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Department of
Agriculture

Forest Service

Pacific Northwest
Research Station



Recent Publications of the Pacific Northwest Research Station, Fourth Quarter, 2006



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Economics

06-472

Fight, R.D.; Barbour, R.J.

2006. Financial analysis of fuel treatments on national forests in the Western United States. Res. Note PNW-RN-555. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

The purpose of this note is to provide a starting point for discussion of fire hazard reduction treatments that meet the full range of management objectives, including budget priorities. Thoughtful design requires an understanding not only of the physical and biological outcomes, but also the costs and potential revenues of applying variations of fire hazard reduction treatments in a wide range of stand conditions. This analysis was done with My Fuel Treatment Planner software and provides estimates of cost and net revenue from fire hazard reduction treatments on 18 dry forest stands from 9 national forests in the Western United States. The data and software tools used in this analysis are all available, so these analyses can be easily modified to address a wider range of treatments and conditions.

Keywords: Financial analysis, silviculture, fire, prescriptions, economics, fuel treatments, national forests.

Fire

06-157

Rapp, V.

2006. A clear picture of smoke: Bluesky smoke forecasting. Science Update 14. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

Over the last several decades, the overall air quality goal in the United States has been to protect public health and clear skies by reducing emissions. At the same time, however, the risk of catastrophic fire has been rising in forests around the country as overly dense trees and understory brush crowd the stands. Prescribed fire—planned, controlled

burning within specified conditions—is one important tool used to reduce hazardous fuels in forests, woodlands, and grasslands. Land managers are faced with the challenge of reducing fire risk while meeting air quality standards.

Keywords: Smoke, catastrophic fire, hazardous fuels.

Forest Management

06-501

Busby, G.M.

2006. Export chip prices as a proxy for nonsawtimber prices in the Pacific Northwest. Res. Note PNW-RN-554. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 p.

Forest-land managers use price data and market analysis to form expectations and make informed management decisions. There is an abundance of price data for sawtimber, but for nonsawtimber, the availability of price data is limited. This constrains the ability of forest-land managers to form reasonable price expectations for stands that contain both sawtimber and nonsawtimber. In this paper, I show that export chip prices are a reasonable proxy for nonsawtimber prices in the Pacific Northwest. This conclusion is supported by evidence of arbitrage between the chip export market and three domestic markets in the Pacific Northwest. As to the chip export market in general, I observed increasing chip prices from 1968 through 1995, a structural break in 1995, after which point we observe declining prices. I also found evidence of an inverse relationship between chip price and lumber production.

Keywords: Wood chips, nonsawtimber, chip prices, residue prices.

06–524

Reynolds, K.M.

2006. Sustainable forestry in theory and practice: recent advances in inventory and monitoring, statistics and modeling, information and knowledge management, and policy science. Gen. Tech. Rep. PNW-GTR-688. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. [CD-ROM]

The importance to society of environmental services, provided by forest ecosystems, has significantly increased during the last few decades. A growing global concern with the deterioration of forests, beginning perhaps most noticeably in the 1980s, has led to an increasing public awareness of the environmental, cultural, economic, and social values that forests provide. Around the world, ideas of sustainable, close-to-nature, and multifunctional forestry have progressively replaced the older perception of forests as only a source for timber. The international impetus to protect and sustainably manage forests has come from global initiatives at management, conservation, and sustainable development related to all types of forests and forestry. A few of the more notable initiatives include the 1992 Earth Summit in Rio de Janeiro, Brazil (United Nations Conference on Environment and Development), regional follow-ups to the Earth Summit such as the Montreal Process and Helsinki Accords, the forest elements of the Convention on Biological Diversity, and the Framework Convention on Climate Change.

Keywords: Sustainable forestry, forest ecosystems, multifunctional forestry.

Invasive Plants and Animals

06–496

Bisson, P.A.

2006. Assessment of the risk of invasion of national forest streams in the Pacific Northwest by farmed Atlantic salmon. Gen. Tech. Rep. PNW-GTR-697. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 28 p.

This report describes the evidence for invasion of Pacific Northwest streams by Atlantic salmon (*Salmo salar*) that have escaped from marine salmon farms, and assesses the potential impact of farmed salmon invasion on native fishes inhabiting streams on National Forest System lands. The current risk to streams on national forest lands in the Pacific Northwest from Atlantic salmon invasions appears to be low and is limited to a few areas in northwest

Washington and southeast Alaska. However, long-term risks may be substantial if fish continue to escape from marine rearing pens or freshwater hatcheries. The two greatest threats appear to be that (1) Atlantic salmon could transmit a serious disease or parasite to native fishes, and (2) escaped salmon could eventually adapt to local conditions, leading to self-sustaining populations. If Atlantic salmon populations are eventually established, this species' preference for swiftly flowing stream habitats could facilitate competition with currently at-risk species such as steelhead (*Oncorhynchus mykiss*). This could result in a pattern of expansion similar to that observed in other nonnative aquatic plants and animals, in which a prolonged early colonization period is followed by a rapid phase of exponential growth as breeding populations adapt to local conditions.

Keywords: Atlantic salmon, invasive aquatic species, salmon farms, Pacific Northwest streams.

Land Use

06-488

Alig, R.

2006. Society's choices: land use changes, forest fragmentation, and conservation. Science Findings 88. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p.

Changing patterns of land use are at the heart of many environmental concerns regarding U.S. forest lands. Of all the human impacts to forests, development is one of the most significant because of the severity and permanency of the change. Concern about the effects of development on America's forests has risen sharply since the 1990s. In our market-based economy, increasing human populations and income, people's lifestyle choices, and other socio-economic factors inevitably lead to greater demands for residential, commercial, and industrial building sites, and the conversion of some forest lands to developed uses. Researchers at the Pacific Northwest Research Station in Corvallis, Oregon, project more than 50 million acres of U.S. forests to be converted to developed uses, such as houses, urban areas, and infrastructure, over the next 50 years. Population growth is expected to be above the national average in both the South and the Pacific Northwest, two key forestry regions, and land use changes can potentially affect a wide range of market and nonmarket goods and services that forests provide.

Keywords: U.S. forest lands, population growth, land development.

Plant Ecology

06–201

Visalli, J.D.

2006. Roger Lake Research Natural Area: guidebook supplement 29. Gen. Tech. Rep. PNW-GTR-685. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 34 p.

Roger Lake Research Natural Area (RNA), a 174.7-ha reserve in north-central Washington, contains a rich diversity of landforms, plant communities, and wildlife habitats. Spreading outward from the lake itself, sedge and sphagnum fens give way to upland coniferous forest, granitic cliffs, and a relictual, high-altitude big sagebrush–whitebark pine (*Artemisia tridentata*–*Pinus albicaulis*) meadow. Five sensitive plant species and several vertebrate species that are rare in the region occur in the RNA. Dynamic ecological processes in action in the RNA are revealed in the paludification of the forest edge; aging, broken beaver dams; and widespread bark-beetle-induced conifer mortality.

Keywords: Research natural area, Roger Lake, vascular plants, sensitive plants.

Plant Pathology

06-430

Miller, R.E.; Harrington, T.B.; Thies, W.G.; Madsen, J.

2006. Laminated root rot in a western Washington plantation: 8-year mortality and growth of Douglas-fir as related to infected stumps, tree density, and fertilization. Res. Pap. PNW-RP-569. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 37 p.

A 4-year-old Douglas-fir plantation in the western Washington Cascades was monitored for 8 years after fertilization with potassium (K), nitrogen (N), and K+N to determine fertilizer effects on rates of mortality from laminated root rot (LRR) and other causes relative to a nonfertilized control. Each element was applied at a rate of 300 lb/acre on and around 0.2-acre plots replicated seven times in a randomized complete block design. Cumulative mortality from LRR did not differ significantly among fertilizer treatments, and losses were strongly related to density of infected stumps from the previous stand ($r^2 = 0.74$). Mortality from disease and other sources accelerated during the 8 years of monitoring. Average tree growth and stand volume were greatest in treatment N and were

reduced where N was combined with K. Continued monitoring is needed to identify potential longer term effects of the fertilizer treatments on susceptibility of Douglas-fir to LRR and *Armillaria* spp.

Keywords: Douglas-fir, laminated root rot, infected stumps, fertilizer treatments.

Resource Inventory

05-249

Azuma, D.L.; Hiserote, B.A.; Dunham, P.A.

2005. The western juniper resource of eastern Oregon. Resour. Bull. PNW-RB-249. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 18 p.

This report summarizes resource statistics for eastern Oregon's juniper forests, which are in Baker, Crook, Deschutes, Gilliam, Grant, Harney, Jefferson, Klamath, Lake, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler Counties. We sampled all ownerships outside of the National Forest System; we report the statistics on juniper forest on national forest lands by using data from the national forest, Pacific Northwest Region inventory. Statistical tables summarize the area covered by juniper trees and juniper forest, wood volume, and numbers of trees, by ownership and juniper type. We found juniper on an estimated 6.5 million acres, a little more than half that was considered forest land. Evidence suggests that amount of forest land will continue to increase.

Keywords: Forest inventory, western juniper, resource statistics, eastern Oregon.

06-455

Donnegan, J.A.; Butler, S.L.; Kuegler, O.; Stroud, B.J.; Hiserote, B.A.; Rengulbai, K.

2007. Palau's forest resources, 2003. Resour. Bull. PNW-RB-252. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

The Forest Inventory and Analysis Program collected, analyzed, and summarized field data on 54 forested plots on the islands in the Republic of Palau. Estimates of forest area, tree stem volume and biomass, the numbers of trees, tree damages, and the distribution of tree sizes were summarized for this statistical sample. Detailed tables and graphical highlights provide a summary of Palau's forest resources and a comparison to 1987 data.

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

05-144

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 non-national-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.

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

Wood Utilization

06-142

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

2006. Alaska Wood Tides [Newsletter]. Sitka, AK: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Alaska Wood Utilization Research and Development Center. 4 p.

This issue of the newsletter of the Wood Utilization Research and Development Center in Sitka features an article on recent biomass developments in Alaska. It also provides research updates, an events calendar, and lists of current and upcoming publications.

Keywords: Biomass, wood products, wildland-urban interface.

06-530

Nicholls, D.; Roos, J.

2006. Red alder kitchen cabinets—How does application of commercial stains influence customer choice? Res. Note PNW-RN-556. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

A better understanding of consumer reaction and preferences for red alder (*Alnus rubra* Bong.) secondary products will help Alaska producers in entering new markets. In this study, red alder kitchen cabinets were commercially stained to six different levels and displayed at home shows in Portland, Oregon, and Anchorage, Alaska. The stains simulated the appearance of six commercial species. Respondents indicated their preferred cabinet doors, under the assumption of remodeling their kitchen. Brighter shades of stain were generally more popular than the three darkest shades. There were no statistically significant differences in preferences between male and female respondents. The influence of market location was found to be highly significant for unstained and for maple-stained cabinets. These results indicate a strong potential for red alder to be commercially stained to a wide range of appearances, targeting different demographic groups.

Keywords: Red alder, cabinets, commercial stain, consumer preference, Alaska forest products.

Publications Available Elsewhere

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Aquatic/Riparian Systems

Reeves, G.H.; Bisson, P.A.; Rieman, B.E.; Benda, L.A.
2006. Postfire logging in riparian areas. *Conservation Biology*. 20(4): 994–1004.

This paper examines the potential ecological effects of salvage logging in riparian areas and identifies factors that influence potential impacts of such activities based on the available scientific literature and our collective experience working in riparian and aquatic ecosystems.

Keywords: Salvage logging, riparian ecosystems, wildfire.
(see Corvallis Laboratory order form.)

Atmosphere

Wiedenmeyer, C.; Tie, X.; Guenther, A.; Neilson, R.; Granier, C.

2006. Future changes in biogenic isoprene emissions: How might they affect regional and global atmospheric chemistry? *Earth Interactions*. 10(3): 1–19.

Isoprene is emitted from vegetation to the atmosphere in significant quantities, and it plays an important role in the reactions that control tropospheric oxidant concentrations. This paper presents a study of the change in biogenic isoprene emissions that would result from both anthropogenic land-cover and climate-driven changes. The Model for Ozone and Related Tracers, version 2 (MOZART-2) was run with the different isoprene emission scenarios to simulate the potential changes in global atmospheric chemical composition. The results were used to evaluate changes in the ozone production chemistry under different emission scenarios. The impacts of changing isoprene emissions are regionally dependent, with large changes in China, the Amazon, and the United States and Europe.

Keywords: Isoprene emissions, land-cover change, ozone production, simulation.

(see Corvallis Laboratory order form.)

Botany

Vance, N.; Neill, A.; Morton, F.

2006. Native grass seeding and forb planting establishment in a degraded oak savanna plant community in the Coast Range foothills of western Oregon. *Native Plants Journal*. 7(1): 35–46.

After a dense stand of conifers encroaching on an oak savanna/meadow was removed, exotic forbs and grasses quickly populated the newly disturbed area. Establishing desirable native grasses and forbs that contribute to native plant diversity and compete with exotic species could aid in restoring this oak savanna plant community. Two experiments were conducted over time to test different native plant establishment approaches for increasing native plant diversity and abundance. The first evaluated effect of sown native grass species establishment on graminoid cover and composition. The second evaluated three outplanted native perennial forb species to determine their survival. Concurrent with the experimental work, we compared change in the plant community, including species richness and forb and graminoid cover. Graminoid cover changed over time, was significantly higher in sown than unsown plots, and significantly decreased cover of outplanted native forbs but not their survival. Species survival was high the first year after outplanting but declined in subsequent years; nevertheless, outplanted forbs produced flowers and fruits by the third year. Species richness and abundance increased, and composition of native and exotic forbs and grasses changed over the years, influencing establishment of native species. Efforts to improve native plant diversity and abundance within a dense population of native and exotic species may require varied and repeated treatments, as well as more time to assess plant interactions.

Keywords: Oak savannah, exotic weeds, native forb propagules, native grass seed, restoration.

(see Corvallis Laboratory order form.)

Economics

Quigley, T.M.

2005. Evolving views of public land values and management of natural resources. *Rangelands*. 27(3): 37–44.

In 2005, the USDA Forest Service celebrated its 100th birthday. The agency had evolved from a handful of employees in 1905 to an agency of 35,000 employees managing more than 190 million acres of forests and grasslands. The values expressed by the agency and its early employees have evolved through time. Providing the greatest good to the greatest number in the long run continues to express key underlying values of the agency. As public interests and values have shifted through time, so have those of the agency and its employees. Leaders in the agency were surveyed in 1989 and 2004 about their values, their perception of public values, and the values of the Forest Service. The shifts in values through time are discussed.

Keywords: Forest Service, public values, economics, rangeland values.

(see Station Director’s Office order form.)

Roos, J.A.; Eastin, I.L.

2005. Market segmentation and analysis of Japan’s residential post and beam construction market. *Forest Products Journal*. 55(4): 24–30.

A mail survey of Japanese post and beam builders was conducted to measure their level of ethnocentrism, market orientation, risk aversion, and price consciousness. The data were analyzed utilizing factor and cluster analysis. The results showed that Japanese post and beam builders can be divided into three distinct market segments: “open to import segment,” “low price sensitivity segment,” and “conservative segment.” A demographic profile of the “open to import segment” revealed that they are relatively newer companies, highly price sensitive, composed of larger builders, and targeting the lower end affordable housing market. This market segment was also found to be stronger in Japan’s urban regions and weaker in the Kyushu region. Managerial implications for how exporters can target the open to import segment are discussed.

Keywords: Japan, lumber, marketing, export, cluster analysis.

(see Alaska Wood Utilization Research and Development Center order form.)

Roos, J.A.; Donovan, G.H.; Nicholls, D.L.

2005. How does species name affect consumer choice? An analysis and implications for cabinet door marketers. *Forest Products Journal*. 55(5): 21–26.

Consumers choose products based on various tangible and intangible attributes. Previous research has shown that there is a difference between appearance-based and word-based evaluations of wood species. However, little research has been done on how this difference affects consumer choice. This study examines how the presence or absence of species name affects a cabinet door’s popularity. The results showed significant differences between appearance-based and species-name-based preferences for cabinet doors.

Keywords: Marketing, cabinets, hardwood, red alder, wood products, secondary processing.

(see Alaska Wood Utilization Research and Development Center order form.)

Ecosystem Structure and Function

Lenihan, J.M.; Bachelet, D.; Drapek, R.; Neilson, R.P.

2006. The response of vegetation distribution, ecosystem productivity, and fire in California to future climate scenarios simulated by the MCI dynamic vegetation model. California Energy Commission Report. CEC-500-2005-191-SF: 1–19.

The objective of this study was to dynamically simulate the response of vegetation distribution, carbon, and fire to three scenarios of future climate change for California using the MAPSS-CENTURY (MC-10) dynamic general vegetation model. Under all three scenarios, alpine/subalpine forest cover declined with increased growing season length and warmth, and increases in the productivity of evergreen hardwoods and increased temperature led to the displacement of evergreen conifer forest by mixed evergreen forest. The simulated responses to changed in precipitation were complex, involving not only the effect on vegetation productivity, but also changes in tree-grass competition mediated by fire.

Keywords: General vegetation model, vegetation distribution, carbon, fire, climate change.

(see Corvallis Laboratory order form.)

Lawler, J.J.; White, D.; Neilson, R.P.; Blaustein, A.R.

2006. Predicting climate-induced range shifts: model differences and model reliability. *Global Change Biology*. 12: 1568–1584.

Predictions of future range shifts have relied on a variety of modeling approaches with different levels of model accuracy. Using a common data set, we investigated the potential implications of alternative modeling approaches for conclusions about future range shifts and extinctions. Our common data set entailed the current ranges of 100 randomly selected mammal species found in the western hemisphere. Using these range maps, we compared six methods for modeling predicted future ranges. We conclude that the types of models used in a study can have dramatic effects on predicted range shifts and extinction rates; and that model-averaging approaches appear to have the greatest potential for predicting range shifts in the face of climate change.

Keywords: Climate change, extinction, geographic range, model prediction, model averaging.

(see Corvallis Laboratory order form.)

Malcolm, J.R.; Liu, C.; Neilson, R.P.; Hansen, L.; Hannah, L.

2006. Global warming and extinctions of endemic species from biodiversity hotspots. *Conservation Biology*. 20(2): 538–548.

Global warming is a key threat to biodiversity, but few researchers have assessed the magnitude of this threat at the global scale. We used major vegetation types as proxies for natural habitats and, based on projected future biome distributions under doubled-CO₂ climates, calculated changes in habitat areas and associated extinctions of endemic plant and vertebrate species in biodiversity hotspots. Projected extinctions ranged from <1 to 43 percent of the endemic biota (average 11.6 percent), with biome specificity having the greatest influence on the estimates, followed by the global vegetation model and then by migration and biome classification assumptions.

Keywords: Biomes, climate change, general circulation models, global vegetation models, migration, species extinctions.

(see Corvallis Laboratory order form.)

Marshall, J.D.; Monserud, R.A.

2006. Co-occurring species differ in tree-ring $\delta^{18}\text{O}$ trends. *Tree Physiology*. 26: 1055–1066.

The stable oxygen isotope ratio ($\delta^{18}\text{O}$) of tree-ring cellulose is jointly determined by the $\delta^{18}\text{O}$ of xylem water, the $\delta^{18}\text{O}$ of atmospheric water vapor, the humidity of the atmosphere and perhaps by species-specific differences in leaf structure and function. Atmospheric humidity and the $\delta^{18}\text{O}$ of water vapor vary seasonally and annually, but if the canopy atmosphere is well mixed, atmospheric characteristics should be uniform among co-occurring trees. In contrast, xylem water $\delta^{18}\text{O}$ is determined by the $\delta^{18}\text{O}$ of water being drawn from the soil, which varies with depth. If co-occurring trees draw water from different soil depths, this soil-water $\delta^{18}\text{O}$ signal would be manifest as differences in $\delta^{18}\text{O}$ among the trees. We examined the variation in tree ring $\delta^{18}\text{O}$, over eight decades during the 20th century, among three species co-occurring in natural forest stands of the northern Rocky Mountains in the USA. We sampled 10 Douglas-firs (*Pseudotsuga menziesii* (Mirb.) Franco var. *glauca*), 10 ponderosa pines (*Pinus ponderosa* Laws.) and seven western white pines (*Pinus monticola* Dougl.). As expected, variation in atmospheric conditions was recorded in the $\delta^{18}\text{O}$ of the cellulose produced in a given year, but observed climatic correlations with $\delta^{18}\text{O}$ were weak. Significant correlations with June climate data included daily maximum temperature ($r = 0.29$), daily minimum temperature ($r = -0.25$), mean temperature ($r = 0.20$), mean daily precipitation ($r = -0.54$), vapor pressure deficit ($r = 0.32$), and solar radiation ($r = 0.44$). Lagged effects were observed in Douglas-fir and western white pine. In these species, the $\delta^{18}\text{O}$ of a given annual ring was correlated with the $\delta^{18}\text{O}$ of the previous ring. Ponderosa pine showed no significant autocorrelation. Although the species means were correlated among years ($r = 0.67$ to 0.76), ponderosa pine was consistently enriched in $\delta^{18}\text{O}$ relative to the other species; differences were close to 2 percent and they are steadily increasing. Relative to the mean for the three species, ponderosa pine is becoming steadily more enriched (1.0 percent). In contrast, Douglas-fir is being steadily depleted and western pine is intermediate, with an enrichment of 0.5 percent. Because all trees were exposed to the same atmospheric conditions, the differences in $\delta^{18}\text{O}$ observed between species are likely due either to differences in the depth of water extraction or leaf function. If the former, presumably ponderosa pine has steadily taken up more water from near the soil surface and Douglas-fir has shifted uptake to a greater depth. If the latter, we suggest the pronounced changes in leaf-water $\delta^{18}\text{O}$ are a result of changes in leaf structure and function with tree size and age.

Keywords: Cellulose, climate, conifers, *Pinus monticola*, *Pinus ponderosa*, *Pseudotsuga menziesii*, stable oxygen isotope ratio, tree rings.

(see Portland Laboratory order form.)

Veblen, T.T.; Donnegan, J.A.

2006. Historical range of variability of forest vegetation of the national forests of the Colorado Front Range. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Region and the Colorado Forest Restoration Institute. 151 p.

This report is a response to the widespread recognition that forest resource planning and decisionmaking would benefit from a series of assessments of the historical range of variability (HRV) of the ecosystems that make up the national forest lands of the Rocky Mountain region. Over the past 5 years, we have benefitted from numerous discussions with many Forest Service personnel of topics directly related to the HRV assessment. In the current report, we address issues and alternative interpretations that have become apparent to us from these discussions with individuals and in numerous workshops. We also address issues raised by Forest Service personnel in written reviews of the initial drafts of the report.

Keywords: Colorado Front Range, ecological disturbance, forest resource planning.

(see Portland Laboratory order form.)

Fire

McIver, J.D.; McNeil, R.

2006. Soil disturbance and hill-slope sediment transport after logging of a severely burned site in northeastern Oregon. *Western Journal of Applied Forestry*. 21(3): 123–133.

Soil disturbance and hill-slope sediment transport were measured after a postfire logging operation conducted 2 years after the 1996 Summit Wildfire (Malheur National Forest), in northeastern Oregon. The wildfire was relatively severe, killing an average of 86 percent of the trees in experimental units, and leaving an average of 34 percent mineral soil exposed. Soil disturbance was measured both pre- and postharvest in four replicate units in each of three postfire harvest treatments. There was a significant difference among treatments in the percentage of mechanically disturbed soil area, with an average of 19.4 percent disturbed in fuel reduction units and 15.2 percent in commercial units. Displacement, compaction, and erosion were the most common types of machine-caused soil disturbance. Controls had significantly less change in mean displacement from pre- to posttreatment compared to fuel reduction units, and significantly less change in erosion compared to commercial units. At the experimental unit

level, there was a significant correlation between the number of stems removed and the total amount of mechanical soil disturbance observed. Multiple regressions indicated that logging activity, reflected by the number of stems removed, explained more variation in soil disturbance than relative fire severity, reflected by tree mortality, forest floor mass, or the percentage of mineral soil exposed. Despite averages of 6.7 percent compacted and 14.9 percent area displaced in harvested units, there was no correspondence between disturbance within units and sediment collected in silt fences below units. Visual inspections indicated that relatively little sediment exited the experimental units in the short term, and that the existing road system was responsible for contributing most of the sediment transport observed in the study.

Keywords: Salvage logging, postfire logging, soil compaction, erosion, restoration.

(see La Grande Laboratory order form.)

Wiedinmyer, C.; Quayle, B.; Geron, C.; Belote, A.; McKenzie, D.; Zhang, X.; O'Neill, S.; Wynne, K.K.

2006. Estimating emissions from fires in North America for air quality modeling. *Atmospheric Environment*. 40: 3419–3432.

Fires contribute substantial emissions of trace gases and particles to the atmosphere. These emissions can impact air quality and even climate. We have developed a modeling framework to estimate the emissions from fires by taking advantage of a combination of complementary satellite and ground-based data to refine estimates of fuel loadings. Various satellite drivers were used in conjunction with data mined from literature to determine fire location and timing, fuel loadings, and emission factors. Daily emissions of particulate matter and numerous trace gases from fires were estimated by using this method for 3 years. Annual emission estimates differ by as much as a factor of two. Regional variations in emissions correspond to different fire seasons within the region. Comparisons of these results with other published estimates show reasonable agreement.

Keywords: Fire emissions, North America, FCCS, MODIS, fuel loadings.

(see Pacific Wildland Fire Sciences Laboratory order form.)

Fish

Williams, R.N.; Stanford, J.A.; Lichatowich, J.A.; Liss, W.J.; Coutant, C.C.; Whitney, R.R.; Mundie, P.R.; Bisson, P.A.; Powell, M.S.

2006. Return to the river: strategies for salmon restoration in the Columbia River basin. In: Williams R., ed. Return to the river. Burlington, MA: Elsevier Inc. 629–666. Chapter 13.

The lack of progress toward salmon recovery goals in the Columbia Basin has been linked to restoration programs that sought to circumvent important ecological processes. Recovery of anadromous salmonids in the basin will need to be centered around an explicitly defined conceptual foundation based on ecological principles. Defining what the river must be and moving the ecosystem to that point is essential to bring about salmon recovery and to achieve other watershed restoration goals.

Keywords: Pacific salmon, Columbia River, salmon recovery strategy.

(see Olympia Laboratory order form.)

Forest Management

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

2005. Growth and yield of all-aged Douglas-fir–western hemlock forest stands: a matrix model with stand diversity effects. *Canadian Journal of Forest Research*. 35: 2368–2381.

A density-dependent matrix model was developed for Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco)–western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) forest stands in the Pacific Northwest of the United States. The model predicted the number and volume of trees for 4 species groups and 19 diameter classes. The parameters were based on species-dependent equations linking individual tree growth, mortality, and stand recruitment to tree and stand characteristics, including stand diversity in terms of tree species and size. The equations were estimated with individual tree and stand data from 2,706 permanent plots in western Washington and Oregon, largely from private and state lands, measured twice at an average interval of 10 years. Other things being equal, diameter growth increased slightly with species diversity and decreased with size diversity. Recruitment increased with species diversity and decreased with size diversity. Mortality was independent of species diversity and tended

to increase with size diversity. There was practically no relationship between individual tree volume and species or size diversity. The number of trees predicted by the model over the interval between successive inventories was generally unbiased. Long-term predictions with different initial conditions were consistent with standard yield tables and compared favorably with those of the Forest Vegetation Simulator. The model also implied that, independently of its initial condition, an undisturbed stand would eventually reach a steady state dominated by western hemlock more than 1 m in diameter, with few trees of other species and size.

Keywords: Douglas-fir, western hemlock, diversity, mortality, recruitment, biometrics.

(see Portland Laboratory order form.)

Monserud, R.A.; Huang, S.; Yang, Y.

2006. Predicting lodgepole pine site index from climatic parameters in Alberta. *The Forestry Chronicle*. 82(4): 562–571.

We sought to evaluate the impact of climatic variables on site productivity of lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) for the province of Alberta. Climatic data were obtained from the Alberta Climate Model, which is based on 30-year normals from the provincial weather station network. Mapping methods were based on ANUSPLIN, Hutchinson's thin-plate smoothing spline in four dimensions (latitude, longitude, elevation, climatic variable). Site indices based on stem analysis (observed dominant height at an index age of 50 years at breast height) were used as a measure of forest site productivity. A total of 1,145 site index plots were available for lodgepole pine, the major forest species in Alberta. Regression analyses were used to predict site index as a function of climatic variables for each plot. The strongest linear predictors of site index were growing degree days >5 °C (GDD5), the Julian date when GDD5 reaches 100 (D100), and July mean temperature. A nonlinear model with D100 as the predictor variable was chosen as the final model. Both the observed and the predicted site indices from the 1,145 locations were interpolated by using ANUSPLIN and mapped by using ArcView. We concluded that climate is an important component of site productivity, accounting for about one quarter of the variation in lodgepole pine site index across the province.

Keywords: Site index, climate variable, Alberta Climate Model, ANUSPLIN, site productivity map, lodgepole pine

(see Portland Laboratory order form.)

Szaro, R.C.; Peterson, C.E.; von Gadow, K.

2006. Operational experiments for sustainably managing forests. *Allgemeine Forest- und Jagdzeitung*. 177(6/7): 98–104.

Historically, applied manipulative studies of forests have tested the ability of specific silvicultural treatments to address wood production objectives. Changing societal values now demand expanded approaches to forest management that also integrate social, ecological, and economic goals. As a result, many recent (past decade) experimental manipulations have become multidisciplinary in scope and approach and involve restorative treatments, novel silvicultural approaches, or variants of more traditional approaches that are relevant to operational scales. We examine a wide range of manipulative forest ecological experiments that have addressed a variety of responses to changes in forest structure or function. The silvicultural treatments employed in these experiments were oftentimes designed by interdisciplinary teams (e.g., forest ecologists, sociologists, biologists, economists, and silviculturists) with wood production and additional ecological, social, or economic objectives as joint outcomes. Individually and collectively these studies represent major investments by research and land management organizations to meet increasing public demands for forests that provide healthy environments for people (clean air and water), support biological diversity (e.g., habitat), and sustain economic productivity (wood or other forest products and jobs).

Keywords: Sustainable forest management, forest ecological experiments, uncertainty, continuous cover, ecosystem management.

(see Portland Laboratory order form.)

Thies, W.G.; Westlind, D.J.

2006. Application of chloropicrin to Douglas-fir stumps to control laminated root rot does not affect infection or growth of regeneration 16 growing seasons after treatment. *Forest Ecology and Management*. 235: 212–218.

A study was established near Matlock, Washington, to test application of chloropicrin to infected stumps after harvest to manage laminated root rot. Treatments were assigned randomly to four plots in each of the eight blocks: (a) 100 percent labeled dosage to all stumps, (b) 20 percent labeled dosage to all stumps, (c) 100 percent labeled dosage to only visibly *Phelinus weirii*-infected (stump-top stain or advanced decay) stumps, and (d) control (nothing done to the stumps). Holes were drilled into stump tops, a dose of chloropicrin poured in, and the holes plugged. The labeled

dosage was 3.3 ml of chloropicrin per kilogram of estimated stump and root biomass. Diameter at breast height, total height, and mortality of trees were recorded every 2 to 5 years. A total of 1,041 tagged trees were observed for 16 growing seasons following treatment. Application of chloropicrin to stumps in the harvested stand did not influence the rate of LRR-caused mortality or growth of Douglas-fir seedlings in the replacement stand.

Keywords: Laminated root rot, disease control, fumigation, chloropicrin, impacts, epidemiology.

(see Corvallis Laboratory order form.)

Weiskittel, A.; Maguire, D.; Monserud, R.A.

2005. Using hybrid models to predict annual stand-level growth across a range of swiss needle cast severity. *Swiss Needle Cast Cooperative 2005 annual report*. Corvallis, OR: Oregon State University, College of Forestry. 3 p.

This study seeks to better understand changes in crown structure and dynamics imposed by intensive plantation management in an attempt to predict its influence on wood quality and growth response physiology.

Keywords: Net primary production, crown modeling, simulation.

(see Portland Laboratory order form.)

Wimberly, M.C.; Spies, T.A.; Nonaka, E.

2004. Using criteria based on the natural fire regime to evaluate forest management in the Oregon Coast Range of the United States. In: Perera, A.H.; Buse, L.J.; Weber, M.G., eds. *Emulating natural forest landscape disturbances: concepts applications*. New York: Columbia University Press. 146–157. Chapter 12.

The goal of this research was to reexamine current forest management practices and landscape patterns in the Oregon Coast Range by considering them in the context of the natural fire regime. Specific objectives were to (1) contrast the frequencies, sizes, and effects of historical fires with those of forest management disturbances; (2) examine differences in the abundance and pattern of several stages between pre-European settlement and present-day forest landscapes; and (3) assess the potential for applying management based on pre-European settlement fire regimes in the Oregon Coast Range within the framework of present-day forest conditions and socioeconomic constraints.

Keywords: Disturbance, landscape dynamics, forest planning.

(see Corvallis Laboratory order form.)

Genetics

Syring, J.; Willyard, A.; Cronn, R.; Liston, A.

2005. Evolutionary relationships among *Pinus* (Pinaceae) subsections inferred from multiple low-copy nuclear loci. *American Journal of Botany*. 92(12): 2086–2100.

Sequence data from nrITS and cpDNA have failed to fully resolve phylogenetic relationships among *Pinus* species. Four low-copy nuclear genes, developed from the screening of 73 mapped conifer anchor loci, were sequenced from 12 species representing all subsections. Individual loci do not uniformly support either the nrITS or cpDNA hypotheses and in some cases produce unique topologies. Combined analysis of low-copy nuclear loci produces a well-supported subsectional topology of two subgenera, each divided into two sections, congruent with prior hypotheses of deep divergence in *Pinus*. The placements of *P. nelsonii*, *P. krempfii*, and *P. contorta* have been of continued systematic interest. Results strongly support the placement of *P. nelsonii* as sister to the remaining members of section *Parrya*, suggest a moderately well-supported and consistent position of *P. krempfii* as sister to the remaining members of section *Quinquefoliae*, and are ambiguous about the placement of *P. contorta*. A successful phylogenetic strategy in *Pinus* will require many low-copy nuclear loci that include a high proportion of silent sites and derive from independent linkage groups. The locus screening and evaluation strategy presented here can be broadly applied to facilitate the development of phylogenetic markers from the increasing number of available genomic resources.

Keywords: Incongruence, nuclear genes, phylogeny, Pinaceae, Pinus.

(see Corvallis Laboratory order form.)

Geomorphology and Hydrology

Moore, R.D.; Wondzell, S.M.

2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: a review. *Journal of the American Water Resources Association*. 41(4) 763–784.

This paper reviews hydrologic processes relevant to watershed and riparian management of small streams in the Pacific Northwest. It is difficult to draw broad generalizations on the hydrologic effects of forest harvest because of the great range in the nature of postharvest weather events, in catchment characteristics, in details of the road and harvesting systems, and in the time since harvesting. Most studies show that annual water yield generally increases after forest harvest, and that low flows tend to become less extreme. Also, peak flows usually increase, but this effect typically diminishes with event magnitude. However, the practical impact of peak flow increases are unknown because large events tend to have the greatest impacts on streams.

Keywords: Forest harvest, hydrology, peak flows, riparian zones.

(see Olympia Laboratory order form.)

Sakals, M.E.; Innes, J.L.; Wilford, D.J.; Sidle, R.C.; Grant, G.E.

2006. The role of forests in reducing hydrogeomorphic hazards. *Forest, Snow, and Landscape Research*. 80(1): 11–22.

Maintaining high levels of protective function requires active management, as forests are dynamic features in which conditions are always changing. Roles of protective forests include (1) retaining material in upslope positions and (2) physically containing material during transport and deposition. The recognition and management of these functions is required for the best management of protection forests.

Keywords: Debris flows, floods, landslides, forest ecosystems.

(see Corvallis Laboratory order form.)

Wondzell, S.M.

2006. Effect of morphology and discharge on hyporheic exchange flows in two small streams in the Cascade Mountains of Oregon, USA. *Hydrological Processes*. 20: 267–287. <http://www.interscience.wiley.com>. (26 August 2005).

Stream-tracer injections were conducted in five reaches of two headwater streams to examine the effect of channel morphology on hyporheic exchange flows. Tracer injections were conducted at high- and low-baseflow discharge to examine the effect of changing discharge on hyporheic exchange flows. Results showed that pool-step sequences were the dominant morphologic features controlling transient storage. Further, both the size of the transient storage zone and the hydrologic residence time were related to the size of the steps. Valley-floor constraint did not influence transient storage at the time scales and under the watershed conditions at which this study was conducted. The extent of hyporheic zone, tracer transport times to wells and proportion of stream water present in wells changed little from low- to high-baseflow discharge, despite a fourfold change in discharge.

Keywords: Hyporheic zone, stream tracer experiments, transient storage models, groundwater.

(see Olympia Laboratory order form.)

Landscape Ecology

Spies, T.A.; Hemstrom, M.A.; Youngblood, A.; Hummel, S.

2006. Conserving old-growth forest diversity in disturbance-prone landscapes. *Conservation Biology*. 20(2): 351–362.

A decade after its creation, the Northwest Forest Plan is contributing to the conservation of old-growth forests on federal land. However, the success and outlook for the plan are questionable in the dry provinces, where losses of old growth to wildfire have been relatively high and risks of further loss remain. We summarize the state of knowledge of old-growth forests in the plan area, identify challenges to conserve them, and suggest some conservation approaches that might better meet the goals of the plan. Historically, old-growth forests in these provinces ranged from open, patchy stands, maintained by frequent low-severity fire, to a mosaic of dense and open stands maintained by mixed-severity fires. Old-growth structure and composition were spatially heterogeneous, varied strongly with topography and elevation, and were shaped by a complex disturbance regime of fire, insects, and disease. With fire suppression and cutting of large pines (*Pinus* spp.) and Douglas-firs (*Pseudotsuga menziesii* [Mirbel] Franco), old-growth diversity has declined and dense understories have developed across large areas. Challenges to conserving these forests include a lack of definitions needed for planning of fire-dependent old-growth stands and landscapes, and conflicts in conservation goals that can be resolved only at the landscape level. Fire suppression has increased the area of the dense, older forest favored by northern spotted owls (*Strix occidentalis caurina*) but increased the probability of high-severity fire. The plan allows for fuel reduction in late-successional reserves; fuel treatments, however, apparently have not happened at a high enough rate or been applied in a landscape-level approach. Landscape-level strategies are needed that prioritize fuel treatments by vegetation zones, develop shaded fuel breaks in strategic positions, and thin and apply prescribed fire to reduce ladder fuels around remaining old trees. Evaluations of the current and alternative strategies are needed to determine whether the current reserve-matrix approach is the best strategy to meet plan goals in these dynamic landscapes.

Keywords: Northwest Forest Plan, ecosystem management, fire, forest dynamics.

(see Corvallis Laboratory order form.)

Monitoring

Spies, T.A.; Martin, J.R.

2006. Monitoring late-successional forest biodiversity in the Pacific Northwest, U.S.A. *The Forestry Chronicle*. 82(3): 364–367.

The era of ecosystem management for federal forest lands in the Pacific Northwest began in 1994 with the adoption of the Northwest Forest Plan. This plan was designed to maintain and restore species and ecosystems associated with late-successional and old-growth forests on over 10 million ha of federal lands in Washington, Oregon, and California. The plan called for implementation monitoring, effectiveness monitoring, and validation monitoring for a variety of ecological and socioeconomic components. Monitoring has become a central part of management of the federal forests in the region, and managers and scientists have gained considerable experience in implementing this large and complex program. The components of the monitoring plan include late-successional/old-growth vegetation, northern spotted owls, marbled murrelets, aquatic habitat, and social conditions. The monitoring plan is strongly based on vegetation layer created with thematic mapper satellite imagery and on a regional grid of forest inventory plots. The lessons learned from the implementation of this monitoring plan include (1) agencies need to devote considerable resources to ensure that effective monitoring will occur at broad scales; (2) aggregation of local monitoring efforts is not a substitute for a designed regional monitoring plan; (3) vegetation structure and composition, measured with satellite imagery and inventory plots, is a cost effective, broad-scale indicator of biological diversity; (4) some species, such as threatened and endangered species, are not necessarily covered with habitat approaches and may require population monitoring; (5) our scientific understanding of monitoring components will differ widely as will the approaches to data collection and analysis; (6) monitoring requires research support to develop and test metrics and biodiversity models; (7) links of monitoring to decisionmaking (adaptive management) are still being forged.

Keywords: Pacific Northwest, USA, aquatic ecosystems, endangered species, old-growth forests, regional ecosystem management.

(see Corvallis Laboratory order form.)

Plant Pathology

Schaberg, P.G.; Hennon, P.E.; D'Amore, D.V.; Hawley, G.J.; Borer, C.H.

2005. Seasonal differences in freezing tolerance of yellow-cedar and western hemlock trees at a site affected by yellow-cedar decline. *Canadian Journal of Forest Research*. 35: 2065–2070. <http://cjfr.nrc.ca>. (3 September 2005).

To assess whether inadequate cold hardiness could be a contributor to yellow-cedar (*Chamaecyparis nootkatensis* (D. Don) Spach) decline, we measured the freezing tolerance of foliage from yellow-cedar trees in closed-canopy (nondeclining) and open-canopy (declining at elevations below 130 m) stands at three sites along an elevational gradient in the heart of the decline in southeastern Alaska. Foliar freezing tolerance was also assessed for sympatric nondeclining western hemlock (*Tsuga heterophylla* (Raf.) Sarg.). Measurements were made in fall, winter, and spring to evaluate if seasonal differences in cold hardiness help explain species-specific injury. Significant differences in freezing tolerance attributable to site, canopy closure, species, and the interaction of canopy closure and species were each detected for at least one sample period. However, only two results were consistent with field reports of yellow-cedar decline: (1) between winter and spring measurements, yellow-cedar trees dehardened almost 13 °C more than western hemlock trees, so that yellow-cedar trees were more vulnerable to foliar freezing injury in spring than hemlock; and (2) stands below 130 m appeared more vulnerable to freezing injury than stands above 130 m.

Keywords: Yellow-cedar, freezing, forest decline, climate change.

(see Juneau Laboratory order form.)

Range Management

Wisdom, M.J.; Rowland, M.M.; Tausch, R.J.

2005. Effective management strategies for sage-grouse and sagebrush: A question of triage? Effective management strategies for sage-grouse and sagebrush, transactions of the 70th North American wildlife and natural resources conference. Washington, DC: Wildlife Management Institute. 2: 206–227

The sagebrush (*Artemisia* spp.) ecosystem still occupies over 100 million acres, but the abundance and condition of sagebrush communities is declining rapidly in response to a variety of detrimental land uses and undesirable ecological processes. To effectively reverse these negative trends, managers are confronted with three related problems: (1) a high probability of threshold effects that are difficult or impossible to avoid or overcome; (2) a lack of resistance in most sagebrush communities to changes caused by human-associated disturbances; and (3) a lack of resiliency in most sagebrush communities to return to former native states once a community change occurs. We discuss these challenges and suggest possible strategies for improvement.

Keywords: Sage grouse, sagebrush, restoration, habitat management.

(see La Grande Laboratory order form.)

Recreation

Stynes, D.J.; White, E.M.

2006. Reflections on measuring recreation and travel spending. *Journal of Travel Research*. 45: 8–16.

This article reviews problems encountered in using visitor surveys to measure travel spending. Lack of consistency in question wording, spending categories, and units of analysis makes it difficult to compare results across studies. Spending results can be quite sensitive to a number of data-handling issues, in particular, the treatment of outliers, contaminants, and missing spending data. It is recommended that spending averages be estimated for narrowly defined visitor segments so they can be validated with engineering approaches and common sense. Further research evaluating alternative designs for measuring spending is needed to address a host of methodological issues.

Keywords: Recreation spending, visitor sampling, economic impact.

(see Corvallis Laboratory order form.)

Regional Assessments

Sizer, N.; Bass, S.; Mayers, J.; Arnold, M.; Auckland, L.; Belcher, B.; Bird, N.; Campbell, B.; Carle, J.; Cleary, D.; Counsell, S.; Enters, T.; Fernando, K.; Gullison, T.; Hudson, J.; Kellison, B.; Klingberg, T.; Owen, C.N.; Sampson, N.; Vermeulen, S.; Wollenberg, E.; Shackleton, S.; Edmunds, D.; Durst, P.; Dykstra, D.P.; Holmes, T.; Hunter, I.; Killmann, W.; Malayang, B.S., III; Putz, F.E.; Shanley, P.

2006. Wood, fuelwood, and nonwood forest products. In: Sastry, C., de los Angeles, M., eds. Millennium Ecosystem Assessment. Volume 3: Policy Responses. Washington, DC: Island Press. 257–293. Chapter 8.

This chapter assesses the impact on ecosystem health and human well-being of actions taken to influence the production and use of wood, fuelwood, and nonwood forest products (also known as nontimber forest products). These actions are responses to the ecosystem and human well-being conditions and trends associated with forest products that are assessed in the Millennium Assessment (MA), Current State and Trends (chapters 9 and 21). The effectiveness of these responses is also assessed in relation to the possible scenarios in MA scenarios. The chapter discusses (1) driving forces of change in ecosystems that produce wood, fuelwood, and nonwood forest products, and the problems and opportunities they create; (2) interventions and actions to tackle the problems; (3) an assessment of selected responses; and (4) lessons learned. Other chapters in this and other MA volumes assess ecosystems and services closely linked to the provision of wood, fuelwood, and nonwood forest products. Gaining a full picture of the state of forests and woodlands, the provisioning services of wood and nonwood forest products, and the human actions taken to address problems linked to wood and nonwood forest products requires looking at them as well.

Keywords: Industrial wood, fuelwood, nontimber forest products.

(see Portland Laboratory order form.)

Remote Sensing

Lefsky, M.A.; Harding, D.J.; Keller, M.; Cohen, W.B.; Carabajal, C.C.; Del Bom Espirito-Santo, F.; Hunter, M.O.; Cosme de Oliveria, R., Jr.

2005. Estimates of forest canopy height and aboveground biomass using ICESat. *Geophysical Research Letters*. 32(L22S02): 1–4.

The exchange of carbon between the atmosphere and forested ecosystems is a vital component of the global carbon cycle. LIDAR remote sensing has a unique capability for estimating forest canopy height, which has a direct and increasingly well understood relationship to aboveground carbon storage. Although the Geoscience Laser Altimeter System (GLAS) sensor on the ICESat satellite has collected an unparalleled data set of LIDAR waveforms over terrestrial targets, processing of GLAS data to create reliable estimates of forest height is complicated by the pulse broadening that occurs when waveform sampling LIDAR is used with large footprints.

Keywords: Biomass trees, remote sensing.

(see Corvallis Laboratory order form.)

Schroeder, T.A.; Cohen, W.B.; Song, C.; Canty, M.J.; Zhiquang, Y.

2006. Radiometric correction of multi-temporal Landsat data for characterization of early successional forest patterns in western Oregon. *Remote Sensing of Environment*. 103 16–26.

Detecting and characterizing continuous changes in early forest succession by using multitemporal satellite imagery requires atmospheric correction procedures that are both operationally reliable, and that result in comparable units (e.g., surface reflectance). This paper presents a comparison of five atmospheric correction methods (two relative, three absolute) used to correct a nearly continuous 20-year Landsat TM/ETM+ image data set (19 images) covering western Oregon (path/row 46/29) to like surface reflectance values.

Keywords: Remote sensing, calibration, Landsat TM.

(see Corvallis Laboratory order form.)

Silviculture

Seymour, R.S.; Guldin, J.; Marshall, D.D.; Palik, B.

2006. Large-scale, long-term silvicultural experiments in the United States: historical overview and contemporary examples. *Allgemeine Forst und Jagdzeitung*. 177(6/7): 104–111.

This paper reviews experience and research findings from selected large-scale, long-term silvicultural experiments in four regions of the United States: the Northeast, the Lake States, the mid-South, and the Pacific Northwest. As early as the 1920s, when there was nationwide interest in multi-aged silviculture, researchers recognized that silvicultural systems involving within-stand variation in age and size structure could not be tested effectively on small (<1 ha) plots, and began installation of compartment-scale (10 to 20 ha) trials on many experimental forests throughout the United States. Large-scale trials have experienced a revival in the past decade. Although large-scale experiments are difficult and expensive to install, properly replicate, monitor, and maintain over time, they also have many important benefits.

Keywords: Experimental forests, multiaged silviculture, regeneration methods, structural retention, gap harvesting.

(see Olympia Laboratory order form.)

Turner, D.P.; Ritts, W.D.; Cohen, W.B.; Gower, S.T.; Running, S.W.; Zhao, M.; Costa, M.H.; Kirschbaum, A.; Ham, J.; Saleska, S.; Ahl, D.E.

2006. Evaluation of MODIS NPP and GPP products across multiple biomes. *Remote Sensing Environment*. 102: 282–292.

Estimates of daily gross primary production (GPP) and annual net primary production (NPP) at the 1-km spatial resolution are now produced operationally for the global terrestrial surface by using imagery from the MODIS (Moderate Resolution Imaging Spectroradiometer) sensor. Ecosystem-level measurements of GPP at eddy covariance flux towers and plot-level measurements of NPP over the surrounding landscape offer opportunities for validating the MODIS NPP and GPP products, but these flux measurements must be scaled over areas on the order of 25 km² to make effective comparisons to the MODIS products. Here, we report results for such comparisons at nine sites varying widely in biome type and land use.

Keywords: MODIS, landsat, net primary production, gross primary production, biomes, validation, global, monitoring.

(see Corvallis Laboratory order form.)

Youngblood, A.; Metlen, K.L.; Coe, K.

2006. Changes in stand structure and composition after restoration treatments in low elevation dry forests of northeastern Oregon. *Forest Ecology and Management*. 234: 143–163.

This study reports changes in overstory and stand structure, coarse woody debris (logs), and understory composition from an experiment designed to compare alternative treatments to reduce fuels and accelerate the development of late-successional stand structure in low-elevation dry ponderosa pine and Douglas-fir forests of northeastern Oregon. Treatments included a single-entry thin from below conducted in 1998, a late-season underburn conducted in 2000, a thin from below followed by a late-season underburn (thin + burn), and controls. Results are discussed in the context of management options from fuel reduction and restoration of ecosystem health and ecological integrity of similar low-elevation dry forests.

Keywords: Stand structure, ponderosa pine, fuel reduction treatments, thinning, broadcast burning.

(see La Grande Laboratory order form.)

Threatened, Endangered, Sensitive Species

McKelvey, K.S.; Von Kienast, J.; Aubry, K.B.; Koehler, G.M.; Maletzke, B.T.; Squires, J.R.; Lindquist, E.L.; Loch, S.; Schwartz, M.K.

2006. DNA analysis of hair and scat collected along snow tracks to document the presence of Canada lynx. *Wildlife Society Bulletin*. 34(2): 451–455.

Species identification based on snow tracks is often unreliable. We investigated the efficacy of using DNA from hair and scat collected while snowtracking for species identification. Species identification rates for samples collected along snow tracks were high for both hair (81 percent) and scats (97 percent). Usable DNA samples were collected at a rate of one sample per 1.2 km. These amplification rates and frequencies of encounter make the collection of DNA samples from snow tracks feasible for Canada lynx and potentially other rare carnivores. We recommend adding the collection of hair and scat to snow-track surveys whenever verifiable species identification is a high priority.

Keywords: Lynx canadensis, lynx, survey, distribution, noninvasive genetic sampling.

(see Olympia Laboratory order form.)

Wildlife

Carey, A.B.

2006. Active and passive forest management for multiple values. In: Olson, D.H., ed. *Biodiversity*. Northwest Naturalist. 87(1): 18–30.

Comparisons of natural and managed forests suggest that single-focus management of second growth is unlikely to achieve broad conservation goals because biocomplexity is important to ecosystem capacity to produce useful goods and services. Biocomplexity includes species composition, the absolute and relative abundance of those species, and their arrangement in space.

Keywords: Forests, biodiversity, biocomplexity, sustainability.

(see Olympia Laboratory order form.)

Carey, A.B.

2006. AIMing to restore forests: evaluation with SER criteria. In: Olson, D.H., ed. *Biodiversity*. Northwest Naturalist. 87(1): 31–42.

Active, intentional management (AIM) is a conservation approach that emphasizes a full range of active and passive management techniques to manage important ecological and hydrologic processes to conserve biodiversity, reconcile conflicts over management of natural resources, and provide various goods, ecological services, and recreational and spiritual opportunities. This paper discusses AIM approaches relative to criteria stated in the Society for Ecological Restoration Primer on Ecological Restoration.

Keywords: Biodiversity, biocomplexity, restoration.

(see Olympia Laboratory order form.)

Lehmkuhl, J.F.; Kistler, K.D.; Begley, J.S.; Boulanger, J.

2006. Demography of northern flying squirrels informs ecosystem management of western interior forests. *Ecological Applications*. 16(2): 584–600.

We studied northern flying squirrels in the eastern Washington Cascade Range to quantify abundance patterns, and to inform management of fire, fuel, and sensitive species in western interior forests. Ponderosa pine forest was poorer habitat for flying squirrels than young or mature mixed-conifer forest. Annual recruitment rate was lower in open pine than in young and mature forest. Annual apparent survival rates varied from 45 percent to 59 percent over 4 years. Management in such dry forests to restore stable low-intensity fire regimes would alter source habitat and reduce flying squirrel densities. Alternative management for mixed-fire regime characteristics likely would enhance habitat.

Keywords: Flying squirrel, old growth, fuels management, ecosystem management.

(see Wenatchee Laboratory order form.)

Marcot, B.G.

2006. Habitat modeling for biodiversity conservation. In: Olson, D.H., ed. *Biodiversity*. Northwest Naturalist. 87(1): 56–75.

Habitat models address only one component of biodiversity but can be useful in addressing and managing single or multiple species and ecosystem functions, for projecting disturbance regimes, and in supporting decisions. I review categories and examples of habitat models, their utility for biodiversity conservation, and their roles in making conservation decisions.

Keywords: Biodiversity conservation, habitat modeling, indicators, surrogates, multispecies, influence diagrams, structural equation modeling.

(see Portland Laboratory order form.)

Olson, D.H.

2006. Biodiversity conservation—a place holder: introduction to papers in this issue. In: Olson, D.H., ed. *Biodiversity*. Northwest Naturalist. 87(1): 1–9.

This discussion of biodiversity conservation serves to introduce seven additional papers that are the proceedings of the biodiversity workshop held in February 2005 in Corvallis, Oregon. Key issues of Pacific Northwest, and specifically forest biodiversity, conservation are reviewed.

Keywords: Conservation, biological diversity, Pacific Northwest, species management.

(see Corvallis Laboratory order form.)

White, R.; Molina, R.

2006. The Pacific Northwest Research Station Biodiversity Initiative: scoping out the challenges in managing for biodiversity. In: Olson, D.H., ed. *Biodiversity*. Northwest Naturalist. 87(1): 10–17.

The PNW Research Station Biodiversity Initiative seeks to determine the types of science tools needed by natural resource professionals to meet diverse and complex biodiversity goals. We report here the results of our scoping phase in which a broad cross-section of people whose work involves managing for biodiversity and describe their priority needs, challenges, and concerns.

Keywords: Biodiversity, management, monitoring, information needs, resource managers.

(see Portland Laboratory order form.)

Wood Utilization

Nicholls, D.L.; Roos, J.

2006. Lumber attributes, characteristics, and species preferences as indicated by secondary wood products firms in the continental United States. *Holz als Roh- und Werkstoff*. 64: 253–259. <http://www.springerlink.com/content/v531162636007xwn/?p=f172757c82a0494cab6c6a57fff97c1a&pi=0>. (1 February 2006).

The purpose of this research was to evaluate selected lumber attributes, species preferences, and lumber use properties among secondary wood manufacturers in the United States. Our sample included producers of kitchen cabinets, furniture, doors, windows, and molded products who attended regional and national wood manufacturing events. More than 51 percent of respondents had annual sales of less than \$500,000, and the median company size was five employees. Results are presented for 17 selected lumber attributes, and indicate that appearance-related attributes were generally the most important, and that use of certified lumber was generally the least important. Price-related attributes (including low price and price stability) were generally intermediate in importance. There were statistically significant differences among geographic regions for four of the attributes, and among business types for three of the attributes. The most popular species for use by secondary manufacturers included the oaks, maple, and cherry, and there were strong preferences for kiln-dried, 4/4 (2.54 cm) lumber having random length and width.

Keywords: Rural communities, wood utilization.

(see Alaska Wood Utilization Research and Development Center order form.)

**Wisdom, M.J.; Vavra, M.; Boyd, J.M.;
Hemstrom, M.A.; Ager, A.A.; Johnson, B.K.**

2006. Understanding ungulate herbivory-episodic disturbance effects on vegetation dynamics: knowledge gaps and management needs. *Wildlife Society Bulletin*. 34(2): 283–292.

Herbivory by wild and domestic ungulates is a chronic disturbance that can have dramatic effects on plant succession. Specific herbivory effects, however, are not easily predicted under different combinations of episodic disturbance such as fire, timber harvest, and insect defoliation. This lack of predictability poses a substantial obstacle to effective management of ungulate herbivory with other disturbance agents to meet vegetation goals for land management. We contend that useful landscape research on herbivory must examine the interactions of ungulate grazing with other disturbance regimes at spatial scales of interest to forest and rangeland managers and under varying ungulate densities and species.

Keywords: Elk, cattle, ungulate herbivory, grazing, vegetation, vegetation dynamics.

(see La Grande Laboratory order form.)

Todoroki, C.; Lowell, E.

2006. Increasing value from pruned logs with partial knowledge of internal defects. *New Zealand Journal of Forestry Science*. 36(2/3): 424–434.

The hypothesis that lumber value increases when the saw pattern embodies partial knowledge of the internal defect structure was tested. Two methods for estimating the internal structure were evaluated: one used annual ring counts and the other used the definition of defect core. The former method was applied to pruned *Pseudotsuga menziesii* (Mirb.) Franco (Douglas-fir) logs from the United States and the latter to logs from New Zealand that, although they had diameters similar to the United States logs, were substantially younger, pruned much earlier, and had smaller defect cores. Digital models of the logs were constructed. External shape representations were based on direct log measurements. Internal defects were computer-generated for U.S. logs, whereas actual branch stub measurements were used for the New Zealand logs. The models were sawn in the AUTOSAW sawing simulator, and the resultant lumber was graded and priced. The sum of lumber prices established a value for each log. That value was compared with lower and upper bounds derived from parallel simulations based on volume-optimising and value-optimizing saw patterns, respectively. The lower bound assumed no a priori knowledge of internal defects, whereas the upper assumed full a priori knowledge. With the annual ring count method there was no significant difference in mean log value when compared to the lower bound; however, potential to increase value, demonstrated by the difference between lower and upper bounds was significant at 3 percent. With the defect core method, a significant increase of 5 percent was found and potential to increase value was nearly 11 percent.

Keywords: Pruned logs, nondestructive evaluation, clearwood, value.

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How does species name affect consumer choice? An analysis and implications for cabinet door marketers.

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