# POSTER SESSION ABSTRACTS

## THE CONSORTIUM FOR SUSTAINABLE FOREST AND RANGELAND ECOSYSTEMS

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USFS-PNW Research Station
1133 N. Western Avenue
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[1]WSU Natural Resource Sciences and Cooperative Extension

The Consortium for Sustainable Forest and Rangeland Ecosystems was created to provide a forum where scientists, land managers, and regulatory personnel could share information, discuss priority resource issues, and direct personnel and funding to accomplish common ecosystem management goals at landscape, watershed and regional levels. The US Department of Agriculture Forest Service, Regions 1 and 6; the Pacific Northwest Research Station; Washington State University; the University of Washington; and the Washington Department of Natural Resources have committed to be full-partner agencies. Current projects underway at the Consortium include landscape description and analysis at river basin and regional scales, defining disturbance regimes of upland and riparian systems, evaluation of livestock/wildlife impacts on riparian systems, and habitat evaluations of sensitive plant and animal species. A project with Oregon State University will examine the collaborative learning process required to implement ecosystem management principles among multiple ownerships and jurisdictional authorities. The Consortium for Sustainable Forest and Rangeland Ecosystems is headquartered in Wenatchee, Washington. Washington State University Cooperative Extension directs the technology transfer of ecosystem management principles to field practitioners and public education activities.

For more information, contact Richard Everett (509-662-4315), USFS-PNW Research Station, 1133 N. Western Avenue, Wenatchee, WA 98801; Edward DePuit (509-335-8570) or David Baumgartner (509-335-2964), Department of Natural Resource Sciences, Washington State University, Pullman, WA 99164-6410.

## WSU DEPARTMENT OF NATURAL RESOURCE SCIENCES

**Edward J. DePuit**

Department of Natural Resource Sciences
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Pullman, WA 99164-6410

Washington State University (WSU), founded in 1890, is the land-grant university for the state of Washington. WSU's main campus in Pullman is located in the Palouse country of southeast Washington. As a comprehensive teaching-research-public service university located in the natural resource rich inland Pacific Northwest, it has an important position in addressing the region's forest health and ecosystem sustainability problems. WSU has facilities and faculty in every county of the state through Cooperative Extension, and agricultural and natural resources research efforts. With 18,000 undergraduate and graduate students statewide, WSU has a wide variety of prestigious academic programs, including more than 150 undergraduate majors, options, and degree programs, and more than 100 graduate degrees.

WSU is uniquely positioned by virtue of its land-grant mission, faculty, and location to provide comprehensive education, research, and technology transfer programs to help solve current forest health problems and to help ensure the sustainability of ecosystems. In fact, many of the University's programs are directly or indirectly working on these problems. Solutions to these problems include: 1) development of new, and better use of current, scientific knowledge and management experience, 2) integration of biological, social, and physical sciences, 3) approaches based on characteristics and need of nonindustrial private owners, industry, local residents, and public agencies, and 4) enhanced educational programs for university students and continuing education to help practicing professionals. Interdisciplinary, all-university programs in environmental and natural resource management education and research are conducted in all colleges. Programs and centers specializing in environmental impact assessment and actual resource management are offered in many departments and centers.

The Department of Natural Resource Sciences is committed to the four disciplinary groups it contains (forestry, range management, wildland recreation, and wildlife biology) to meet the challenges of resource management and education into the next century. It has the objective of preparing students for careers in these disciplinary areas with holistic perspectives on resource management, and an ability to conduct research in natural resource sciences that will increase the basic knowledge and productivity of the resources while maintaining or improving

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## THE APPLEGATE PARTNERSHIP

**Michael Amaranthus*, Jack Shipley, and Sue Rolle**

PNW Research Station, P.O. Box 440, Grants Pass, OR 97526*

The Applegate Partnership is a community-based project involving industry, conservation groups, natural resource agencies, and residents cooperating to encourage and facilitate the use of natural resources principles that promote ecosystem sustainability. Through community involvement and education, the Applegate Partnership supports management of all land within the watershed in a manner that sustains natural resources and contributes to the economic and community well-being within the Applegate Valley.

The Applegate River watershed encompasses approximately 500,000 acres in southern Oregon. Intensive timber harvest, fire suppression, and a decade of drought have dramatically changed the composition and structure of the forests in the Applegate. Overly dense, stagnant timber stands, high levels of insect mortality, extensive roading, increased rural development, and high risk of catastrophic fire characterize the area. The Partnership believes it is imperative to proactively manage these lands but in a manner that is ecologically credible, aesthetically acceptable, and economically viable. Projects are being developed that promote ecosystem sustainability and restoration, community revitalization, economic opportunity, and outreach and education.

Research and monitoring are essential to achieve and evaluate the goals of the Partnership. A new approach is being developed and implemented. Research and monitoring efforts: 1) directly involve the Partnership and community in setting priorities and objectives, 2) employ the local workforce, 3) provide training, tools, and understanding within the community, and 4) will emphasize a wide array of forest uses, products, and values. In the past, citizens have turned to the courts to overturn public forest land management decisions. The Applegate Partnership is a dynamic new model of teamwork that promotes community "grass roots" participation in activities and decisions.

## AUDIO-TELEMETRY WILDLIFE MONITORING SYSTEM

**Doug Bonham**

10900 NE 8th St., Suite 300, Bellevue, WA 98004

A prototype audio-telemetry system is being developed that is intended to provide remote and automated electronic monitoring of vocalizing wildlife, including spotted owls, murrelets, canids, and elk. This system incorporates computer analysis of signals received by a new type of audio receiver for which, when used with an IBM desktop computer, can recognize certain types of wildlife vocalizations and determine the direction from which the vocalizations originated. Initial testing indicates that an accuracy of two degrees is possible. The prototype receiver has been used in combination with a Global Positioning System (GPS) receiver to locate vocalizing owls.

The prototype system to be demonstrated at the conference utilizes a desktop IBM computer to analyze data that was preprocessed and recorded by the receiver in the field. Further development of this system planned for 1994 includes the incorporation of the computer analysis into the field unit. Future enhancements of this system that appear feasible include their radio transmission of data from field receiver to a computerized recording center.

This non-invasive method of monitoring wildlife would not require the capture or handling of animals, as does radio-telemetry. An audio-telemetry system has the disadvantage of being unable to collect data on animals that are not vocalizing. Although this audio-telemetry system can broadcast recordings of owl vocalizations and monitor subsequent responses from owls, broadcasting vocalizations it is not required and would not be used when it would pose a risk to owls.

## A DESCRIPTIVE ANALYSIS OF VEGETATION COVER TYPE AND STRUCTURAL LAND COVER COMPONENTS OF THE SELWAY-BITTERROOT WILDERNESS

**Charlene Bucha* and Leon Neuenschwander[1]**

Heppner Range District
P.O. Box 7, Heppner, OR 97836*

[1]University of Idaho

Researchers are using satellite digital imagery and geographic information systems to describe and quantify spatial patterns, compare landscapes, identify significant differences, and to determine relationships of functional processes in landscape patterns. In the Selway-Bitterroot Wilderness (SBW), TM satellite imagery was compared with MSS and SPOT imagery to determine the most appropriate method for analyzing the wilderness landscape. TM imagery was selected and combined with Defense Mapping Agency elevational data to assess and quantify the structural and vegetational components of the landscape. Size, distribution, and neighboring patch associations of the structural classes within potential forest type were quantitatively defined to describe the existing current condition in the wilderness and to describe the variation of structural components that exists on the landscape. This baseline data set provides a summary of general trends within the SBW landscape and will be used in future studies, wilderness monitoring, management decisions, and policy revision.

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## ECOSYSTEM MANAGEMENT: AN EXPERIMENT IN MANAGED STANDS

**Andrew B. Carey*, Suzanne M. Wilson[1], Ted B. Thomas[1], Todd M. Wilson[1], Lisa J. Villa[1], Jim Trappe[2], and Wes Colgan[2]**

[1]Olympia Forestry Sciences Laboratory
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[2]Oregon State University

Our recent research has shown that arboreal and forest-floor small mammals are more abundant in old growth forests than in young forests. Differences in abundance of fallen trees, snags, and understory development can account for much of the variability in mammal populations across young and old stands. Additionally, we have shown that spotted owl habitat use reflects mammalian prey abundance and degree of understory development. We hypothesize that synergistic effects on trophic pathways among plant, fungal, invertebrate, and vertebrate populations can be enhanced in managed stands thereby restoring many characteristics of old-growth forests. Our experimental methods in young managed stands entail creating cavities in live trees to benefit flying squirrels and other cavity-users. Also, we created three levels of overstory density to produce understory diversity and enhance tree growth. Our experimental design consists of four randomized blocks. Two blocks have substantial coarse woody debris and two blocks have virtually none. Each block has four 13-ha stands and four treatments: no intervention; cavities-added; variable density thinning with underplanting; and cavities plus thinning. Cavity and thinning treatments were applied in 1992-1993. Underplanting will begin in the spring of 1994. Pretreatment and ongoing sampling includes vascular plants, coarse woody debris, fungi, forest-floor small mammals, arboreal rodents, and mammalian diets.

## NATURAL AND ARTIFICIAL DEN SITES USED BY NORTHERN FLYING SQUIRRELS ON THE FOREST ECOSYSTEM STUDY

**Andrew B. Carey*, David E. Johnson, and Suzanne M. Wilson**

Olympia Forestry Sciences Laboratory
3625 93rd Avenue SW, Olympia, WA 98512*

Northern flying squirrels (*Glaucomys sabrinus*) are of interest for a variety of reasons. Their role as the primary prey of the northern spotted owl (*Strix occidentalis caurina*) and their function as dispersers of ectomycorrhizal-fungi spores make them important components of the forest ecosystem. Natural den sites used by flying squirrels include stick nests, moss nests, cavities, stumps, snaps, downed logs, and root wads. As part of an experimental study in managed Douglas-fir (*Pseudotsuga menziesii*) forests on the Fort Lewis Military Reservation near Olympia, Washington, we are supplementing natural den sites with nest boxes and artificial trees cavities. Thirty-two artificial cavities and nest boxes (1:1 ratio) were installed in each of eight stands (32 acres each) during spring 1992. Nearly 400 den sites were found between December 1991 and December 1993. During that time, 27 individual flying squirrels used 12 nest boxes, but no artificial tree cavities. Flying squirrels are expected to use the artificial nest boxes and cavities more fully over the next two years. The project will be evaluated in 1995.

## REPRESENTATIVENESS ASSESSMENT OF TERRESTRIAL AND AQUATIC ECOSYSTEMS WITHIN RESEARCH NATURAL AREAS OF THE NORTHERN REGION, USDA FOREST SERVICE

**Steve Chadde* and Dr. Angela Evenden**

Natural Areas Ecologist
RAWE, P.O. Box 766, Missoula, MT 59807*

The Northern Region of the USDA Forest Service includes 13 national forests and grasslands in northern Idaho, Montana, North Dakota, and northwestern South Dakota. Present within the Region are ecosystem types ranging from alpine tundra, subalpine and montane coniferous forests, semiarid shrublands and grasslands, and aquatic and wetland ecosystems.

A primary objective of the research natural area (RNA) system is to encompass representative examples of all terrestrial and aquatic ecosystem types occurring in the Region. To date, 120 RNAs have been established or await formal designation. These protected sites provide ecological reference areas where ecosystem composition, structure, and processes can be monitored through time. A comprehensive network of long-term ecological research areas is vital to successful implementation of ecosystem management on national forest lands. RNAs are also established to protect special ecosystem elements such as uncommon plant communities and sensitive species, thereby contributing to the maintenance of biological diversity.

To determine how well the current RNA network encompasses the Region's ecosystem diversity, we conducted an assessment of:

(1) element representation (e.g., Douglas-fir communities) within the overall Northern Region RNA system, and

(2) geographic representation of elements within aquatic and terrestrial ecoregions (e.g., aquatic - Upper Clark Fork River aquatic section; terrestrial - Flathead Valley Section).

As a result of our analysis, gaps or missing elements in the RNA system were identified, and RNA assignments for specific ecosystem types were made to each National Forest. Follow-up studies are planned to identify and evaluate candidate RNA sites.

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# ANNOUNCING... FVS 6.2 (PROGNOSIS MODEL) FOR DOS

**Kathleen Duncan**

Computer and Systems Specialist
WSU-Information Department, CAHE, Pullman, WA 99164-6244

FVS Version 6.2 (Forest Vegetation Simulator, formerly the Prognosis Model) is a FORTRAN computer program for projecting development of forest stands. FVS variants have been developed for 13 geographic regions that include most of the commercial forest land west of the Great Plains. Each variant represents ecological conditions that can support forest stands within a region. Furthermore, since stand growth projections are based on increment predictions for individual trees, the model can simulate a broad spectrum of management actions, including strategies designed to mitigate various pest and disease impacts.

FVS is available from Washington State University Cooperative Extension through a grant with the USDA Forest Service.

- System requirements; IBM compatible DOS 3.3 or above, 2 Mbytes memory, hard disk, 386SX or better, math coprocessor.
- Available electronically (no charge): Anonymous FTP to cru2.cahe.wsu.edu (134.121.80.17), no password (this is an OS2 FTP site), change directory to fvs. Access via dial electronic bulletin board: 509-335-2996.
- Available by mail on self-extracting 3-1/2 inch diskette or high density 5-1/4 inch diskettes. Cost $35.00 for the first diskette, $20.00 for each additional diskette (up to three variants per diskette). Complete source code for all variants is available for $75.00. Payable to Washington State University.
- You can become a registered user (no charge) by sending us your name, mailing address, E-Mail address, and the names, versions, and zip-file creation dates of the FVS variants you are using.
- Contact: Kathleen Duncan, 303 Hulbert Hall, Washington State University, Pullman WA 99164-6230.
  Phones (509) 335-2890 FAX: (509) 335-2863 Internet address: duncan@wsuaix.csc.wsu.edu
  Forest Service use:
  internet!wsuaix.csc.wsu.edu!duncan@att:x400
- Available Variants (Pest Extensions and other variants available soon):

| Variant Name | Abbreviation | Zip-file name |
|---|---|---|
| Blue Mountains | BM | BMZ.EXE |
| Central Idaho | CI | CIZ.EXE |
| Central Rockies | CR | CRZ.EXE |
| East Cascades | EC | ECZ.EXE |
| Eastern Montana | EM | EMZ.EXE |
| Klamath Mountains | NC | NCZ.EXE |
| North Idaho (Inland Empire) | NI | NIZ.EXE |
| South Central Oregon/ Northeast California | SO | SOZ.EXE |
| South East Alaska/ Coastal British Columbia | AK | AKZ.EXE |
| Tetons | TT | TTZ.EXE |
| Utah | UT | UTZ.EXE |
| West Cascades | WC | WCZ.EXE |
| Western States | WS | WSZ.EXE |

# APPLICATIONS OF THE WATER EROSION PREDICTION PROJECT (WEPP) TO ECOSYSTEM MANAGEMENT

**William J. Elliot**

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## Description

The Water Erosion Prediction Project (WEPP) soil erosion model is being developed by an interagency group of scientists including the USDAs Forest Service, Agriculture Research Service, Soil Conservation Service, and the Department of Interior Bureau of Land Management, and US Geological Survey. Scientists from these agencies throughout the United States have been working since 1985 to develop an erosion prediction model to replace the Universal Soil Loss Equation (USLE).

The WEPP model is a complex computer program that describes the processes that lead to erosion. These processes include infiltration and runoff; soil detachment, transport, and deposition; and plant growth, senescence, and residue decomposition. The model uses a daily time step to calculate soil water content in multiple layers and plant growth/decomposition. The effects of tillage processes and soil consolidation are also modeled.

## Forest Applications and Research

The ability of the WEPP model to predict runoff, sediment yield, and eroded sediment size distribution make it ideally suited for studying the interrelationships between ecosystem management decisions and soil erosion.

In forests, the majority of sediment comes from forest roads, and in some conditions, from skid trails, or following severe fires. It is necessary to model the entire watershed to estimate amounts of runoff contributing to stream flows to determine how much of the eroded sediment is transported downstream.

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A weather sequence generator is being developed for the mountains in the western United States by developing a 10-km grid of past climate, and extrapolating from the 10-km to the watershed of interest. Currently, the computer programs and database necessary to run the mountain climate weather sequence generator are being completed. Considerable computing power is necessary to develop the 10-km grids, and that process is ongoing.

Erodibility and hydraulic conductivity values for undisturbed and disturbed harvest areas and forest roads have been measured, and from those results, methods to predict forest soil erodibility are being developed.

A process-based forest growth model is being developed that will allow the prediction of plant regrowth following harvesting. The model will include competition between grass, shrubs, and trees for radiation and soil water.

Validation studies applying the WEPP model to forest conditions have thus far been encouraging. Preliminary applications of the model to field problems are being developed.

## BLACKS MOUNTAIN INTERDISCIPLINARY RESEARCH PROJECT

**Connie R. Gill**

PSW Research Station
Redding Silviculture Laboratory, 2400 Washington Avenue
Redding, CA 96001

The Blacks Mountain Interdisciplinary Research Project is a new, integrated approach to quantify the effects of resource management activities on complex ecosystem structures, functions, and processes. The Project is located on the Blacks Mountain Experimental Forest in northeastern California in the interior ponderosa pine forest type. Its objective is to determine the responses on an array of forest components such as wildlife, sustainable productivity, and biodiversity to different levels of management intensity. Two distinct forest structures will be developed and maintained for at least 50 years by using a variety of silvicultural and other management activities, including timber harvesting, cattle grazing, and prescribed fire. The structures are one of old-growth characteristics (high structural diversity) and a simpler forest, created to minimize structural differences (low structural diversity). These contrasting forest structures will enable researchers to detect response differences of wildlife, insects and disease, genetics, biodiversity, and carbon budget. Treatments will be replicated on twelve 250-acre plots. Currently, baseline data for wildlife and vegetation are being collected and the information integrated by referencing an accurate, permanently monumented 100 meter grid. The data will be spatially and temporally analyzed using a Geographic Information System. Treatments are scheduled to begin in 1995.

## THE PACFISH STRATEGY: AN ECOSYSTEM MANAGEMENT APPROACH FOR MANAGING ANADROMOUS SALMONID HABITAT

**Richard A. Hardt*, Jack E. Williams[1], and Cindy D. Williams[2]**

[1]BLM-Office of the Director
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[2]USDA Forest Service

The USDI Bureau of Land Management (BLM) and the USDA Forest Service (FS) are developing PACFISH, an interagency strategy for managing anadromous salmonid habitat on BLM and FS administered lands in Washington, Oregon, Idaho, and California. Hundreds of stocks of Pacific anadromous salmonids are spawned and reared on lands administered by the agencies. Recent reports have found that about half of the 400 stocks of native Pacific anadromous salmonids are showing significant declines in numbers, and 106 are already extinct. The goal of PACFISH is to arrest and reverse the decline in anadromous salmonid habitat by maintaining and restoring the health, sustainability, and productivity of entire watersheds. As currently proposed, components of the PACFISH strategy include initiating watershed analysis and identifying key watersheds; determining riparian goals, site-specific riparian management objectives, and associated standards and guidelines; creating riparian habitat conservation areas and restoring watersheds. The strategy focuses on habitat features required for healthy aquatic ecosystems, such as appropriate pool frequency and width to depth ratios, cool water temperatures, woody debris in streams, streambank stability, and lower bank angles.

## AERIAL SKETCHMAPPING AS AN INVENTORY TOOL FOR LANDSCAPE SCALE ANALYSIS IN WHITEBARK PINE ECOSYSTEMS

**Tim McConnell and Beth Hodder***

Glacier View Ranger District
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The need for information on the existing condition of whitebark pine, and a limited budget to conduct such surveys, led the USDA Forest Service Northern Region and the Glacier View Ranger District, Flathead National Forest, in a study to determine the feasibility of using aerial sketchmapping to inventory whitebark pine at the landscape level. This type of survey had never been attempted before. A two-day survey (nine total hours) from a fixed wing plane produced a map of the existing condition of over 100,000 acres of whitebark pine on the Glacier View Ranger District.

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The survey team included a pilot, mapper, and observer. While flying at 1,000' above ground, the mapper sketched broad polygons onto USGS 7.5" topographic maps, using codes to represent mature and immature mixed conifer and pure whitebark pine stands, and the amount of whitebark pine mortality. The observer took photographs, used binoculars to view areas difficult to see, and discussed codings with the mapper.

Post-flight validation included checking the aerial sketchmap against previous stand examinations and completing exams in areas with no previous surveys. At the landscape scale level, this survey had an understood coarse resolution.

Several benefits resulted from the flight. First, immediately upon landing, a complete map showing the "big picture" of whitebark pine throughout the entire district was available for analysis and use. This was a significant savings of time and money over traditional ground surveys, because the flight covered such a large area in a short time period. Also, the resulting map indicated the greatest distribution of live, healthy whitebark pine and areas with the easiest access. This information helped managers decide where to invest in intensive ground and photo interpretation work and where to look for management opportunities. Finally, a digitized layer of the mapped polygons was produced which can be summarized in data tables and overlayed with other digitized information for further analysis.

## TEANAWAY ECOSYSTEM MANAGEMENT PROJECT: A COOPERATIVE APPROACH IN A MULTIPLE LANDOWNER SETTING

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Boise Cascade Corporation has initiated an Ecosystem Management Project on a contiguous 50,000 acre block of its ownership on the east slope of the Cascade Mountains of Washington State. The overall project goal is to demonstrate approaches and methodologies that meet the objectives of ecosystem management while providing the opportunity for commodity production on forest lands. Our land classification scheme is comprised of two data layers; existing vegetation and potential climax vegetation. A combination of these layers results in a diversity matrix of ecological land types (ELT). This matrix can be used to compare the composition of the present landscape at different spatial scales with landscapes resulting from other disturbance regimes. We will determine a disturbance history of the landscape defined by habitat type. We will link disturbance history to a spectrum of stand structures that might have developed from that history. Starting in 1994, we will begin surveying understory and overstory plants, breeding birds, small mammals and herpetofauna. By knowing which wildlife and plant species are associated with particular ELT's, we can measure the response of species to different silvicultural manipulations. Where appropriate, we will use particular silvicultural prescriptions to mimic natural disturbances in adaptive management experiments. In a related but separate study, we will be characterizing a number of habitat variables in a subsample of all ecological land types. These variables will be used to drive habitat suitability models that will help determine cost/benefit ratios of alternative management practices, both within ELT's and across the project area.

Although Boise Cascade is providing funding, cooperative studies are being planned with the University of Washington, the Wenatchee National Forest, the Yakima Indian Nation and the Yakima River Management Cooperative. Representatives from these agencies and other key individuals will comprise focus groups that will provide additional expertise and direction for the project.

## TESTING AN ECOSYSTEM MODEL FOR PREDICTING STAND AND TREE GROWTH

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Given the uncertainty of future climate regimes, it has become necessary to develop growth and yield models that can respond to potential changes in climate. TREE-BGC, a variant of the physiological process model FOREST-BGC, was used to simulate the growth of 998 trees in uneven-aged stands near Kamloops, B.C. Stand variables were aggregated from a tree list. A disaggregation logic was used to allocate stand level estimates of carbon gain and respiration costs to individual trees. Trees were "grown" using allometric equations to allocate growth between height and diameter. Mortality occurred when the maintenance respiration demands of the tree exceeded the carbon allocated to the tree. Model results were tested statistically to compare the cumulative diameter distributions, and the stand basal area and volume growth after a 20-year period. Plot level estimates of basal area growth and volume growth were highly correlated with actual measurements ($r^2$ = 0.94 and 0.96, respectively; n = 24). The simulated cumulative diameter and height distributions were not significantly different from the actual cumulative diameter and height distributions for 23 of the 24 plots (a = 0.05). The model was shown to predict volume growth within $\pm$ 20 $m^3$ $ha^{-1}$, and basal area growth within $\pm$ 10 $m^2$ ha-1 (a = 0.05), over a twenty-year period. Stand mortality appeared to emulate the so-called self-thinning rule and a maximum size-density relationship was found.

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# FIRE RELATED CONSIDERATIONS AND STRATEGIES IN SUPPORT OF ECOSYSTEM MANAGEMENT: CALIFORNIA FUELS COMMITTEE AND SIERRA NATIONAL FOREST, CLOVIS, CALIFORNIA

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Some ecosystems will burn; it's just a question of when! So why are we surprised when the inevitable cycle repeats itself once again in the short interval fire-adapted ecosystems of California? Our failure to balance our important and effective fire suppression programs with an equally important prescribed fire program has put the health and productivity of these ecosystems at risk.

We have not effectively communicated the consequences of excluding fires in fire-adapted types or displayed the trade-offs among the alternatives over time to either our publics or our own decision makers. Applying the new Forest Service policy initiative of ecosystem management to fire management will present fundamentally important challenges and opportunities.

Expanding the prescribed fire program seems a simple and biologically sound way to restore sustainable conditions. However, the use of fire, especially at a landscape scale, presents a serious dilemma to managers who must evaluate fire's potential to regulate biotic productivity and stability against the negative effects of smoke and the risk of consequences which inhibit its use. Remediation efforts will encounter significant problems. However, avoiding treatments creates serious consequences:

- Change from relatively low damage, stand-maintenance fires to more severe high damage, stand-replacement disturbances
- Conversion from fire-resistant species to fire-intolerant species having less resilience to fire disturbances
- Less controllable and more costly wildfires
- Increasing danger to firefighters
- Growing threat to wildland/urban interface values where development is occurring in fire prone types
- Increasing potential for higher particulate matter emissions as fuel loads and understory biomass increase

The staffing paper, "Fire Related Considerations and Strategies in Support of Ecosystem Management," identifies the key challenges of managing fire-adapted systems. It also outlines a course of action and makes five recommendations that better positions Forest Service fire management efforts:

- increasing internal and external awareness of fire ecology principles,
- better displaying long-term economic and biological trade-offs,
- building stronger prescribed burning expertise,
- better managing the risks surrounding prescribed fire applications, and
- better aligning program elements in fire management to more fully complement one another.

Aggressive fire suppression must remain an essential cornerstone of the Forest Service mission. Concurrently, however, fire and aviation management must position itself so that it can effectively respond to the challenges of ecosystem management.

# KOOTENAI NATIONAL FOREST

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The Kootenai National Forest has been trying for the past two years to develop processes with which to implement ecosystem management on the ground and to form a basis for our Forest Plan revision. These processes have been, and are being, tested within specific projects on all Districts in order to integrate for an eventual mid-scale analysis to be completed for the entire Forest. Posters demonstrate processes in temporal and spatial analysis methods as illustrated by pollen/sediment/charcoal studies that provide insight into fire intensity and frequency as well as vegetation succession over time; WATSED modeling using historic fire regimes; organization of the Forest into landscape units of varying hierarchical scales; spatial patch analysis (using Fragstats and UTOOLS); target landscape prescriptions for forested ecological systems based on historic intensity and frequency of disturbance patterns; and habitat implications for wildlife. Ecosystem management is like a giant, 5,000 piece jigsaw puzzle that will hopefully end up in a usable, practical, cohesive picture, but at present remains in pieces that are slowly (and painfully!) coming together. We still lack many answers — but illustrate these efforts for comment and review.

# VISUALIZATION OF FORESTED LANDSCAPES

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Forest management decisions require input from a variety of resource specialists. These specialists can have difficulty communicating details and implications of possible management activities to other specialists involved in land management planning.

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This poster display will introduce UTOOLS, PC software designed to help resource specialists development and communicate resource management plans.

UTOOLS was developed to meet a growing demand for efficient and flexible computer tools for analyzing and mapping spatial data. UTOOLS provides programs to convert polygon and line (vector) maps into a Paradox "spatial" database. Standard Paradox queries can then be used to examine GIS layers and related attribute information. UTOOLS provides mapping tools to display the "spatial" database in 2D (UMAP and UVIEW) or 3D perspective views (UVIEW). The perspective views generated by UVIEW can include database attributes represented using different colors and vegetative cover developed using a simple canopy closure model or a more complex description of stand structure. GIS data stored in Paradox databases can be exported from UTOOLS for use in other landscape analysis programs such as FRAGSTATS, DISPLAY, HEIWEST, and HEICALC.

UTOOLS combines the power of a relational database with a simple terrain viewing interface to help resource specialists develop and communicate landscape management alternatives.

## ECOSYSTEM MANAGEMENT THROUGH CONSENSUS: PUBLIC PARTICIPATION AND THE PINE DISTRICT — WALLOWA-WHITMAN NATIONAL FOREST

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[1]Wallowa-Whitman National Forest

In August 1988, a contentious public and Forest Service staff met together in an attempt to form a common vision for the future of the lands administered by the Pine District. The meeting catalyzed the development of three products: 1) a common vision; 2) a broad-spectrum public/agency working group (the Pine-Eagle Group); and 3) a scientifically credible landscape-level management plan (MS20/21) for the Pine District, developed by the Pine-Eagle Group. MS20/21 contains all of the primary components of a true landscape-level ecosystem management plan: close public participation, long-term management flexibility (adaptive management), and consideration of multiple scales (from stand to watershed to landscape). MS20/21 consists of a system of mature forest cores and corridors within a matrix of differentially-aged forest, replicated on a sub-watershed scale. From the stand to the landscape scale, the plan emphasizes the role of structure in providing habitat for all species, and calls for a sustained yield of forest products within that structural framework. MS20/21, and the Pine-Eagle Group that produced it, may serve as an example of how ecosystem management could be practiced in a more harmonious future.

## FORGING A COMMON VISION FOR STEWARDSHIP OF THE BLUE MOUNTAINS: THE BLUE MOUNTAINS NATURAL RESOURCES INSTITUTE

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The Blue Mountains Natural Resources Institute was formed in 1990 with a mission "to enhance the long-term economic and social benefits of natural resources in the Blue Mountains in ways that are ecologically sound and sustainable." The BMNRI addresses that mission by developing or encouraging research, development, application, demonstration, and education. Although administratively a program within the research branch of the Forest Service, the BMNRI staff functions under the direction of a board of directors, composed of a broad spectrum of political, educational, industrial, and agency people with keen interest in natural resources. Much of the actual work undertaken by the BMNRI staff is accomplished by sharing the resources of over 80 partners, all of whom share the BMNRI's mission. The hope is that the BMNRI can serve as a focal point for exchange of information, ideas, and values so that difficult decisions on natural resource issues can be made within a truly social environment.

## ANALYSIS OF RIPARIAN VEGETATION AGE STRUCTURE AND FOREST LAND OWNERSHIP IN THE CENTRAL OREGON CASCADES

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Vegetation along the banks of mountain streams in the western Oregon Cascades comprises an integral part of the transition zone between land and water-based ecosystems, and as such, is a vitally important and unique natural resource. Forestry is a major land use in this region, and harvesting riparian vegetation has serious and well-documented impacts on ecological and hydrological processes. In order to protect riparian vegetation, "buffer strips" are often required by the presiding management agency. However, buffer strip management regulations and enforcement vary substantially among the many owners of forest land in the region. Given these set of circumstances, it was unclear what the general ecological condition of riparian vegetation was. This study examined the riparian stand structure and age characteristics, as identified from Landsat Thematic Mapper imagery, within five different land ownership classes. The study also

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examined the pattern of change in the occurrence of old-growth conifers that occurred with increasing lateral distance from the stream, across various land ownership classes. It was found that there was typically a predominance of younger, mixed open canopy riparian conditions on low elevation private industrial and interspersed federal lands. In contrast, older conifers tended to dominate riparian vegetation on higher elevation federal lands. Furthermore, it was found that change from an older to younger seral stage with increasing lateral distance from the stream tended to occur more rapidly on low elevation private industrial and interspersed federal lands.

This study provides insight into how the condition of riparian vegetation correlates to the corresponding ownership or management regime. Vegetation inventories across large regions such as the study area have only recently become feasible with advances in remote sensing technology, digital image processing techniques, and geographic information systems. The employment of these new technologies has introduced a scale of investigation which enables landscape scale patterns, processes, and human influences on riparian systems to be better understood.

## MODELING FUELS AND FIRE DYNAMICALLY: FIRE EXTENSION TO THE FOREST VEGETATION SIMULATOR WORK IN PROGRESS

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The purpose of this work is to provide a management tool for dynamic fuel modeling in order to assess how fuels, fire behavior and fire effects (fuel consumption, tree mortality) change over time and with different management alternatives. Fuels and dead woody biomass are modeled dynamically by linking estimated rates of falldown, decay and consumption to the Forest Vegetation Simulator (Stand Prognosis Model). Linkage of fire behavior and tree mortality models provides capability to show effects of fire-caused tree mortality on stand development.

This work will be useful in showing effects of forest health problems on changes in surface organic material over time. It will also be useful in evaluating the long term effects of various management alternatives. For example, stand development can be modeled under a historic fire regime, a fire suppression alternative, and a partial harvest and prescribed fire alternative to see how fuels, potential fire behavior, and stand structure change over time. This kind of information will help managers develop stand treatment alternatives that mimic natural ecological processes.

Existing models of vegetation development, fire behavior and fire effects are being used in this study. Fuel accumulation and decay predictions are being developed for this study.

## ECOSYSTEM MANAGEMENT AND THE GENETIC RESOURCES PROGRAM OF THE BLUE MOUNTAINS

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Genetic diversity is the basis of all biodiversity, existing from the individual to the landscape level. Genetic diversity plays a major role in the adaptation of species to their current environments, as well as in their ability to adapt to new climates and environmental stresses in the future.

In the Blue Mountains Province, the fundamental goal of the applied genetics program is to produce high quality seed on a sustained basis in quantities sufficient for both planned and unplanned reforestation and restoration activities. High quality seed is genetically diverse, adapted to conditions of the planting site, and capable of producing healthy and vigorous growing stock. The use of high quality seed is especially critical given the detrimental impacts of past management practices and natural disturbances on native gene pools. Selective harvesting, insect and disease outbreaks, and stand-replacing wildfires have resulted in the loss of valuable seed sources and locally adapted populations. By ensuring large breeding populations, designating small breeding zones (ecological units for seed transfer), and the broad scale testing of seed parents and plant populations, our applied genetics program can enhance gene conservation and seed production in early seral species; generate new information regarding levels and patterns of genetic variation in Blue Mountain species and populations; maintain or enhance genetic variation in native gene pools; and maintain local adaptation.

The benefits of genetic resource programs to ecosystem health and biodiversity are substantial and long-term. Tremendous progress has been made in the Blue Mountains with respect to applied genetics programs for commercial conifers. We will continue with the development of seed and clone banks for reforestation and restoration activities, particularly given the continued high risk of large scale stand-replacing wildfires and insect and disease epidemics. In addition, greater emphasis is being given to the integration of genetic conservation perspectives into other pertinent aspects of ecosystem management, including threatened, endangered, and sensitive species restoration, riparian and range habitat improvement, native plants programs, watershed analysis, and land management planning efforts.

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## DNA TYPING OF MUSHROOM STRAINS USING MOLECULAR TECHNIQUES

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Commercial harvesting may potentially impact genetic diversity in edible wild mushroom species. Yet, little is known about the genetic variability of these organisms across spatial scales and in relationship to disturbed and undisturbed landscapes. In order to manage mushroom resources, a method is needed to efficiently assess intraspecific genetic diversity.

We have developed methods for genetically typing mushroom strains by polymerase chain reaction (PCR) technology using a relatively new PCR procedure termed random amplification of polymorphic DNA (RAPD). We show the feasibility of assessing genetic variability and taxonomic relatedness using these DNA typing methods.

For this study we characterized isolates of shiitake (*Lentinula edodes* (Berk) Pegler) mushrooms, maintained by Northwest Mycological Consultants (NMC), a private spawn and research company in Oregon. Strains have been characterized on the basis of phenotypic characters such as temperature sensitivity and cultivation requirements. The genetic relationships of strains were, for the most part, obscure. Using RAPD-PCR technology we developed a DNA "profile" for each strain and calculated genetic distances between the strains. The overall variability of DNA profiles is an indicator of the genetic variation in the NMC shiitake mushroom collection. Our DNA typing methods give consistent, reproducible results using either mycelium or mushroom stages of isolates. We demonstrate that intraspecific genetic diversity in mushrooms can be assessed independently of the environmental, developmental, and temporal factors that may confound typing procedures when evaluations are based on classical morphological or compatibility methodologies.

We anticipate that RAPD-PCR typing will allow intraspecific genetic variation in wild mushroom populations to be assessed and monitored for ecosystem management of this important forest resource.

## STUDIES ON THE MOLECULAR POPULATION BIOLOGY OF THE PINE SHOOT BEETLE IN NORTH AMERICA

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The pine shoot beetle (*Tomicus piniperda*) is an introduced pest from Europe or Asia that has recently been found in several states in the Great Lakes region. This insect has the potential to spread to other regions and exploit diverse ecological niches. Because of the serious threat to native North American pine forests and to tree plantations, a Federal quarantine exists on movement of forest products from *Tomicus*-infested counties.

The origin(s) and dispersal characteristics of the Great Lakes pine shoot beetles are unknown. In order to understand more about the population biology of this exotic insect pest as it adapts to North American niches, we are characterizing representative populations by molecular methods.

We utilize polymerase chain reaction technology for amplifying diagnostic genomic fragments of pooled DNA in order to "fingerprint" existing, geographically-distinct populations of *T. piniperda*. Amplification conditions are optimized for generation of consensus DNA profiles of the individual populations. We calculate the genotypic relatedness of these consensus profiles for putative identification of founder populations and to gain insight into possible dispersal routes of the beetle throughout the Great Lakes region. Over time, these approaches may allow identification of biotypes of the pest that are successfully adapting to North American pines.

These approaches for characterizing and monitoring populations of organisms that threaten forests and tree plantations can serve an important role in modern ecosystem management strategies.

## IMPLEMENTING SPATIAL PLANNING FOR ECOSYSTEM MANAGEMENT

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Demands for a diverse array of products are being placed on managers and planners of activities on forested lands. These include timber and other forest products, and creation and maintenance of desired conditions for wildlife, aquatic organisms, aesthetics, and recreational opportunities.

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Spatial planning for ecosystem management requires three elements: 1) an assessment of the current situation, 2) a statement of goals, and 3) a means of identifying spatially feasible alternatives.

The Scheduling and Network Analysis Program, SNAP II, has been developed to assist managers in creating alternatives for management planning and measuring cumulative effects. Management activities include the timing and location of silvicultural treatments, choice of harvest methods, road locations, and riparian management strategies.

Specific spatial controls include the distribution and percentage of seral stages, size of openings, and habitat connectivity across the landscape and over time. Streams and roads are explicitly treated with cumulative impact analysis for stream temperature and habitat effectiveness.

SNAP II has been developed under the sponsorship of the USDA Forest Service and the Washington Department of Natural Resources. Current applications are in the range of 500 to 1000 polygons, 1000 to 2000 roads segments, and 800 to 1200 stream segments over 5 to 30 time periods. Over 400 planners have attended SNAP II training over the last 3 years. SNAP II is public domain software and can be obtained through the USDA Forest Service.

## ROLES OF USDA FOREST SERVICE GENETIC RESOURCE PROGRAM IN ECOSYSTEM MANAGEMENT IN OREGON AND WASHINGTON

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The USDA Forest Service genetic resource program in Region 6 includes a team of geneticists serving Oregon and Washington. The program interacts with internal and external resource specialists to provide guidance on genetics and seed production of tree, grass, forb, and shrub species. The wealth of experience present in the genetic resources program can help reduce costly mistakes in carrying out new programs, and would complement that of other resource people seeking input on genetic and seed collection issues. The resident team of geneticists and associated specialists has extensive experience with establishment of field administrative studies, seed collection, seed extraction, and seed storage, and can help plan and implement projects which require this type of information.

Species such as western larch, ponderosa pine, western white pine, and white bark pine are important components of the western interior forests and the genetic resources program has efforts underway to work with these species. Examples of new or ongoing efforts of the genetic resources program include (a) screening and breeding for blister rust resistance in white pines, (b) examining genetic variation in species of interest (via common garden studies or isozymes) to help delineate seed movement guidelines, (c) establishment of seed production areas, seed orchards, or containerized seed orchards to meet urgent demands for seed quickly,( d) initiation of a survey of whitebark pine status in Oregon and Washington, (e) organization of multi-discipline training courses on blister rust, tree climbing, and seed collection and storage, and (f) storage of individual plant collections of seed or pollen for further study or short- to mid-term germplasm storage. The experience and facilities available to the genetic resource program makes it possible for the program to respond to urgent needs and to pull in assistance from other resource specialists, researchers, or organizations.

## APPLICATION OF ECOSYSTEM MANAGEMENT CONCEPTS IN A FIRE ALTERED LANDSCAPE OF THE EASTERN SIERRA NEVADA MOUNTAINS, CALIFORNIA

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The Donner Ridge Fire disturbed 44,000 acres of forest near Truckee, California in 1960. Today, this landscape is a fragmented mosaic of barren areas, brushfields, plantations and young growth stands of eastside pine and mixed conifer. Vegetation patterns, landscape functions and forest successional processes have been altered by the fire. Human impacts associated with historic logging, fire suppression, residential development, recreation use and reforestation site preparation methods used in the 1960's have also contributed to this altered state. Many watersheds have yet to recover, with existing conditions outside of desired thresholds.

The Donner Ecosystem Management Project incorporates a landscape analysis and design approach. This is a joint interdisciplinary planning effort between the Truckee and Sierraville Ranger Districts of the Tahoe National Forest (Region 5), the Carson Ranger District of the Toiyabe National Forest (Region 4) and Tahoe Donner, a large residential/resort community within the analysis area. The Donner Analysis Area is 96,000 acres in size and includes all watersheds impacted by the Donner Ridge Fire. Specific issues identified by the Interdisciplinary Team to be addressed in the analysis include:

- Protection of resources and plantation investments from another catastrophic wildfire.
- Improvement of visual resources in burned areas.
- Fire and early site preparation impacts to soil productivity.
- Lack of conifer species, structural and visual diversity.
- Reforestation needs.

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- Dense and contiguous stands of brush threatening plantation survival and contributing to extreme fire hazard.
- Excessive stand densities are decreasing health and growth.
- Increasing pest caused tree mortality and damage.
- Fisheries resources negatively affected by inconsistent stream flows.
- Degradation of deer fawning habitat and migration corridors.
- Need for recreational use plan (conflicts between user groups).
- Need for a comprehensive traffic management plan.

This landscape planning effort is being conducted in three phases: 1) analysis, 2) public participation and landscape design, and 3) project implementation. The analysis will be used to develop overall strategies to reduce fire hazards, protect plantation investments, rehabilitate damaged watersheds, improve wildlife and fish habitats, improve forest health and reduce user conflicts. The objective is to identify desired conditions (DC's) for landscape elements that are consistent with natural processes and vegetation patterns as well as human values and resource needs. National Environmental Policy Act (NEPA) planning areas and potential projects needed to reach the DC's will be identified and prioritized. The poster describes the analysis, design, and implementation process and provides an overview of project status and public involvement strategies.

## IMPLEMENTING ECOSYSTEM MANAGEMENT ON A USDA FOREST SERVICE TIMBER SALE IN SOUTHEAST ALASKA

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Ecosystem Management is a relatively new policy direction with the USDA Forest Service; consequently, few templates exist for its implementation, particularly in regards to large timber sales. Ecosystem management is currently being applied on the 200,000 acre Control Lake Project Area on Prince of Wales Island. Approximately 255 harvest units form a pool from which alternatives will be selected for a timber harvest of 187 MMBF. The area in and around the Project Area has experienced extensive timber harvest for the last 40 years. Intensive timber management is intended for the remainder of the 100 year rotation by the Forest Plan. Ecosystem Management implementation has involved the following: 1) identification and mapping of thirty ecosystem management landscape zones (EMLZs) based on their functions and values, 2) determining the optimum level of entry into the EMLZs, and 3) stand level ecosystem management using 10 silvicultural treatments, plus variations, that are applied by setting. Treatments are selected based upon specific stand attributes (mistletoe, blowdown, tree diameter and height, logging system capability) and by the Interdisciplinary Team's objectives for each EMLZ. This ecosystem management approach is biologically driven and responsive to social issues and management concerns. It is also a useful tool for alternative development within the NEPA process.

## INTERIOR MIXED CONIFER FORESTS OF NORTHEAST CALIFORNIA: NATURAL DISTURBANCE PATTERNS AND APPLIED ECOSYSTEM MANAGEMENT

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The mid to high elevation forests of Northeast California: eastern Klamath Mountains, Cascade Range, Modoc Plateau and Warner Mountains, are dominated by white fir, Ponderosa pine and western juniper. These forests are enriched with a mixture of 23 other conifer species including Brewer spruce and Washoe pine that irregularly occur across the landscape as a mosaic of individuals or groups of species mixed in with the ponderosa pine and white fir dominated forests.

Past fires, sheep and cattle grazing, timber harvest, wildlife forage management, and fire suppression have created a very diverse landscape mosaic of patchy even- and all-aged forests. These forests consist of even-aged clumps, all-aged stands with large residual trees, snags, and coarse woody debris with most tree and shrub regeneration occurring in varied size gaps.

Harvesting timber using an ecosystem management approach has been applied to some of these very diverse forests using the principle of "Leave all the Parts" and trying to duplicate low to medium intensity natural fire disturbances. The objective was to maintain late successional stand structural characteristics, reduce contiguous forest fuels, retain relative large blocks of undisturbed forest, allow early successional plants to reproduce and encourage all conifers to naturally regenerate.

Examples are presented to illustrate the natural disturbance patterns compared to various "New Forestry" silvicultural cuts using cable, helicopter and tractor harvest systems with various site preparation and fuel reduction treatments.

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## TIMBERLAND RECOVERY

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Ecosystem management concepts are being developed in response to the popular perception that our forests are in poor health due to gross mismanagement. To what extent this is true is debatable; however, the backlash is resulting in a steady increase in restrictions and prohibitions placed on harvesting and other consumptive uses. Our poster display will demonstrate our approach to ecosystem management through pictures and text of actual operations.

On the positive side of the current turmoil—monetary value of timber has skyrocketed. This situation has created opportunities for us to enter abused and/or neglected forests and restore the ecological integrity of the area. We do this in the following ways:

1. refining silvicultural prescriptions to smaller areas,
2. using equipment that by design is low-impact and operating it in a low-impact manner,
3. using equipment that by design is low-impact and operating it in a low-impact manner, and
4. timing operations to meet silvicultural and ecological criteria.

We know we can even operate in areas that are currently being restricted (such as 300-foot stream buffer corridors) and minimize impacts so that cumulative negative ecological effects are negligible. Ecosystem management can include consumptive uses of our forests without setting it all aside.

## INFLUENCE OF DROUGHT STRESS AND LOW IRRADIANCE ON PLANT WATER RELATIONS AND STRUCTURAL CONSTITUENTS IN NEEDLES OF *PINUS PONDEROSA* SEEDLINGS

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Forestry Sciences Laboratory
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Forestry methods that are applied to meet the goals of sustainable ecosystems require a different approach to growing and managing shade-intolerant forest tree species that heretofore were regenerated under open canopy. The objective of this study was to examine the influence of low light on tolerance to prolonged drought of seedlings of ponderosa pine (*Pinus ponderosa* (Dougl. ex Laws), a species that is an important component of the Columbia River Basin ecosystems. Shaded and unshaded *P. ponderosa* var. *scopulorum* and unshaded *P. ponderosa* var. *ponderosa* seedlings were drought-stressed to compare varietal responses to drought. The maximum irradiance received by shaded seedlings was 10% of full light. Seedlings were progressively drought stressed until water potentials were -5.0 MPa. Major varietal differences in drought response was in the relative water content of the apoplast ($RWC_a$) and in needle cellulose content. The shaded seedlings showed tissue damage at relative water contents <60%, and died at severe water deficits from which unshaded seedlings recovered. Correspondingly they had significantly less cellulose in the needle tissue, as well as lower symplastic osmotic concentration, higher cell volume-to-mass ratio, lower bulk modulus of elasticity at full turgor and water content of the apoplast. These differences suggest that light is an essential component of ponderosa pine's successful adaptation to drought. Further studies are needed to assess what minimum irradiance levels are required to maintain sufficient drought-stress adaptivity in this species.

## PLANT PRO-TEC

**Jerry Walters**

Plant Pro-Tec, Inc.
P.O. Box 902, Palo Cedro, CA 96073

**Plant Pro-Tec (Garlic)** is an innovative product which discourages deer, elk, and rabbits from browsing newly planted or older forest trees, Christmas trees, horticultural and other plants. Although Plant Pro-Tec (Garlic) is a relatively new product, the concepts involved are not new. We have known for some time that the garlic odor repels browsing animals and that aversive conditioning occurs. These and other aspects of Plant Pro-Tec (Garlic) are outlined below. I can provide more information if needed.

The fact that garlic discourages animals from browsing plants is indicated in a number of journal articles. Most gardening books also indicate that garlic can be used to protect plants. Because Plant Pro-Tec (Garlic) repellents emit a strong, long lasting garlic odor, browsing animals are repelled.

The fact that Plant Pro-Tec (Garlic) does repel deer is indicated by the Sierra Pacific Industries (SPI) letter. My note at the bottom of the SPI letter is important. If they were pleased with the product they used in 1992, they should really be pleased with the results from the present product. On a scale from 1 to 10, with 10 being a very effective repellent and 1 being a repellent that is hardly worth the effort to put out, the product that SPI used was about a 3. The product today is about a 9! As indicated in the note, every aspect of the product has been improved. The biggest improvement as far as repelling browsing animals is that the product contains garlic oil instead of garlic juice. Garlic oil is about 1,000 times stronger than garlic juice—200 pounds of fresh garlic is distilled down to 1 ounce of garlic oil.

The Features of Plant Pro-Tec (Garlic) sheet indicates why and how the repellents work. It also covers shipping, storage, shelf life, release of the repelling garlic odor, and how to attach the repellent to a plant. The Product Prices sheet indicates that Plant Pro-Tec (Garlic) repellents cost $0.22 each. This is about the same price as the Vexar Tube and stake. However, the Plant Pro-Tec (Garlic) repellents are much less expensive to ship, store, and install (see the enclosed catalog page about Vexar tubes). Also

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there are no maintenance or removal costs involved with Plant Pro-Tec (Garlic) repellents as there are with Vexar tubes. The Plant Pro-Tec (Garlic) repellent will not cause damage to the seedling as the Vexar tube often does.

The repelling garlic odor is released over time—it should last 1 year. It may repel until the device **photodegrades** in about 24 months (Under Redding, California conditions). The garlic odor lasts a long time because of the cone on the inside of the device. The cone is permeable to the garlic odor but impermeable to air. In other words, the cone allows the garlic odor out but prevents oxidation of the sulfur compounds which give the garlic its repelling odor. Once the barrier which contains the garlic odor during storage and transport is displaced, the garlic odor becomes evident. A deer or elk's nose is from 100 to 1,000 times more sensitive than ours. This means that if we can smell it from an inch away, a deer or elk should smell it from 100 to 1,000 inches away.

Plant Pro-Tec (Garlic) repellents can be used to discourage browsing of individual plants or to create borders around areas. Individual plants could be in reforestation or riparian areas. Borders could be used to keep animals out of an area or to direct them to other areas.

## J. HERBERT STONE NURSERY

**Jerry Wojack* and Colleen Archibald**

J. Herbert Stone Nursery
2606 Old Stage Rd., Central Point, OR 97502*

The J. Herbert Stone Nursery has been actively working toward supplying plant materials, services, and expertise to projects that embody the concepts of ecosystem management. Located in Southern Oregon, the Nursery is a Forest Service facility that has specialized in the production of bareroot conifer seedlings. Now the Nursery has expanded its mission to include production of plant materials for all resource needs. The Nursery began a Native Grass Program in response to a need for native grass seed and seedlings for restoration projects. Now in its third year, we are growing grass seed for seven national forests and one BLM District office, representing twenty-three species and sixty-five seedlots. The poster and display will show the plants and seed of eight commonly grown native grass species and how they are collected and grown.

The Nursery also grows many native shrubs, forbs, and trees seedlings. These come in all sizes and shapes. Depending on the best propagation techniques, these plants can be grown from seed or from cuttings. The display will show a variety of plant materials that can be used for ecosystem restoration. It will also focus on the Pacific yew production program that began in 1991.

## EASTSIDE ECOSYSTEM MANAGEMENT RESEARCH TEAM

**Andrew Youngblood*, Patrick H. Cochran, Cathy Rose, Carol Carter, and Boyd E. Wickman**

PNW Research Station, Silviculture Laboratory
1027 NW Trenton Avenue, Bend, OR 97701*

The Pacific Northwest Research Station has formed a new Eastside Ecosystem Management Research Team to focus on ecosystem management research east of the crest of the Cascade Range in Oregon and Washington. The Silviculture Laboratory in Bend, Oregon will serve as the headquarters for the team. Proposed research will integrate disciplines and emphasize ecosystem processes to help resource managers better understand the effects of management activities on all ecosystem components in eastside forests. During the next ten years, this team will characterize and measure the condition of old-growth ponderosa pine and grand fir forests, identify management options that accelerate the development of old-growth ponderosa pine and grand fir forests, and determine the factors and processes influencing changes in successional stages of ponderosa pine and grand fir forests.

## VIABLE ECOSYSTEMS

**David Zalunardo**

Ochoco National Forest, P.O. Box 490, Prineville, OR 97754

The Ochoco National Forest has devised a system to classify vegetation on a landscape basis. The Viable Ecosystem model provides a process to apply ecosystem management concepts to project level planning. This system compares existing vegetation with site potential. The model focuses on relationships between combinations of vegetation structure and species composition, and habitat requirements for animals, insects and plants. Viable Ecosystems is a useful tool for cumulative effects analysis of broad scale changes in vegetation at a subwatershed to forestwide scale and subsequent changes in animal, insect or plant communities.

The Viable Ecosystem model stratifies the environmental gradient using plant associations. These associations were then grouped based on similar productivities, disturbance regimes, and responses to disturbance. Six major Plant Association Groups were recognized on the Ochoco National Forest ranging from Western Juniper to Subalpine fir. Successional processes and disturbance regimes were then described for each Plant Association Group and seral/structural states defined.

The historic range of variability for each seral/structural stage was estimated based on fire histories, land survey notes from the 1870's, USDA publications circa 1900, and anecdotal information from various sources. Guidelines were then developed for each plant association group. These guidelines designate a range

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of percentages for each of 13 seral/structural states. Collectively they provide for all of the possible combinations of species composition and structure possible in each plant association group.

These seral/structural stages represent habitat for each of the 327 wildlife species present in the Blue Mountains. Each wildlife species was associated with the seral/structural stage(s) suitable for reproductive or foraging habitat with each Plant Association Group. Species viability was linked to species habitat needs (amount and distribution). This provides a coarse filter (landscape level) habitat conservation strategy for all the wildlife species present on the forest. The coarse filter is then combined with a fine filter (species, population level) monitoring strategy for habitat specialists. Habitat specialists were defined as the species with the narrowest ecological amplitudes (habitat requirements). In essence, those species we have the most potential to trend toward listing under the Endangered Species Act. We envision this as a fine-tuning of the indicator species concept on a landscape basis.

Existing vegetative conditions are derived from satellite imagery. This imagery yields the seral/structural stages of existing vegetation. These are then compared to the guidelines to provide a focused purpose and need for any management activity on a subwatershed to watershed basis. A case study of a proposed application of this process is displayed.

## LONG-TERM ECOSYSTEM PRODUCTIVITY — INTEGRATED RESEARCH SITES (IRS)

**Mike Amaranthus[1] and Robyn Darbyshire***

Chetco Ranger District
555 5th Street, Brookings, OR 97415*

[1]Siskiyou National Forest

The Siskiyou, Umatilla, Wenatchee, and Willamette National Forests in the Pacific Northwest Region and the Olympic Experimental Forest of the Washington Department of Natural Resources are evaluating a variety of ecological conditions in managed forests and testing them across a variety of ecosystems. These Forests, in partnership with the Pacific Northwest Research Station, scientists from Oregon State University, University of Oregon, University of Washington, the Olympic Natural Resource Center and interested members of the pubic are evaluating ways to maintain forest resources and sustainability in a long-term and integrated research framework that answers management questions for many decades into the future.

### What are the integrated research sites suppose to show?

These results will help show how to sustain long-term ecosystem function and productivity by examining the interrelationship between species composition, soil properties and organic matter over time. The treatments will be assessed and compared in many ways by scientists and resource managers representing biological, physical, economic and social sciences. Vegetation, wildlife, soils, special forest products, climate, economics, public perception and social concerns will be examined.

The ecosystem study will provide mangers, scientists and the public with a better understanding of the ability to manage forests for sustained ecological, social and economic values. Specifically, they will evaluate the ability to maintain soil productivity, forest health, fiber production, an array of plant and animal species and determine public acceptance for the treatments.

### What exactly are the integrated research sites?

Each site has at least 3 replications of 4 whole plot treatments that evaluate a range of ecological conditions with differing species composition and abundance. Treatments are accomplished through promotion or retention of (1) early seral species (2) mid-seral species (3) late seral species and structure, and (4) through no intervention, allowing natural succession to occur. The resultant differing guilds of plant species that dominate these stands will uniquely influence soil and aerial environments and thus ecosystem function and productivity. The trees on the Integrated Research Sites currently range from 50 - 110 years old.

Each whole plot treatment is divided into subplot treatments (6 ha each) that examine the effects of organic matter inputs on soil properties, nutrient cycling, and subsequent ecosystem productivity. Treatments are accomplished by leaving a range of organic inputs after harvest-scaled as a percentage of current standing biomass for each site.

### How do integrated research sites relate to ecosystem management?

Most research to date has focused on short-term results, single resources or events with little integration of the needs of communities, managers and scientists. What has evolved is a fragmented body of specialized knowledge lacking integration both spatially and temporally. Some of the current advocated changes in management are assumed to improve ecosystem function and productivity, but are as yet undocumented and require testing before broad-based application can be done with confidence. The IRS embody the ecosystem approach to scientific inquiry involving a wide range of groups and individuals in the planning and implementation of the project. IRS research goes well beyond fiber production examining a variety of resources such as soil, birds, fungi, biological diversity and recreation and aesthetic values. The IRS is of sufficient size and integration to provide the context for long-term study. Such an approach is necessary because ecosystem productivity can only be truly understood in terms of generations of human and trees.

### Where can I get more information?

Program efforts are coordinated by Mike Amaranthus (503-471-7581) or Robyn Darbyshire (503-469-2196). Forest efforts are coordinated by Robyn Darbyshire (Siskiyou National Forest, 503-469-2196), Ismael Caballero (Umatilla National Forest, 509-522-6290), Charlie Stansel (Wenatchee National Forest 509-653-2205), Jim Overton (Willamette National Forest, 503-822-3317), and Richard Bigley (Olympic Experimental Forest, 206-753-0671).

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## FOREST - SOILS INTERPRETATIONS

**Dennis Robinson**

Soil Conservation Service
Rock Pointe Tower II, Suite 450, W 316 Boone Avenue
Spokane, WA 99201-2348

This poster illustrates the relationships of forested soils to resulting interpretations. Soils differ in their ability to produce a crop and also to withstand forces acting upon them. Interpretations for forest operations such as harvesting and road construction are provided. Quality technical transfer of interpretations results in good forest management.

## WSU COOPERATIVE EXTENSION

**David M. Baumgartner*, Donald P. Hanley, and Donna Dekker-Robertson**

Dept. of Natural Resource Sciences Cooperative Extension
Washington State University Pullman, WA 99164-6410*

The Smith-Lever Act of 1914 gave each land-grant university a mandate to extend results of research and scientific expertise to the people of the state in order to improve the quality of their lives and enterprises. The provisions of this act created a unique partnership of governments that supports Cooperative Extension. Cooperative Extension, a nationwide network that combines federal, state, and local expertise and resources, brings noncredit, practical education to the people. At WSU, Cooperative Extension is administered from the College of Agriculture and Home Economics.

Cooperative Extension strengths are: 1) unbiased research-based information, 2) problem-solving education to meet local needs and solve local problems, 3) diverse, highly qualified faculty and staff, 4) well-trained volunteers who increase faculty effectiveness, 5) interdisciplinary approach to address human issues, 6) two-way interaction between the university and the people, and 7) partnership of county, state, and federal governments that reaches people in all thirty-nine counties.

Through town hall meetings, community planning meetings, and other advisory systems, Cooperative Extension analyzes needs and focuses its programs on high priority interests of the people of the state. Current programs emphasize: 1) Sustaining Agricultural and Natural Resources, 2) Environmental Stewardship, 3) Community and Economic Vitality, 4) Food Safety and Health, and 5) Capacity Building in Families and Youth.

Extension natural resources educational programs are designed to meet the emerging issues and opportunities of integrated, ecosystem-level understanding and management of natural resources, and of applying such management within the socioeconomic constraints of today's society.

It is estimated that there are over 75,000 nonindustrial private forest owners (NIPF) with 20 or more acres suitable for commercial timber production in the state of Washington. The challenge is to educate those interested in intensive management to use proper stewardship techniques. Many owners want their land for nontimber purposes, particularly on smaller acreages. Those owners not interested in intensive commercial management need to be educated to practice stewardship management for their objectives. Since the knowledge and abilities of NIPF owners vary greatly the role of public and private forest advisors, such as county agents, state farm foresters, and private forestry consultants, is very important in helping ensure proper forest management. Because forest advisors play a vital role in providing advice and technical assistance to NIPF owners, it is critical that their knowledge is up-to-date. Seventy-nine percent of the state's commercial forestland is directly managed by professional foresters. Rapid technological advances, increased resource demands, policy changes, and greater interest in and knowledge about environmental factors are causing obsolescence of the professional natural resource manager's knowledge. Cooperative Extension is recognized as the state's lead agency in technology transfer, continuing education, and for aiding in research implementation for those professional managers. Urban and community forests and windbreaks play a vital role in the environmental quality and economy of Washington. These important resources effect erosion, economics, agricultural production, wildlife, snow and dust management, water quality, and aesthetics. The rangeland resources and livestock which depend on grazing lands to various degrees are of major importance to the state's economy. In addition to direct economic benefits, forests and rangeland are important habitat for wildlife and plants, including threatened and endangered species. These rangelands are also important to water quality and quality outdoor recreation aesthetics.

Accomplishments are very significant. Over the past three years, the Forest Stewardship extension program for landowners conducted more than 100 workshops and classes with over 2,000 attendees. Approximately 70% of the owners responding to surveys said that they learned information that would enable them to better manage their forests. Over 16,000 copies of "Forest Stewardship Notes" are distributed twice annually. A reader survey indicated over 30,000 readers with 98% having learned some or much new information, 80% of the readers own forestland totaling over 750,000 acres and as a result of the newsletter, 25% of the owners have started or changed forestry practices and 56% will do so in the future., Annually, an estimated 2,000 individual requests for advice or information are answered.

In a typical year, 2,500 professionals from Washington and other states attended 25 WSU sponsored or co-sponsored educational programs which include topics such as: computer applications, silviculture, forest pest management policy, NIPF management, soil management, harvesting, genetics and economics. For one 16-month period, WSU Cooperative Extension agents and specialists conducted or helped facilitate 51 professional natural resources programs, including forestry for 6,839 foresters, range managers, wood technologists, wildlife biologists, and other natural resource professionals. These programs totaled 860

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hours of instruction for 81,670 contact hours of technology transfer. To put this in perspective, it is the equivalent of over 5,444 university semester credits or 363 full-time university students for one semester.

## LEAPING FOR CHANGE

**Donna Dekker-Robertson, Peter Griessmann, Ole Helgerson, Tom Brannon, David Baumgartner*, and Don Hanley**

WSU Cooperative Extension
Washington State University Pullman, WA 99164-6410

**LEAP** *(Loggers Education to Advance Professionalism)* is intended to strengthen the partnership between professional loggers and foresters. The two groups depend on each other to develop and implement forest prescriptions, thus ensuring future forests. Both groups have specific work to do in the woods, and it is not the intent of this program to turn loggers into foresters or vice versa. However, knowledge of the basic principles of forestry should create a link of understanding between loggers and foresters. Through workshops and field demonstration, loggers will be educated about forest ecology,. silviculture, mitigating harvest impacts, the "whys" behind the Washington Forest Practices Act, and other topics. The LEAP program is intended to be a continuing series to educate loggers over time, and keep them abreast of changes in both understanding of forest ecosystems and new regulations.

### Why teach ecology and silviculture?

- Washington's Forest Practices Act contains many regulations about protection of riparian zones, recruitment of snag trees for wildlife, and other practices that protect and enhance the ecosystem. Teaching ecology helps loggers to understand the purpose behind regulations and to fulfill or even exceed them without costly supervision by state agencies.
- Loggers implement many silvicultural prescriptions. While some stand treatments such as fertilization and pruning may be done without a logger's assistance, stand density control and species composition adjustments require trees to be cut. Loggers that know something about silviculture can understand why thinning enhances stand value and can correctly choose crop trees to leave as residuals. Many timber sales, particularly on small private lands, do not involve foresters at all. Loggers that understand how forests renew themselves can develop and implement harvest plans with a greater likelihood of regeneration success.
- Both foresters and loggers complain about communication barriers. When communication barriers exist, the outcome is seldom optimal. Teaching loggers forest ecology and silviculture can provide a common language, which will facilitate clear understanding between the forester who develops the management plan and the logger who implements it. Good working relationships between landowners, loggers and foresters can ensure that the landowner's objectives are met while the forest is continually renewed.
- The public's perception of loggers is not good. Many loggers work hard to minimize the disturbances to the ecosystem caused by timber harvesting, but one poor logging job can establish the impression that loggers don't care about forest stewardship. When the public perceives loggers as professionals who are careful about their work and interested in learning how to protect ecosystems, their image of loggers will be enhanced.

### Some target skills for loggers after LEAP.

- When doing partial cuts such as thinning, the logger makes tree selection with silvicultural objectives in mind. The logger also identifies and saves the desired species, and avoids or minimizes damage to the stand.
- The logger can choose wildlife trees and snags and protects them during harvest. Additionally, the logger avoids soil and water damage and follows the requirements of the Forest Practices Act.
- The logger uses density, size, and spacing as targets for stand management.
- The logger designates skidtrails or cableways to effectively harvest the area and minimize soil compaction and matches equipment and systems to the site and the landowner's objectives.
- The logger communicates with the forester and the landowner, and educates other loggers and crew members about forest ecology and silviculture.

## IS THE NORTHERN SPOTTED OWL WORTH MORE THAN THE ORANGUTAN?

**Donna Dekker-Robertson* and Lauren Fins[1]**

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University of Idaho[1]

There are recognized financial and opportunity costs associated with the reduction or elimination of timber harvest on productive forests. It has recently become clear that there are additional costs associated with harvests foregone, which range from increased pollution to species extinction at distant sites. An appropriate way to mitigate these unwanted costs is to link the foregone harvests at some sites to increased productivity of the renewable wood resource at other sites (Libby, 1994).

Setting aside forested areas from timber harvest in the Pacific Northwest has implications that extend far beyond the region. In the global economy, wood from the Pacific Northwest goes to satisfy demand in markets both in the United States and on the Pacific Rim. The withdrawal of timber supplies in this region requires both the United States and other countries to look elsewhere for their wood. The FEMAT report (1993) assumes

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that Canadian softwood imports will remain stable, but does not consider expected reduction's in British Columbia's annual allowable cut nor the effect of increased timber buying from Pacific Rim nations. As wood demand grows worldwide, there are two likely providers of wood for the future, the tropical rain forests of the developing world and the forests of Siberia.

Tropical rainforests cover, or have recently covered, about 1,037,400,000 acres* worldwide. Some 2,000,000 species are considered to be at risk of extinction as a result of forest disruption and deforestation (Libby, 1994), including those that were recently made extinct as a result of disrupting rainforests. Although the percentage of species that become extinct per area disrupted varies substantially according to the proportion of the ecosystem already disturbed, one can estimate an average area disrupted per disruption-caused species extinction. That is 1,037,400,000 acres divided by 2,000,000 species, or 518 acres per species. Surprisingly to many, the productivity of native tropical forests with respect to harvestable wood is low, typically ranging from about 205 to about 480 board feet per acre per year (bd ft/acre/yr). About 345 bd ft/acre/yr is a robust average. By way of contrast, coastal Douglas-fir forests in the Pacific Northwest can grow from 1200 to 4800 bd ft/acre/yr, and in the interior, ponderosa pine can grow from 515 to 2060 bd ft/acre/yr. For that reason, far more hectares of tropical rainforest than Douglas-fir forest must be harvested to produce a comparable amount of wood. And far more species are at risk in the tropics than in the Pacific Northwest.

Lest others believe that the "wood mine" in Siberia holds the answer, Lippke (1991) points out that lands in the Pacific Northwest are 15 times more productive than in Siberia. To replace the estimated 4.7 billion board feet of timber foregone due to set-asides for the northern spotted owl, 1.53 million acres would have to be harvested annually in the Russian forests. Quoted in *Evergreen*, Lippke concluded, "There will be habitat losses on the 1.53 million harvested acres, likely involving endangered species, potentially more than offsetting any habitat gains on the 100,000 acre reduced harvest in the Pacific Northwest." There are no laws mandating reforestation in Siberia.

While substitution of alternative building materials has been proposed, studies have shown that with few exceptions, the alternatives to wood are more harmful to the environment in terms of energy costs, fossil $CO_2$ released, and toxic materials released incidental to their manufacture (Koch 1992). Recycling wood and paper, and reducing the amount of unnecessary wood use, are laudable efforts but are insufficient to deal with the magnitude of the demand. For that reason, timber production needs to be intensified on many acreages, including some lands within the national forests, to meet that demand while offsetting the impact of lands withdrawn from timber harvest.

In 1909, New Zealand found itself in about the same situation as we find ourselves today in the Pacific Northwest. The export of native woods was an important component of the economy, but the annual cut had peaked in 1905 and begun to decline. A Royal Commission determined that changes in logging practices or milling techniques could not reverse this decline. In 1913, another Royal Commission found that New Zealand could not meet its anticipated domestic wood needs by selective cutting in the remaining native forests, and recommended that an aggressive program of intensive forest plantations be initiated. Today, New Zealand meets 100% of its net domestic wood needs from plantations, and about 30% of its original native forest is now in protected reserves. Furthermore, for every unit of wood used at home, another is shipped overseas. Unlike the United States, most conservation organizations in New Zealand strongly support the plantation program, recognizing its part in saving both local and tropical native forests.

At present, world wood demand is increasing by 2.97 million board feet every hour, or 27.1 billion board feet every year. Over the next 20 years an additional 32.6 billion board feet **per year** will be required to meet the demand. In other words, we need to find another British Columbia or 6 more New Zealands to harvest **each year**. A critically important point to remember is that in the next century, humankind is expected to double its numbers to 10 or 11 billion people. The present poorest one billion will increase to 5 billion (Piel 1992). Their increasing demands on their own forests for fuelwood, coupled with emerging environmental programs in the developing world, will curtail or stanch entirely the flow of timber from these countries to the United States (O'Laughlin, 1994). For that reason, it is important to act now to establish plantations of genetically improved, fast-growing, well-adapted trees that are resistant to diseases and insects, and that will meet our own wood demands in the next century. *(* NOTE: English measurements have been used to assist Americans in conceptualization, but is another indication of how "local" rather than "global" our thinking is.)*

## RESEARCH ON NONLETHAL APPROACHES TO WILDLIFE REFORESTATION DAMAGE REDUCTION

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There is a diverse flora and fauna in interior forests of the Pacific Northwest. Some species of mammals pose a hindrance to successful reforestation. For example, pocket gophers (*Thomomys* spp.) clip or debark seedlings and roots; deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) trample seedlings, and browse and antler rub seedlings and saplings. A wide array of protective measures are available to reduce these types of damage, but they are not equally effective, equally priced, or equally acceptable to the public. We are conducting research on nonlethal approaches to reduce damage by deer and elk and by pocket gophers. Approaches under investigation for deer and elk include repellents (predator odors, plant extracts, and other potential compounds) and immunocontraception. We may also investigate various electronic devices. To reduce pocket gopher damage we are investigating systemic and contact repellents,

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physical barriers, land use practices such as sheep grazing, and the selection of site preparation methods that reduce habitat quality for gophers. Several of these approaches appear promising, based on preliminary trials; however, many specific problems need to be resolved. We are also awaiting the results of long-term field trials.

## TIMBER HARVEST PLANNING SYSTEM

**Jack Cullen**

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The Washington State Department of Natural Resources (DNR) has been producing operational timber harvest plans since 1990 with an integrated planning system using computer technology. Primary system functions are: logging setting location; physical harvesting feasibility analysis, transportation system location; timber harvest scheduling; and economic analysis of generated alternatives. Planning methodology integrates technology, procedures, human and organizational factors to enhance system utility and user acceptance. The system is constructed from off-the-shelf software modules using a personal computer version of ARC/INFO to move data from one module to another. The flexible, modular design of the system allows incorporation of new technology and procedures as they are developed. Two principal modules incorporated into the current system are the USDA Forest Service PLANS and SNAP programs. The system interfaces with and uses data from the DNR geographic information system. The system supports the DNR large-scale landscape planning process. Cooperative development and production projects with University of Washington faculty and students have enhanced DNR system development efforts. Development continues using prototyping, designed field tests and production projects.

## LEADING OUT IN ECOSYSTEM MANAGEMENT

**David J. Wright**

Idaho Panhandle National Forests, 1201 Ironwood Drive
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Empowered by the Chief of the Forest Service of the U.S. Department of Agriculture to "Lead Out In Ecosystem Management," the Idaho Panhandle National Forests have adopted an Aquatic Ecosystem Strategy designed to focus management activity of the Forest. Using a watershed based analysis process, ecosystems have been identified which are critical habitats to native fish communities of North Idaho and the Upper Columbia River Basin. The Forest is moving forward in assessing existing resource conditions in each river basin ecosystem and identifying desired future conditions. Simultaneously, the Forest is implementing projects at a watershed level to improve vegetative health, watershed health, and fish and wildlife habitats. By continuing analysis while implementing projects to deal with known problems, the Forest can adaptively manage to facilitate timely management based on actual experience. This strategy is designed to accommodate future management issues and discovery in a pro-active manner. Examples of projects currently underway are depicted in a series of captioned photographs and maps. Activities displayed include road obliteration, fish habitat improvement in streams, vegetative treatments and associated work activities.

## ARTIFICIAL CAVITY NESTING STRUCTURES IN MANAGED SECOND GROWTH TIMBER STANDS

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The importance of snags to wildlife has been well documented in recent years by a variety of authors (Brown, et al., 1985; Thomas, et al., 1979; Davis, et al., 1983; Bull and Meslow, 1977). Over 100 species of birds and mammals use snags during some portion of their life cycle, with 53 of these species cavity-dependent (Brown, et al., 1985). Cavity-nesting birds usually account for about 30-45 percent of the bird population in forested areas, but can account for as many as 66 percent (Snyder 1970, 1971, 1972). The harvest of old growth timber has reduced the number of snags available for primary and secondary cavity nesters (Hams, 1984). Cunningham and Balda (1980) determined that the number of suitable nesting cavities limits population size of cavity nesters. In 1977 the USDA Forest Service adopted a policy of retaining or creating snags in order to maintain a viable, self-sustaining population of cavity nesting species. In an attempt to compensate for lack of snags in managed stands, artificial cavity nesting structures, of various sizes and types, have been installed in recently thinned second growth stands in the South Fork Thinning sale on the North Bend Ranger District of the Mt. Baker-Snoqualmie National Forest.

Tree topping and girdling appear to be the most successful techniques for snag creation (Bull, 1986; Conner, 1980). Snag creation will only be effective for secondary cavity nesters if a primary cavity nester excavates a suitable nest site. Artificial cavities which simulate the desired nesting cavities selected by secondary cavity nesters may facilitate and expedite secondary cavity creation. Cavity nesting boxes for bats, flying squirrels, passerines, small owls, and wood ducks have been installed in a variety of spatial locations throughout units, such as next to edges, closed canopy managed and unmanaged stands, riparian and wetland corridors and interior thinned areas. Cavities and cave starts have also been created inside trees and face plates installed for assisting in viewing species nesting attempts. Nest platforms for large raptors such as osprey and bald eagle have been installed adjacent to rivers and lakes. Tops of trees have been blasted, topped, and girdled using a variety of methods, to create

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snags. Modifying snags to reduce safety hazards while still providing some snag habitat in campgrounds and other areas of high safety concern is a priority for manipulation. Monitoring use of these artificial nesting structures by location and species will assist in determining the most appropriate structures to focus supplementing cavity nesting habitat in the future.

## MAINTAINING WILDLIFE HABITAT OVER TIME IN MANAGED FOREST STANDS

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**Retain and Maintain Habitat:** An emphasis of forest management on the Darrington District of the Mt. Baker-Snoqualmie National Forest has been the design of projects to retain or maintain habitat for wildlife and sensitive plant species. Thinned second growth stands (Bench Thin, Dubor and Dontbor, and Whitehorse Thin) have included provisions for connecting habitat as well as prescriptions for stand development toward structure found in late-successional stands.

1. Large diameter trees are retained by setting upper diameter limits for take trees based on stand data to retain the dominant trees. This also assists in "clumping" of trees in a more irregular pattern of leave trees.
2. Multi-layer canopies are encouraged by retaining a portion of the understory (lower diameter limits on take trees) and leaving the hardwoods. Hardwoods provide species diversity, nitrogen fixation (alders), and are expected to provide cavities and snags as the stand matures and hardwoods are shaded out. "Favored species status" is also used to retain desired species, such as western white pine, or sitka spruce in stands of primarily western hemlock and Douglas-fir. Western red-cedar is another species often retained for diversity, especially on sites with large cedar stumps. Use of favored species status provides variety in the stocking and canopy layers.
3. Large woody material is maintained by limiting take of the down material. Another tactic for maintaining woody material is the use of prescriptions or targets of down material which may include cutting trees for specifically meeting size class distribution of large woody material on the forest floor.
4. Snags are retained in the riparian areas, connecting habitat, and with leave pockets around some snags. Timber sale administrators have worked with the sawyers to maintain safe working conditions while leaving snags where possible.

These design elements are some examples of the Forest's attempt to meet wildlife habitat needs over the rotation of the stand. Even with these design elements, snags or wildlife trees are removed due to safety concerns and the mechanical treatment of the stand. The creation of artificial structures has been used to supplement the wildlife structure needs in the short term.

**Wildlife structures - Mimicking nature:** Snag creation has included traditional tree topping and girdling with use of chain saws and climbing equipment. Variations of these techniques used on the Forest include the following:

1. Flap—chain saws are used to cut a "flap" by cutting into the bark and a portion of the surface wood, from three to thirty-six inches wide, and thirty-six inches tall. This creates a wedge opening under the bark (gap kept open by stick wedged in top of cut) for potential use as bat roosts. Flaps can be located most anywhere on the tree, preferably with several on different sides of the tree and at different heights for variety in temperature regimes.
2. Packing, caving and bark removal in patches—chain saws are used to create entry starts in the bark for fungus and may serve as a visual stimuli to primary excavators.
3. Strikes—Slits are cut with chain saws to simulate cracks or fissures in the bark. Cuts are from two to three inches wide to fifteen inches wide, and several feet long to mimic trees with large cankerous opening. Cuts made in live trees need to be of sufficient size so edges heal, but do not seal over.
4. Cavity tapping—Access opening were cut in trees found to be hollow or rotten with no visible entry point. The creation of a visible entry point may stimulate interest from both primary and secondary excavators, as well as provide potential roost opportunities.
5. Crown flapping—The dead tops of trees are often preferred perch sites for raptors. Chain saws were used to cut flaps around the trunk in the upper quarter of the tree to girdle the tree and providing a snag top, while also creating wedge openings in the bark for possible bat roosts.
6. Limbing—Removing a number of the upper branches (limbing) takes some of the "sail" out of a tree's crown so it is less apt to be blown down in a windstorm. The more open crown of the limbed trees have been used as hunting perches by raptors and staging areas by bald eagles.

While these are some of the additional techniques used by the Forest for creating snag and wildlife tree conditions, the maintenance of forest structure to provide natural homes and foraging conditions is the primary goal for management of wildlife habitat over time.

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# THE WHITE SAND ECOSYSTEM MANAGEMENT PROJECT "PUTTING ECOSYSTEM MANAGEMENT INTO ACTION"

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The White Sand Interdisciplinary (ID) Team examined ecosystem composition, structure, and function in the White Sand Planning Area just south and east of the Powell Ranger Station in Idaho County, Idaho. The ID Team sought to understand the historic range of ecosystem variability while considering public desires for management of the White Sand area. Landscape level desired conditions were developed by comparing knowledge of ecosystems to Clearwater Forest Plan direction. This hierarchical analysis considered broad landscapes beyond ranger district boundaries and individual sites.

Using a landscape analysis and design process developed by Diaz and Apostol, Pacific Northwest Region USDA-Forest Service, the White Sand ID Team proposed landscape scale desired conditions, called target landscape patterns. Target landscape patterns are not new Forest Plan allocations but are criteria for developing site-specific management prescriptions that meet desired landscape patterns. They reflect local ecosystem patterns and processes and social desires.

Site-specific possible management activities were proposed that would change the existing condition of the area to be more like the desired condition. The wide variety of possible management activities included fish habitat enhancement, timber harvest, vista creation, visual rehabilitation of existing harvests, construction and reconstruction of roads and trails, and management of road and trail access. Ecosystem analysis, Forest Plan direction, landscape level desired conditions, and possible management activities are all displayed in the White Sand Integrated Resource and Ecosystem Analysis document, also called the White Sand IRA.

Findings of the White Sand IRA defined the purpose and need for action, the framework for any management activities that would be proposed. The findings of and public responses to the White Sand IRA were used to propose management actions for the next 10 years. Selection of this "proposed action" from the larger list of possible management activities in the IRA provided the starting point for considering site-specific ways to manage the White Sand landscape over the next decade. The proposed action integrates social needs and expectations with the ecological capabilities of the land. The purpose and need for action, proposed action, and initial issues are displayed in the White Sand Ecosystem Management Project Position Statement document.

Upcoming events relevant to the completion of planning efforts for the White Sand area include public meetings to develop alternative management schemes for consideration in an Environmental Impact Statement (EIS), field evaluation of proposed activities, estimation of potential effects of the alternatives, public review of the draft analysis and preferred alternative, and a decision for implementation of one alternative. Monitoring of key resources and ecosystem response to the selected alternative will set the stage for possible changes to management practices in the future. This site-specific application of Ecosystem Management principles will help the Forest Service answer questions about integrating resources and managing for the long-term.

# MANAGING WILDLIFE IN FOREST ECOSYSTEMS: EXPLORING CRITICAL PROCESSES AND INTERACTIONS

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Managing forests using the emerging principles of landscape ecology and sustainable ecosystem management requires new information and better tools for forest wildlife managers. We describe critical information gaps greatly impacting forest management in the future. Forest managers need better capabilities to predict both short- and long-term changes in wildlife populations under a broader range and mix of habitat conditions. Wildlife habitat and ecosystem performance models urgently require validation and support from monitoring and evaluation efforts. Some of the most important information needs include:

- identifying clear regional biodiversity management objectives to promote coordinated management efforts across artificial landscape boundaries
- identifying critical habitat components for a broader range of species
- establish effects of integrated pest management, changing fire regimes, and reducing energy/chemical inputs on wildlife habitat
- formulating techniques for restoring degraded habitats
- focusing on spatial and temporal habitat relationships of wildlife populations, including population viability analysis and habitat requirements for migration and dispersal
- understanding the impacts of herbivory and predator-prey relations as ecosystem processes
- managing carnivores, threatened and endangered populations, and resolving conflicts with overabundant wildlife populations impacting other rare or sensitive species

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## CENTER FOR SUSTAINING AGRICULTURE AND NATURAL RESOURCES

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Concerns about the long-term sustainability of our current natural resource management practices are leading to changes within the public land-grant institutions. Responding to state-wide support for programs focusing on the environment and Washington agriculture, the Washington legislature authorized the establishment of the *Center for Sustaining Agriculture and Natural Resources (CSANR)* at Washington State University in 1991. The Center was formed within the College of Agriculture and Home Economics to provide a focal point for addressing the issues of agricultural and natural resource sustainability.

The Center's primary mission is to preserve the quality of the Washington State's food supply and environment while enhancing the economic viability of farms and rural areas. The Center serves a leadership function and acts as a resource center to improve the effectiveness of public efforts towards sustaining agriculture and natural resources. The Center recognizes that increased public education and dialogue are crucial to solving resource conflicts in the state. It is working to engage a broad range of interest groups in coalition building. Among the Center's goals is providing coordination and integration with the College of Agriculture and Home Economics and the Washington State University system, with other institutions and state agencies, and with different farmer, consumer, industry, and environmental groups.

During a series of open town meetings, Washington State residents concerned with the preservation and enhancement of Washington's natural resources helped the Center to establish priority interests and activities and to identify persons representing diverse interest groups to participate in a state-wide CSANR advisory system.

Currently, the Center is involved in the following activities:

- **Composting Research and Education Program** including: annual composting conferences, composting seminar series, composting course for undergraduate and graduate students, laboratory compost research, and establishing an on-campus composting site for composting of university generated bio-wastes and coal ash.
- **Developing an Inter-University Agroecology Program** involving several of Washington's academic institutions. The program will combine the educational resources of several universities and colleges to develop an interdisciplinary study program providing students instruction and experience in social, biological, and physical sciences pertaining to sustainable agriculture.
- **Co-Sponsoring Regional and National Conferences on Sustainable Resource Management** including Composting on the Palouse; Science and Sustainability: Reshaping Agricultural Research and Education; the 1994 Farming for Profit and Stewardship Conference, and Ecosystem Management in Western Interior Forests.
- **Information and Networking to Promote Sustainable Food Systems** through facilitation of on-farm problem-solving, computer sustainable agriculture information update services, and proposal development with diverse food system stakeholder groups.

## BALANCING FOREST ECOSYSTEMS AND WILDLIFE ON PRIVATE LANDS

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Ownership patterns in Washington indicate that approximately 50% of non-federal forest lands (approximately 4.4 million acres) occur as nonindustrial private forest owned by approximately 40,000 people. These lands are often in river bottoms and other low land forest areas encompassing riparian areas and other important habitats critical for fish and wildlife not always well represented on Federal forest lands.

Surveys have shown nonindustrial forest landowners own their land for values other than fiber production, including fish, wildlife and aesthetics. However, these landowners do not always have needed resources or expertise essential for planning and implementing practices that provide for their goals.

The Forest Stewardship Program, established in 1990 attempts to bridge this gap by providing education, technical assistance and monetary incentives to assist nonindustrial private forest landowners to manage their woodlands to meet their goals and objectives soundly. Emphasis is placed upon ecosystem management rather than traditional forestry where fiber production is the primary objective. Forest Stewardship is a voluntary program funded by the U.S. Forest Service, administered by the Department of Natural Resources and utilizes expertise provided by the Department of Fish and Wildlife and other trained professionals.

Recognizing that forest ecosystems are dependent upon countless elements and processes, Stewardship personnel work with private landowners to define and manage for components such as wildlife trees. Wildlife trees provide structural complexity to forest stands, function as nests, roosts, dens, perches, and feeding sites for over 127 animals native to this area. Decay of such downed wood provides litter to the forest floor, recycling nutrients and providing shelter and foraging substrate for various ground dwelling organisms. Interrelationships between fungi, downed wood, snags, and species diversity are managed for by such measures as maintaining downed wood, nurse logs, snags,

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and artificial structures which can mimic nest sites selected for by bird, bat, and small mammal species. Difficult concepts such as the relationship between habitat diversity and fragmentation and impacts on wildlife are addressed between neighbors within a watershed and management plans developed which mitigate adverse affects upon wildlife.

Historically, numerous forested areas have been converted to agricultural land and vacant lots. Forest Stewardship encourages such property owners in the restoration to a functioning forest by making planting recommendations given the type of plant associations that occur on adjacent less disturbed areas.

The first step in having a Stewardship Forest is the development of a management plan which guides the landowner in their objectives. Workshops and consultations are available from Stewardship personnel in the planning process. Cost share money for implementation of practices outlined in the plan are available for reforestation, soil and water protection, riparian and woodland protection, and fish and wildlife habitat enhancement projects.

For instance, recognizing that an understanding of forest ecosystems is vital to maintaining fish and wildlife, biologists work with foresters, trained woods workers, and landowners to provide fish and wildlife habitat.

Cavity nesting birds and bats, which contribute to insect control, may decline in numbers if insufficient numbers of dead trees and nest sites are available. In order to maintain such species, snags, artificial cavities, and bird boxes can be created or built. Flanges may be created in live trees to provide housing and roost sites for bats, which in turn act as predators on night flying insects. Platforms may be erected to provide hunting perches for hawks, which assist in rodent control.

Downed wood is retained in order to provide housing for amphibians, small mammals, foraging opportunities for woodpeckers, and display areas for grouse. Loafing platforms for turtles and loons would be appropriate enhancement measures for loons and turtles in lakes. Salmon habitat can be enhanced by creating pools which provide over wintering habitat. Other stream enhancement measures include fencing riparian areas from livestock, planting eroding slopes and streambanks with native vegetation.

Maintenance of fish and wildlife habitat in conjunction with some timber harvest is a challenging proposition. Forest Stewardship personnel work with landowners to find the solutions that are right for them and their forest.

# WASHINGTON FOREST STEWARDSHIP PROGRAM

**Steve Gibbs**

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The Forest Stewardship Program is a nationwide program designed to assist nonindustrial private forest landowners in managing their properties using an integrated multi-resource approach. Emphasis is on attracting new landowners who have not previously managed their forests. The program is funded by the USDA Forest Service and is administered by the Washington Department of Natural Resources (DNR) in close cooperation with the Washington Department of Fish and Wildlife, WSU Cooperative Extension, USDA Soil Conservation Service, local Conservation Districts, private sector natural resource consultants, and several other organizations.

The program consists of four primary components:

- **Technical Assistance**—DNR and SCS forests, and a Department of Fish and Wildlife Biologist, provide on site advice and planning assistance to landowners.
- **Financial Assistance**— The stewardship Incentive Program (SIP) can help reimburse landowners for a variety of multi-resource enhancement projects.
- **Educational Assistance**—Washington State University Cooperative Extension conducts a statewide Forest Stewardship Education Program for NIPF landowners.
- **Recognition Program**—Landowners who actively implement the management recommendations in their Forest Stewardship Plan are eligible for "Stewardship Forest" recognition.

For more information contact any Washington Department of Natural Resources offices or write to: **Forest Stewardship Program, WA-DNR, P.O. Box 47046, Olympia, WA 98504-7046.**

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## INTEGRATION OF GIS AND ECOSYSTEM PROCESS MODELS FOR SITE-SPECIFIC SIMULATION OF BLISTER RUST HAZARD IN NORTHERN IDAHO WHITE PINE FORESTS

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Multidisciplinary interest in the integration of spatial and mathematical models for simulation of ecological processes is increasing, but development of such systems has aged because computer hardware and software lacked the necessary power to accomplish it. Today, the proper tools exist. The use of computer programming software to develop linkages for the integration of a geographic information system (spatial) and an ecosystem process model (mathematical) enable computer simulation of a blister rust epidemic on western white pine. Newly programmed modules transferred data and passed command line parameters within and among the components of the hazard simulator to achieve the desired level of integration. The quality of the linkages and usefulness of the graphic output for support in pest-management decision-making determined the success of the developed product.

## TIMBER HARVESTING RESIDUE TREATMENTS: SOIL, MICROSITE, NATIVE PLANT AND CONIFER SEEDLING RESPONSES

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Logging slash, created during harvest of coniferous forests in Eastern Washington and Oregon, has traditionally been burned prior to planting. While slash burning reduces fire hazard and creates openings for planting, increasing concerns about smoke pollution and loss of nutrients are restricting the use of fires for residue disposal. This study examined alternative slash disposal methods in mixed conifer forests at four sites on the eastern slopes of the Cascade Mountains of Washington. Slash treatments consisted of: 1) chopping, 2) piling and burning, 3) fall broadcast burning, 4) spring broadcast burning, 5) pulling merchantable material (PUM), and 6) leaving slash. Plots were planted with either Douglas-fir (*Pseudotsuga menzesii)* or lodgepole pine (*Pinus contorta)* depending on location. Soil pH, total nitrogen, temperature, and bulk density were examined for treatment effects. Seedling performance was evaluated using survival rates and height growth. Treatments had little effect on soil pH or total N in the B horizon and had variable effects on the O horizon. Some increases in bulk density of the B horizon were observed, but not at all sites or with all treatments. First-year survival was good for all treatments at all sites with the exception of the PUM treatment which had 80% survival at one site and the chop treatment which was 70% survival at another site.

## AMERICAN TREE FARM PROGRAM

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The American Tree Farm Program started right here in Washington state back in 1941. The purpose was, and still is, to recognize landowners who are actively managing their property for long-term production of wood fiber, fish and wildlife habitat, water quality, and recreational value. Now, more than 50 years later, the American Tree Farm System has over 70,000 members in all 50 states. Currently, over 1,200 certified Tree Farms are certified in Washington.

The American Forest Foundation sponsors the program nationally. In Washington, the Washington Forest Protection Association sponsors the program.

Any landowners who own 10 or more acres, have a written management plan, and have demonstrated significant forest management accomplishment, can apply to have their property certified a Tree Farm.

Landowners who are interested, but have not yet had significant "on-the-ground" management accomplishment, can be enrolled as "pioneer" Tree farmers. Management must be compatible with wood fiber production; however, this need not be the landowner's primary objective.

Certified Tree Farmers receive free Tree Farm signs, a Tree Farm Certificate, and a free subscription to the national Tree Farmer Magazine.

Interested Tree Farmers are eligible to compete for annual County, Area, State, Regional, and National Tree Farmer of the Year Awards. All Tree Farmers are invited to attend the annual Washington Tree Farm Award banquet each fall.

The process for becoming a "Tree Farmer" is simple and has no cost to you. Many foresters volunteer to do Tree Farm certification inspections. Your local DNR Forest Landowner Assistance Forester can do the inspection. Volunteers from local chapters of the Society of American Foresters also do many inspections. To arrange for a forester to contact you, call or write to: Washington Tree Farm Program, Washington Forest Protection Association, 711 Capitol Way, Suite 608, Olympia, WA 98501 (206) 352-1500.

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# AMERICAN FORESTS' FOREST ECOSYSTEM HEALTH INITIATIVE: RAISING PUBLIC AWARENESS AND PROMOTING CONSTRUCTIVE POLICY DEBATE

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Over the past three years, AMERICAN FORESTS has focused significant energy on a national information and policy initiative concerning forest-ecosystem health in the Inland West. We have worked with scientists, federal and state resource managers, private forest industry, and environmental organizations to help define the nature of the region's forest-health problem, identify the environmental, economic, and social implications presented by existing resource conditions and past activities, and to develop policy and management responses that would help restore more socially desirable ecological conditions in the region's forests. Our goal is to heighten public awareness and provide a common base of information in order to promote constructive policy debate and move toward effective policy action both regionally and nationally. It is our hope that policy and management responses developed in the Inland West can serve as a model for efforts to restore and maintain forest-ecosystem health in other regions of the U.S.

We chose to focus on the Inland West because forest-health concerns in the region were becoming widely recognized and creating a sense of urgency. Symptoms of the problem, such as historically unprecedented forest age-class structures, species composition, and stocking levels, as well as increasing insect and disease activity, tree mortality, and wildfire risk, were widely accepted. And, past activities that resulted in these conditions—fire suppression, logging, and grazing—were generally agreed upon by scientists and resource managers. We believe that this setting provides an important opportunity for defining and demonstrating an ecosystem-management approach which attempts to balance environmental, economic, and social objectives. In addition, an initiative focusing on the unique ecological conditions for the Inland West forests, which vary substantially from the Pacific Northwest forests, will help inform the public and policymakers that ecosystemæmanagement approaches will vary from region to region.

Our forest-ecosystem health initiative combines AMERICAN FORESTS' activities in the areas of policy research, policy advocacy, communication, and education. Under the umbrella of our Forest Policy Center, we have organized a number of policy and scientific workshops focusing on forest health in the Boise National Forest, as a case study, and in the more broadly defined Inland West. These workshops resulted in several policy papers and a book which we have used as the basis for briefings and Congressional testimony in Washington, D.C. Our policy advocacy program has worked, at the request of Congressional leaders, to develop dialogue among various interest groups and to help draft legislation that may serve as a vehicle to address forest-ecosystem health concerns. Our communications staff has worked with regional and national media to convey policy information on the issue and encourage broad coverage. And, our magazine, *American Forests*, and policy newsletter, *Resource Hotline,* have featured regular stories and editorials on our forest-health efforts as well as those being undertaken by others in the Inland West. We are committed to this forest-ecosystem health initiative, and to seeking cooperative efforts to promote constructive policy debate and action to improve resource conditions in the Inland West.

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