



United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station



Recent Publications of the Pacific Northwest Research Station, Fourth Quarter 2002



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January 2003

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Pacific Northwest Research Station Publications

The following publications may be ordered by using the form on the inside back cover. Circle the code number for the publication.

Bibliographies

02-329

Pacific Northwest Research Station
2002. Recent publications of the Pacific Northwest Research Station, third quarter 2002. Portland, OR: U.S. Department of Agriculture, Forest Service. 26 p.

Keywords: Bibliographies (forestry).

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/qlist.htm>.)

Biometrics

02-143

van Hees, W.W.S.
2002. A comparison of two estimates of standard error for a ratio-of-means estimator for a mapped-plot sample design in south-east Alaska. Res. Note PNW-RN-532. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 9 p.

Comparisons of estimated standard error for a ratio-of-means (ROM) estimator are presented for forest resource inventories conducted in south-east Alaska between 1995 and 2000. Estimated standard errors for the ROM were generated by using a traditional variance estimator and also approximated by bootstrap methods. Estimates of standard error generated by both traditional and bootstrap methods were similar. Percentage differences between the traditional and bootstrap estimates of standard error for productive forest

acres and for gross cubic foot growth were generally greater than respective differences for nonproductive forest acres, net cubic volume, or nonforest acres.

Keywords: Sampling, inventory (forest), error estimation.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Economics

02-051

Koteen, J.; Alexander, S.J.; Loomis, J.B.
2002. Evaluating benefits and costs of changes in water quality. Gen. Tech. Rep. PNW-GTR-548. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 32 p.

Changes in water quality can influence the benefits water users receive. It is not possible, however, to come up with one formal definition of water quality that fits all water uses. This paper examines six water quality parameters and their influence on six water uses. The water quality parameters include clarity, quantity, salinity, total suspended solids, temperature, and dissolved oxygen. Changes in these parameters are evaluated to determine values for municipal, agricultural, recreational, industrial, hydropower, and nonmarket uses of water. A variety of techniques can be used to estimate nonmarket values for changes in water quality, such as the travel cost method, the contingent valuation method, and the hedonic property method. The data collected on changes in water quantity per acre-foot and its effect on recreationists' benefits were analyzed by using multiple regression in a meta-analysis. Results from the regression were

used to analyze changes in consumer surplus for particular activities and uses for an additional acre-foot of water. Information in tables is included to provide empirical evidence as to how certain water quality parameters affect a particular use. The tables provide values from previous studies and the valuation techniques used in each study. From these values, we find mean values of changes in water quality and how these changes monetarily affect the use in question.

Keywords: Dissolved oxygen, instream flow, nonmarket values, recreation, salinity, water clarity, meta-analysis.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

01-105

McKeever, D.B.

2002. Domestic market activity in solid wood products in the United States, 1950-1998. Gen. Tech. Rep. PNW-GTR-524. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.

Solid wood is important to the construction, manufacturing, and shipping segments of the U.S. economy. Nearly all new houses are built of wood, and wood building products are used in the construction of nonresidential buildings and in the upkeep and improvement of existing structures. Solid wood is used extensively to produce and transport manufactured products. It also provides a renewable energy source for industrial, commercial, and residential applications. In 1998, 19.6 billion cubic feet, roundwood equivalent, of all timber products were consumed in the United States, down slightly from 1996, but considerably greater than in 1962. About 87 percent of this was for industrial products, and 13 percent for fuelwood. Excluding fuelwood, solid wood timber products accounted for about 67 percent of the industrial roundwood consumed, and pulpwood products accounted for about 33 percent. Large amounts of residues are generated in the production of solid wood products, about 10 to 15 percent of total industrial roundwood consumption. Thus, solid wood

products and pulpwood products each account for about half of the industrial roundwood consumed. This report examines solid wood timber products consumption in the United States over the past four and a half decades, relates changes in consumption to economic, social, and institutional factors during the period, and presents estimates of consumption in major end-use markets. Trends in timber products production, foreign trade, and domestic consumption over the past half century also are examined.

Keywords: Production, consumption, timber products consumption, wood use, fuelwood.

This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

01-316

Stevens, J.A.; Montgomery, C.A.

2002. Understanding the compatibility of multiple uses on forest land: a survey of multiresource research with application to the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-539. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 44 p.

This report describes multiresource research as it has coevolved with forest policy objectives—from managing for single or dominant forest uses, to managing for compatible multiple forest uses, to sustaining ecosystem health on the forest. The evolution of analytical methods for multiresource research is traced from impact analysis to multiresource modeling, and examples of true joint production of forest products, goods, and services are given. Empirical results from studies related to wood compatibility in the Pacific Northwest (PNW) are compiled. We found that: (1) in most cases, joint production research has been too specific or too theoretical to be directly applicable by land managers, (2) compatibility studies generally demonstrate compatibility between wood production and other uses, (3) increasing sophistication in modeling

methodologies and dramatically growing data describing interactions between forest uses will likely make future tradeoff analysis more realistic and useful, and (4) compatibility analysis can be useful for policy analysis by establishing standards of efficiency against which to evaluate policy alternatives.

Keywords: Multiple use, multiresource research, compatibility, joint production, production possibilities, tradeoff analysis, forest management, forest planning models.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

02-142

Warren, D.D.

2002. Harvest, employment, exports, and prices in Pacific Northwest Forests, 1965-2000. Gen. Tech. Rep. PNW-GTR-547. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 11 p.

This publication provides historical information on log harvest; employment in the forest industries; international trade in logs, lumber, and chips; and volume and average prices of sawtimber stumpage sold by national forests.

Keywords: Log harvest, employment (forest products industries), exports (forest products), and stumpage prices.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Fire

Wright, C.S.; Ottmar, R.D.; Vihnanek, R.E.; Weise, D.R.

2002. Stereo photo series for quantifying natural fuels: grassland, shrubland, woodland, and forest types in Hawaii. Gen. Tech. Rep. PNW-GTR-545. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 91 p.

Single and stereo photographs display a range of natural conditions and fuel loadings in grassland, shrubland, woodland, and forest types in Hawaii.

Each group of photos includes inventory information summarizing vegetation composition, structure, and loading, and as appropriate, woody material loading and various site characteristics. The natural fuels photo series is designed to help land managers appraise fuel and vegetation conditions in natural settings.

Keywords: Hawaii, biomass, fuel loading, natural fuels.

(To order this publication, write to Clint Wright, Forestry Sciences Laboratory, 400 North 34th St., Suite 201, Seattle, WA 98103 or email him at cwright@fs.fed.us)

Forest Management

01-075

Graham, A.C.; Kruger, L.E.

2002. Research in adaptive management: working relations and the research process. Res. Pap. PNW-RP-538. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 55 p.

This study uses a multimethod approach to study conceptions of working relations and the research process among a small group of USDA Forest Service scientists participating in efforts to implement adaptive management. This study addresses the degree to which practices and perspectives of key adaptive management participants reflect an orientation conducive to adaptive management. Scientists ranged from highly collaborative to relatively independent in their orientations toward working with others, particularly nonscientists. Scientists also displayed wide variation in perceptions of science, from science as an open-ended, value-laden process to more traditional views of science as objective and oriented toward ascertaining conclusive truth. A major implication suggested by this study is that a holistic and collaborative orientation among leading science participants in adaptive management seems to be a necessary but insufficient condition for

social learning and the fulfillment of adaptive management objectives. Recommendations are made for future adaptive management efforts, and propositions for further study are suggested.

Keywords: Adaptive management, social learning, collaboration, integration, working relations, research process, natural resources.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw>)

02-171

Rapp, V.

2002. Fire risk in east-side forests. Science Update 2. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 11 p.

Wildfire was a natural part of east-side ecosystems before the 20th century. The fire regimes, or characteristic patterns of fire—how often, how hot, how big, what time of year—helped to create and maintain different types of forests. Forests are dynamic, and fire interacts with other ecological processes. These disturbance regimes are being closely studied by scientists from the USDA Forest Service, Pacific Northwest Research Station and other institutions. Over the past century, land use and management practices have changed disturbance regimes in east-side forests, particularly in dry, low-elevation forests that were historically dominated by large, widely spaced ponderosa pines. Now, in the 21st century, the extent of high-severity fire regimes exceeds that of low-severity fire regimes in east-side forests. The forests that are most likely to have changed from low-severity to high-severity regimes are the forests near human communities. Fires can pose risks to people and their communities, even though those fires may be a natural part of the ecosystem in which those

people happen to live. A variety of passive and active restoration options can be used to manage—but not eliminate—risk. Scientists can offer some information about the outcomes of these choices.

Keywords: Fire risk, east-side forests, wildfire, fire regimes, disturbance regimes.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw>)

Range Management

02-048

Bunting, S.C.; Kingery, J.L.; Hemstrom, M.A. [and others]

2002. Altered rangeland ecosystems in the interior Columbia basin. Gen. Tech. Rep. PNW-GTR-553. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 71 p. (Quigley, T.M., ed.; Interior Columbia Basin Ecosystem Management Project: scientific assessment).

A workshop was held to address specific questions related to altered rangeland ecosystems within the interior Columbia basin. Focus was primarily on public lands administered by the USDA Forest Service and USDI Bureau of Land Management. Altered ecosystems were considered to be those where human-induced or natural disturbances are of sufficient magnitude to affect ecosystem processes, causing long-term loss or displacement of native community types and loss of productivity, making it difficult or impossible to restore these ecosystems to historical conditions. Seventeen rangeland potential vegetation types (PVT) were identified by the Interior Columbia Basin Ecosystem Management Project and briefly described. Reasons that rangeland ecosystems are altered include presence of invasive species, uncharacteristic grazing effects, climatic change, change in fire regime, and other factors related to human presence. However, primary causes of alteration and restoration potential differ among PVTs.

Some altered rangeland ecosystems may be restored by stabilizing ecosystem processes, restoring native plant communities, reducing the spread of invasive species, or conserving existing biota. In some altered conditions, these options have a relatively high probability of success over the short term with low to moderate cost at the site scale. However, in other altered areas, restoration options are expensive, have a low probability of success, and require long time-frames. Restoration of rangeland PVTs is also necessary for the survival of some animal species whose populations are in decline, such as the Columbia sharp-tailed grouse and greater sage grouse.

Keywords: Altered rangelands, Columbia sharp-tailed grouse, greater sage grouse, restoration, potential vegetation types, rangeland ecosystems.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Regional Assessments

02-009

Diaz, N.M.; Haynes, R.W.

2002. Highlights of science contributions to implementing the Northwest Forest Plan—1994 to 1998. Gen. Tech. Rep. PNW-GTR-540. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p.

During 5 years of research (1994-98) in support of the Northwest Forest Plan (NWFP), Pacific Northwest Research Station scientists and their collaborators have made significant progress in both validating some of the NWFP's major assumptions and providing research that sets the stage for further evolution of the plan. Studies have provided new information in the areas of wildlife conservation and population viability, aquatic conservation measures, adaptive management, the socioeconomic dimension, ecological processes and functions, landscape-scale issues, and stand-development strategies. A key

theme in the findings is the need for NWFP implementation and research efforts to increasingly address the significant ecological variation throughout the region, the dynamic nature of our forest ecosystems, the need to integrate information across science disciplines, and the benefits of managing adaptively.

Keywords: Northwest Forest Plan, ecosystem management, conservation, land management, alternative silviculture, landscape ecology, adaptive management.

This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Silviculture

01-106

Curtis, R.O.; Marshall, D.D.

2002. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 14—Stampede Creek: 30-year results. Res. Pap. PNW-RP-543. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 77 p.

Results of the Stampede Creek installation of the levels-of-growing-stock (LOGS) study in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) are summarized. To age 63 (planned completion of 60 feet of height growth), volume growth on the site III natural stand has been strongly related to levels of growing stock, but basal area growth-growing stock relations were considerably weaker. Marked differences in tree size distributions have resulted from thinning. Periodic annual volume increments at age 63 are still two to three times greater than mean annual increment; this stand is still far from culmination. Results of this southwest Oregon installation are generally similar to those reported from other LOGS installations, although development has been slower than on the site II installations that make up the majority of the series.

Keywords: Thinning, growing stock, growth and yield, stand density, Douglas-fir, Pseudotsuga menziesii, series—Douglas-fir LOGS.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw>.)

02-040

DeBell, D.S.; Harrington, C.A.; Shumway, J.
2002. Thinning shock and response to fertilizer less than expected in young Douglas-fir stand at Wind River Experimental Forest. Res. Pap. PNW-RP-547. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 20 p.

Three thinning treatments (thinned to 3.7 m x 3.7 m, thinned to 4.3 m x 4.3 m, and an unthinned control treatment with nominal spacing averaging 2.6 m x 2.6 m) were installed in a 10-year-old Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) plantation growing on a low-quality site at Wind River Experimental Forest in southwest Washington. Two years after thinning, two fertilizer treatments were superimposed on the design (0 nitrogen and 224 kg nitrogen per hectare applied as ammonium nitrate). Diameter growth increased with increasing spacing throughout the 6-year study period, and it was increased by fertilizer in the thinning and the control treatments. Height growth was initially reduced slightly by thinning, but by the third 2-year period after thinning, height growth in thinned, unfertilized treatments was equal to or greater than height growth in the unthinned, unfertilized treatment. Fertilizer increased height growth an average of 13 percent in the first 2 years. The mild, ephemeral nature of thinning shock in our study as contrasted with severe, long-lasting shock in earlier studies nearby could have been caused by use of maladapted seed sources in the earlier studies. The less dramatic response to fertilization in this trial compared to others in the area may have been the result of better-adapted seed source on an area with less severe fire history.

Keywords: Thinning, thinning stock, fertilization, nitrogen, seed source, fire, Wind River.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

02-107

Parker, S.; Hummel, S.S., comps.
2002. Beyond 2001: a silvicultural odyssey to sustaining terrestrial and aquatic ecosystems. Gen. Tech. Rep. PNW-GTR-546. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 114 p.

The 2001 National Silviculture Workshop was held in Hood River, Oregon, and hosted by the Mount Hood National Forest, the Gifford Pinchot National Forest, and the Pacific Northwest Research Station. This biennial workshop began in 1973 in Marquette, Michigan. The general purpose of the workshop is to provide a forum for scientists and land managers to exchange ideas and information and to develop opportunities for future collaboration. The 2001 workshop focused on the role of silviculture in supporting wildlife habitat and riparian management objectives. This document contains the papers that were offered at the 2001 workshop and are grouped according to four themes: wildlife, vegetation, aquatic systems, and social systems.

Keywords: Silviculture, wildlife, vegetation, aquatic systems, social systems.

This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Social Sciences

02-152

Donoghue, E.M.; Haynes, R.W.
2002. Assessing the viability and adaptability of Oregon communities. Gen. Tech. Rep. PNW-GTR-549. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 13 p.

This work responds to the need to assess progress toward sustainable forest management as established by the Montréal Process Criteria and Indicators. The focus is on a single indicator (commonly referred to as Indicator 46) that

addresses the “viability and adaptability to changing economic conditions, of forest-dependent communities, including indigenous communities.” Communities in Oregon were assessed in terms of their connectivity to service centers, socioeconomic well-being, and proximity to public lands. Fifty-four communities rated relatively low in these combined characteristics and were considered less adaptable to changing socioeconomic conditions.

Keywords: Community resiliency, criteria and indicators, forest dependency, Montréal Process, socioeconomic well-being, sustainable forest management.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

02-043

Elmer, D.M.; Christensen, H.H.; Donoghue, E.M., comps.

2002. Understanding the links between ecosystem health and social system well-being: an annotated bibliography. Gen. Tech. Rep. PNW-GTR-559. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 47 p.

This bibliography focuses on the links between social system well-being and ecosystem health. It is intended for public land managers and scientists and students of social and natural sciences. Multidisciplinary science that addresses the interconnections between the social system and the ecosystem is presented. Some of the themes and strategies presented are policy and management processes, ecosystem management, conceptual approaches, sociocultural processes, ethics, economic perspectives

and analysis, methods and indicators for assessment, and environment-human interactions. This bibliography identifies the contributions toward understanding the links between ecosystems and social systems made by historically disparate disciplines.

Keywords: Ecosystem health, social system well-being, sustainability, natural resources, human ecology, environment-human interactions, links, interconnections, economics, ecosystem management, social values, ethics, indicators, methods.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

02-055

Moseley, C.

2002. A survey of innovative contracting for quality jobs and ecosystem management. Gen. Tech. Rep. PNW-GTR-552. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 36 p.

This survey identifies and defines innovative contracting mechanisms developed in the USDA Forest Service Pacific Northwest Region and northern California. A survey of nine case studies reveals that several new mechanisms have facilitated ecosystem management, quality jobs, and administrative efficiencies, but at times innovation was hampered by Forest Service institutional structures and downsizing.

Keywords: Contracting, stewardship, innovation, workforce development, economic development, ecosystem management, Pacific Northwest, rural communities.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

01-324

Kakoyannis, C.; Stankey, G.H.

2002. Assessing and evaluating recreational uses of water resources: implications for an integrated management framework. Gen. Tech. Rep. PNW-GTR-536. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 59 p.

An understanding of human uses and values for water is necessary for resolving conflicts over the variety of competing demands on the water resource. We explore how water-based recreation affects and is in turn affected by the water regime and water management, including how key social trends might influence water-based recreation in the future. Our review found that although water is a critical component of many recreational experiences, our lack of understanding of current and anticipated water-based recreation use trends hampers our ability to effectively manage for recreation. Furthermore, certain key drivers of social change, including population growth and migration, will likely greatly alter future recreation trends in the Pacific Northwest. Our examination found that changes to the water resource, such as altered flow regimes, will have important consequences for the availability and quality of recreation opportunities. Although there are a variety of conflicts among recreationists and between recreation and other uses of water, we have a limited understanding of how to successfully resolve

them. Effective management will require examining the links between recreational opportunities and water management so as to minimize negative impacts to both recreation and the water regime.

Keywords: Recreation, water management, demographics.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Wildlife

01-173

Lance, E.W.

2002. Montague Island marmot: a conservation assessment. [Gen. Tech. Rep.] PNW-GTR-541. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

The hoary marmot from Montague Island, south-central Alaska, was classified as a distinct subspecies based on smaller size and skull characteristics relative to other island and mainland populations. The taxonomic validity of the Montague Island marmot (*Marmota caligata sheldoni*) is questionable as conclusions were based on the analysis of no more than eight specimens. With the exception of one relatively recent sight record, Montague Island marmots have not been reported or collected since the early 1900s. A conservation concern exists, particularly owing to the unknown population status and questionable taxonomy of this island endemic subspecies that may be negatively affected by land management practices.

Keywords: Hoary marmots, Marmota caligata sheldoni, island endemics, Montague Island, Montague Island marmot, taxonomy.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

01-174

Lance, E.W.

2002. Montague Island vole: a conservation assessment. [Gen. Tech. Rep.] PNW-GTR-542. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 14 p.

Montague Island tundra voles were first described in the early 1900s. Based on their large size and dark coloration relative to other island and mainland populations, tundra voles from Montague Island were classified as a distinct subspecies. Research conducted in the 1990s detected significant differences in the size and shape of Montague Island voles, but not significant genetic differentiation. Montague Island voles seemed abundant in the 1990s, although there was no attempt to estimate population size. Concern remains that Montague Island voles are reproductively and therefore genetically isolated. More sensitive genetic techniques can now be used to test genetic distinctiveness across populations. A conservation concern exists owing to the unknown population status and still questionable taxonomy of this island endemic subspecies. It is unknown if land management practices affect this isolated population.

Keywords: Tundra vole, island endemics, Microtus oeconomus elymocetes, Montague Island, Montague Island vole, taxonomy.

(This publication is available to download in pdf at <http://www.fs.fed.us/pnw/pubs.htm>.)

Publications Available Elsewhere

The following publications are available through interlibrary loan, by writing to the locations indicated, or by using the form indicated.

Aquatic and Riparian Systems

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

2001. Ten years of vegetation succession on a debris-flow deposit in Oregon. *Journal of the American Water Resources Association*. 37(6): 1693-1708.

We tracked vegetation succession on a debris-flow deposit in Oregon's Coast Range to examine factors influencing the development of riparian plant communities following disturbance. Our results suggest that successional patterns were influenced by substrate variability, species composition of initial colonizers, propagule sources and their distribution, and species life-history traits such as growth rate, competitive ability, and shade tolerance.

Keywords: Riparian vegetation, disturbance, succession, debris flow.

(See Corvallis order form.)

Rieman, B.; Peterson, J.T.; Clayton, J. [and others]

2001. Evaluation of potential effects of federal land management alternatives on trends of salmonids and their habitats in the interior Columbia River basin. *Forest Ecology and Management*. 153: 43-62.

We studied salmonid fishes and their habitats as indicators of conditions in aquatic ecosystems and used Bayesian belief networks as a formal, quantitative framework to address the issues of land management alternatives proposed for the interior Columbia River basin. Because empirical information is limited at the scales relevant to our analysis, an ability to combine both empirical and more subjective information was key to the analysis. We constructed two general networks. One represented the influence of landscape characteristics and existing and predicted management activities on aquatic habitats. A second represented the influence of habitat,

existing biotic conditions, and ocean and migratory conditions for two anadromous species on the status of six widely distributed salmonid fishes. In the long term, all three land management alternatives were expected to produce positive changes in the status and distribution of the salmonids and their habitats. Trends were stronger for habitat than for the status of salmonids because of greater uncertainty in linking the fish and habitat networks and constraints outside spawning and rearing habitat on federal lands in the study area. Trends were stronger for resident salmonids than for anadromous forms because of additional effects of the migratory corridor assumed for the latter. The alternative that approached ecosystem restoration more conservatively generally produced the strongest positive change, and the alternative designed to promote more aggressive restoration, the weakest. Averaged across the basin, differences among the alternatives were small. Differences were greater at finer temporal and spatial scales. By formalizing our understanding and assumptions in these networks, we provided a framework for exploring differences in the management alternatives that is more quantifiable, spatially explicit, and flexible than previous approaches.

Keywords: Bayesian belief networks, fish, salmon, trout, Columbia River basin, aquatic habitat.

(See La Grande order form.)

Atmosphere

Ferguson, S.A.

2001. Climatic variability in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 62-69.

Climate is a driving factor in forest health and productivity that limits species survival and productivity and affects disturbance processes. Complex topography and mosaics of land cover

compound the variability of climate in eastern Oregon and Washington. The area is a transition zone between marine, arctic, and continental influences with associated extremes in weather. Such extremes affect insect populations, animal migration, streamflow, flooding, and wildfire potential. Additionally, human activities such as deforestation and atmospheric pollution interact with climate and may cause changes similar in magnitude to the glacial-interglacial epoch in the next 50 to 100 years. Effects of anthropogenic climate changes are ambiguous, however, and could counterbalance each other. For example, tree populations may have more difficulty reestablishing, but growth rates could accelerate. Conversely, management actions can mitigate the effect of climate on fisheries, water resources, wildfire, and floods. Management actions can affect climate by modifying carbon exchange and water and energy exchange between land and atmosphere. Models are increasingly able to predict climate variability and trends in climate-related disturbances such as wildfire.

Keywords: Climate, disturbance processes, land management.

(See Seattle order form.)

Economics

Alexander, S.J.

2001. Who, what, and why: the products, their uses, and issues about management of non-timber forest products in the United States. In: Davidson-Hunt, I.; Duchesne, L.C.; Zasada, J.C., eds. *Forest communities in the third millennium: linking research, business, and policy toward a sustainable non-timber forest product sector—Proceedings of a meeting held October 1-4, 1999, Kenora, Ontario, Canada*. Gen. Tech. Rep. NC-217. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 18-22.

Nontimber forest products in the United States include floral greens, Christmas ornamentals, wild edibles, medicinals, crafts, and transplants. People harvest products from forests for personal use, cultural practices, and sale. The tremendous variety of species harvested for the many

markets stands in stark contrast to our poor knowledge of the biology, prices, or responses to harvest and habitat change for most of the species. The diversity of species harvested, lack of knowledge about the plants or their uses, and inadequate institutions to ensure sustainable harvesting complicate policymaking and law enforcement.

Keywords: Nontimber forest products, forest policy.

(See Corvallis order form. To order a copy of the complete proceedings, write to North Central Distribution, One Gifford Pinchot Drive, Madison, WI 53705. Quantities are limited.)

Haynes, R.; Fight, R.; Lowell, E. [and others] 2001. Economic aspects of thinning and harvest for forest health improvement in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 199-207.

Management activities that affect forest health and productivity are driven by social, political, and economic processes. Economic feasibility is important in determining the extent to which various treatments proposed to improve forest health will actually be applied. Three socioeconomic institutions create incentives that are important determinants: markets, land uses, and the processing industry. We have extensive information on timber markets, and land uses have been studied at broad scales. Thinning undertaken for forest health improvement provides mostly small-diameter and dead material, but markets for products from small and dead logs are limited. Harvesting and manufacturing costs, resource characteristics, and lumber prices influence the way timber is processed (i.e., what products are made); design of timber sales (i.e., amount and size of raw materials offered) influences harvest cost. Processing equipment that scans logs and processes them according to shape can greatly improve product yield. Decision tools that incorporate these factors into financial evaluations can assist in harvest and other treatment decisions.

Keywords: Economics, forest management, forest health and productivity.

(See Portland order form.)

Ecosystem Structure and Function

Cohen, W.

2000. "BigFoot" blazes trails for LTER remote sensing. LTER Network News. 13(1): [Not paged].

The moderate-resolution imaging spectrometer will play an important role in measuring and monitoring surface variables. Validation of these global data products is crucial for establishing the accuracy of the data products for the scientific user community and to provide feedback for improving the data processing algorithms.

Keywords: Carbon cycling.

(See Corvallis order form.)

Janisch, J.E.

2001. Carbon storage in a Pacific Northwest conifer forest ecosystem: a chronosequence approach. Corvallis, OR: Oregon State University. 170 p. Ph.D. dissertation.

Evergreen-dominated forests of the Pacific Northwest attain some of the highest carbon storage of any terrestrial ecosystem. The impacts of stand-destroying disturbance, such as wildfire and clearcutting, on carbon flux and stores in these forests over time, however, are disputed. To better understand these impacts, I pursued three objectives: (1) empirically derive estimates of log, stump, and belowground coarse root decomposition (k) rates; (2) empirically derive estimates of live tree bole net primary productivity rates; and (3) investigate successional change in net ecosystem productivity following harvest of 400- to 600-year-old trees by clearcut logging and wildfire.

Keywords: Carbon cycling, old-growth forest, decomposition.

(Available only through library or interlibrary loan.)

Kiester, A.R.

2001. Species diversity, overview. Encyclopedia of Biodiversity. New York: Academic Press: 441-451. Vol. 5

There are several ways to think about and measure species diversity. The most basic idea is that of species richness, which is simply a count of the number of species inhabiting a given

area or habitat. Species richness may be further classified by abundance, size, or ecological role. Measures of species diversity link to many ecological processes such as population dynamics and competition, evolutionary processes such as adaptive radiation and the evolution of phenotypic plasticity, and communities and biomes. Because species diversity is relatively easy to measure and is understandable by many people, it is an important policy tool. Conservation programs and goals are often cast in terms of the number of species that might be protected by a given action.

Keywords: Species diversity.

(See Corvallis order form.)

Peterson, D.W.; Peterson, D.L.; Ettl, G.J.

2002. Growth responses of subalpine fir to climatic variability in the Pacific Northwest. Canadian Journal of Forest Research. 32: 1503-1517.

We studied regional variation in growth-limiting factors and responses to climatic variability in subalpine forests by analyzing growth patterns for 28 tree-ring growth chronologies from subalpine fir (*Abies lasiocarpa*) stands in the Cascades Range and the Olympic Mountains in Oregon and Washington. Factor analysis identified four distinct time series of common growth patterns; the dominant growth pattern at any site varied with annual precipitation and temperature (elevation). Throughout much of the region, growth is negatively correlated with winter precipitation and spring snowpack depth, indicating that growth is limited primarily by short growing seasons. On the driest and warmest sites, growth is negatively correlated with previous summer temperature, suggesting that low summer soil moisture limits growth. Growth patterns in two regions were sensitive to climatic variability associated with the Pacific Decadal Oscillation, apparently responding to low-frequency variation in spring snowpack and summer soil moisture. This regional-scale analysis shows that subalpine fir growth in the Cascades and Olympics is limited by different climatic factors in different subregional climates. Climate-growth relations are similar to those for a

co-occurring species, mountain hemlock (*Tsuga mertensiana*), suggesting broad biogeographic patterns of response to climatic variability and change by subalpine forest ecosystems in the Pacific Northwest.

Keywords: Subalpine fir, Abies lasiocarpa, climate variability, dendroecology, dendrochronology, radial growth, subalpine forests.

(See Wenatchee order form.)

Fire

Camp, A.E.

2000. A sustainable alternative to administrative set-asides for providing late-successional forest habitat in fire-regulated landscapes. In: Proceedings of the management of fire maintained ecosystems workshop. [Victoria, BC: The British Columbia Forest Service and the Forestry Continuing Studies Network]: 21-23.

Prior to the European settlement of the inland West, the dominant disturbance regime consisted of frequent, low-severity fires that maintained open stands of early successional tree species over much of the landscape. Areas that burned less frequently than the surrounding matrix may be thought of as "fire refugia." These areas were able to progress farther along successional trajectories and supported denser, multicanopy stands consisting of a mix of species, some of which were shade tolerant, but not tolerant of fire. Current management goals of increasing amounts and connectivity of late-successional habitat put entire landscapes at risk to insects, diseases, and catastrophic fire. An alternative strategy to setting aside large, late-successional reserves is to dynamically incorporate such habitat in areas where it occurred historically. Research conducted on the eastern slopes of the Cascade Range in Washington indicates that historical fire refugia were associated with and can be predicted from various combinations of physiographic and topographic variables. Locations of historical fire

refugia provide managers with a template for sustainably incorporating late-successional habitat in fire-related landscapes.

Keywords: Fire refugia, fire-regulated landscape.

(See Wenatchee order form.)

Ottmar, R.D.; Vihnanek, R.E.; Regelbrugge, J.C. 2000. Stereo photo series for quantifying natural fuels. Volume IV: pinyon-juniper, chaparral, and sagebrush types in the Southwestern United States. PMS 833. Boise, ID: National Wildfire Coordinating Group, National Interagency Fire Center. 97 p.

Three series of single and stereo photographs display a range of natural conditions and fuel loadings in pinyon-juniper, chaparral, and sagebrush types in the Southwestern United States. Each group of photos includes inventory information summarizing vegetation composition, structure and loading, and as appropriate, woody material loading and density by size class, forest floor depth and loading, and various site characteristics. The natural fuel photo series is designed to help managers appraise fuel and vegetation conditions in natural settings.

Keywords: Woody material, biomass, fuel loading, natural fuels, pinyon-juniper, pinyon pine, Pinus edulis, Pinus monophylla, juniper, Juniperus monosperma, Juniperus osteosperma, sagebrush, Artemisia, chaparral, coastal sage scrub.

(Available from the National Interagency Fire Center, Bureau of Land Management, 3833 S Development Avenue, Boise, ID 83705. Orders are taken by mail or fax request at (208) 387-5573. The cost for this volume is \$27.53.)

Sandberg, D.V.; Ottmar, R.D.; Cushon, G.H.
2001. Characterizing fuels in the 21st century.
International Journal of Wildland Fire. 10:
381-387.

This paper is an introduction to the characterization of wildland fuelbeds for the purposes of predicting and assessing fire behavior and fire effects, for mapping fire hazard and potential fire effects, and for inferring fuelbed properties from remote sensing or ecological modeling. We present the initial design of a system of fuel characteristic classes (FCCs), suggestions for changes in the design, and ways to generate data and implement the system. Our objective in designing FCCs is to provide fuel managers with a nationally consistent and long-lasting system to classify fuelbeds and to provide numerical inputs to fire behavior, fire effects, and dynamic vegetation models.

Keywords: Wildland fire, prescribed fire, fuels, fuelbeds, fire management, fuel treatment, carbon balance, fire behavior, fuel models, biomass emissions, smoke management.

(See Corvallis order form.)

Fish

Fox, M.J.

2001. A new look at the quantities and volumes of in-stream wood in forested basins within Washington state. Seattle, WA: University of Washington. 232 p. M.S. thesis.

The most consistent predictors of wood volumes and quantities are bankfull width (as a function of basin size) and ecoregion. Wood quantity, volume, and mean piece size increased with channel size due to the increased proclivity for fluvial transport and spatial accretion, along with greater lateral area for wood to accumulate. Forest stand characteristics such as stem density and diameter are influenced by distinctive climates particular to each ecoregion, which in turn influence the size and quantity of instream wood. Percentile distributions describe the range of wood quantities and volumes in streams

draining unmanaged basins by discrete bankfull width classes for three distinguishable ecoregion groups. The data also support expanded definitions for minimum volumes of key pieces.

Because both favorable and adverse conditions contributed to wood loading ranges, I suggest that the 75th percentiles in each bankfull width class and ecoregion be used to represent the lower limit for optimum wood quantities and volumes as an index of habitat quality.

Keywords: Large woody debris, stream habitat, Washington state.

(Available only through library or interlibrary loan.)

Howell, P.J.

2001. Effects of disturbance and management of forest health on fish and fish habitat in eastern Oregon and Washington. Northwest Science. 75(Special issue): 157-165.

Effects of fire, forest insects and diseases, grazing, and forest health treatments on fish populations and habitat are reviewed. Fire, insects, and disease affect woody debris recruitment to streams, canopy cover and water temperature, stream flow, channel erosion, sedimentation, nutrients, and residual vegetation. Effects from fire vary depending on fire severity and extent, geology, soil, topography and orientation of the site, and precipitation. Most effects moderate within a decade. Erosion and wood recruitment also are influenced by fire lines, road construction, and timber harvest. Although some disturbance effects (severe fire and subsequent floods) appear catastrophic and may last centuries, natural disturbances help create and maintain diverse, productive aquatic habitats. Return of fish populations following wildfires can be rapid depending on local refugia, life history patterns, access for migrants, and species distribution. Although there is little documentation, restoration of the structure, function, and processes of watersheds more

similar to those to which native species evolved may favor those species. Risk from thinning may be minimized by conserving key habitats and populations, focusing intensive treatments on upland sites. Low-impact logging systems and pulsed treatments consistent with natural disturbance regimes may help.

Keywords: Fish habitat, species of concern, salmonids, disturbance processes, forest management, exotic fishes.

(See La Grande order form.)

Forest Management

McCool, S.F.; Stankey, G.

2001. Representing the future: a framework for evaluating the utility of indicators in the search for sustainable forest management. In: Raison, R.J.; Brown, A.G.; Flinn, D.W., eds. Criteria and indicators for sustainable forest management. New York: CABI Publishing: 93-105. Chapter 6.

We explore three questions critical to the selection of appropriate and suitable indicators of sustainable forest management (SFM). First, we examine the character of sustainability and SFM. Second, we propose the types of institutional changes needed for a more effective pursuit of SFM and the selection of relevant, appropriate, and suitable indicators. Finally, we propose a set of tests for evaluating the usefulness of criteria and indicators of SFM for the individual forest unit level.

Keywords: Sustainability, forest management, criteria and indicators.

(Available in bookstores and libraries.)

McIver, J.D.; Starr, L.

2001. A literature review on the environmental effects of postfire logging. *Western Journal of Applied Forestry*. 16(4): 159-168.

Literature on logging after wildfire is reviewed, with a focus on environmental effects of logging activity and the removal of large woody structure. As in unburned stands, log retrieval systems differ considerably in their immediate effects on

soils in the postfire environment, with ground-based systems generally causing more disturbance than aerial systems. Recovery methods used by managers can mitigate erosion effects. Ground disturbance from postfire logging can encourage establishment of different plant species (including nonnative) and can influence the growth of trees. The removal of large woody structure typical in postfire logging operations can change plant species composition, reduce plant species richness, and increase conifer growth in the first years after logging but can also reduce the probability that insect pest populations will build up and infest adjacent stands. Removal of large woody structure can cause declines in the abundance of several cavity-nesting species. Overall, studies on the environmental effects of postfire logging are limited, arguing for the use of adaptive management to monitor effects of logging and to adjust practices accordingly.

Keywords: Postfire logging, salvage harvest, fuel, down wood, wildlife habitat, recovery, hydrology, wildfire, habitat structure.

(See La Grande order form.)

Genetics

Sorensen, F.C.

2001. Effect of population outcrossing rate on inbreeding depression in *Pinus contorta* var. *murrayana* seedlings. *Scandinavian Journal of Forest Research*. 16: 391-403.

Self and cross families from marginal and nonmarginal populations were grown 2 years in the nursery. Selfing decreased means of size traits and increased within-family variance. These effects were smaller, particularly for variance, in the marginal population. Increased natural selfing in the marginal population had apparently purged severely deleterious alleles affecting survival and vigor, which somewhat mitigated the negative effect of increased inbreeding in the marginal populations.

Keywords: Deleterious alleles, family variances, inbreeding, lodgepole pine, purging, selfing.

(See Corvallis order form.)

Sorensen, F.C.

2002. Effect of leader clipping on height growth of young coastal Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*). *Western Journal of Applied Forestry*. 17(2): 75-77.

Leaders of 3- to 7-year-old Douglas-fir seedlings were left unclipped or were clipped for 1 to 4 consecutive years. Response to clipping was significantly linear and was about 30 percent (19 cm) per year clipped. All treatments had equal elongation in the 4 years after clipping, and the initial depressing effect on height was still present at age 23. Effect of damage on variance in genetic tests is discussed.

Keywords: Height and diameter growth, animal damage.

(See Corvallis order form.)

Geomorphology and Hydrology

Wondzell, S.M.

2001. The influence of forest health and protection treatments on erosion and stream sedimentation in forested watersheds of eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 128-140.

A variety of treatments have been proposed to reduce long-term risks to forests from wildfire, insects, and disease. I examine the potential effects of these treatments on sediment production, channel forming processes, riparian vegetation, and risks to riparian zones. Wildfires can affect upland erosion; erosion from prescribed fires burning the same area should be much less. Dense riparian vegetation may help regulate the amount of sediment reaching streams, depending on the geomorphic setting. Forest pathogens are not expected to accelerate erosion and stream sedimentation directly, but indirect effects might be substantial if they lead to increased wildfire. The largest risk of erosion is expected from ground-disturbing activities during fuel treatments, such as building roads

and firebreaks or salvage logging or thinning. Intense grazing has changed riparian vegetation, leading to bank erosion and widening or incision of stream channels. Improved grazing methods can result in major changes to riparian vegetation, but response of channel morphology will likely be slow. Most studies reviewed were at the site or small-watershed scale, but cumulative effects across a large region are difficult to assess. With current knowledge, dramatically changing forest practices across eastern Oregon and Washington—such as widespread use of prescribed fires, salvage logging, and mechanical fuel treatments—provide a long-term, landscape-scale experiment, and cumulative effects are unknown.

Keywords: Erosion, stream sedimentation, disturbance processes, forest management, forest health and productivity.

(See Olympia order form.)

Harvesting

Camp, A.

2002. Damage to residual trees by four mechanized harvest systems operating in small-diameter, mixed-conifer forests on steep slopes in northeastern Washington: a case study. *Western Journal of Applied Forestry*. 17(1): 14-22.

Trees marked for retention and trees left on site as unmerchantable in four harvest units, each thinned to 20-foot spacing by using different harvesting technologies, were surveyed for damage prior to and following commercial thinning. Criteria analyzed included the overall incidence of wounds, incidence of wounds of different sizes and severity classes, and wound location. Each of the four systems tested performed better for some criteria than others. In general, cut-to-length processing caused less

damage to the residual stand than did whole-tree harvest; skyline yarding was less damaging than forwarder yarding. Some of the damage incurred may have been a function of the silvicultural prescription and the season of harvest. Appropriate silvicultural prescriptions and harvesting technologies can be used to limit wounding to acceptable levels.

Keywords: Small-timber harvesting, cable yarding, cut-to-length, lodgepole pine, western larch, tree wounding, commercial thinning.

(See Wenatchee order form.)

Heninger, R.; Scott, W.; Dobkowski, A.
[and others]

2002. Soil disturbance and 10-year growth response of coast Douglas-fir on nontilled and tilled skid trails in the Oregon Cascades. *Canadian Journal of Forest Research*. 32: 233-246.

Yarding at eight clearcuts was executed with tracked and rubber-tired skidders on both wet and dry soils. Douglas-fir seedlings were hand planted within four treatment areas: in skid ruts in either nontilled or tilled trails, in adjacent soil berms, and in adjacent areas with minimal or no soil disturbance. Mean height growth on nontilled trails averaged 24 percent less than logged-only areas in year 4 after planting and decreased to 6 percent less in year 7. Ten years after planting, trees in skid-trail ruts averaged 4 percent more survival but 10 percent less total height and 29 percent less volume than those on logged-only plots. Tillage improved tree height and volume growth to equal that on logged-only areas.

Keywords: Soil disturbance, bulk density, Douglas-fir, height and volume growth.

(See Olympia order form.)

Invasive Plants and Animals

Harrod, R.J.

2001. The effect of invasive and noxious plants on land management in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 85-90.

A key issue for forest and rangeland health and productivity in eastern Oregon and Washington is the effect that invasive species have on ecosystems. Although some exotic plant introductions were accidental, many were intentional for wildlife habitat improvement, ornamental purposes, wood or fiber production, soil conservation, livestock forage production, or other crop uses. Exotic species, or weeds, can be significant components of global environmental change because of their potential to alter primary productivity, decomposition, hydrology, nutrient cycling, and natural disturbance regimes. At smaller scales, they alter the structure, composition, and successional pathways of ecosystems. They lower diversity by outcompeting native plants. Disturbance caused by forest restoration activities (thinning and prescribed fire) can promote weed spread, but ultimately will improve native plant diversity and productivity, improving ecosystem resistance to weed invasion. Restoration strategies need to include consideration of weed prevention and control and restoration of native species. Prevention includes restoring ecosystem processes; control includes biological, manual, mechanical, herbicidal, and prescribed burning methods; restoration involves returning native plants to a site. Monitoring is important to provide managers with information that will allow them to evaluate restoration activities and modify ineffective restoration approaches.

Keywords: Nonnative invasive plants, noxious weeds, disturbances processes, forest management, forest health and productivity.

(See Wenatchee order form.)

Hayes, J.L.; Ragenovich, I.

2001. Non-native invasive forest insects of eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 77-84.

An increasing number of nonnative insects are reaching our ports and beyond as a result of global trade or from other regions of the United States. Historically the forests east of the Cascade Range have had few serious invaders, but there is growing concern over the increased potential for invasion. Species may become established and inflict substantial damage before eradication or mitigation measures can be identified and implemented. In general, treatments and practices that improve forest health reduce the risk of outbreaks of indigenous species; however, this premise is unsupported for nonnative invasive insects. Prevention and suppression efforts include investigating potential invaders and pathways of introduction, developing detection and monitoring strategies, and aggressive eradication efforts, as well as regulatory restrictions. Management strategies will likely differ for each potential invader. Examples of east-side invaders include larch casebearer, successfully controlled by introduced parasitoids; the gypsy moth—both Asian and European strains—that has thus far been prevented from establishing in the Pacific Northwest through diligent surveillance and immediate eradication efforts; and the balsam woolly adelgid, a sap-feeding insect that appears to be increasing without an immediate solution. A number of introduced woodboring insects also have been discovered in Oregon and Washington.

Keywords: Nonnative invasive insects, disturbance processes, forest management, forest health and productivity.

(See La Grande order form.)

Invertebrates

Torgersen, T.R.

2001. Defoliators in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 11-20.

Information on the four main defoliators of conifers in eastern Oregon and Washington is abundant. Because of concerns about growth suppression and mortality of trees during widespread defoliator outbreaks, much research effort has been focused on these species. They are western spruce budworm, Douglas-fir tussock moth, Pandora moth, and larch casebearer. Various interactions of defoliators with other system components and natural regulatory processes have been described, as have monitoring and suppression techniques using pheromone traps. Large-scale suppression projects using both chemical and biological materials have been used in attempts to control some defoliator outbreaks. Although such suppression projects have prevented some tree mortality and growth loss, they have been largely ineffective in changing the outbreak behavior of these insects. Some suppression materials have undesirable side effects on nontarget insects such as sensitive or endangered moths, butterflies, and skippers, or on other ecological processes. Successful control of larch casebearers has been achieved by introduction of parasitic wasps. For most defoliators, the recommended strategy is preventative: silvicultural treatment to promote a diversity of tree species, stand structures, and moderate stocking levels. Decision-support tools UPEST and UTOOLS analyze insect and disease risks, and the forest vegetation simulator models effects of insects and diseases on stand growth.

Keywords: Defoliators, insect outbreaks, insect pest management, disturbance processes, forest management.

(See La Grande order form.)

Land Use

Herring, M.; Greene, S.

2001. Forest of time: research at the Wind River Experimental Forest, 1908-1919. *Forest History Today*. Spring/fall: 36-43.

The lessons of history are evident in this article adapted from an upcoming book that will trace 100 years of research history at the Wind River Experimental Forest. We demonstrate the value of long-term research as the Wind River story shows that outcomes are not always predictable, and research results can change over time. The article was offered in recognition of the 75th anniversary of the USDA Forest Service, Pacific Northwest Research Station.

Keywords: History, experimental forests, long-term studies, silviculture.

(See Corvallis order form.)

Landscape Ecology

Hemstrom, M.A.

2001. Vegetative patterns, disturbances, and forest health in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 91-109.

Vegetative patterns in eastern Oregon and Washington are largely a result of environmental conditions, species distributions, plant ecology, and disturbances operating at multiple scales. In turn, vegetative patterns strongly influence the amount, severity, and distribution of disturbances generated by various agents. At all scales, vulnerability to disturbance appears to increase when vegetation condition and pattern differ from the historical and expected range. Generally, forests that are older, composed of larger trees, denser, more homogeneous, or more contiguous than would be expected under historical disturbance regimes are more vulnerable to mortality from insects and disease. Factors related to vulnerability include site potential; host abundance; canopy structure; host size; patch vigor, density, and connectivity; topography; and logging. Mortality from insects and disease contributes to diverse habitat, but current tree mortality from insects and disease is often outside the historical range. High mortality may

continue because many forests have become more homogeneous, contiguous, and dominated by shade-tolerant species owing to fire suppression and management. Uncharacteristically severe fires will likely increase over the next 100 years even with restoration management because of changed vegetation patterns and other factors. Information at stand scale is relatively abundant, but much broad-scale information is based on models and expert opinion.

Keywords: Vegetative pattern, forest health and productivity, disturbance processes, forest management.

(See Portland order form.)

Hemstrom, M.A.; Korol, J.J.; Hann, W.J.

2001. Trends in terrestrial plant communities and landscape health indicate the effects of alternative management strategies in the interior Columbia River basin. *Forest Ecology and Management*. 153: 105-126.

Current and potential future conditions of terrestrial plant communities and landscape health were modeled for three alternative public land management strategies in the interior Columbia River basin. Landscape health was defined as an integration of the degree to which vegetation and disturbance conditions resemble native patterns and support levels of human activity. The range of vegetation and disturbance variability for a period before the middle 19th century was used as a basis for comparison of current and future regimes with the "historical" system. Departure from the historical regime in wildland environments was found to be related to altered disturbance patterns, especially changed fire regimes, forest insect and disease levels, and excessive livestock grazing effects. Overall, midseral forests are currently more prevalent than they were in the past, and old forests, especially single-layer structural types, are less abundant. Nonnative plant species and altered plant community composition conditions exist across broad areas of rangelands. Landscape health has declined substantially in many areas. Proposed management strategies that emphasize maintenance

and restoration activities in a hierarchical landscape approach should generate improved landscape health conditions over the next 100 years. The massive scale of changes to disturbance and vegetation patterns from historical to current times and the cost of implementing restoration activities, however, make dramatic improvement unlikely.

Keywords: Disturbance, landscape ecology, simulation modeling, vegetation changes, vegetation communities, landscape health, terrestrial communities.

(See Portland order form.)

Keane, R.E.; Parsons, R.A.; Hessburg, P.F.
2002. Estimating historical range and variation of landscape patch dynamics: limitations of the simulation approach. *Ecological Modelling*. 151: 29-49.

Landscape patterns in the Northwestern United States are mostly shaped by the interaction of fire and succession, and conversely, vegetation patterns influence fire dynamics and plant colonization processes. Historical landscape pattern dynamics can be used by resource managers to assess current landscape conditions and develop target spatial characteristics for management activities. The historical range and variability (HRV) of landscape pattern can be quantified from simulated chronosequences of landscape vegetation maps and can be used to (1) describe temporal variation in patch statistics, (2) develop limits of acceptable change, and (3) design landscape treatment guidelines for ecosystem management. Although this simulation approach has many advantages, the limitations of this method have not been explored in detail. To demonstrate the advantages and disadvantages of this approach, we performed several simulation experiments by using a spatially explicit, multiple pathway model to quantify the range and variability in six class and landscape pattern metrics for four landscapes in the Northwestern United States.

Keywords: Landscape pattern, historical range and variation, landscape fire succession modeling, landscape pattern metrics.

(See Wenatchee order form.)

Mycology

Amaranthus, M.P.; Pilz, D.; Moore, A.
[and others]

2000. American matsutake (*Tricholoma magnivelare*) across spatial and temporal scales. In: Powers, R.F.; Hauxwell, D.L.; Nakamura, G.M., tech. coords. Proceedings of the California Forest Soils Council conference on forest soils biology and forest management, Feb. 23-24, 1996. Gen. Tech. Rep. PSW-GTR-178. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 99-108.

Spatial and temporal uncertainties about American matsutake (*Tricholoma magnivelare* (Peck) Redhead) ecology and production hinder efforts to manage this valuable resource on a sustained basis. Our studies indicate that production and value of American matsutake vary strongly over time, are spatially related to individual host plants, and can be enhanced by certain practices at various spatial scales.

Keywords: American matsutake, Tricholoma magnivelare.

(See Corvallis order form. To order a copy of the complete proceedings, email Richard Schneider at rschneider@fs.fed.us or write to Richard Schneider, Rocky Mountain Research Station, 240 W Prospect Road, Fort Collins, CO 80526.)

Plant Ecology

Irvine, J.; Law, B.E.; Anthoni, P.M.; Meinzer, F.C.
2002. Water limitations to carbon exchange in old-growth and young ponderosa pine stands. *Tree Physiology*. 22: 189-196.

Seasonal patterns of transpiration, net ecosystem carbon exchange (NEE), canopy conductance, soil water content, soil temperature, and soil respiration were measured in old-growth and recently regenerating ponderosa pine stands in Oregon. By August, soil volumetric water content

had declined to a seasonal minimum of 0.07 at both sites. Between April and June, both stands showed similar rates of transpiration. Thereafter, trees at the regenerating site showed increasing drought stress with canopy stomatal resistance increasing sixfold by mid-August relative to values for trees at the old-growth site. Soil respiration at the old-growth site showed a strong seasonal correlation with soil temperature with no discernable constraints imposed by declining soil water. In contrast, soil respiration at the regenerating site peaked before seasonal maximum soil temperatures and declined thereafter with declining soil water. No pronounced seasonal pattern in daytime NEE was observed at either site between April and September. At the regenerating site, this behavior was driven by concurrent soil water limitations on soil respiration and assimilation, whereas there was no evidence of seasonal soil water limitations on either process at the old-growth site.

Keywords: Eddy covariance, net ecosystem exchange, soil CO₂ fluxes, soil water deficit, transpiration.

(See Corvallis order form.)

Kerns, B.K.

2001. Diagnostic phytoliths for a ponderosa pine-bunchgrass community near Flagstaff, Arizona. *The Southwestern Naturalist*. 46(3): 282-294.

Phytolith analysis could play an important role in understanding vegetation dynamics in Southwestern ponderosa pine (*Pinus ponderosa*) forests, which have been dramatically altered by fire suppression and other factors. My objectives were to develop a phytolith reference collection and classification system for a ponderosa pine-bunchgrass community found near Flagstaff, Arizona. Twenty-seven species of grasses and ponderosa pine were examined for diagnostic phytoliths. Twenty other species common to the area also were examined for redundant forms. Seven Poaceae phytolith forms were identified, and a new diagnostic phytolith for ponderosa pine, the spiny body, was defined. Vegetation reconstructions using soil phytolith assemblages

based on the system developed in this paper could be used to understand grass-tree and grass vegetation dynamics.

Keywords: Phytoliths, ponderosa pine, Pinus ponderosa, Arizona.

(See Corvallis order form.)

Kerns, B.K.; Moore, M.M.; Hart, S.C.

2001. Estimating forest-grassland dynamics using soil phytolith assemblages and $\delta^{13}\text{C}$ of soil organic matter. *Ecoscience*. 8(4): 478-488.

Our objectives were to examine the relation between contemporary vegetation and surface soil phytolith assemblages and to use phytoliths and $\delta^{13}\text{C}$ of soil organic matter (SOM) to explore forest-grassland vegetation dynamics. We established plots within three canopy types with different grass species compositions in a ponderosa pine (*Pinus ponderosa*) forest in northern Arizona and collected vegetation data and surface and subsurface mineral soil samples. Surface soil phytolith assemblages strongly reflected vegetation at the site scale. Local vegetation patterns associated with overstory canopy types were weakly detected. Regional influxes of phytoliths were minor. Phytolith assemblages and $\delta^{13}\text{C}$ of SOM reflect long-term accumulation of organic matter in soils and may not mirror contemporary vegetation for many reasons, including spatial shifts in species distribution and productivity. Combining all our phytolith and $\delta^{13}\text{C}$ evidence, we suggest that C_4 grasses were more widely distributed but less abundant, grasses were more spatially continuous, total grass productivity was greater, and species in the genera *Koeleria* and *Bromus* were more common in the past.

Keywords: Forest understory, $\delta^{13}\text{C}$, C₃, C₄, grasslands, nonmetric multidimensional scaling, northern Arizona, ponderosa pine, Pinus ponderosa, phytolith assemblages.

(See Corvallis order form.)

Scholz, F.G.; Bucci, S.J.; Goldstein, G. [and others]

2002. Hydraulic redistribution of soil water by Neotropical savanna trees. *Tree Physiology*. 22: 603-612.

The magnitude and direction of water transport by the roots of eight dominant Brazilian savanna (Cerrado) woody species were determined with a heat-pulse system that allowed bidirectional measurements of sap flow. The patterns of sap flow observed during the dry season in species with dimorphic root systems were consistent with the occurrence of hydraulic redistribution of soil water, the movement of water from moist to drier regions of the soil profile via plant roots. In these species, shallow roots exhibited positive sap flow during the day and negative sap flow during the night. Sap flow in the taproots was positive throughout the 24-hour period. A third sap-flow pattern was observed at the end of the dry season after a heavy rainfall event when sap flow became negative in the taproot and positive in small roots, indicating movement of water from upper soil layers into shallow roots, and then into taproots and deeper soil layers. Natural and manipulated patterns of sap flow in roots and stems were consistent with passive movement of water toward competing sinks in the soil and plants. Because dry shallow soil layers were often a stronger sink than the shoot, a dimorphic root system may be a prerequisite for maintenance of a positive water balance in deciduous Cerrado species that remain leafless for a prolonged period during the dry season.

Keywords: Heat-pulse method, hydraulic lift, roots, sap flow.

(See Corvallis order form.)

Plant Pathology

Hennon, P.E.; Beatty, J.S.; Hildebrand, D.
2001. Hemlock dwarf mistletoe. Forest Insect and Disease Leaflet 135. [Washington, DC]: U.S. Department of Agriculture, Forest Service. 8 p.

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosendahl) G.N. Jones, causes a serious disease in western hemlock and several other tree species along the Pacific coast of North America. The small, seed-bearing plant lives exclusively as a parasite on living trees. This leaflet describes the biology and management options for this important forest disease.

Keywords: Mistletoe, disease management.

(See Juneau order form. This publication also is available to download at <http://www.fs.fed.us/r6/nr/fid/fidls/hemlock-dm.pdf>.)

Parks, C.G.; Flanagan, P.T.

2001. Dwarf mistletoes (*Arceuthobium* spp.), rust diseases, and stem decays in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 31-37.

The four dwarf mistletoe species of concern in eastern Oregon and Washington are Douglas-fir dwarf mistletoe, larch dwarf mistletoe, western dwarf mistletoe, and lodgepole pine dwarf mistletoe. Dwarf mistletoe can be controlled by cutting infected trees and planting nonsusceptible tree species. Models are available for dwarf mistletoe effects and landscape vulnerability. Of over 50 species of rusts in the Pacific Northwest, only a few cause significant effects: white pine blister rust; western gall rust, stalactiform rust, and comandra rust; fir broom rust; spruce broom rust; and incense-cedar rust. Genetic resistance and tree species manipulation can be used to control rusts, and infected branches can be eliminated by pruning. Site hazard ratings based on habitat type and elevation are available. Timber losses from heart rot (stem) decay are greater than from all other diseases, but infected trees, both living and dead, provide valuable wildlife habitat. Species of greatest concern are *Phellinus pini* and *Echinodontium tinctorium* (Indian paint fungus) with *Fomitopsis officinalis* being less common. Harvesting trees when

younger than 90 years old and limiting wounds on remaining trees may decrease infection. Although all these tree diseases can cause tree deformities, growth loss, and tree mortality, the brooms and specific wood decay conditions promote ecological and structural diversity.

Keywords: Rust disease, dwarf mistletoe, stem decay, heart rot decay, disturbance processes, forest health and productivity, forest management.

(See La Grande order form.)

Range Management

Coe, P.K.; Johnson, B.K.; Kern, J.W.
[and others]

2001. Responses of elk and mule deer to cattle in summer. *Journal of Range Management*. 54: A51-A76.

Cattle graze seasonally on nearly 70 percent of the land in the United States West, and mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) are sympatric with cattle in most of these areas. Managing rangelands for cattle, elk, and mule deer in montane habitats is complicated because interactions vary from potential competition to commensalism, and the response of elk or mule deer to cattle may differ seasonally depending on forage availability and quantity. At the Starkey Experimental Forest and Range, elk and mule deer were free ranging within a 78-km² study area enclosed by a 2.4-m-high fence while cattle were moved among pastures in summer on a deferred-rotation schedule. Elk, mule deer, and cattle were located with an automated telemetry system from 1993 to 1996, and locations were linked to a geographic information system.

Keywords: Elk, Cervus elaphus, competition, distribution, habitat selection, mule deer, Odocoileus hemionus, resource selection.

(See La Grande order form.)

Recreation

Stankey, G.H.

1999. The recreation opportunity spectrum and the limits of acceptable change planning systems: a review of experiences and lessons. In: Aley, J.; Burch, W.R.; Conover, B.; Field, D., eds. *Ecosystem management: adaptive strategies for natural resources organizations in the 21st century*. Philadelphia, PA: Taylor and Francis: 173-188. Chapter 12.

The recreation opportunity spectrum and the limits of acceptable change are resource management planning systems that have been widely applied in North America and overseas in recent years. This chapter updates the breadth and nature of experience that has been gained in these applications. Because the application of both systems continues to be plagued by operational and conceptual difficulties, several specific problems must be addressed in order to achieve successful implementation of either system.

Keywords: Recreation opportunity spectrum, limits of acceptable change, recreation.

(Available in bookstores and libraries.)

Regional Assessments

Hann, W.J.; Hemstrom, M.A.; Haynes, R.W.
[and others]

2001. Costs and effectiveness of multi-scale integrated management. *Forest Ecology and Management*. 153: 127-145.

To understand benefits of integrating management at landscape scales, we estimated cost and projected integrated outcomes for three alternatives for public land management in the interior Columbia River basin over 100 years.

Effectiveness was measured in terms of costs and trends of long-term (100 years) land and fire management, landscape health, and reduction of risks across several broad aquatic, terrestrial, landscape, and socioeconomic indicators. Lowest costs with most positive cumulative trends for these variables occurred where alternatives “step down” assessment and planning from broader scales, focusing restoration efforts sufficiently to overcome opposite effects of traditional reserve protection or commodity management strategies. Integrated management implemented at interconnected scales seems to have multiple positive outcomes. Landscape health, conditions for native fish and wildlife species, and jobs from restoration activities can improve while risks to firefighters and property decline.

Keywords: Ecosystem management, landscape ecology, fire, simulation modeling, management systems, management cost, management philosophy, risk preference.

(See Portland order form.)

Quigley, T.M.; Haynes, R.W.; Hann, W.J.
2001. Estimating ecological integrity in the interior Columbia River basin. *Forest Ecology and Management*. 153: 161-178.

The shift in land management strategies toward ecosystem-based management focuses attention on the need for broad-scale estimates of ecological conditions. This poses two challenges for the science community: (1) estimating broad-scale ecosystem conditions from highly disparate data, often observed at different spatial scales, and (2) interpreting these conditions relative to goals such as sustainability. For the Interior Columbia Basin Ecosystem Management Project, we estimated relative composite ecological integrity by clustering conditions among proxy variables representing three relative component integrity ratings (forest land, rangeland, and aquatic integrity). We estimated future

trends in ecological integrity under three management alternatives. Federal land managers are using estimates of current composite ecological integrity to prioritize management activities and understand the effects of management actions. Composite ecological integrity provides an estimate of relative system conditions within the interior Columbia River basin assessment area that is responsive to changes in broad-scale land management practices.

Keywords: Ecosystems, ecological integrity.

(See Portland order form.)

Remote Sensing

Kaartinen, A.

2002. Evaluating Landsat-based stratification for a two-phase forest inventory in northwest California: precision and operational considerations. Helsinki, Finland: University of Helsinki. 83 p. M.S. thesis.

Three Landsat TM-based geographic information system layers representing forest type and land cover were evaluated as alternatives to conventional photointerpretation-based stratification of forest inventory field plots for a 2.5-million hectare study area on California's northern coast. Two of the layers were developed from general purpose vegetation classification products, and the third was a custom-built supervised classification system. Estimates for timberland area, timber volume in timberland, volume of down wood, and areas of three shrub cover abundance classes were calculated based on an iteratively developed stratification scheme from each dataset and photo stratification. The approaches were evaluated on the basis of standard errors of the estimates and conformance to accuracy standards used by the forest inventory and analysis program. Time, cost, and operational considerations were also evaluated for each dataset based on observations made during the study.

Keywords: Satellite image analysis, two-phase sampling, stratified forest inventory.

(Available only through library or interlibrary loan.)

Social Science

Stankey, G.H.

2000. Future trends in society and technology: implications for wilderness research and management. In: Cole, D.N.; McCool, S.F.; Freimund, W.A.; O'Loughlin, J., comps. Wilderness science in a time of change conference—Volume 1: Changing perspectives and future directions. Proceedings RMRS-P-15-VOL-1. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 10-23.

Judging the impact of social and technological trends on the future of wilderness is complex. Declining public trust, growing demands for scrutiny, a need to recognize the link between biophysical and socioeconomic systems, and the need for criteria to select among futures challenge us. A burgeoning global population will increase resource impacts, but more critically, the growing gap between haves and have-nots will aggravate equity concerns. Future technological changes are problematic; they will enhance understanding of wilderness but also make it more accessible. We lack ethical frameworks for resolving such dilemmas; what we can do will almost always outpace our ability to decide what we should do.

Keywords: Wilderness, recreation, social trends.

(See Corvallis order form. To order a copy of the complete proceedings, email Richard Schneider at rschneider@fs.fed.us or write to Richard Schneider, Rocky Mountain Research Station, 240 W Prospect Road, Fort Collins, CO 80526.)

Special Forest Products

Kerns, B.K.; Liegel, L.; Pilz, D.; Alexander, S.
2002. Biological inventory and monitoring. In: Jones, E.T.; McLain, R.J.; Weigand, J., eds. Nontimber forest products in the United States. Lawrence, KS: University Press of Kansas: 237-269.

Biological inventory and monitoring of nontimber forest products (NTFP) species are critical issues in the formulation of sustainable land management plans and policies and conservation-based economic development. Inventory and

monitoring information regarding NTFP species can be obtained from a number of sources, including local and indigenous knowledge, existing forest resource inventories, statistically designed inventories, scientific investigations and holistic studies embracing social, political, and biophysical processes. The type, relevance, and cost of information provided by each of these approaches differ considerably, so managers, stakeholders, and policymakers will benefit from understanding the strengths and limitations of strategies used to assess resource conditions and trends. The purpose of this chapter is to provide a detailed, but relatively nontechnical overview and critique of special methods and factors to consider when designing and implementing an inventory and monitoring program, examining or analyzing existing data, or formulating policies based on a resource assessment. We also suggest several approaches to inventory and monitoring that can guide future efforts and point out knowledge gaps.

Keywords: Nontimber forest products, inventory, monitoring.

(Available in bookstores and libraries.)

Pilz, D.; Molina, R.

2002. Commercial harvests of edible mushrooms from the forests of the Pacific Northwest United States: issues, management, and monitoring for sustainability. *Forest Ecology and Management*. 155: 3-16.

We begin by examining a variety of issues raised by mushroom harvesting and how these issues interact with forest ecosystem management choices. Next, we discuss (1) regulations currently being used by managers to conserve the mushroom resource while further information is gathered, (2) unique challenges and considerations inherent to the study of fungi, and (3)

current research and monitoring activities in the Pacific Northwest. We conclude by outlining a cost-effective approach to long-term monitoring of the resource. This approach includes public participation and a broad collaboration among public land management agencies, private forest landowners, forest managers, researchers, and research organizations.

Keywords: Mushrooms, nontimber forest products, ecosystem management, research, monitoring.

(See Corvallis order form.)

Threatened, Endangered, and Sensitive Species

Bull, E.L.; Wales, B.C.

2001. Effects of disturbance on amphibians of conservation concern in eastern Oregon and Washington. *Northwest Science*. 75(Special issue): 174-179.

The effects on amphibians of forest insects, tree diseases, wildlife, and management strategies designed to improve forest health (e.g., thinning, prescribed burns, road removal, and spraying with pesticides or biological microbial agents) are discussed. Those species that occur in forested habitats in eastern Oregon and Washington that are considered of concern include the Oregon spotted frog, Columbia spotted frog, northern leopard frog, Cascades frog, tailed frog, Larch Mountain salamander, and Cope's giant salamander. Little is known about the effects of forest health on amphibians, although tree mortality resulting from insects and disease is unlikely to dramatically affect these species, except for the tailed frog and Larch Mountain salamander. Both these species depend on overstory canopy to maintain temperature and moisture conditions;

timber harvest in their habitats has rendered them unsuitable. Wildfire, and prescribed burning to a lesser extent, may alter the abundance of prey, coarse woody debris, and vegetation, which could influence movements and survival of dispersing amphibians. Spraying with pesticides could negatively affect these species if the abundance of their prey is decreased. Spraying with biological microbial agents is unlikely to affect prey abundance. Additional research is needed to determine if these disturbance agents are contributing to the decline of many of these amphibians.

Keywords: Amphibians, species of concern, disturbance processes.

(See La Grande order form.)

Raphael, M.G.; Evans Mack, D.; Cooper, B.A.
2002. Landscape-scale relationships between abundance of marbled murrelets and distribution of nesting habitat. *The Condor*. 104: 331-342.

We used ornithological radar to count marbled murrelets (*Brachyramphus marmoratus*) flying inland within 10 river drainages on the Olympic Peninsula, Washington, during 1998-2000. We tested whether the number of murrelets entering drainages could be predicted from the amount and spatial configuration of suitable murrelet nesting habitat within drainages. The maximal number of murrelet radar targets was positively correlated with the amount of late-seral habitat in each of the 3 years sampled. Numbers of murrelets increased as the amount of core area of late-seral habitat and proximity of patches increased and decreased with increasing amounts of edge of late-seral patches. Neither the maximal nor the mean number of inbound marbled murrelets detected with radar differed overall between years; the effect of year was small relative to the effect of habitat on murrelet abundance. Our results suggest that changes in the amount or distribution of nesting habitat should result in detectable changes in murrelet

numbers at the scale of individual drainages. Thus, radar-based counts at selected drainages could be a more sensitive indicator of habitat conditions than larger scale at-sea population surveys, allowing managers to assess whether conservation and restoration of forest habitat are successful in conserving populations of the murrelet.

Keywords: Marbled murrelet, Brachyramphus marmoratus, fragmentation, monitoring, Olympic Peninsula, radar, river drainage.

(See Olympia order form.)

Singleton, P.H.; Lehmkuhl, J.F.; Gaines, W.
2001. Using weighted distance and least-cost corridor analysis to evaluate regional-scale large carnivore habitat connectivity in Washington. In: ICOET 2001 proceedings. [Raleigh, NC: International Conference on Ecology and Transportation]: 583-594.

Population fragmentation and isolation are primary concerns for conservation of large carnivores. Highways are often important landscape features contributing to regional-scale habitat fragmentation for these species. We used geographic information system weighted distance and least-cost corridor techniques to map relative landscape permeability and landscape linkages for large carnivores in Washington and adjacent portions of Idaho and British Columbia.

Keywords: Landscape ecology, regional assessments, threatened and endangered species, wildlife.

(See Wenatchee order form.)

Wildlife

Lehmkuhl, J.F.; Kie, J.G.; Bender, L.C.
[and others]

2001. Evaluating the effects of ecosystem management alternatives on elk, mule deer, and white-tailed deer in the interior Columbia River basin, USA. *Forest Ecology and Management*. 153: 89-104.

Elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*) are highly valued for their game, aesthetic, and spiritual qualities by sportsmen, wildlife enthusiasts, and Native Americans in North America. As part of the Interior Columbia Basin Ecosystem Management Project (ICBEMP), we (1) defined key habitat associations of those species that could be used for a broad-scale analysis of management practices, and (2) defined how three ecosystem management alternatives of a supplemental draft environmental impact statement (SDEIS) might affect the regional distribution of habitat for those species across the basin over the next 100 years. For the three species, we developed a Bayesian belief network model that used available SDEIS datasets to estimate historical, current, and future habitat capability under the management alternatives in each of the 7,467 subwatersheds in the study area. The model quantified "inherent habitat capability" (IHC) as a function primarily of forage habitat capability, with cover as a minor influence. Forage habitat capability was a function of the percentage area of rangeland and early-seral forest community types, and the qualitative influences of livestock overgrazing, wildfire, and prescribed fire. For the current and future periods, an "adjusted habitat capability" was estimated by adjusting IHC for the negative effects of poor security from human disturbance. Open road density, cover area, and a terrain relief index were used to estimate the security effect. Habitat capability was reported by 15 ecological

regions within the study area as mean subwatershed capability. Under all management alternatives, habitat capability increased about 5 percent for the three ungulate species over the next 100 years. Limitations of the coarse analysis scale restrict application of the model to large-scale assessments. Lacking regional population data, verification of model output was not feasible at the scale of analysis. The model was, however, considered useful for tracking regional changes given the available habitat data and regional-scale objectives of the effort.

Keywords: Elk, Cervus elaphus, mule deer, Odocoileus hemionus, white-tailed deer, Odocoileus virginianus, forest management, ecosystem management, Bayesian model.

(See Wenatchee order form.)

Marcot, B.G.; Holthausen, R.S.; Raphael, M.G. [and others]

2001. Using Bayesian belief networks to evaluate fish and wildlife population viability under land management alternatives from an environmental impact statement. *Forest Ecology and Management*. 153: 29-42.

We developed procedures for using Bayesian belief networks (BBN) to model habitat and population viability of selected at-risk fish and wildlife species. The BBN models represent the ecological causal web of key environmental correlates (KECs) that most influence habitat capability, the potential population response for each species, and the influence of habitat planning alternatives. These models represent site-specific KECs, habitat capability at the subwatershed level, and pattern of habitat capability across all subwatersheds. We derived estimates of prior and conditional probabilities from a mix of empirical data and expert judgment, mostly the latter. Sensitivity analyses identified planning decisions and KECs that most influence

species outcomes and can help prioritize monitoring activities. The BBN models, however, substitute for neither field studies nor empirical, quantitative population viability analyses of population demography and genetics.

Keywords: Bayesian belief networks, Bayesian statistics, wildlife modeling, fish modeling, population viability, Columbia River, interior Columbia basin.

(See Portland order form.)

Reynolds, K.M.

2001. Prioritizing salmon habitat restoration with the AHP, SMART, and uncertain data. In: Schmoldt, D.L., Kangas, J.; Mendoza, G.A.; Pesonen, M., eds. *The analytic hierarchy process in natural resource and environmental decision making*. Dordrecht, The Netherlands: Kluwer Academic Publishers: 199-217. Chapter 13.

Ecological assessments provide essential background information about ecosystem states and processes and are thus a useful starting point for applying adaptive ecosystem management. As a logical follow-up to ecological assessment, managers may wish to identify, and set priorities for, ecosystem maintenance and restoration activities. The simple multiattribute rating technique (SMART) is a useful extension to the standard analytic hierarchy process (AHP) model that allows characterization of uncertainty in attribute values of alternatives, and thus is one way of incorporating risk analysis into the standard AHP model. *Criterion DecisionPlus* is used to demonstrate application of the AHP and SMART methods to the problem of evaluating priorities for salmon habitat restoration projects.

Keywords: Salmon habitat restoration, watershed, uncertainty, SMART, simple multiattribute rating technique.

(Available in bookstores and libraries.)

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