific Northwest Research Station
2004. Recent publications of the Pacific Northwest Research Station, first quarter 2004. Portland, OR: U.S. Department of Agriculture, Forest Service. 24 p.

*Keywords: Bibliographies (forestry).*

## Economics

### 04-131

Warren, D.D.
2004. Production, prices, employment, and trade in Northwest forest industries, all quarters 2002. Resour. Bull. PNW-RB-241. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 171 p.

Provides current information on lumber and plywood production and prices; employment in the forest industries; international trade in logs, lumber, and plywood and average prices of stumpage sold by public agencies; and other related items.

*Keywords: Forestry business economics, lumber prices, plywood prices, timber volume, stumpage prices, employment (forest products industries), marketing (forest products), imports and exports (forest products).*

## Fire

### 03-458

White, S.M.
2004. Bridging the worlds of fire managers and researchers: lessons and opportunities from the Wildland Fire Workshops. Gen. Tech. Rep. PNW-GTR-599. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 41 p.

The Wildland Fire Workshops in Oregon, Arizona, and Colorado were designed to engage managers and researchers to list priorities for research; characterize effective partnerships; identify qualities of effective information, tools, and processes; and evaluate the workshops. Participants responded that research should be approached at multiple scales and focused on social issues. Effective partnerships occur when stakeholders interact at multiple stages, when time is allowed, and where accountability exists. Effective information, tools, and processes are adequately and consistently funded, user friendly, and often championed by key individuals.

*Keywords: Wildfire, communication, technology transfer, applied research, management, information, partnerships.*

## Landscape Ecology

### 03-106

Harrington, C.A., comp.
2003. The 1930s survey of forest resources in Washington and Oregon. Gen. Tech. Rep. PNW-GTR-584. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 123 p.

The forest resources of Washington and Oregon were surveyed in the early 1930s. Many publications and maps were produced from the survey data. Forest cover maps created in the 1930s have recently become available in digital formats, but little documentation was provided with the electronic files. Older publications are not readily available. This report provides a brief overview of the survey and includes a CD-ROM that includes excerpts from early publications that deal with survey, planning, conduct, or results from the survey, the forest type maps in several geographic information system (GIS) or graphics formats (ArcView™ shape files, ArcExplorer™ project files, and .jpg, a graphics file format). A copy of ArcExplorer™ (to view and print the ArcExplorer™ files) is also included.

*Keywords: Forest inventory, forest survey, 1930s, forest cover, forest type maps, Washington, Oregon, Douglas-fir region, ponderosa pine region.*

## Plant Ecology

### 04-023

Aitken, M.; Parks, C.G.
2004. Guide to the common *Potentilla* species of the Blue Mountains ecoregion. Gen. Tech. Rep. PNW-GTR-603. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 50 p.

This guide will help identify common *Potentilla*, especially when flowers are not present. There are illustrations to accompany the dichotomous key and glossary.

*Keywords:* Potentilla*, plant key, Blue Mountains.*

## Silviculture

### 03-256

Miller, R.E.; Reukema, D.L.; Anderson, H.W.
2004. Tree growth and soil relations at the 1925 Wind River spacing test in coast Douglas-fir. Res. Pap. PNW-RP-558. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 41 p.

The Wind River spacing test is the earliest field trial seeking to determine the most appropriate spacing for planting Douglas-fir. Greater growth at widest spacings was reported previously. Seeking explanations, we (1) measured and mapped several site factors (topographic relief, depth to bedrock, soil properties) and (2) related these factors to tree and stand growth. Because soils in the widest spacings are generally deeper and have more available water capacity than do soils in closer spacings, we conclude that some of the superior growth in the 10- and 12-foot spacings is due to more favorable soil. Based on visual comparisons of tree size, we suspect that spacing is probably the stronger factor affecting tree performance at this site.

*Keywords: Douglas-fir,* Pseudotsuga menziesii*, tree size, tree spacing, stand yields, soil depth.*

## Special Forest Products

### 04-086

Donoghue, E.M.; Benson, G.L.; Chamberlain, J.L., tech. coords.
2004. Sustainable production of wood and non-wood forest products: Proceedings of IUFRO Division 5 Research Groups 5.11 and 5.12, Rotorua, New Zealand, March 11-15, 2003. Gen. Tech. Rep. PNW-GTR-604. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 120 p.

This proceedings is a collection of 18 papers and extended abstracts from talks presented at the International Union of Forest Research Organizations (IUFRO) All-Division 5 Conference. This conference emphasized the many

ways that forest products research can contribute to sustainable choices in forest management. The two IUFRO Research Groups represented in this proceedings are Sustainable Production of Forest Products Research Group (5.12) and Nonwood Forest Products Research Group (5.11). The papers address many aspects of wood and nonwood forest products including forest management; product development; economic development implications; local, national, and international protocols; assessments; and research strategies.

*Keywords: Forest products, nontimber forest products, nonwood products, sustainable forest management, wood products.*

## Wildlife

### 02-006

Bromley, R.G.; Rothe, T.C.
2003. Conservation assessment for the dusky Canada goose (*Branta canadensis occidentalis* Baird). Gen. Tech. Rep. PNW-GTR-591. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 79 p.

In response to the changing status of the population of dusky Canada geese that nest in the Copper River Delta region of south-central Alaska, the Pacific Flyway Council and Study Committee and agencies responsible for management of the species conducted a conservation assessment. This report provides a comprehensive synthesis of biological information on dusky Canada geese, presents an updated assessment of factors affecting the size and stability of the population, and serves as an aid to conservation planning and identification for future needs.

*Keywords:* Branta canadensis occidentalis*, migratory birds, wildlife management.*

## Wood Utilization

### 03-143

Rapp, V.
2003. Alaska forest products: using resources well. Science Update 5. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 11 p.

Despite abundant forest resources in the state, the Alaska forest products industry declined throughout the 1990s and early 21st century. The team at the Alaska Wood Utilization Research and Development Center in Sitka works to find technological and economic solutions for a durable forest products industry in Alaska. The team has found that wood recovery could be improved at nearly every sawmill in Alaska. Strong potential exists for sawmills to add kilns and dry lumber, which could sell at higher prices. Wood residues such as chips and sawdust could be viewed as resources instead of as wastes. Value-added products could supply the domestic market in Alaska. The center's goal is to find ways to make the best possible uses of forest resources in Alaska.

*Keywords: Alaska, wood utilization, forest products, lumber recovery, value-added products.*

## 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 and Riparian Systems

Bilby, R.E.; Beach, E.W.; Fransen, B.R. [and others]

2003. Transfer of nutrients from spawning salmon to riparian vegetation in western Washington. Transactions of the American Fisheries Society. 132: 733-745.

We compared riparian plant communities along streams in two watersheds (Griffin and Kennedy Creeks) in western Washington above and below barriers to spawning salmon. Salmonberry foliage was analyzed for nitrogen stable isotope ratio ($\delta^{15}N$), an indicator of salmon-derived nitrogen, and total nitrogen (N) and phosphorus (P) content. In addition, we compared cover, plant density, and species richness of shrub and understory vegetation between sites with and without salmon. The $\delta^{15}N$ values in salmonberry leaves at sites with salmon were higher than at sites without salmon at Kennedy Creek but not Griffin Creek. Salmonberry foliage possessed significantly higher levels of total N and P adjacent to salmon spawning reaches in both watersheds. Shrub cover was greater at sites with salmon at Griffin Creek, and shrub species diversity was higher at sites with salmon at Kennedy Creek. Understory plants at Griffin Creek sites with salmon exhibited greater cover, species diversity, and plant density than sites without salmon. Understory plant density and species diversity were higher at sites with salmon at Kennedy Creek. Results indicate that Pacific salmon carcasses contribute to nutrient availability in riparian areas and influence the cover, density, and diversity of riparian shrub and understory vegetation.

*Keywords: Salmon carcasses, riparian vegetation, marine nutrients.*

(See Olympia order form.)

Independent Scientific Advisory Board

2002. A review of strategies for recovering tributary habitat. Portland, OR: Northwest Power Planning Council. 54 p.

Whether tributary habitat improvements have achieved, or are likely to achieve, the goal of recovering conditions favoring the natural production of native salmonids in the Columbia River basin is an open question, and a review of the approaches, assessment procedures, and implementation strategies for habitat improvement is therefore timely. In this report we examine several topics central to the recovery of tributary habitat: (1) the biological objectives related to habitat recovery, (2) the strategies for implementing restoration, (3) the incentives for implementing restoration, (4) the scientific foundation for habitat recovery, and (5) monitoring and evaluation. The objective of the review is to answer the question, “What concepts and strategies should be incorporated in habitat recovery actions to improve their chances for success?”

*Keywords: Salmon, watersheds, stream habitat, restoration.*

(See Olympia order form.)

Independent Scientific Advisory Board
2003. Hatchery surpluses in the Pacific Northwest. Fisheries. 27(12): 16-27.

Substantial experimental evidence demonstrates that domestication selection can genetically alter hatchery populations in a relatively few generations and that hatchery-reared adults returning from the ocean and spawning in the wild produce fewer progeny than adults of wild origin. More limited evidence suggests that interbreeding between hatchery-reared adults and wild fish can reduce the fitness of the wild population. We conclude that decisions to permit hatchery-reared adults to spawn in the wild should be based on the needs of wild populations and the ability of the habitat to support additional reproduction, not based simply on the availability of hatchery-reared adults returning from the ocean.

*Keywords: Salmon, fish hatcheries, Columbia River, supplementation.*

(See Olympia order form.)

Johnson, S.L.
2003. Stream temperature: scaling of observations and issues for modeling. Hydrological Processes. 17: 497-499.

Stream temperatures have become a major issue in some regions and the center of policy debate. Many contradictions exist in published literature about the factors controlling stream temperature. Although the influences of stream temperature appear to be simple, we have much to learn about these complex processes. This commentary addresses two main points regarding modeling of stream temperature dynamics: problems with air temperature correlations to predict stream temperature and the importance of scaling of factors, both microclimatic influences as well as reach-scale upstream influences.

*Keywords: Aquatic ecosystems, watershed management, stream ecology, stream functions, attitudes, perceptions, water quality.*

(See Corvallis order form.)

Johnston, J.G., Jr.
2002. Riparian canopy cover in northeastern Washington: stream temperature response, historical reference conditions, and management effects. Seattle, WA: University of Washington. 104 p. M.S. thesis.

Northeastern Washington riparian forests have undergone changes to species composition and structure as a result of land management. Understanding how timber harvest affects stream temperature, how riparian management alters stand conditions, and how riparian canopy cover was historically distributed across the landscape will aid in the selection of appropriate riparian treatments. Stream temperatures in adjacent harvested/nonharvested reach pairs were not statistically significant, but linear regression showed a statistically significant increase of maximum temperature with a decrease in canopy cover. Comparing riparian stand conditions recorded in historical and current land surveys showed a decrease in fire-adapted tree species and decreased tree size. Historical distribution of riparian canopy cover on northeastern Washington streams was investigated by measuring cover shown in historical (1930s and 1940s) aerial photography. Basin area, valley bottom width, surficial geology, and flow direction exhibited the best relations with canopy cover; elevation was a poor predictor of cover. The final objective, to evaluate the influence of management on riparian cover, was assessed by using canopy cover and land management type measured from historical and current (1994 and 2000) aerial photographs. Reaches affected by recent (within the past 10 years) timber harvest showed a decrease in cover between the historical and current periods. Reaches without recent active management (only fire suppression) had more cover than those in the historical condition. Results indicated that for mature, fire-suppressed stands, if no greater than about 15 percent canopy cover was removed during timber harvest, then cover levels were likely to be retained near historical levels.

*Keywords: Riparian canopy, stream temperature.*

(Available through library or interlibrary loan.)

## Atmosphere

O'Neill, S.M.; Lamb, B.K.; Chen, J. [and others]
2002. Modeling aerosol formation and transport in the Pacific Northwest with the community multi-scale air quality (CMAQ) modeling system. In: 2002 models-3 users' workshop. Research Triangle Park, NC: Environmental Protection Agency: [Not paged].

The Northwest Regional Modeling Center (NWRMC) demonstration project was undertaken to determine the feasibility of using the Community Multiscale Air Quality (CMAQ) modeling system to investigate regional haze in the Pacific Northwest. This study is unique because previous particulate matter (PM) studies have focused on urban areas in the Northeastern United States and the Los Angeles basin. The Pacific Northwest offers a different situation because of the heavily urbanized areas situated in a domain dominated by forests, mountains, and agricultural areas. The approach of the NWRMC involved two phases. In the first phase, results from CMAQ were compared to results from other air quality models used in California. The second phase of the project involved expanding to a regional-scale domain to investigate aerosol formation and transport. The highest PM2.5 concentrations occurred in three regions of the domain: the north slope of the Olympic Mountains, the Columbia River Gorge area, and the mountains of central Idaho. This is the first step in a comprehensive performance evaluation of CMAQ for the Pacific Northwest. The NWRMC emission inventory (EI) solution tended to overpredict PM2.5 concentrations with a normalized bias of 93 percent while the national emission trend 1996 EI solution slightly underpredicted with a bias of -15 percent.

*Keywords: Air quality modeling, CMAQ, Pacific Northwest, aerosol formation, model sensitivity, emission inventories.*

(See PWFS order form.)

Sestak, M.; O'Neill, S.; Ferguson, S. [and others]
2002. Integration of wildfire emissions into Models-3/CMAQ with the prototypes: Community Smoke Emissions Modeling System (CSEM) and BlueSky. In: 2002 models-3 users' workshop. Research Triangle Park, NC: Environmental Protection Agency: [Not paged].

This paper describes two efforts to develop appropriate emissions models for wildland burning. Based on a common calculation of consumption and emissions, two approaches to calculate emissions from wildfires are presented. Only preliminary comparisons of the results from the different approaches are presented, but they illustrate that the computations appear to yield similar results. Further testing and experience will clarify this in the future.

*Keywords: Wildfire emissions, smoke modeling, air quality, regional assessments, smoke.*

(See PWFS order form.)

## Biometrics

Hann, D.D.; Marshall, D.D.; Hanus, M.L.
2003. Equations for predicting height-to-crown-base, 5-year diameter-growth rate, 5-year height-growth rate, 5-year mortality rate, and maximum size-density trajectory for Douglas-fir and western hemlock in the coastal region of the Pacific Northwest. Res. Contrib. 40. Corvallis, OR: Oregon State University, College of Forestry, Forest Research Laboratory. 83 p.

Permanent research plots were used to develop equations to predict height-to-crown-base, 5-year diameter growth rate, 5-year height growth rate, 5-year mortality rate, and maximum size-density trajectory for Douglas-fir and western hemlock in the coastal region of the Pacific Northwest. Equations were first developed for untreated plots. The effects of nitrogen fertilization and thinning, both singly and in combination, upon each equation were then examined by comparing predicted values from equations developed from the untreated plots to actual

measurements from treated plots. From this, modifiers to the untreated equations were developed whenever the treatment responses proved to be significantly different from those predicted by the equations for the untreated plot. Equations developed in this study have been inserted into the stand management cooperative version of ORGANON, a model used to predict the development of stands over time.

*Keywords: ORGANON growth-and-yield model, stand development, stand management cooperative.*

(Copies of this publication are available from the Forestry Communications Group, OSU, 256 Peavy Hall, Corvallis, OR 97331-5704; phone (541) 737-4271; email forspub@cof.orst.edu.)

## Ecosystem Structure and Function

Bachelet, D.; Neilson, R.P.; Hickler, T. [and others]
2003. Simulating past and future dynamics of natural ecosystems in the United States. Global Biogeochemical Cycles. 17(2): 14-1–14-21.

Simulations of potential vegetation distribution, natural fire frequency, and carbon pools and fluxes are presented for two dynamic global vegetation models (DGVMs) from the second phase of the Vegetation/Ecosystem Modeling and Analysis Project. Results link vegetation dynamics to biogeochemical cycling for the conterminous United States. Two climate change scenarios were used: a moderately warm scenario from the Hadley Climate Center and a warmer scenario from the Canadian Climate Center. Both include sulfate aerosols and assume a gradual $CO_2$ increase. Both DGVMs simulate a reduction of Southwestern desert areas, a westward expansion of eastern deciduous forests in the western part of the Pacific Northwest and in north-central California, and both predict an increase in total biomass burnt in the next century with a more pronounced increase under the Canadian scenario. Under the Hadley scenario, both DGVMs simulate increases in total carbon stocks. Under the Canadian scenario, both DGVMs simulate a decrease in live vegetation carbon. We identify similarities in model behavior that are due to the climate forcing and explain differences by the different structure of the models and their different sensitivity to $CO_2$. We compare model output with data to enhance our confidence in their ability to simulate vegetation distribution and ecosystem processes.

*Keywords: Climate change, simulation, model, vegetation distribution, fire frequency, carbon, vegetation dynamics.*

(See Corvallis order form.)

Carey, A.B.
2003. Biocomplexity and restoration of biodiversity in temperate coniferous forest: inducing spatial heterogeneity with variable-density thinning. Forestry. 76(2): 127-136.

Single-species conservation and natural resources seem insufficient for protecting biodiversity; conventional forestry is suspect in sustainability. In the Northwestern United States, comparisons of natural and managed coniferous forests suggest that single-species conservation and conventional forestry are unlikely to be successful because biocomplexity is more important than individual habitat elements in maintaining the diversity of forest ecosystems and their capacity to produce useful goods and services. Experimental results from inducing heterogeneity into tree canopies support the importance of biocomplexity to various biotic communities including soil organisms, vascular plants, fungi, birds, small mammals, and vertebrate predators. Holistic management, however, requires a suite of techniques to direct developmental processes to a useful trajectory.

*Keywords: Biocomplexity, managed forests, holistic management.*

(See Olympia order form.)

Carey, A.B.
2003. Restoration of landscape function: Reserves or active management? Forestry. 76(2): 221-230.

A 20-year program of research suggests that old-growth forests are ecologically unique and highly valued by people; that naturally young forests with legacies from old forests sustain many, if not all, of the higher organisms associated with old growth; and that many managed forests are depauperate in species. Thus, restoring landscape function entails restoring function to managed stands; structures and processes of forest development provide adequate guidance for restoring this function through active management. Systems of reserves and riparian corridors that do not take into account ecological restoration of managed forests and degraded streams may be self-fulfilling prophecies of forest fragmentation. Intentional management of stands and landscapes can reduce the need for wide riparian buffers, produce landscapes dominated by late-seral stages that are hospitable to wildlife associated with old-growth forest, provide a sustained yield of forest products, and contribute to economic, social, and environmental sustainability.

*Keywords: Old growth, managed forests, fragmentation.*

(See Olympia order form.)

Hessburg, P.F.; Reynolds, K.M.; Salter, R.B.; Richmond, M.B.
2002. Emulating natural forest patterns in the inland Northwest, USA. In: Buse, L.J.; Perera, A.H., comps. Emulating natural forest landscape disturbances: concepts and applications—popular summaries. For. Res. Info. Pap. 149. Sault Ste. Marie, ON: Ontario Forest Research Institute, Ontario Ministry of Natural Resources: 79-81.

Over the last 200 years, the combined effects of settlement and management have markedly affected the natural patterns of inland Northwest forests in the United States and their associated functionality. We describe methods for characterizing range and variation of reconstructed natural forest patterns for the purpose of emulating some of the characteristics of those patterns though restorative treatments. We compare the current patterns of an example watershed with ranges of reference conditions from its corresponding ecoregion and discuss application to landscape pattern restoration.

*Keywords: Landscape restoration, reference conditions, vegetation patterns, fire regimes.*

(See Wenatchee order form.)

Laurence, J.A.; Andersen, C.P.
2003. Ozone and natural systems: understanding exposure, response, and risk. Environment International. 29: 155-160.

Research aimed at understanding the response of plants to ozone has been conducted for over four decades, but little of it has addressed intact natural systems. Even so, there is sufficient scientific information at this time to support air quality standards that will protect natural terrestrial ecosystems from ozone. What is unknown is the risk associated with continued exposure of natural systems, including both aboveground and belowground components, in combination with other stresses including changing temperature and precipitation, elevated carbon dioxide, pests and pathogens, invasive species, and other activities that may fragment the landscape. Research to support an assessment of the ecological risk associated with ozone as it exists, in a milieu of stresses, must include endpoints beyond those addressed in the past, primarily productivity and species composition. To estimate the risk to society of ozone impacts on natural systems, endpoints such as the integrity of soil food webs, the quantity and quality of water supplied from terrestrial ecosystems, wildlife and recreational values, and the transfer and fate of carbon, nutrients, and water within the systems must be quantified. Not only will this research provide the basis for a sound estimate of risk, but it also will improve our understanding of fundamental ecosystem processes.

*Keywords: Food webs, belowground processes, risk assessment.*

(See Corvallis order form.)

Mooney, H.A.; Kalin Arroyo, M.T.; Bond, W.J. [and others]
2001. Mediterranean-climate ecosystems. In: Chapin, F.S., III; Sala, O.E.; Huber-Sannwald, E., eds. Global biodiversity in a changing environment: scenarios for the 21st century. New York: Springer-Verlag: 157-199. Chapter 9.

This chapter reviews the current status of biological diversity in the Mediterranean-climate regions of the world, makes comparisons among them, and examines the threats to biological systems now and in the future.

*Keywords: Mediterranean ecosystem, biodiversity, climate change, land use change.*

(Available in bookstores and libraries.)

Neilson, R.P.
2003. The importance of precipitation seasonality in controlling vegetation distribution. In: Weltzin, J.F.; McPherson, G.R., eds. Changing precipitation regimes and terrestrial ecosystems. Tucson, AZ: University of Arizona Press: 47-71. Chapter 4.

In this chapter, broad patterns of climate and vegetation distribution over North America are summarized with emphasis on the conterminous United States. Several regions are highlighted as case studies for the development and examination of hypotheses concerning the importance of precipitation seasonality on vegetation distribution. These hypotheses are examined by using new models of vegetation distribution and dynamics. Further scenarios of climate and vegetation change are examined through known mechanisms and past excursions of climate and vegetation. Some thoughts on current uncertainties and future directions are discussed.

*Keywords: Climate change, precipitation seasonality, vegetation distribution, simulations.*

(Available in bookstores and libraries.)

Vanderbilt, K.L.; Lajtha, K.; Swanson, F.J.
2002. Biogeochemistry of unpolluted forested watersheds in the Oregon Cascades: temporal patterns of precipitation and stream nitrogen fluxes. Biogeochemistry. 62: 87-117.

The objectives of this paper are to synthesize long-term patterns of nitrogen dynamics in precipitation and stream water at the H.J. Andrews Experimental Forest in Oregon and to look for biotic and/or hydrologic influences on seasonal and annual patterns of nitrogen export.

*Keywords: Nutrient cycling, nitrogen, water chemistry, experimental watersheds.*

(See Corvallis order form.)

## Fire

Hinzman, L.D.; Fukuda, M.; Sandberg, D.V. [and others]
2003. FROSTFIRE: an experimental approach to predicting the climate feedbacks from the changing boreal fire regime. Journal of Geophysical Research. 108(D1): 9-1–9-6.

The FROSTFIRE research project conducted a prescribed burn of a 970-hectare watershed in interior Alaska. To the best of our knowledge, this is the first experimental burn of a watershed and the most thoroughly documented prescribed fire in history. Although extensive fire research has been conducted in more temperate regions, relatively little has been done in the boreal forest and almost none in the areas of discontinuous permafrost. The goal of this project was to examine the impacts of weather and vegetation on fire behavior and the resulting effects of fire on feedbacks to climate. The research was conducted in the Caribou-Poker Creeks Research Watersheds near Fairbanks, Alaska. This information was compared with measurements taken during and after the fire. Although the fire

was artificially ignited, the fire behavior and fire effects were similar to those of naturally occurring fires. Close collaboration among agencies and among scientists of several countries was critical to the success of the project.

*Keywords: Research prescribed burn, climate feedbacks, fire, fire effects, air quality, fire management, fire behavior, fire research, Alaska, boreal forest, permafrost.*

(See Corvallis order form.)

Kelsey, R.G.; Joseph, G.
2003. Ethanol in ponderosa pine as an indicator of physiological injury from fire and its relationship to secondary beetles. Canadian Journal of Forest Research. 33: 870-884.

Sixteen days after a September wildfire, ethanol and water were measured in stem phloem and sapwood sampled at breast height and base of ponderosa pine with zero (control), moderate, heavy, and severe crown scorch. Ethanol increased with each level of injury. Phloem and sapwood from trees with severe scorch contained 14.6 and 52.8 times more ethanol, respectively, than controls. Ethanol in phloem and in adjacent sapwood were related, as were concentrations at the stem base and breast height within sapwood. This is consistent with ethanol synthesis and diffusion from phloem or cambium into the sapwood where it moves upward in the transpiration stream and is metabolized by needles. As tissues in live trees recovered from heat injuries, their ethanol concentrations declined. In contrast, when trees lost their entire crowns in the fire, transpirational movement stopped and ethanol concentrations increased in their stems. Bark, ambrosia, and longhorned beetles landed in greater numbers on fire-damaged trees than on controls the following spring and summer, suggesting that ethanol was being released to the atmosphere in sufficient quantities to function as a beetle attractant and arrestant. Sapwood ethanol measured 16 days after the fire provided the best binary logistic regression model for predicting second-year mortality for trees with heavy and severe fire scorch.

*Keywords: Ethanol, tree physiology, fire injury, bark beetles, kairomone, host attractant, ponderosa pine, mortality.*

(See Corvallis order form.)

Kruger, L.E.; Agrawal, S.; Monroe, M. [and others]
2002. Keys to community preparedness for wildfire. In: Jakes, P.J., comp. Homeowners, communities, and wildfire: science findings from the National Fire Plan: Proceedings of the 9th international symposium on society and resource management. Gen. Tech. Rep. NC-231. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 10-17.

Assessment of a community's vulnerability to wildfire often focuses on landscape conditions or ecological factors such as forest type, age distribution, forest health, topography, or hydrology. Vulnerability, however, is also a function of social factors. We need to understand both the social and ecological factors that influence community vulnerability to wildfire so that we can recommend strategies to decrease a community's risk within a given landscape. By learning how communities are preparing for wildfire and taking action to reduce risk, we can share examples of community preparedness activities with other communities and better understand how to support communities in taking action.

*Keywords: Community preparedness for wildfire, partnerships, networks, agency commitment.*

(See Juneau order form for this article. If you would like the complete General Technical Report NE-231, it is online, or you can order a hard copy from the North Central Research Station's Web site at http://www.treesearch.fs.fed.us/pubs/viewpub.jsp?index=11852.)

Lehmkuhl, J.F.; Everett, R.L.; Schellhaas, R. [and others]

2003. Cavities in snags along a wildfire chronosequence in eastern Washington. Journal of Wildlife Management. 67(1): 219-228.

Occurrence of bird-excavated cavities in snags was sampled in a chronosequence of 26 wildfire burns (ages 1 to 81 years) on the east slope of the Washington Cascade Range. Cavities occurred in 5.5 percent of the 1,867 recorded snags, with 69 percent of the snags in burn areas less than 20 years old. More cavities occurred in ponderosa pine and Douglas-fir than in other tree species. Few or no cavities were found in large samples of subalpine fir and lodgepole pine snags. Large diameter, burn age of more than 20 years, soft decay, broken tops, and moderate height were important predictors of cavities in ponderosa pine and Douglas-fir snags. Cross-validated classification models to predict cavity occurrence were 97 percent accurate for ponderosa pine snags, and 88 percent accurate for Douglas-fir snags. In burns less than 20 years old, Douglas-fir snags with broken tops had higher cavity excavation rates than snags with whole tops. Cavity excavation was not associated with topographic variables. Maintaining or restoring snag habitat after fires would include the development of defective trees in green forests to provide immediate postfire snag habitat, postfire retention of those trees in the short term, and retention of large snags for long-term snag habitat.

*Keywords: Snags, salvage, wildfire, birds.*

(See Wenatchee order form.)

McIver, J.; Matzka, P.

2002. A national study on the consequences of fire and fire surrogate treatments for fuel reduction in dry forests. In: Baumgartner, D.M.; Johnson, L.R.; DePuit, E.J., comps., eds. Small diameter timber: resource management, manufacturing, and markets—symposium proceedings. MISC 0509. Pullman, WA: Washington State University, University Cooperative Extension: 165-166.

An integrated network of 13 long-term research sites has been established to provide information on the economics and environmental consequences of alternative fuel reduction treatments in dry forests nationwide. Four alternative treatments have been implemented: (1) cuttings and mechanical fuel reduction alone, (2) prescribed fire alone, (3) both mechanical treatments and prescribed fire, and (4) unmanipulated control. Response to treatment will be determined through repeated measurement of a comprehensive set of variables at each site, including aspects of fire behavior and fuel, vegetation, wildlife, entomology, pathology, soils, and economics. Preliminary analysis of economics and fuels data on one site (Hungry Bob) indicate that (1) there are significant differences in production rate among different combinations of single-grip harvester and forwarder and (2) under certain conditions, mechanical treatment can be used in tandem with prescribed fire to achieve desired fuel reduction at the lowest cost.

*Keywords: Prescribed fire, mechanical fuel reduction, restoration.*

(See La Grande order form.)

Sandberg, D.V.; Ottmar, R.D.; Peterson, J.L.; Core, J.

2002. Wildland fire in ecosystems: effects of fire on air. Gen. Tech. Rep. RMRS-GTR-42-vol. 5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 79 p.

This state-of-knowledge review about the effects of fire on air quality can assist land, fire, and air resource managers with fire and smoke planning, and with their efforts to explain to others the science behind fire-related program policies and practices to improve air quality. Chapter topics include air quality regulations and fire; characterization of emissions from fire; the transport, dispersion, and modeling of fire emissions; atmospheric and plume chemistry; air quality impacts of fire; social consequences of air quality impacts; and recommendations for future research.

*Keywords: Ecosystem, fire effects, air quality, air pollution, air resource management, fire behavior, fire research.*

(This publication is available in electronic format at www.fs.fed.us/rm/pubs/rmrs_gtr_42_5.pdf. To order a hard copy of this publication send an email to Richard Schneider at rschneider@fs.fed.us; contact him at Rocky Mountain Research Station, 240 West Prospect, Fort Collins, CO 80526; or call him at (970) 498-1392.)

## Forest Management

Julin, K.R.; D'Amore, D.V.

2003. Tree growth on forested wetlands of southeastern Alaska following clearcutting. Western Journal of Applied Forestry. 18(1): 30-34.

Growth of forested wetlands was investigated in this southeast Alaska study. Eighteen young, even-aged stands dominated by western hemlock and Sitka spruce rotted in wet, organic soils were sampled. The soils were cryohemists and cryosaprists ranging in depth from 38 centimeters to more than 2 meters. The stands were naturally regenerated, densely stocked, and had wood volume production ranging form 12 to 78 cubic meters per hectare for 15- and 46-year-old stands, respectively.

*Keywords: Forested wetland, tree growth, Histosols.*

(See Juneau order form.)

Torgersen, T.R.

2002. Characteristics of log resources in northeastern Oregon: case studies of four management treatments. In: Laudenslayer, W.F., Jr.; Shea, P.J.; Valentine, B.E. [and others], tech. coords. Proceedings of the symposium on the ecology and management of dead wood in Western forests. PSW-GTR-181. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 795-810.

Sampling data are presented for log resources in stands in the Blue Mountains of northeastern Oregon. Data are presented from four case studies in which log resources were assessed in mid- and late-structure mixed conifer and ponderosa pine stands. The studies describe log resources before and after selective harvest and salvage harvest to reduce fuels or remove dead and dying volume, after prescribed burns, and in old-growth stands. Log resources are compared with regional guidelines for amounts of residual logs after harvest. Log resources increased modestly after salvage logging. Overall, there were more but shorter logs after harvest. The number of large logs (at least 30 centimeters in large-end diameter) were maintained in one case and were reduced in two cases. Management implications of the standards for residual logs are discussed.

*Keywords: Woody fuel, log resources, Blue Mountains, northeastern Oregon.*

(See La Grande order form. This article was published by the Pacific Southwest Research Station as part of a proceedings. If you would like a copy of the individual article, fill out the form for the laboratory indicated. To order a copy of the complete proceedings, PSW-GTR-181, send an email to Richard Schneider at rschneider@fs.fed.us; contact him at Rocky Mountain Research Station, 240 West Prospect, Fort Collins, CO 80526; or call him at (970) 498-1392. The entire publication also is available on the Web at http://www.fs.fed.us/psw/publications/documents/gtr-181.)

## Genetics

Cronn, R.C.; Adams, K.L.

2003. Quantitative analysis of transcript accumulation from genes duplicated by polyploidy using cDNA-SSCP. BioTechniques. 34(4): 726-734.

Repeated rounds of polyploidy have been commonplace in the lineages leading to modern eukaryotic genomes, giving rise to widespread gene duplication. Genes duplicated by polyploidy may continue to be expressed at equal levels following polyploidization, or their expression may be dramatically altered. In this report, we describe how single-stranded conformational polymorphism (SSCP) analysis of RT-PCR products can be used to evaluate the expression status (presence and relative quantity) of highly similar homoeologous gene pairs from an allotetraploid genome. This cDNA-SSCP approach was used to evaluate transcript abundance in “synthetic tetraploid” mRNA pools (mixtures of diploid products), and three natural homoeologous gene pairs expressed in tetraploid cotton (*Gossypium hirsutum*) ovules. Results from replicated tests show that cDNA-SSCP reliably separated duplicated transcripts with 99 percent sequence identity. Most significantly, the method yields quantitative estimates of transcript ratios in template pools ranging from equimolar to approximately 100:1.

*Keywords: Transcript accumulation, polyploidy.*

(See Corvallis order form.)

Negi, M.S.; Rajagopal, J.; Chauhan, N. [and others]

2002. Length and sequence heterogeneity in 5S rDNA of *Populus deltoides*. Genome. 45: 1181-1188.

The 5S rRNA genes and their associated nontranscribed spacer (NTS) regions are present as repeat units arranged in tandem arrays in plant genomes. Length heterogeneity in 5S rDNA repeats was previously identified in *Populus deltoides* and was also observed in the present study. Primers were designed to amplify the 5S rDNA NTS variants from the *P. deltoides* genome. The PCR-amplified products from the two accessions of *P. deltoides* (G3 and G48) suggested the presence of length heterogeneity of 5S rDNA units within and among accessions, and the size of the spacers ranged from 385 to 434 bp. Sequence analysis of the NTS revealed two distinct classes of 5S rDNA within both accessions: class 1, which contained GAA trinucleotide microsatellite repeats, and class 2, which lacked the repeats. The class 1 spacer shows length variation owing to the microsatellite, with two clones exhibiting 10 GAA repeat units and one clone exhibiting 16 repeat units. However, distance analysis shows that the class 1 spacer sequences are highly similar inter se, yielding nucleotide diversity (p) estimates that are less than 15 percent of those obtained for class 2 spacers (p = 0.0183 vs. 0.1433, respectively). The presence of microsatellites in the NTS region leading to variation in spacer length is reported for and discussed for the first time for *P. deltoides*.

*Keywords: ADNr 5S,* Populus*, microsatellite, ADN répétitive, hétérogénéité de séquence.*

(See Corvallis order form.)

Senchina, D.S.; Alvarez, I.; Cronn, R.C. [and others]

2003. Rate variation among nuclear genes and the age of polyploidy in *Gossypium*. Molecular Biology and Evolution. 20(4): 633-643.

Molecular evolutionary rate variation in *Gossypium* (cotton) was characterized by using sequence data for 48 nuclear genes from both genomes of alletetraploid cotton, models of its diploid progenitors, and an outgroup. Substitution rates differed widely among the 48 genes, with silent and replacement levels ranging from 0.018 to 0.162 and 0.000 to 0.073, respectively, in comparisons between orthologous *Gossypium* and outgroup sequences. About 90 percent of the genes, however, had silent substitution rates spanning a more narrow threefold range. Because there was no evidence of rate heterogeneity among lineages for any gene, and because rates were highly correlated in independent tests, evolutionary rate is inferred to be a property of each gene or its genetic milieu rather than the clade to which it belongs. Evidence from about 200,000 nucleotides (40,000 per genome) suggests that polyploidy in *Gossypium* led to a modest enhancement in rates of nucleotide substitution. Phylogenetic analysis for each gene yielded the topology expected from organismal history, indicating an absence of gene conversion or recombination among homoeologues subsequent to allopolypoloid formation. By using the mean synonymous substitution rate calculated across the 48 genes, allopolyploid cotton is estimated to have formed circa 1.5 million years ago (mya), following divergence of the diploid progenitors about 6.7 mya.

*Keywords:* Gossypium*, cotton, polyploidy, molecular clock, substitution rates, evolution.*

(See Corvallis order form.)

## Geomorphology and Hydrology

Gomi, T.; Sidle, R.C.; Woodsmith, R.D.; Bryant, M.D.

2003. Characteristics of channel steps and reach morphology in headwater streams, southeast Alaska. Geomorphology. 51: 225-242.

The effect of timber harvesting and mass movement on channel steps and reach morphology was examined in 16 headwater streams of southeast Alaska. Channels steps formed by woody debris and boulders are significant channel units in headwater streams. Number, intervals, and heights of steps did not differ among management and disturbance regimes. A negative exponential relationship between channel gradient and mean length of step intervals was observed in the fluvial reaches of recent landslide and old-growth channels. No such relationship was found in upper reaches where colluvial processes dominated. Woody debris and sediment recruitment from regenerating riparian stands may have obscured any strong relationship between step geometry and channel gradient in young alder, young conifer, and recent clearcut channels. Channel reaches are described as pool riffles, step pools, step steps, cascades, rapids, and bedrock. Geometry of channel steps principally characterized channel reach types. We infer that fluvial processes dominated in pool-riffle and step-pool reaches, while colluvial processes dominated in bedrock reaches. Step-step, rapids, and cascade reaches occurred in channels dominated by both fluvial processes and colluvial processes. Step-step reaches were transitional from cascades (upstream) to step-pool reaches (downstream). Woody debris recruited from riparian corridors and logging activities formed steps and then sequentially might modify channel reach types from step pools to step steps. Scour, runout, and deposition of sediment and woody debris from landslides and debris flows modified the distribution of reach types (bedrock, cascade, and step pool) and the structure of steps within reaches.

*Keywords: Forest streams, woody debris, channel morphology, timber harvesting, mass movement, riparian vegetation.*

(See Wenatchee order form.)

Kasahara, T.; Wondzell, S.M.

2003. Geomorphic controls on hyporheic exchange flow in mountain streams. Water Resources Research. 39(1): 3-1–3-14.

Simulations of stream-subsurface water interactions (hyporheic exchange) using a three-dimensional steady state groundwater flow model and a particle tracking model were conducted to estimate relative effects of channel morphology features on the extent, volume, and residence time of hyporheic exchange flow. Our results showed that the way in which channel morphology controlled exchange flows differed with stream size, and in some cases, with channel constraint. Pool-step sequences were the dominant morphological features driving hyporheic exchange flow in both constrained and unconstrained 2$^{nd}$-order sites. Multiple features interacted to drive hyporheic exchange flow in the unconstrained 5$^{th}$-order site, and there was relatively little exchange flow in the bedrock-constrained 5$^{th}$-order site.

*Keywords: Hyporheic zone, residence time distribution, groundwater flow models, channel morphology.*

(See Olympia order form.)

## Invertebrates

Daterman, G.; Eglitis, A.; Czokajlo, D. [and others]
2001. Attract and kill technology for management of European pine shoot moth (*Rhyacionia buoliana*) and western pine shoot borer (*Eucosma sonomana*). Journal of Forest Science. 47(2): 66-69.

An attract-and-kill (A&K) formulation was developed as a control for European pine shoot moth (EPSM) and western pine shoot borer (WPSB) in western pine plantations and tree nurseries. Owing to the cryptic larval habits of these insects, conventional insecticide sprays are not very effective for managing them. Attract-and-kill technology is designed to selectively attract and kill the male moths of the target species, and thus remove them from the population and prevent or reduce moth reproduction. The A&K formulation combines the selective attraction of the sex pheromone with a contact insecticide. Because only the target species are attracted to the formulation, there is little or no impact on beneficial insects or other nontarget organisms within the treatment area. Trap catch data indicated that in comparison to numbers of male EPSM captured on untreated plots, male moths on treated plots were reduced by 86 to 100 percent, and trap captures of WPSB in treated areas were reduced more than 80 percent in comparison to untreated areas.

*Keywords: Western pine shoot borer,* Eucosma sonomana*, European pine shoot moth,* Rhyacionia buoliana*, attract-and-kill technology, pheromones, insect control, western pines.*

(See Corvallis order form.)

Furniss, M.M.; Holsten, E.H.; Schultz, M.E.
2002. Species of Alaska Scolytidae: distribution, hosts, and historical review. Journal of the Entomological Society of British Columbia. 99: 83-92.

The species of Scolytidae in Alaska have not been compiled in recent times although many of them are included in earlier broader works. The authors of these works are summarized in a brief history of forest entomologists in Alaska. Fifty-four species of Alaska Scolytidae are listed belonging to 24 genera. They infest 15 species of trees and shrubs of which 10 are conifers and 5 are angiosperms. Fifty species are bark beetles that inhabit phloem, and four species are ambrosia beetles that live in the sapwood. All are species native to Alaska.

*Keywords: Bark beetles, Scolytidae, conifers, angiosperms, Alaska.*

(See Anchorage order form.)

Holsten, E.H.; Shea, P.J.; Borys, R.R.
2003. MCH released in a novel pheromone dispenser prevents spruce beetle, *Dendroctonus rufipennis* (Coleoptera: Scolytidae), attacks in south-central Alaska. Forest Entomology. 96(1): 31-34.

Field tests of 3-methyl-2-cyclohexen-1-one (MCH), the antiaggregation pheromone of the spruce beetle, *Dendroctonus rufipennis*, were conducted in south-central Alaska. The deployment of MCH in a novel releaser significantly reduced trap catches and spruce beetle attacks. The results of this study demonstrate the first successful field test of MCH in Alaska.

Keywords: *Bark beetles,* Dendroctonus rufipennis*, semiochemicals,* Picea *spp., Alaska (south-central).*

(See Anchorage order form.)

## Landscape Ecology

Hessburg, P.F.; Agee, J.K.
2003. An environmental narrative of inland Northwest United States forests, 1800-2000. Forest Ecology and Management. 178: 23-59.

Fire was arguably the most important forest and rangeland disturbance process in the inland Northwest for many millennia. Prior to the Lewis and Clark expedition, fire regimes ranged from high severity with return intervals of one to five centuries to low severity with fire-free periods lasting three decades or less. Native American burning contributed to the fire ecology of grasslands and lower montane dry and mesic forests, especially where ponderosa pine was the dominant overstory species, but the extent of this contribution is unknown. Two centuries of settlement, exploitation, management, and climate variation have transformed the fire regimes, vegetation and fuel patterns, and overall functionality of these forests beginning at the first contact of early settlers with Native Americans and extending to the present. Owing to its geographic isolation, the inland Northwest was perhaps the last region to be discovered by early settlers. In 200 years the region has undergone fur trapping and trading; sheep, cattle, and horse grazing; the loss of Native American burning; timber harvesting; mining; road construction; native grassland conversion to agricultural production; urban and rural area development; and fire suppression. We highlight key changes to forest landscape patterns and processes that occurred under these combined influences, discuss implications of the changes, and progress toward restoring sustainability. Adaptive management emphasizes the twin notions that incomplete knowledge and high degrees of risk and uncertainty about Earth and climate systems will always limit land and resource management decisions, and that management is chiefly a learning and adapting process. We discuss current issues and future options associated with ecosystem management, including the low likelihood of social consensus concerning desired outcomes, the lack of integrated planning, analysis, and decision-support tools, and mismatches between the existing National Environmental Policy Act planning process, congressional appropriations, and complex management and restoration problems.

*Keywords: Landscape change, human settlement, management history, environmental narrative, inland Northwest, fire regimes, vegetation patterns, adaptive ecosystem management.*

(See Wenatchee order form.)

Hessburg, P.F.; Smith, B.G.; Salter, R.B. [and others]
2003. Interior Columbia basin forests and rangelands, 1930s to present. In: Rapport, D.J.; Lasley, W.L.; Rolston, D.E. [and others], eds. Managing for healthy ecosystems. New York: Lewis Publishers: 661-692. Chapter 67.

We characterized recent historical and current vegetation composition and structure of a representative sample of subwatersheds on all ownerships within the interior Columbia River basin and portions of the Klamath and Great Basins. We characterized change in vegetation spatial patterns by using a set of class and landscape metrics and a spatial pattern analysis program; we translated that change in vegetation patterns

to change in patterns of vulnerability to wildfires, smoke production, and 21 major forest pathogen and insect disturbances. Forest land cover expanded (woodland area expanded in most); shrubland area declined; patch sizes of forest cover types are now smaller, and current land cover is more fragmented. Landscape area in old multistory, old single story, and stand initiation forest structures declined; dense, multilayered, intermediate forest structures increased. Patches with medium and large trees are currently less abundant on the landscape. Basin forests are now dominated by shade-tolerant conifers and exhibit elevated fuel loads and severe fire behavior attributes, indicating expanded future roles of certain defoliators, bark beetles, root diseases, and stand replacement fires.

*Keywords: Change detection, landscape assessment, spatial patterns, reference variation, ecosystem health, forest health, fire exclusion, disturbance regimes.*

(Available from bookstores and libraries.)

McKenzie, D.; Peterson, D.W.; Peterson, D.L. 2003. Modelling conifer species distributions in mountain forests of Washington state, USA. The Forestry Chronicle. 79(2): 253-258.

The effects of climatic change on vegetation may be particularly strong in mountains because warmer temperatures affect the depth and duration of snowpacks, which are key limiting factors for tree growth. We quantified associations between climatic and biophysical variables and individual conifer species distribution in mountain forests at three spatial scales, by using generalized linear models. We compared simple climatic variables to biophysical variables derived from climatic variables. For most species, a unimodal response to moisture and temperature gradients was evident. Responses of most species were consistent across three spatial scales. By identifying ecological niches, we can forecast the redistribution of species on the landscape in response to climatic change and alert managers to particularly sensitive or vulnerable ecosystems and landscapes.

*Keywords: Species distribution, mountain forests, climate change, conifers, generalized linear models, unimodal response.*

(See Wenatchee order form.)

## Monitoring

Gaines, W.L.; Harrod, R.J.; Lehmkuhl, J.F. 2003. Monitoring biodiversity for ecoregional initiatives. In: Busch, D.E.; Trexler, J.C., eds. Monitoring ecosystems: interdisciplinary approaches for evaluating ecoregional initiatives. Washington, DC: Island Press: 377-402. Chapter 14.

Monitoring biological diversity is important for land managers to determine if management strategies meet legal mandates, achieve goals and objectives identified in ecoregional initiatives, and to implement an adaptive approach to ecosystem management. Our approach starts with the identification of monitoring questions; then the identification of monitoring questions and methods is accomplished through an interdisciplinary approach, building on baseline information from ecoregional assessments. We provide several samples of methods land managers can use to quantify and interpret monitoring data. Because monitoring biodiversity is a potentially large effort, it is better to monitor a few elements well than to spread resources too thin. Focus monitoring on elements that have relevance to key management issues. To monitor biodiversity at a variety of temporal and spatial scales, an interagency effort based on cooperation and collaboration is needed. Collaboration between researchers and managers is especially important. Managers with skills in the quantitative sciences are needed to quantify and interpret monitoring information.

*Keywords: Monitoring, adaptive management.*

(Available in bookstores and libraries.)

## Plant Ecology

Hennon, P.E.; McClellan, M.H.; Palkovic, P. 2002. Comparing deterioration and ecosystem function of decay-resistant and decay-susceptible species of dead trees. In: Laudenslayer, W.F., Jr.; Shea, P.J.; Valentine, B.E. [and others], eds. Proceedings of the symposium on the ecology and management of dead wood in Western forests. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 435-444.

The pattern and rate of deterioration of dead trees differ by species and lead to important differences in their ecosystem function. This is illustrated by two species with different modes of death and decay—yellow-cedar (*Chamaecyparis nootkatensis*) and western hemlock (*Tsuga heterophylla*). The heartwood of yellow-cedar trees contains compounds that inhibit decay. Most yellow-cedar trees die standing and persist as snags with intact tops for 80 years or more. Western hemlock lacks these specialized heartwood compounds and exhibits a more rapid deterioration. Also, modes of tree death, heart rot levels, and type of saprophytic decay may differ considerably by stand age for western hemlock. A greater diversity of structures is produced by the death and deterioration of western hemlock than yellow-cedar.

*Keywords: Woody debris, snags, western hemlock,* Tsuga heterophylla*, Alaska yellow-cedar,* Chamaecyparis nootkatensis*.*

(See Juneau order form. This article was published by the Pacific Southwest Research Station as part of a proceedings. If you would like a copy of the individual article, fill out the form for the laboratory indicated. To order a copy of the complete proceedings, PSW-GTR-181, send an email to Richard Schneider at rschneider@fs.fed.us; contact him at Rocky Mountain Research Station, 240 West Prospect, Fort Collins, CO 80526; or call him at (970) 498-1392. The entire publication also is available on the Web at http://www.fs.fed.us/psw/publications/documents/gtr-181.)

## Plant Pathology

Madkour, S.A.; Laurence, J.A. 2002. Egyptian plant species as new ozone indicators. Environmental Pollution. 120: 39-353.

The aim of this study was to test and select one or more highly sensitive, specific, and environmentally successful Egyptian bioindicator plants for ozone ($O_3$). For that purpose more than 30 Egyptian species and cultivars were subjected to extensive screening studies under controlled environmental and pollutant exposure conditions to mimic the Egyptian environmental conditions and $O_3$ levels in urban and rural areas. Four plant species were found to be more sensitive to $O_3$ than the universally used $O_3$ bioindicator, tobacco Bel W3, under the Egyptian environmental conditions used. These plant species—jute (*Corchorus olitorius* c.v. local), clover (*Trifolium alexandrinum* L. c.v. Masry), garden rocket (*Eruca sativa* c.v. local), and alfalfa (*Medicago sativa* L. c.v. local), ranked in order of decreasing sensitivity, exhibited $O_3$ injury symptoms faster and at lower $O_3$ concentrations than Bel W3. Three variables were tested in search of a reliable tool for the diagnosis and prediction of $O_3$ response prior to the appearance of visible foliar symptoms: pigment degradation, stomatal conductance ($g_s$), and net photosynthetic $CO_2$ assimilation ($P_{net}$). Pigment degradation was found to be unreliable in predicting species sensitivity to $O_3$. Evidence supporting stomatal conductance involvement in $O_3$ tolerance was found only in tolerant species. A good correlation was found between $g_s$, restriction of $O_3$ and $CO_2$ influx into the mesophyll tissues, and $P_{net}$. Changes in $P_{net}$ seemed to depend largely on fluctuations in $g_s$.

*Keywords: Ozone indicators, Egyptian plant species.*

(See Corvallis order form.)

## Silviculture

Flanagan, P.T.; Parks, C.G.
2002. Insect and disease considerations in small diameter timber. In: Baumgartner, D.M.; Johnson, L.R.; DePuit, E.J., comps., eds. Small diameter timber: resource management, manufacturing, and markets—a symposium proceedings. MISC0509. Pullman, WA: Washington State University, Cooperative Extension Service: 93-95.

Small trees have smaller root systems and smaller boles, less foliage, occupy different canopy positions, and are subjected to different stresses than large trees. As a result, bark beetles, defoliators, dwarf mistletoes, rusts, root diseases, needle diseases, canker diseases, and stem decays affect small trees differently than large trees. An appreciation for these differences aids in management of stands composed of small trees.

*Keywords: Slash, suppression, understory, pruning.*

(See Wenatchee order form.)

Harrington, T.B.; Ezell, A.W.; Yeiser, J.L.; Cobb, J.O.
2002. First-year woody plant control following several formulations and timings of glyphosate with or without imazapyr. In: Proceedings: Southern Weed Science Society. 55: 78-81.

Several formulations of glyphosate were applied with or without imazapyr in June and October 2000 at sites located in Georgia, Mississippi, and Texas. The objective of the research was to compare control of woody species between experimental and conventional formulations of glyphosate with or without imazapyr. Percentage change in total length of woody stems was evaluated immediately before treatment and 1 year following treatment. In general, the experimental formulations of glyphosate provided levels of woody control similar to that observed for Accord®SP or generic glyphosate. Woody control from Accord®SP was often greater than that observed from generic glyphosate, especially at the Georgia site.

*Keywords: Site preparation, woody control.*

(See Olympia order form.)

Marshall, D.D.; Johnson, G.P.
2003. Silviculture options in coastal small diameter stands. In: Baumgartner, D.M.; Johnson, L.R.; DePuit, E.J., comps., eds. Small diameter timber: resource management, manufacturing, and markets—symposium proceedings. MISC0509. Pullman, WA: Washington State University, Cooperative Extension Service: 157-164.

Precommercial thinning is a commonly applied treatment in young Douglas-fir stands near the end of the initiation stage of stand development to enhance tree growth, survival, and value. Changes during the last two decades in markets, wood processing and harvesting technologies, and the prospect of a future log supply coming almost entirely from plantations, however, are causing opportunistic silviculturists to rethink their strategies for managing young plantations and what they define as a “dense” stand.

*Keywords: Density management, fertilization, precommercial thinning, pruning, Douglas-fir.*

(See Olympia order form.)

Youngblood, A.; Ferguson, D.E.
2003. Changes in needle morphology of shade-tolerant seedlings after partial overstory canopy removal. Canadian Journal of Forest Research. 33: 1315-1322.

We hypothesized that shade-tolerant seedlings undergo changes in needle morphology in response to increased insolation. We compared the needle morphology of grand fir, subalpine fir, and Engelmann spruce, all shade-tolerant species commonly present as advance regeneration in northeastern Oregon. Morphological characteristics, including needle size, stomatal density, thickness of mesophyll tissue, size of individual palisade mesophyll cells, and number of epidermis cell layers, were examined by photomicroscope and scanning microscopy for 4 years across three light environments: (1) high light in open stands; (2) suddenly increased light after partial overstory removal; and (3) deep shade in closed canopies. Within this portion of their distribution, these three conifers were unable to morphologically adapt their needles to a rapid increase in light availability.

*Keywords: Grand fir, subalpine fir, Engelmann spruce, advance regeneration, shade needles, sun needles, stomatal density, needle size, palisade mesophyll.*

(See La Grande order form.)

## Soil

D'Amore, D.V.; Lynn, W.C.
2002. Classification of forested Histosols in southeast Alaska. Soil Science Society of America Journal. 66(2): 554-562.

Organic soils are an important substrate for cycling carbon between terrestrial and atmospheric pools. The degree of decomposition of organic soil material influences the physical and chemical characteristics that control the carbon cycles in these soils. Although organic soils are abundant in southeast Alaska, little information is available on the state of decomposition or variability within organic soil mapping units. Determination of physical (fiber content) and chemical (pyrophosphate color) decomposition helps classify the soils and improve interpretation of map units. Fiber content and pyrophosphate color were determined on 115 samples from 23 organic soils from the Tongass National Forest. Results indicate that complexes of hemic and sapric suborders mapped in the soil survey are dominantly hemic. Some fiber analyses differ considerably from statements in descriptions of established series in the Tongass soil survey. Suborder classes provide a means to incorporate appropriate decomposition levels into existing soil series.

*Keywords: Histosols, soil mapping, fiber content, soil taxonomy.*

(See Juneau order form.)

Miller, D.; Anderson, H.
2003. Soil compaction: concerns, claims, and evidence. In: Baumgartner, D.M.; Johnson, L.R.; DePuit, E.J., comps., eds. Small diameter timber: resource management, manufacturing, and markets—symposium proceedings. Pullman, WA: Washington State University, Cooperative Extension Service: 97-106.

Soil resistance to penetration was measured in 7- to 27-acre operational units in overstocked mixed-conifer stands at the Fritz Timber Sale in northeastern Washington. Different combinations of felling and yarding equipment were used to thin eight of these units; no combination was replicated. Two other units remained nonharvested controls. By using a recording penetrometer, resistance was measured to the 33-cm depth at 10 stations on 5 to 17 100-foot-long, randomly oriented transects in each unit. Ground-based harvesting equipment operated off and on designated trails. Although trails occupied 6 to 57 percent of the harvested units, total area of strong compaction on these trails differed greatly. Consequences of soil compaction for tree performance at this sale area are unknown. At the relatively few places where trees were measured, response to compaction ranged from mostly negative through none to positive. Therefore, current claims about dire consequences of compaction for long-term site

productivity must be based largely on limited sampling, assumptions about the consequences of compaction for tree performance, and speculation. We assert that uncertainty about the consequences of compaction and other forms of soil disturbance will remain until long-term tree performance is correctly measured over a wide range of regional soils and climatic conditions.

*Keywords: Commercial thinning, harvesting equipment, soil bulk density, penetration resistance, penetrometer, northeastern Washington.*

(See Olympia order form.)

## Threatened, Endangered, and Sensitive Species

Smith, W.P.; Carraway, L.N.; Gavin, T.A. 2003. Cranial variation in Columbian white-tailed deer populations: implications for taxonomy and restoration. Proceedings of the Biological Society of Washington. 116(1): 1-15.

We examined variation in 18 cranial dimensions among three disjunct populations of white-tailed deer (*Odocoileus virginianus*) in the Pacific Northwest to test the hypothesis that they were from a single taxon. Previous allozyme analyses indicated considerable variation among the three populations, but genetic divergences were less than conventional benchmarks used to separate subspecies. We observed substantial variation in cranial dimensions among the three populations that graphically sorted into three distinct morphological groups and corresponded with east-west and north-south geographical gradients. Specimens of the Northwestern whitetails (*O. v. ochrourus*) from northern Idaho had longer and broader skulls than Columbia whitetails (*O. v. leucurus*) from the lower Columbia River or southwestern Oregon; specimens from southwestern Oregon had shorter rostrums and a narrower cranium than those from the lower Columbia River. Even after controlling for differences in size related to age or sex, specimens from southwestern Oregon were relatively smaller animals with shorter faces and narrower posterior portions of the skulls than specimens in other populations. We contend, however, that the significant cranial variation among populations was largely phenotypic, likely attributable to habitat and other environmental differences among the geographic regions, and conclude that deer from the three populations represent a single taxon, *O. v. leucurus*. Still, the three populations show considerable morphological and genetic variation, remain disjunct and isolated from each other, and are likely on different evolutionary trajectories. Future efforts to recover *O. v. leucurus* should consider strategic reintroductions into portions of its former range. If successful, establishing breeding populations in western and central Oregon will increase the likelihood of gene flow among populations as well as substantially increase the abundance and distribution of Columbia white-tailed deer in Oregon.

*Keywords: Columbia white-tailed deer, cranial variation, endangered species, genetic variation, Northwestern white-tailed deer,* Odocoileus virginianus leucurus*,* Odocoileus virginianus ochrourus*, Pacific Northwest, recovery, taxonomy.*

(See Juneau order form.)

## Wildlife

Berwick, S.; Marcot, B.G.; Paquet, P.; Whitney, P. 2001. Ecosystem-based selection of wildlife species for comparing future landscape alternatives in the Columbia River basin. In: Field, R.; Warren, R.J.; Okarma, H.; Sievert, P.R. Wildlife, land, and people: priorities for the 21st century. Bethesda, MD: The Wildlife Society: 60-63.

This paper describes a new ecosystem-based method for comparing the effects of alternative future conditions on terrestrial wildlife in the Columbia River basin, USA. A clearly defined and rigorous ecosystem approach to land use planning has just become tractable because of the development of a comprehensive and well-documented database on species, habitats, and

key ecological functions. Our working hypothesis is that some species are more likely to reflect system-level effects of land use alternatives than others. We evaluate the breadth and number of 69 key ecological functions (such as pollination or cavity creating) performed by each of the 599 terrestrial vertebrate species of the basin in each of 32 habitats defined and mapped for all 8,300 6$^{th}$-field hydrologic units of about 56 km$^2$ each. Species performing the greatest number of key ecological functions in a habitat are considered to be important to maintenance of normative system patterns and processes. Another list of species that are sole providers of a key ecological function complements the first analysis. These species are deemed important to ecosystem maintenance because the function they perform shows low redundancy—that is, few species provide it, and the function is likely to disappear with them.

*Keywords: Ecosystem, methodology, impacts, species function.*

(Available in bookstores and libraries.)

Bull, E.L.; Shepherd, J.F.
2003. Water temperature at oviposition sites of *Rana luteiventris* in northeastern Oregon. Western North American Naturalist. 63(1): 108-113.

Water temperature at which Columbia spotted frogs (*Rana luteiventris*) deposited eggs was determined at 18 oviposition sites in northeastern Oregon in 2002. Mean daily water temperature on the day of initial egg deposition ranged from 7.6 to 16.0 °C with a mean of 9.6 °C. The maximum water temperature of the first day of egg deposition ranged from 9.8 to 20.2 °C and averaged 15.5 °C. Eggs were not deposited on days when the maximum water temperature was below 9.4 °C. Duration of egg deposition ranged from 1 to 20 days at the 18 sites. Embryos hatched after 12 to 21 days. The mean and maximum daily water temperatures were significantly correlated with number of days to hatching.

*Keywords: Columbia spotted frog,* Rana luteiventris*, embryonic temperature tolerance, northeastern Oregon, ranid.*

(See La Grande order form.)

Cook, R.C.; Cook, J.G.; Garrott, R.A. [and others]
2002. Effects of diet and body condition on fecal progestagen excretion in elk. Journal of Wildlife Diseases. 38(3): 558-565.

Recent research demonstrated the utility of fecal progestagens ($P_4$) for detecting pregnancies in elk (*Cervus elaphus*) during mid to late gestation. Several factors, however, may influence fecal $P_4$ excretion and limit its use in free-ranging animals. We investigated the effects of nutrition and body condition (percentage ingesta-free body fat) on fecal $P_4$ concentrations and incidence of abortion. During mid gestation, 40 gravid cow elk differing in body condition were placed on three diets in which the amount of food offered differed. Feces were collected periodically and analyzed for $P_4$ via radioimmunoassay. We found no significant effect of dietary treatment on $P_4$ concentrations, but as body condition declined, $P_4$ concentrations declined significantly. This decline did not impede the ability to detect pregnancy based on previously reported criteria, even for elk in such poor condition that they aborted. However, fecal $P_4$ concentrations in 10 percent of samples collected from 13 nonpregnant animals maintained on a high plane of nutrition were false-positive for pregnancy.

*Keywords: Abortion,* Cervus elaphus*, condition, elk, nutrition, pregnancy detection, progestagen, reproduction.*

(See La Grande order form.)

Pyare, S.; Smith, W.P.; Nicholls, J.V.; Cook, J.A. 2002. Diets of northern flying squirrels, *Glaucomys sabrinus*, in southeast Alaska. Canadian Field-Naturalist. 116(1): 98-103.

We examined the diet of the northern flying squirrel (*Glaucomys sabrinus*) in 13 stands in temperate rain forest habitat of southeast Alaska, a region in which the ecology of this species is poorly understood. Truffles, the most common food item of squirrels outside Alaska, were present less frequently in squirrel feces than two other food items, epigeous fungi and vegetation, although no food item dominated fecal composition. Truffles were less frequent in fecal samples from mixed-conifer muskeg habitats than from old-growth forest habitats. Overall, we found that squirrels consumed a total of five truffle genera: *Elaphomyces* and *Hymenogaster* being the most common. Compared to populations in the Western contiguous United States, squirrel populations in southeast Alaska consumed truffles less frequently and consumed a smaller total number of truffle genera. In addition, samples from individual squirrels in Alaska tended to contain fewer genera than samples from the contiguous United States. Finally, squirrels in Alaska consumed other food items such as vascular vegetation, lichens, and mushrooms more frequently than squirrels in other geographic areas. These patterns suggest that the association between flying squirrels and truffles may be relatively weaker in southeast Alaska than has been documented elsewhere. Consequently, additional information on life history and ecology of flying squirrels is warranted before forest management guidelines can be developed.

*Keywords: Alaska, diet, lichens, mycophagy, northern flying squirrels, old growth, Pacific Northwest, truffles.*

(See Juneau order form.)

Rowland, M.M.; Wisdom, M.J.; Johnson, D.H. [and others] 2003. Evaluation of landscape models for wolverines in the interior Northwest, United States of America. Journal of Mammalogy. 84(1): 92-105.

The wolverine (*Gulo gulo*) is an uncommon, wide-ranging carnivore of conservation concern. We evaluated performance of landscape models for wolverines within their historical range at two scales in the interior Northwest based on recent observations (n = 421) from Washington, Oregon, Idaho, and Montana. At the subbasin scale, simple overlays of habitat and road-density classes effectively predicted observations of wolverines. At the watershed scale, we used a Bayesian-belief-network model with three inputs to provide spatially explicit estimates of relative habitat capability. At both scales, the best models revealed strong correspondence between means of predicted counts of wolverines and means of observed counts.

*Keywords: Carnivores, conservation planning, interior Columbia basin, models, wolverine.*

(See La Grande order form.)

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