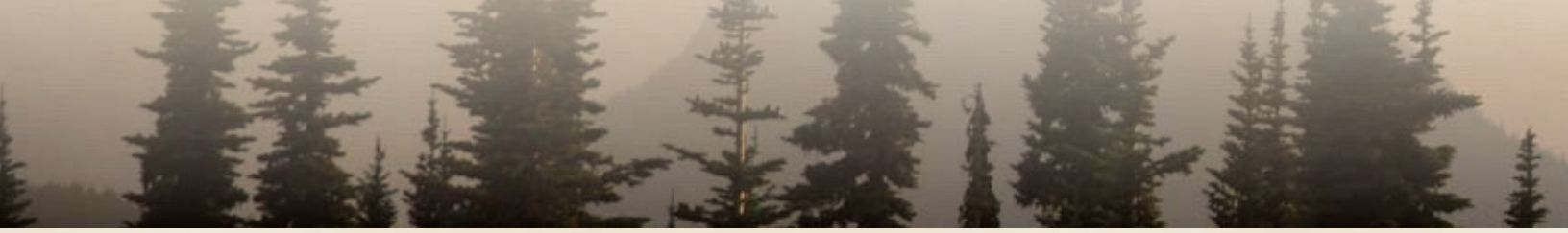
Annual Progress Report 2007

Interagency Regional Monitoring & Research Accomplishments

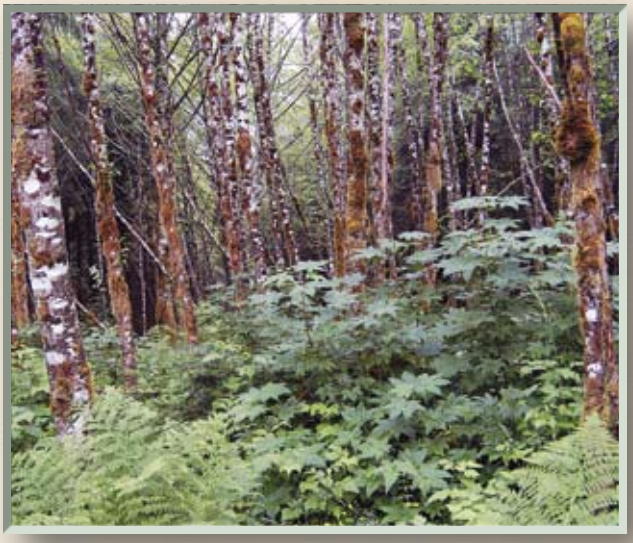
Northwest Forest Plan



Summary

The 1994 Record of Decision (ROD) amended all Bureau of Land Management and Forest Service land and resource management plans in California, Oregon, and Washington within the range of the Northern Spotted Owl. In additionto establishing new management direction for federal forests, the ROD provided a framework for interagency monitoring. This document reports annual accomplishments of recent and ongoing monitoring and research efforts within the range of the Northern Spotted Owl.

Photo Credit: Charlie Crisafulli



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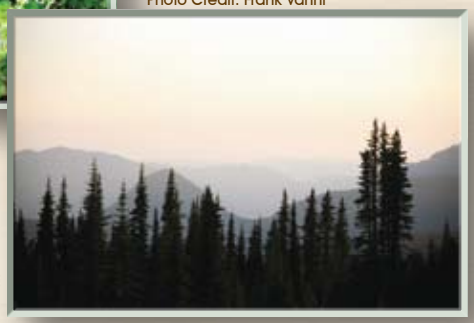
Overview

Photo Credit: Sara Jovan

In March 2006, the Regional Interagency Executive Committee (RIEC) identified sixteen Priority Questions to guide regional monitoring and collaborative research investments within the range of the Northern Spotted Owl. They also developed an overarching regional management objective and strategic fundamental objectives. Priority Questions are tiered to the fundamental objectives of the ROD. They are strategic because they will drive learning activities that address key agency decisions and are designed to focus monitoring and research investments over the next 10 years. These questions represent the issues deemed most pressing, both currently and in the future by the RIEC

Photo Credit: Frank Vanni



At the RIEC's request, this annual report summarizes annual accomplishments from monitoring and research activities that tier to Priority Questions. The Priority Questions accomplishments are part of a revised Adaptive Management strategy, and will be reviewed annually by the RIEC to determine if changes in management policies, standards and guides, or priority questions may be warranted. The Monitoring Accomplishments and Research Accomplishment sections are organized by the sixteen Priority Questions.

Annual progress report 2007

Regional Management Objective:

Sustain northwest forest and rangelands for a broad spectrum of social, economic and ecological values for present and future generations.

1994 ROD Purpose and Need:

- Provide for healthy forest ecosystems with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests) that includes protection for riparian areas and waters.
- Produce a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable and long-term basis.
- Take an ecosystem approach to forest management, with support from scientific evidence, and meet the requirements of existing laws and regulations.
- Improve cooperation between all federal agencies involved.

Strategic Fundamental Objectives

I. Healthy ecosystems
   - Restore watershed condition
   - Maintain and restore old growth habitat
   - Maintain and restore habitats for terrestrial and aquatic species
   - Provide for recovery of listed species
   - Reduce fire risk
   - Reduce risk of loss of habitat from other outside factors(insects, disease, etc)

II. Human dimension and quality of life
   - Produce a predictable & sustainable supply of timber
   - Provide non-consumptive goods and services

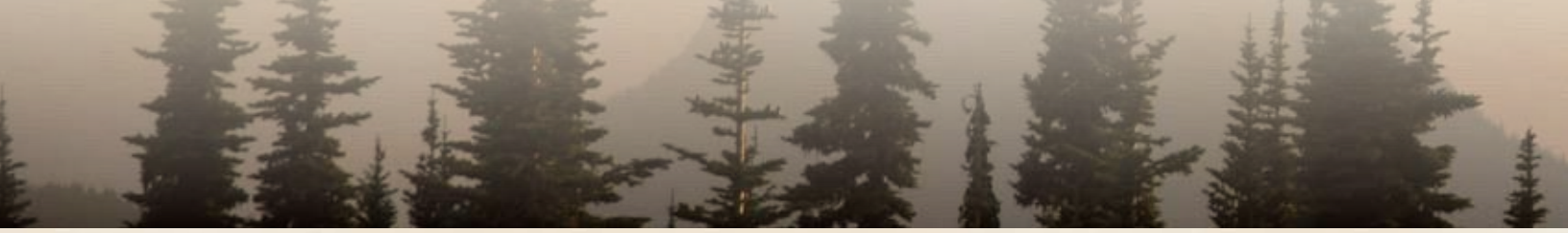
Priority Questions

Management questions best answered by monitoring:

- What is the status and trend of watershed condition?
- What is the status and trend of late-successional old-growth?
- What is the status and trend of Northern Spotted Owl habitat?
- What is the status and trend of Northern Spotted Owl populations?
- What is the status and trend of marbled murrelet habitat and populations?
- What is the status and trend of socioeconomic well being?
- What is the status and trend of government-to-government consultation?
- Did we accomplish planned activities and comply with standards and guides?

Management questions best answered by research

- What is the status and trend of watershed function and how do management actions affect watershed processes and condition?
- How can landscapes be managed to provide for biodiversity and resiliency?
- How effective is federal land management, including the reserve system, in providing for conservation of listed and non-listed species?
- What are the relationships between NSOs, barred owls, and other stressors that will affect populations of NSO?
- What are the relationships between marbled murrelet status & stressors, how does this affect nesting distribution, and can habitat models effectively predict where murrelets nest?
- How is the distribution and abundance of forest habitat changing as a result of climate change and the interactions with fire, insects, disease, and other disturbances?
- What are the effects of fire on ecosystems, and how can restoration activities (pre-fire and post-fire) reduce the adverse risks of fire to ecosystems and communities, and achieve desired forest habitat conditions?
- How well has federal forest management provided for environmental qualities and values associated with late-successional, old-growth, and aquatic ecosystems?



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Monitoring Accomplishments

The federal agencies have developed an effectiveness monitoring program for the areas within the range of the Northern Spotted Owl, encompassing 24.5 million acres of federal land managed by the Forest Service, Bureau of Land Management, and National Park Service in western Washington, Oregon, and northwest California. This monitoring is focused on important regional-scale questions about older forests, listed species (northern spotted owls, marbled murrelets), watershed condition, relations between federal agencies and Tribes, changing socioeconomic conditions in communities closely tied to federal lands, and compliance with meeting Plan standards and guidelines. Monitoring accomplishments are reported below for the management questions best answered by monitoring.

Photo Credit: Tom Iraci

Monitoring Accomplishments

Management Questions Best Answered by Monitoring

What is the status and trend of watershed condition?

The watershed monitoring module (also known as the Aquatic and Riparian Effectiveness Monitoring Program or AREMP) was developed to determine whether the Northwest Forest Plan's aquatic conservation strategy is achieving the goals of maintaining and restoring the condition of watersheds.

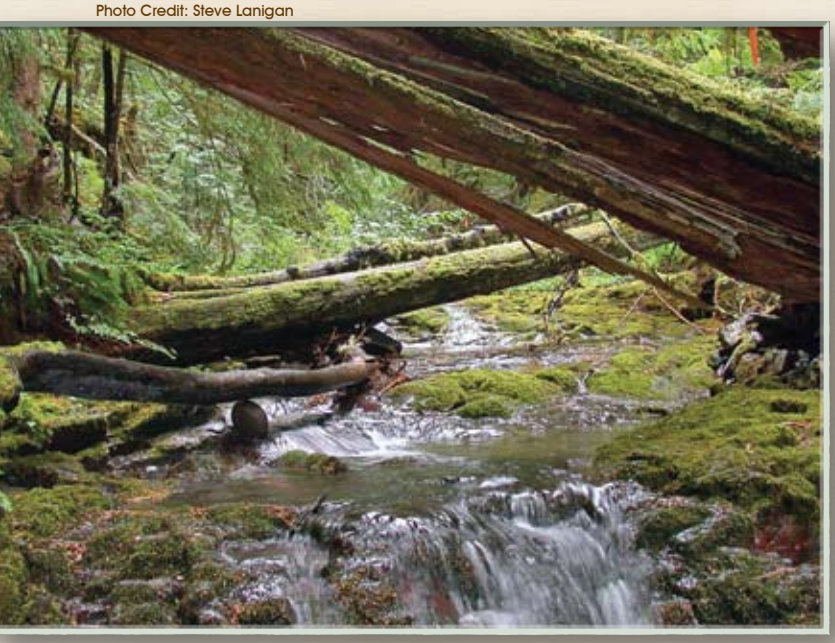
2007 Accomplishments

Highlights of Aquatic and Riparian Effectiveness Monitoring Program (AREMP) accomplishments during the 2007 fiscal year include:

Responding to new direction from Interagency Executives

- Now assessing the condition of every sixth-field watershed in the Plan area that has at least 25% of the stream length in federal ownership (about 1,400 watersheds) using a combination of GIS, remote sensing, and field data. Previously, 250 randomly watersheds were randomly selected to make inferences about watershed conditions within the planning area.
- We continued to align AREMP with the PacFish/InFish Biological Opinion monitoring program (PIBO) by standardizing/refining a core set of protocols and working with PIBO and local units to develop decision-support models in eastern Oregon and Washington.

Photo Credit: Steve Lanigan



Assisting local units in the use of decision-support models

- Identified key watersheds during the Forest Plan revision process.
- Determined fish sustainability based on species distribution and population trends, and habitat condition.
- Determined the likelihood of successfully reintroducing bull trout in the Clackamas River basin.

Continuing to refine the decision-support models used to assess watershed condition

- Developed a landslide model to determine the topographic features associated with landslides and the effects of land management on landslide frequency.
- Determined what macroinvertebrate and amphibian metrics will be used in the models.
- Initiated a study to develop relationships between in-channel and upslope indicators to support a Geographic Information Systems (GIS)/remote sensing-based monitoring program.

Completing another successful field season

- Collected stream data from 21 watersheds on physical, biological, and chemical attributes used to assess watershed condition as part of our normal field sampling program.
- Continued our quality control (QC) program by resurveying 26 QC sites and an additional 20 sites first surveyed in 2006 to enable us to use these data to detect changes in watershed condition.
- Participated in a pilot regional aquatic invasive species survey program.
- Utilized Student Conservation Association (SCA) interns as a successful component of the summer field staff.
- Completed a comprehensive review of the attributes we collect to determine whether to continue or modify sampling protocols.

Monitoring Accomplishments

Figure 1: Map of the watersheds surveyed during 2007 summer field season. Watersheds coded in purple represent those in which initial surveys took place. Watersheds coded in blue indicate watersheds where a site was surveyed in 2006 to assess our quality control efforts and then was resurveyed in 2007 for use in detecting watershed condition trends.

Photo Credit: Steve Lanigan

Figure 2: Crews look for terrestrial amphibians along the stream margin of each sampled stream reach.

Figure 3: Large wood must meet a minimum length and diameter in order to be counted.

Photo Credit: Steve Lanigan

Photo Credit: Steve Lanigan

Photo Credit: Steve Lanigan

Figure 4: New Zealand mudsnails, zebra mussels and quagga mussels are invasive species we now sample for. Although these species are sometimes too small to be readily seen in the field, their presence would be detected when the macro-invertebrate samples we collect are processed.

Figure 5: Percent surface fines, which are an indication of spawning success, are measured at pool-tail-crests.

Continuing our participation in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP)

- Participated in analysis of data from a side-by side protocol comparison test for in-channel physical attributes in the John Day Basin, OR conducted during summer 2005.
- Supported the establishment of a Lower Columbia River Recovery Area pilot where state and federal agencies will use a master sample design to determine sampling sites, establish common protocols, and share data for habitat status and trend monitoring.

Looking Ahead

- Conduct aquatic province workshops in 2008 to refine and update the decision-support models used for assessment watershed condition.
- Continue a pilot program for surveying invasive aquatic and riparian species.
- Conduct a pilot watershed assessment for the Blue Mountains aquatic province, in partnership with the PacFish/Biological Opinion Monitoring Program.
- Collect shade measurements to help validate a shade prediction model being developed by US Forest Service and BLM specialists.
- Develop a geo-spatial data base to manage our field data.

Contact: Steve Lanigan, Watershed Monitoring Module Leader, US Forest Service, slanigan@fs.fed.us

Website: http://reo.gov/monitoring/watershed-overview.shtml

Monitoring Accomplishments

What is the status and trend of late successional old-growth?

The Late-Successional and Old-growth (LSOG) monitoring program provides periodic estimates of the status and trend of older forests in the Northwest Forest Plan area. To characterize older forest amount and distribution, we create maps from remotely sensed data, and we analyze data from permanent inventory plots. To assess trends, we map changes to older forests over time from harvests, wildfires, and other disturbances using remotely-sensed information, and also estimate trends from remeasured inventory data.

In the last major reporting cycle, older forest status was assessed on maps created from satellite imagery collected between 1994 and 1996. Using newer mapping technologies, we are in the process of developing a map of current forest vegetation using 2006/2007 imagery. Also in the previous reporting cycle, changes to older forests were assessed at 4- or 5-year intervals between 1994 and 2003. Using a newer remote sensing change detection approach, we are in the process of mapping changes on an annual interval from the start of Northwest Forest Plan(NWFP) implementation in 1994 through the present.

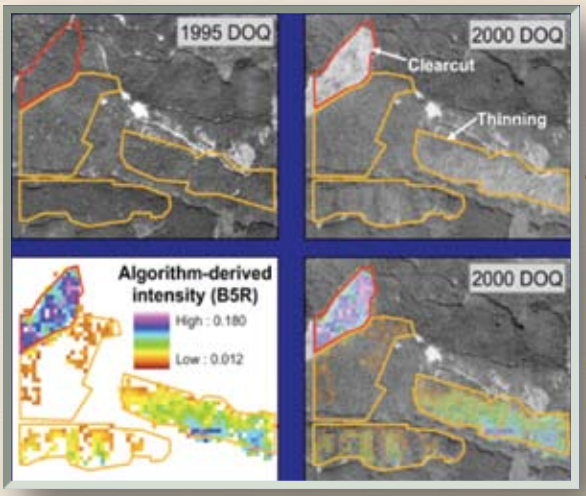


Photo Credit: Steve Lanigan

Figure 2. An example of partial and complete harvests mapped by TB change detection (from Kennedy and others 2007).

2007 Accomplishments

In 2007, the LSOG monitoring program began assembling satellite imagery and plot data to accomplish current vegetation mapping, disturbance mapping, and statistical analysis.

For existing vegetation, we are working in partnership with the Interagency Mapping and Assessment Project (IMAP) and the Pacific Northwest Research (PNW) Station in Corvallis. Using the Gradient Nearest Neighbor (GNN) approach developed by the PNW Station, we are creating a new baseline map of existing forest vegetation at the start of the NWFP. This map uses the same imagery (1994/1996) reported in the initial 10-year status and trends report, but mapped with a newer technology. We are also creating a second map of forest vegetation current to 2006/2007. Having two maps created at two points in time using the same technology will be a first for the monitoring program. It will allow us to move beyond a 'snapshot in time' to true periodic monitoring with repeated measurements. Additionally, maps developed using the GNN approach give us access to a much richer suite of vegetation attributes than we had previously.

To assure consistency with results reported in the first 10-year assessment, we conducted a comparison test of the core attributes mapped using GNN with those mapped using the previous technology (IVMP, or Interagency Vegetation

Figure 1. Remote-sensing based detection of vegetation change is more sensitive to partial harvest under recent technological advances (Trajectory Based Change Detection). Pictured is the Blue Ridge thinning study in Olympia National Forest.

Photo Credit: Steve Lanigan

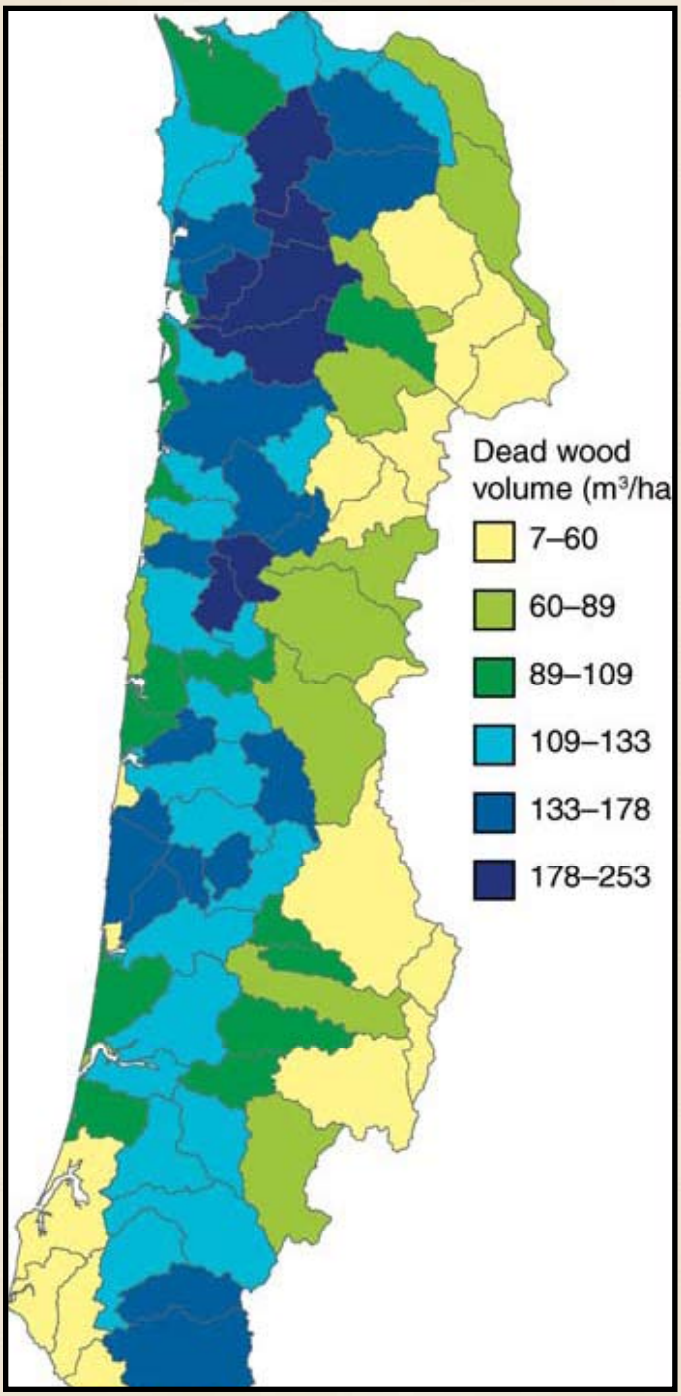


Figure 3. An example of the detail of mapped attributes available from the Gradient Nearest Neighbor approach. This example is from the Coast Range of Oregon (Ohmann and others 2007).

Mapping Project). The test applied both mapping methods to the same 1996 imagery. Results indicated that core attributes (average tree size, canopy closure, storiedness, and covertype) had similar distributions and amounts regardless of whether they came from IVMP or GNN.

Also in 2007, remeasurement was completed for the final panel of permanent FIA/CVS inventory plots in Region 6's Current Vegetation System. Like the repeated vegetation maps, having access to completely remeasured plot data will give us more statistical power in assessing trends over time.

Also in 2007, we piloted a new remote sensing change detection approach developed by PNW Station researchers in Corvallis. The Trajectory Based (TB) mapping approach has two huge advantages over previous methods. First, its efficient algorithm makes use of annual imagery, so that resulting change maps can be assessed annually instead of every 4 or 5 years. Second, while the previous method was reliable only for mapping complete stand-replacing disturbances (clearcuts or severe wildfire), the TB method is sensitive to partial disturbances such as thinning, moderate fire, insect and disease damage, and even recovery (green-up following a disturbance). These features will give us greater temporal and spatial resolution as we assess changes to forest vegetation.

Looking Ahead

Work continues toward completing all vegetation and disturbance mapping will by the end of 2008. Analysis will begin in 2008, and continue through 2009. The results will be reported in the 15-yr assessment to be completed in 2009.

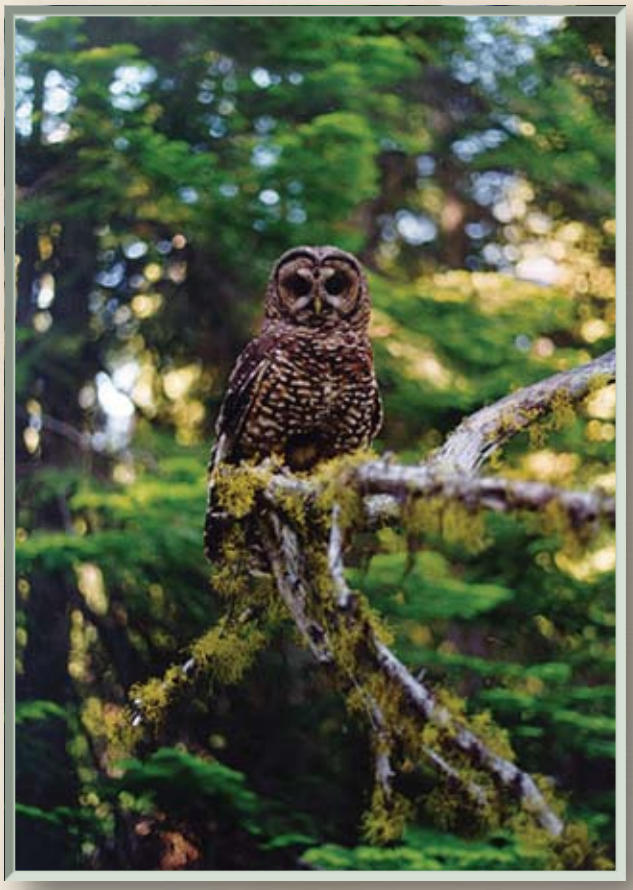
Contact: Melinda Moeur, LSOG Module Leader, US Forest Service, mmoeur@fs.fed.us

Monitoring Accomplishments

What is the status and trend of northern spotted owl habitat? what is the status and trend of northern spotted owl populations?

The northern spotted owl effectiveness monitoring program provides periodic estimates of the status and trend of the owl's population and habitat on federal lands. Population data are collected annually in each of eight, federal demographic study areas distributed across the range of the owl. Biologists attempt to find and mark all spotted owls in these study areas while also gathering information on the age, sex and reproductive status of individual owls. Data from the demographic study areas are analyzed every five years to estimate annual survival, fecundity (number of female young fledged per territorial female) and annual rate of population change (lambda). The last analysis included data compiled through 2003. The next analysis will occur in January of 2009 and assess cumulative data through the 2008 field season.

Photo Credit: Stan Sovern, US Forest Service, PNW Station



The status and trend of owl habitat on federal land is also updated every five years. The habitat analysis uses GIS-compatible data layers on owl locations, vegetation conditions, habitat capability of the federal land, and changes due to wildfire and timber harvest to model the habitat suitability over time. A non-spatial assessment is also conducted using data from the current vegetation survey plots on lands administered by the Bureau of Land Management and the Forest Service. The next analysis to assess the habitat conditions as of 2007 is scheduled for completion in 2009.

2007 Accomplishments

During the 2007 field season, biologists surveyed 1165 sites associated with the eight demography study areas. Occupancy by a pair of spotted owls was recorded at about 39 percent of the sites. The average annual pair occupancy from 2001-2007 was about 46 percent. The count of young fledged during 2007 was 226, which is below the average of 328 young fledged per year between 2001 and 2007. The number of young fledged has been above the average 3 of the last 7 years. Years where the average was exceeded had 492, 445 and 550 young fledged while those years below the average recorded 166, 250, 167 and 226 young fledged.

Dr. Robert Anthony of the U.S. Geological Survey presented information on percent pair occupancy in several of the demographic study areas in Oregon and Washington to executives of the federal agencies (figures 1 and 2). These figures show a continued decline in pair occupancy since the last demographic analysis in 2003.

Monitoring Products

During the 2007 field season, a pilot test of a random plot methodology was conducted to assess the efficacy and cost of this method of monitoring owl populations. Test areas were located on lands in the Wenatchee National Forest in Washington and Willamette National Forest in Oregon. A draft report entitled "Estimating population trend of the northern spotted owl from presence-absence surveys at randomly-sampled plots: pilot study results and implications" was submitted to the Senior Manager's Group for their consideration when determining future spotted owl population monitoring activities on federal lands.

Monitoring Accomplishments

A few of the summary findings of the pilot test were:

- For northern spotted owls, nighttime single-station primary sampling units (PSU's – 1500 ha in size) have higher detection probabilities than for daytime single-station PSU's. However, a daytime survey with just two stations was predicted to have the equivalent detection probability of a single-station nighttime survey.
- For daytime surveys, the estimate of the proportion of PSUs occupied by spotted owls varied from 0.20 on the Wenatchee forest to 0.61 on the Willamette. Probability of detection at a single station on a single visit at either forest was 0.13.
- The report recommend 3 visits to a PSU, and 7 stations per PSU, to achieve reasonable power for detecting trend in proportion of occupied sites over time.
- Results showed that a crew of 2 persons can sample 24 PSUs per season. An example estimate of the survey effort needed for a single area of inference with a 0.6 initial occupancy, showed that in order to detect a 3 percent decline over a 10-year sampling period, 9 crews would need to sample 207 PSUs. The cost for this example was estimated to be $531,000, annually. Costs were shown to increase as the number of inference areas increased and the percent decline to be detected decreased.

Percent of sites occupied by pairs of spotted owls in demography study areas in Oregon and Washington.
Figure 1

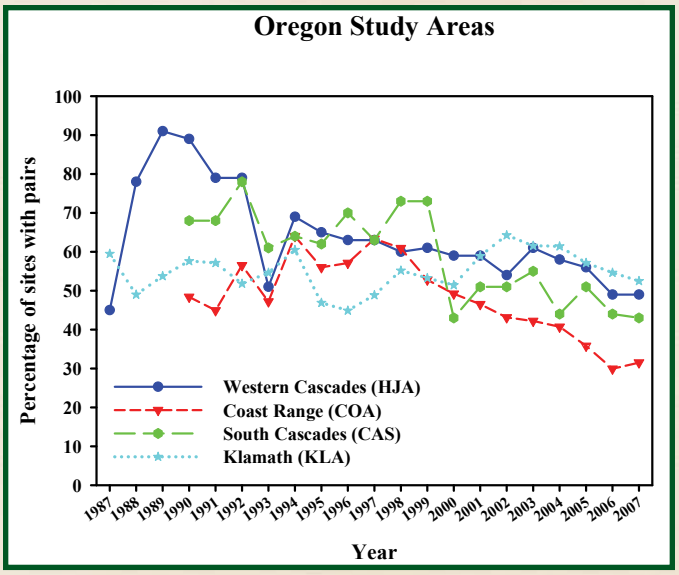
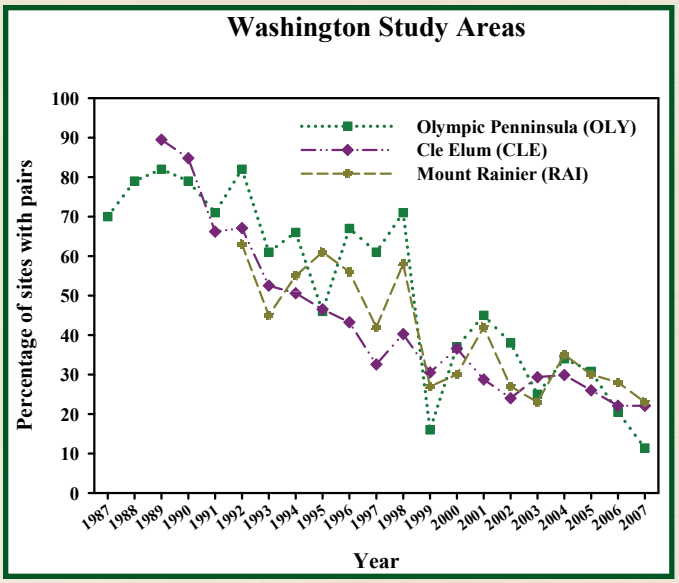


Figure 2



Looking Ahead

Occupancy and reproduction data gathering will be continued in the demographic study areas during the 2008 field season. Compilation of data in preparation for the January 2009 population analysis workshop in Corvallis, OR will be completed. In addition, as base vegetation maps are completed, the construction of owl habitat maps will begin. The BioMapper software program will be used to calculate the habitat suitability scores from the vegetation base maps. These owl habitat maps will be the basis for analyses of habitat status and trend for the 15-year monitoring report scheduled for completion in 2009-10.

Contact: Joe Lint, NSO Monitoring Module Leader, Bureau of Land Management, joseph_lint@or.blm.gov

Monitoring Accomplishments

What is the status and trend of marbled murrelet habitat and populations?

The purpose of the effectiveness monitoring program for the marbled murrelet is to assess population trends and to determine characteristics and trends of suitable murrelet nesting habitat.

Information gathered for this assessment is used to help managers maintain and restore marbled murrelet habitat and populations on federal lands. Effectiveness monitoring for marbled murrelets has two facets: (1) assess population trends at sea using a unified sampling design and standardized survey methods and (2) establish a credible estimate of baseline nesting-habitat conditions by modeling habitat relations, and use the baseline to track habitat changes over time.

Population monitoring is based on estimates of the at-sea murrelet populations, for the coastal waters adjacent to the planning area, in Washington, Oregon and northern California. A team of cooperating scientists conducts murrelet surveys from boats along line transects in those coastal waters, during the murrelet breeding season. The transect data are used to generate population estimates, for each of the five zones (based on Conservation Zones identified in Marbled Murrelet Recovery Plan, Figure 1), and for the five zones combined.

To monitor the amount and distribution of murrelet nesting habitat, initial habitat analyses applied habitat suitability models to remotely-sensed and field-collected data. This effort established a baseline for murrelet nesting habitat for 1994, and evaluated changes for the period ending in 2003. Future habitat analyses will occur at 5-year intervals to track habitat changes over time, with the next analysis planned for 2008-2009. Findings of the habitat and population monitoring program through 2003 were published in 2006 by the U.S. Forest Service Northwest Research Station, as General Technical Report number 650.

Photo credit: Josh London, Washington Dept. of Fish and Wildlife

Marbled murrelet in breeding plumage, in waters off Washington

2007 Accomplishments

Field work focused on sampling to develop a population estimate for 2007, the eighth consecutive year of population sampling under the effectiveness monitoring program. In 2007, about 8,800 km^2 of coastal waters were sampled. Four teams collected the data for the five sampling zones (Zones 1 through 5, Figure 1).

The 2007 marbled murrelet at-sea population estimate was about 17,400 birds off the coast of the Plan area (Conservation Zones 1 through 5), with a 95% confidence interval for the estimate of between 12,800 and 21,900 birds (Table 1). The 2007 estimate was about 7 percent and 14 percent lower than the 2006 and 2005 estimates respectively, but not significantly different from any prior year at the 5% level of significance. Testing for a population decline requires a more formal analysis, and in 2007 the murrelet team conducted a preliminary trend analysis for the 2000 to 2007 period.

The analysis did not detect a trend for the 2000 to 2007 period for the Plan area. The analysis concluded that an increasing trend is unlikely, but the population could be either stable or declining. Population demographic models have predicted population declines in the range of 3 to 7 percent per year for this area. The trend analysis indicated that a 6-to-7 percent annual decline between 2000 and 2007 is unlikely. The data, however, are not sufficient to detect lower rates of population decline, in the range of 2 to 5 percent per year, with sufficient statistical power. While no trend was detected with the 2000-2007 data, the pattern of declining population estimates for each of the past five years (Table 1 and Figure 2) is consistent with declines as predicted by demographic models. Additional at-sea monitoring will be needed to test for annual decline rates smaller than 6-to-7 percent, and to evaluate for future changes in trend.

At a smaller spatial scale than the Plan area, Zones 3 and 4 have consistently had the highest murrelet densities, and Zone 5 the lowest (Figure 2). Densities are also high

Table 1. Summary of marbled murrelet population estimates for the 2000-2007 breeding seasons, for the waters adjacent to the Northwest Forest Plan area.

Year	2007	2006	2005	2004	2003	2002	2001	2000
Population Estimate	17,400	18,800	20,200	20,600	22,200	23,700	22,200	18,600
95% confidence interval for population estimate (+/-)	4,600	2,900	4,300	4,600	4,200	5,300	4,600	5,200

in ocean waters off the Olympic Peninsula, but this does not show in zone-scale densities, because these birds are spread between Zones 1 and 2, where average zone densities are affected by low murrelet densities in other portions of each zone.

Looking Ahead

The habitat team continues to prepare for the upcoming 2009 reanalysis of the amount and distribution of nesting habitat. A pilot test of the new IMAP vegetation data base indicated the IMAP data will perform well in murrelet nesting habitat models, and represents a significant improvement over the vegetation data available for the 10-year analyses. The habitat team plans to continue work, started in 2007, on modifications to the habitat models used for the initial 1994-2003 analyses, to take advantage of improved data sources, including IMAP.

Contact: Gary Falxa, Marbled Murrelet Monitoring Module Lead, U.S. Fish and Wildlife Service, gary_falxa@fws.gov

Figure 1. Marbled murrelet conservation zones, as in the recovery plan for this species (USDI Fish and Wildlife Service 1997). Zone 6 is not part of the Northwest Forest Plan.

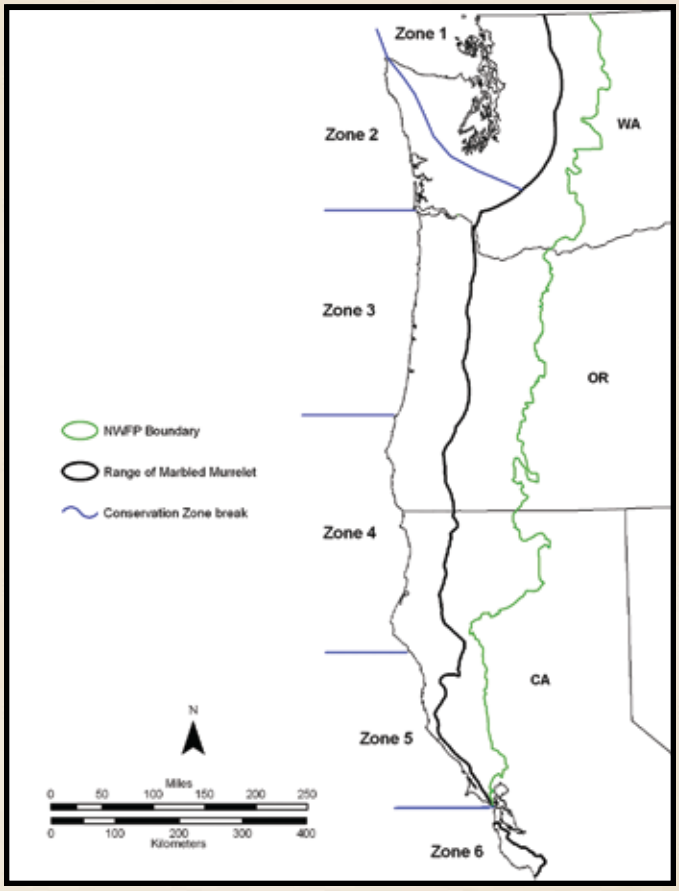
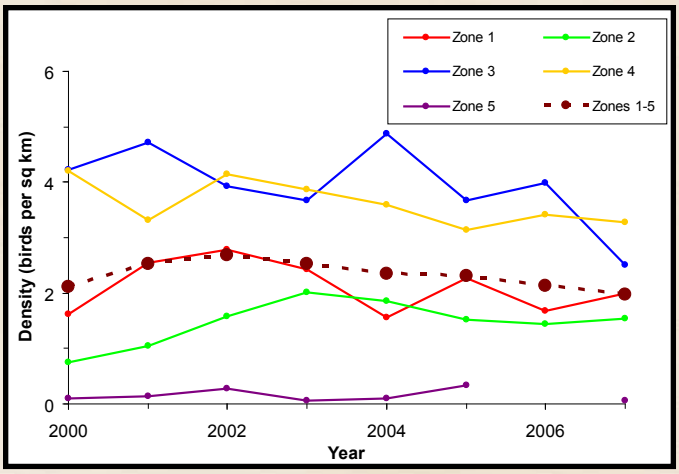


Figure 2. Marbled murrelet population density (birds/km²) by conservation zone, for 2000-2007.



Monitoring Accomplishments

What is the status and trend of socioeconomic well being?

The purpose of the Socioeconomic Monitoring Module is to evaluate progress in meeting the Plan's socioeconomic goals. During the first decade of the Northwest Forest Plan, the Socioeconomic Monitoring Module focused on two questions posed in the Record of Decision (ROD). The questions are: 1) Are predictable levels of timber and non-timber resources available and being produced? 2) Are local communities and economies experiencing positive or negative changes that may be associated with federal forest management?

2007 Accomplishments

During 2007, the Socioeconomic Monitoring Team documented the protocol used for socioeconomic monitoring during the first decade of the Northwest Forest Plan. In addition, the Team's focus shifted from the two questions posed in the ROD to a broad and more integrated single monitoring question: What is the status and trend of socioeconomic well-being? To answer this question, a new socioeconomic monitoring protocol was developed to monitor socioeconomic trends using existing data. The shift from primary data collection to a reliance on existing data is based on direction from the Regional Interagency Executive Committee. Among the existing data sources used in the new monitoring protocol are: U.S. Census, Regional Economic Information System of the Bureau of Economic Analysis (BEA REIS), Bureau of Labor Statistics, County Business Patterns, U.S. Department of Commerce, and Forest Service and Bureau of Land Management.

Looking Ahead

In 2008, the new socioeconomic monitoring protocol will be sent to selected experts for technical review. After revisions are complete, data will be collected for the 15 year report.

Contact: Elisabeth Grinspoon, Socioeconomic Monitoring Module Leader, US Forest Service, egrinspoon@fs.fed.us

Monitoring Accomplishments

What is the status and trend of government-to-government consultations?

The tribal monitoring program is designed to evaluate the unique government-to-government relationship between federal land managers and tribal governments in the Plan area. A total of 76 federally recognized tribes consult with land managers in the Plan area about resources, places of interest, and the quality of the federal-tribal relationship. Key issues addressed by tribal monitoring include the conditions and trends of resources protected by treaty or of interest to American Indian tribes, access to those resources, condition of and access to sites of religious and cultural heritage, and the quality of the government-to-government relationship.

2007 Accomplishments

In May of 2007, the Senior Management Group approved the protocol for monitoring the Effectiveness of the Federal-Tribal Relationship, as recommended by the Tribal Monitoring Advisory Group (TMAG). By August it was decided that two administrative vehicles were to be used to implement the decision. In California, a Participating Agreement between Intertribal Timber Council and USDA Forest Service, Pacific Southwest Region was executed to interview California Tribes. While a contract was awarded to Resource Innovations, the Institute for a Sustainable Environment, at the University of Oregon to conduct monitoring interviews in Oregon and Washington. All work will follow the protocol developed by the TMAG in response to the Regional Interagency Executive Committee (REIC) March 17, 2006 direction to monitor: "What is the status and trend of government-to-government consultation."

Looking Ahead

The timeline for the work has the monitoring interviews completed in 2008 with case studies and reports prepared for publication in 2009.

Contact: Gary Harris, Tribal Monitoring Module Leader, US Forest Service, grharris@fs.fed.us

Monitoring Accomplishments

Did we accomplish planned activities and comply with standards and guides?

Implementation monitoring is used to determine if planned activities and their associated standards and guides are being followed. In the past, a regional implementation monitoring program conducted from 1996- 2005 documented high overall compliance in meeting Northwest Forest Plan and Record of Decision standards and guidelines. For example, overall compliance in the summer of 2005 was 97%.

Photo Credit: Tom Iraci

2007 Accomplishments

A general review of all the monitoring modules for the Northwest Forest Plan, including the Implementation Monitoring Module, occurred in 2006. Due to the high overall levels of compliance, the Regional Interagency Executive Committee (RIEC) decided to discontinue regional- level implementation monitoring at that time and invest limited monitoring resources on other priorities. However, annual monitoring continues to be an important activity at the local level and is reported in District and Forest monitoring reports.

Looking Ahead

Planning has been initiated for the preparation of a 15-year regional summary report of implementation monitoring. This report will be prepared in 2009.

Contact: Shawne Mohoric, US Forest Service, Region 6, smohoric@fs.fed.us

Photo Credit: Tom Iraci

Management Questions Best Answered By Monitoring

What is the status and trend of watershed condition?

Headwater streams contribute wood to fish-bearing streams.

Large wood in streams creates desirable habitat for salmon. Its presence slows water and creates pools, which give fish places to rest and hide. Forest management within a watershed can affect the size and amount of wood that eventually ends up in a fish-bearing stream. The question is, at what spatial scale within a watershed can landscape features best explain habitat features in fish-bearing streams? In southwestern Oregon, scientists found that an intermediate spatial scale, which included headwater streams draining directly into surveyed fish-bearing streams, best explained the presence of large wood in fish-bearing streams. These findings will help managers decide where management within a watershed will most effectively contribute to desirable stream habitat. This multiscale approach is being explored to reduce monitoring costs and target field monitoring locations as part of the Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan.

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Partners: Aquatic and Riparian Effectiveness Monitoring Program (a partnership of federal land management agencies); Oregon State University; USDA Forest Service Region 6; USDI Bureau of Land Management Oregon State Office

Citation: Burnett, K.M.; Reeves, G.H.; Miller, D.J. [and others]. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Ecological Applications. 17(1): 66-80.

Buffers along headwater streams protect amphibians and invertebrates from effects of upslope timber harvests.

Headwater streams have an ecology distinct from larger streams within the watershed. They also contribute critical nutrients to fish-bearing streams farther downstream. Retention of vegetation in streamside buffer zones can minimize the effects of forest management activities on the stream. Although the establishment of riparian buffer zones has been a required forestry practice for more than a decade, the benefits of different riparian buffer widths for headwater wildlife and habitats were relatively untested. In particular, the relation between buffer widths necessary to maintain headwater wildlife with different forestry activities was unknown.

Scientists conducted several studies in northwest Oregon to address these issues. At study sites from near Mount Hood in the Cascade Range to near Coos Bay in the Coast Range, they characterized headwater amphibian communities and found that riparian buffers as narrow as 20 feet retained amphibian diversity and habitat when upland forests were thinned. Another study near Sweet Home, Oregon, found that a 98-foot buffer protected riparian invertebrate communities from the impacts of a clearcut forest harvest. This information helps forest

Photo Credit: Tom Iraci

managers develop management plans that protect wildlife diversity and habitat while also managing timber resources.

Contact: Deanna H. Olson, US Forest Service, Pacific Northwest Research Station, dedeolson@fs.fed.us

Partners: USDI Bureau of Land Management, USDA Forest Service Siuslaw and Willamette National Forests, Oregon State University, Oregon Headwaters Research Cooperative

Citations: Olson, D.H.; Rugger, C. 2007. Preliminary study of the effects of headwater riparian reserves with upslope thinning on stream habitats and amphibians in western Oregon. Forest Science. 53(2): 331-342.

Rundio, D.E.; Olson, D.H. 2007. Influence of headwater site conditions and riparian buffers on terrestrial salamander response to forest thinning. Forest Science. 53(2): 320-330.

Online watershed seminars offer new format for scientists to share expertise.

This new seminar series on watershed sciences allows hydrologists, biologists, ecologists, and others in the watershed-fisheries community of practice to efficiently share key information throughout the year. Topics for 2007 included the effects of forest management on water yield and quality in three experimental forests, modeling biological responses to physical stream changes, and a synthesis of emerging research on the effects of fire and fuel management on fish. Each seminar had about 50 participants. By participating in interactive seminars online, participants avoid the travel costs associated with traditional conferences and symposia, and less travel means fewer carbon emissions. The seminars have been converted to portable electronic presentations for on-demand viewing on the web. More seminars are planned for 2008.

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Partners: USDA Forest Service National Forest System and State and Private Forestry

Links: http://stream.fs.fed.us/wss/

Scientists contribute to special issue of Forest Science and help reveal value of headwater streams to downstream resources and watershed condition.

In the past, headwater streams—those closest to the water's source—have received considerably less attention than larger fish-bearing streams. Recent research, however, has highlighted the importance of headwater streams to downstream aquatic resources and overall watershed condition. Station scientists are playing a major role in developing original research and research syntheses that address several high-priority research needs and information gaps surrounding headwater streams. Studies have focused on the basic ecology, biology, and physical attributes of riparian systems and processes as well as the influences of management practices and policy on the provision of riparian services from headwater streams. This body of work has been captured in a recent special issue of Forest Science that focuses on the science and management of forest headwater streams. This volume will be useful to managers and policymakers responsible for developing management practices and riparian reserve guidelines and to the development of watershed assessments and restoration or conservation plans.

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Partners: National Council for Air and Stream Improvement, Oregon Headwaters Research Cooperative, USDI Bureau of Land Management, Weyerhaeuser Company

More information: Science and management of forest headwater streams (Special issue). Forest Science. 53(2): April 2007.

Citation: Anderson, P.D.; Larson, D.J.; Chan, S.S. 2007. Riparian buffer and density management influences on microclimate of young headwater forests of western Oregon. Forest Science. 53(2): 254-269.

What is the status and trend of late-successional old-growth?

Douglas-fir, western hemlock differ in their ability to extract soil water.

Douglas-fir and western hemlock are two of the most abundant and widely distributed conifers in western North America. Although both species can—and often do—co-occur in forests, their distributions typically extend to different extremes along a moisture gradient: Douglas-fir occurs in drier, interior sites, whereas western hemlock is found in wet coastal areas. To better understand the basis for the species' ecological distributions, scientists studied patterns of soil water extraction and root distribution around old-growth Douglas-fir and western hemlock trees. They found that, although western hemlock tended to have greater root areas, Douglas-fir were better able to seasonally extract water from the soil. This apparent greater efficiency of Douglas-fir roots helps explain why the species grows better on dry sites than does western hemlock. These findings contribute to the fundamental understanding of these species' distributions and are of interest to silviculturists, forest ecologists, tree physiologists, and others charged with developing management strategies.

Contact: Rick Meinzer, US Forest Service, Pacific Northwest Research Station, fmeinzer@fs.fed.us

Partners: U.S. Environmental Protection Agency

Citations: Meinzer, F.C.; Warren, J.M.; Brooks, J.R. 2007. Species-specific partitioning of soil water resources in an old-growth Douglas-fir--western hemlock forest. Tree Physiology. 27: 871-880.

Renninger, H.J.; Meinzer, F.C.; Gartner, B.L. 2007. Hydraulic architecture and photosynthesis capacity as constraints on release from suppression in Douglas-fir and western hemlock. Tree Physiology. 27: 33-42.

Insect-induced tree mortality and loss of canopy closure not necessarily detrimental to pileated woodpeckers.

The pileated woodpecker is a species of conservation concern and an indicator of mature- and old-forest habitat conditions in the Pacific Northwest. Effects of natural and human-caused disturbance on density of nesting pairs, reproductive success, and traditional home ranges were compared over 30 years in two areas and over 15 years in five additional areas. Harvesting, particularly regeneration cuts, which lead to the development of new stands, and loss of dead trees and logs were detrimental to the woodpecker. In one area, density of nesting pairs decreased after extensive timber harvests eliminated most of the stands of mature and old-growth grand fir and reduced the density of nest and roost trees and foraging substrate since 1990. Density of nesting pairs, reproductive success, and home range location remained fairly consistent over 30 years in a second area with extensive tree mortality resulting from insect outbreaks but without regeneration harvests. The woodpeckers had greater reproductive success between 2003 and 2005 in areas where less harvest had occurred and where there were more closed-canopy stands within their home ranges. Given the USDA-USDI 2001 National Fire Plan, the Healthy Forest Restoration Act of 2003, and management emphasis on fuel management and forest restoration, large areas have or will be subject to fuel reduction activities. Findings from this long-term study will be useful to wildlife biologists and resource managers as they manage for multiple goals.

Contact: Evelyn Bull, US Forest Service, Pacific Northwest Research Station, ebull@fs.fed.us

Partners: US Forest Service Pacific Northwest Region; University of Idaho

Citation: Bull, E.L.; Nielsen-Pincus, N.; Wales, B.C.; Hayes, J.L. 2007. The influence of disturbance events on pileated woodpeckers in northeastern Oregon. Forest Ecology and Management. 243: 320-329.

What is the status and trend of northern spotted owl habitat?

Fuel treatments can protect spotted owl habitat.

Natural disturbances such as wildfire are a growing threat to the habitat of many rare wildlife species. Although fuel treatments and other management activities can reduce wildfire impacts, designing effective treatment strategies on large complex landscapes is challenging. Scientists are developing a new wildfire risk assessment framework for measuring the performance of alternative fuel treatment strategies using formal risk science. The framework can be applied to wildlife habitat and other resource values at risk to find fuel management strategies that best meet habitat conservation goals. In a case study on the Deschutes National Forest, the risk analysis indicated that strategic fuel treatments on 10 percent of the project area, excluding habitat of the northern spotted owl, reduced the probability of owl habitat loss from fire by almost 30 percent, compared to no treatment. Results from the risk assessment were used to support the preferred alternative in the final environmental impact statement for the Five Buttes Interface project. This work paves the way for future wildfire risk analysis to support fuel treatment projects. The risk assessment framework can be applied elsewhere to quantify potential benefits of wildland fires and to study social and ecological issues related to wildfire impacts.

Contact: Alan Ager, US Forest Service, Pacific Northwest Research Station, aager@fs.fed.us

Partners: USDA Forest Service Rocky Mountain Research Station

Citation: Ager, A.A.; Finney, M.A.; Kerns, B.K.; Maffei, H. 2007. Modeling wildfire risk to northern spotted owl (Strix occidentalis caurina) habitat in Central Oregon, USA. Forest Ecology and Management. 246: 45-56.

What is the status and trend of northern spotted owl populations?

Research agencies have not completed any projects contributing to this question during the reporting cycle. See Monitoring Accomplishments section.

What is the status and trend of marbled murrelet habitat and populations?

Marbled Murrelet population data could point to an annual decrease.

We compiled and published the scientifically valid field and analytical methods and sampling design to monitor Marbled Murrelet populations in the Northwest Forest Plan area using a standardized, regional protocol. We continued to monitor the population in 2007 and estimated the target population offshore of the five Marbled Murrelet conservation zones within the NWFP area to be 17,350 murrelets with a 95 percent confidence interval of 12,800 to 21,900. We estimated the highest density of birds at the zone level for 2007, 3.3 murrelets per km^2 in Zone 4. The estimated density in Zone 3 declined from 4.0 murrelets per km^2 in 2006 to 2.5 in 2007. Our measure for assessing this monitoring program is its power to detect changes in the mean density (and the resulting mean total population) of murrelets over time. When all of the zones are combined, we would have an 80- to 95-percent chance of detecting a 3- to 4-percent annual decrease with a 10-year sampling period. With 8 years of sampling, we have not yet detected a decline with all zones combined.

Contact: Sherri Miller, US Forest Service, Pacific Southwest Research Station, smiller02@fs.fed.us.

Partners: U.S. Fish and Wildlife, Washington Department of Fish and Wildlife, and Crescent Coastal Research.

Citation: Raphael, M.G., J. Baldwin, G.A. Falxa, M.H. Huff, M. Lance, S. L. Miller, S.F. Pearson, C.J. Ralph, C. Strong, and C. Thompson. 2007. Regional population monitoring of the Marbled Murrelet: Field and analytical methods. Gen. Tech. Rep. PACIFIC NORTHWEST RESEARCH STATION-GTR-716. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

What is the status and trend of socioeconomic well being?

Research agencies have not completed any projects contributing to this question during the reporting cycle. See Monitoring Accomplishments section.

What is the status and trend of government-to-government consultation?

Research agencies have not completed any projects contributing to this question during the reporting cycle. See Monitoring Accomplishments section.

Questions Best Answered By Research:

What is the status and trend of watershed function and how do management actions affect watershed processes and condition?

Hydrologic effects of timber harvest are studied at Caspar Creek.

Hydrologic effects of timber harvest were precisely measured in a large scale experiment in Caspar Creek Experimental Watersheds using 20 stream gages and supporting instrumentation. Fog drip was low in Caspar Creek but comparison with other studies indicates that fog drip varies with local exposure and distance from the coast, and canopy removal can significantly reduce fog drip. Canopy removal increased effective precipitation by an average of 21% and increased peak flows due to the loss of foliar interception. High interception loss during prolonged rainfall produces an important cumulative effect that cannot be modified without reducing the fraction of canopy removed. Increased peak flows resulted in increased suspended sediment yield. Flow and sediment recovered over the 10 years following clearcut logging as the new forest grew and re-established a canopy.

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Partners: California Division of Forestry and Fire Protection

More Information: www.fs.fed.us/Pacific Southwest Research Station/topics/water/caspar/

Citations: Keppeler, E. T. 2007. Effects of timber harvest on fog drip and streamflow, Caspar Creek Experimental Watersheds, Mendocino County, California. in R. Standiford, G. Giusti, Y. Vachovic, W. Zielinski, J. William, M. Furniss, technical editors. Proceedings of the Redwood Region Forest Science Symposium: What Does the Future Hold? PACIFIC SOUTHWEST RESEARCH STATION-GTR-194. USDA Forest Service.

Photo Credit: Tom Iraci

Keppeler, E. T.; Lewis, J.. 2007. Understanding the hydrologic consequences of timber-harvest and roading: four decades of streamflow and sediment results from the Caspar Creek Experimental Watersheds. in M. Furniss and M. McCammon, editors. Advancing the Fundamental Sciences-A Conference for Forest Service Physical Scientists. USDA Forest Service.

Lewis, J.; Keppeler, E. T. 2007. Trends in streamflow and suspended sediment after logging, North Fork Caspar Creek. In: Proceedings of the Redwood Region Forest Science Symposium: What Does the Future Hold? March 15-17, 2004, Rohnert Park, CA. PACIFIC SOUTHWEST RESEARCH STATION GTR-194. USDA Forest Service.

Reid, L. M.; Lewis, J. 2007. Rates and implications of rainfall interception in a coastal redwood forest. Pp.107-117 in: Standiford, Richard B.; Giusti, Gregory A.; Valachovic, Yana; Zielinski, William J., Furniss, Michael J., technical editors. 2007. Proceedings of the redwood region forest science symposium: What does the future hold? Gen. Tech. Rep. PACIFIC SOUTHWEST RESEARCH STATION-GTR-194. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 553 p.

Consequence of Barriers that Disrupt Fish Movement

Restoration of fish passage through culvert barriers has emerged as a major issue in the Pacific Northwest and nationwide. A new report by USGS scientists Robert Hoffman and Jason Dunham reviews basic characteristics of salmonid movement and considers the consequences of disrupting fish movement with human-constructed barriers, such as culverts. Impacts include loss of access to quality habitat, fragmentation and isolation of upstream populations, and increased vulnerability to local disturbances. A short list of high-priority information needs is proposed to support more effective restoration of fish passage through culverts. Understanding the impacts of current barriers on fish populations may provide a useful baseline of information against which the success of restoration can be measured.

Contact: Robert Jr. Hoffman, US Geological Service, robert_hoffman@usgs.gov

Partners: None

More Information: http://pubs.usgs.gov/of/2007/1140/

Citation: Hoffman, R.L., Dunham, J.B., 2007, Fish Movement Ecology in High-Gradient Headwater Streams: Its Relevance to Fish Passage Restoration through Stream Culvert Barriers: U.S. Geological Survey Open-File Report 2007-1140, p. 40.

Fish Respond to Groundwater in Crooker River

USGS landscape ecologist Christian Torgersen presented results of a study at the Lower Crooked River and Middle Deschutes Wild and Scenic Rivers Symposium held on May 3 in Bend, Oregon. Torgersen described fish and aquatic habitat characteristics in the steep canyon of the Lower Crooked Wild and Scenic River, which has never been surveyed systematically for fish diversity. The unusual reversal in fish distribution, with warmwater fishes located upstream of coldwater fishes, can be explained by the extensive inputs of cool groundwater in the lower part of the Lower Crooked River canyon. The study and interdisciplinary symposium were organized and sponsored by the Oregon Bureau of Land Management to describe the unique hydrology and ecology of remote sections of the rivers and to discuss where information gaps remain. This study was not within the region managed under the NWFP, but results are relevant.

Contact: Christian Torgersen, US Geological Service, ctorgersen@usgs.gov

Partners: Oregon State University, Bureau of Land Management

More Information: http://pubs.usgs.gov/of/2007/1125/

Citation: Torgersen, C.E., Hockman-Wert, D.P., Bateman, D.S., Leer, D.W., Gresswell, R.E., 2007, Longitudinal Patterns of Fish Assemblages, Aquatic Habitat, and Water Temperature in the Lower Crooked River, Oregon: U.S. Geological Survey Open-File Report 2007-1125, p. 37.

Researchers Identify Patterns of Cutthroat Trout Movement

Small-scale movements of individual coastal cutthroat trout are common throughout the year in the headwater streams of the Oregon Coast Range, but longer movements are important during winter and spring. Scientists monitored cutthroat trout movement in a stream network that had a natural barrier to movement from downstream. In general, cutthroat trout moved farther in April when spawning peaked and less in October when stream levels were lowest. Some individuals may move great distances, contributing to recolonizations after events such as landslides. Although most cutthroat trout movement is local, management strategies that focus on maintaining and restoring connections to other populations and habitats within a watershed represent an important step toward protecting the evolutionary capacity of stream salmonids.

Contact: Martin Fitzpatrick, US Geological Service, Martin_Fitzpatrick@usgs.gov

Partners: Oregon State University

More Information: http://cat.inist.fr/?aModele=afficheN&cpsidt=18595009

Photo Credit: Steve Lanigan

Citation: Gresswell, R.E., Hendricks, S.R., 2007, Population-scale movement of coastal cutthroat trout in a naturally isolated stream network: Transactions of the American Fisheries Society, v. 136, p. 238-253.

Watershed-Scale Approach Important to Understand Fish Survival

Most of the current knowledge about fish survival in streams is based on small-scale studies that estimate survival rates from changes in abundance. The survival rates of coastal cutthroat trout were examined in two headwater streams in Oregon at the watershed scale. Adult fish were implanted with small electronic tags, and individual fish were monitored seasonally for three years. Overall, the greatest differences in survival were related to annual and seasonal variation, and seasonal physical conditions of the streams were also important. In particular, low-water extremes during dry seasons appeared to increase cutthroat mortality due to decreased food and cover and increased predation. This information may be useful for future management decisions concerning water use, stream diversions, reservoir retention, and large-scale landscape disturbances that affect stream flow.

Contact: Martin Fitzpatrick, US Geological Service, Martin_Fitzpatrick@usgs.gov

Partners: Oregon State University

More Information: http://ir.library.oregonstate.edu/dspace/handle/1957/6221

Citation: Berger, A.M., 2007, Patterns of Coastal Cutthroat Trout Survival in Two Headwater Stream Networks: Corvallis, OR, Oregon State University--M.S. thesis, 82 p.

Enhanced Wetlands Provide Important Temporary Habitats for Fish

Conversion of fertile wetlands to agricultural use is a major cause of wetland loss. Most restoration efforts have focused on restoring critical habitat for plants and migratory wildlife, but the effects on fish populations are poorly documented. A new publication quantifies fish use of freshwater wetlands in the Chehalis River (Washington) floodplain and assesses the effects of wetland enhancement on fish. Enhanced wetlands had higher fish abundances and number of species, including

yearling coho salmon, than other sites. Abundances were highest in late spring, probably reflecting increased fish access and food resources. Fish survival was dependent on emigrating from enhanced wetlands before water quality conditions became harmful. Information about what wetland characteristics influence fish survival in emergent habitats can provide insight into the design of wetland restoration projects that can benefit native fish species.

Contact: Martin Fitzpatrick, US Geological Service, Martin_Fitzpatrick@usgs.gov

Partners: Oregon State University

More Information: Abstract: http://www.ingentaconnect.com/content/bsc/jfb/2007/00000071/00000002/art00012

Citation: Henning, J.A., Gresswell, R.E., Fleming, I.A., 2007, Use of seasonal freshwater wetlands by fishes in a temperate river floodplain: Journal of Fish Biology, v. 71, no. 2, p. 476-492.

How can landscapes be managed to provide for biodiversity and resiliency?

Mid elevation riparian zones contribute to bird diversity in dry forests

Riparian areas are critical to biodiversity, but that importance varies greatly across regions, landscapes, and elevations. Station scientists quantified breeding bird abundance, diversity, and indicator species in riparian and upland dry forests along large streams in the eastern Cascade Range, Washington. Riparian areas did not have more species than upland forests, but riparian bird community composition was different from that of upland forests and contributed to landscape-scale avian diversity. Results from this study indicate that current riparian buffers could be effective avian refuges and movement corridors. Scientists also identified indicator species for predicting and monitoring changes in bird species composition after management practices or environmental changes. Forest managers may use findings and models from this work to predict the biodiversity value of specific riparian areas and could use the indicator species identified in this study to predict and monitor shifts in bird species composition from fuel reduction and other management practices.

Contact: John Lehmkuhl, US Forest Service, Pacific Northwest Research Station, jlehmkuhl@fs.fed.us

Partners: USDA Forest Service, Okanogan-Wenatchee National Forest

Citation: Lehmkuhl, J. F., E. D. Burger, E. K Drew, M. Haggard, J. P. Lindsey, and K. Z. Woodruff. 2007. Breeding birds in riparian and upland dry forests of the Cascade Range. Journal of Wildlife Management 71(8): 2632-2643.

Traditional and local ecological knowledge tapped to conserve biodiversity

Maintaining and restoring native biodiversity is a common goal of forest management in the Pacific Northwest. Station scientists asked about 100 natural resource managers from various institutions what kind of research information would help them reach this goal. They learned managers were interested in knowing how traditional ecological knowledge could be incorporated into efforts to conserve biodiversity in the region.

By synthesizing existing literature on traditional and local ecological knowledge related to forest management among American Indians, family forest owners, and commercial nontimber forest products harvesters, several key points emerged: (1) integrating this knowledge into forest biodiversity conservation is most likely to be successful if the knowledge holders are engaged as active participants in conservation efforts, (2) more

Photo Credit: David D'Amore

information is needed about how different groups are currently implementing their ecological knowledge through forest use and management actions and about the ecological effects of these actions on biodiversity, and (3) several promising models exist for integrating traditional and local ecological knowledge into forest management, but the social, economic, and policy constraints that prevent this knowledge from flourishing should be addressed alongside any strategy for knowledge integration.

Contact: Susan Charnley, US Forest Service, Pacific Northwest Research Station, scharnley@fs.fed.us

Partners: Oregon State University, Institute for Culture and Ecology.

Citation: Charnley, S; Fischer, A.P.; Jones, E.T. 2007. Integrating traditional and local ecological knowledge into forest biodiversity conservation in the Pacific Northwest. Forest Ecology and Management. 246: 14-28.

Pollutant deposition in the Columbia River Gorge correlates with decreased biodiversity

Atmospheric deposition of nitrogen and sulfur pollutants were measured in fogwater, and as wet and dry deposition to forested areas along the Columbia River Gorge, particularly in the National Scenic Area. Nitrogen deposition, and to a lesser degree sulfur deposition, were highly elevated on the western and eastern ends of the Scenic Area. Source emissions on the western end of the Scenic Area were primarily from the Portland urban conglomeration, while emissions on the eastern end were primarily from agricultural activities and the Boardman power plant. Communities of lichens were significantly altered by nitrogen deposition and nitrogen concentrations in lichens were correlated with atmospheric deposition levels. Some fog events were highly acidic. Air pollution is of concern because of decreased visibility in the Gorge, ecological effects on sensitive organisms such as lichen communities, altered nutrient cycling and potential impacts on highly valued cultural resources such as Native American petroglyphs.

Contact: Mark Fenn, US Forest Service, Pacific Southwest Research Station, mfenn@fs.fed.us

Partners: US Forest Service, Pacific Northwest Regional Office

Citation: Fenn, M.E. Geiser, L., Bachman, R., Blubaugh, T.J. and Bytnerowicz, A. 2007. Atmospheric deposition inputs and effects on lichen chemistry and indicator species in the Columbia River Gorge, USA. Environ. Pollut. 146:77-91.

Fisher habitat mapping still underway in northern California

We analyzed recent survey data and mapped environmental variables integrated over a home range scale of 10 km2 to model the distribution of fisher (Martes pennanti) habitat throughout the species' range in California, including specific landscape habitat suitability modeling in the Klamath and Cascades provinces of northern California. Our goal was to identify habitat factors associated with the current distribution of fishers in California, and to test whether those factors differ for widely disjunct northern and southern populations. The result of our work should help managers in each of the California bioregions where fishers occur develop landscape level plans to manage their habitat. Our analyses were also designed to probe whether poor habitat quality can explain the current absence of fishers in the historically occupied northern Sierra Nevada region that separates the two extant populations. Fishers were detected at 64/433 (14.8%) sample units, including 35/111 (32%) of sample units in the Klamath/Shasta region and 28/88 (32%) of sample units in the southern Sierra Nevada. Generalized additive models (GAM) that included mean annual precipitation, topographic relief, forest structure, and a spatial autocovariate term best predicted fisher detections over the species' recent historical range in California. Models derived using forest structure data from ground plots were comparable to models derived from Landsat Thematic Mapper imagery. Models for the disjunct Klamath/Cascades and southern Sierra Nevada populations selected different environmental factors and showed low agreement in the spatial pattern of model predictions. Including a spatial autocovariate term significantly improved model fits for all models except the southern Sierra Nevada. We could not rule out dispersal or habitat in explaining the absence of fishers in the northern and central Sierra Nevada, but mapped habitat quality is low over much of the region. The Klamath region had the greatest extent and continuity of mapped fisher habitat.

Contact: William J. Zielinski, USDA Forest Service, Pacific Southwest Research Station, bzielinski@fs.fed.us

Partners: University of California, Santa Barbara, California.

Citation: Davis, F. W., C. Seo, and W. J. Zielinski. 2007. Regional variation in home-range-scale habitat models for fisher (Martes pennanti) in California. Ecological Applications. 17:2195-2213.

Fire tends to decrease Spider species richness and diversity

Spiders (Arachnida: Araneae) are frequently very effective indicators of old growth stand characteristics and past fires because of their acute sensitivity to differences in habitat architecture, but little is known of the spider fauna in the southern Cascade Range. We assessed spider responses to prescribed fire following stand structure treatments in ponderosa pine stands in the Cascade Range of California. Stands were logged or left untreated to create three levels of structural diversity. We logged one treatment to minimize old-growth characteristics (low diversity), one to enhance old-growth characteristics (high diversity), and we used unlogged Research Natural Areas (RNAs) as old growth, highest diversity reference stands. We conducted low intensity prescribed fire on half of each plot following harvest. Spider assemblages in unburned, logged stands were similar to one another but diverged from RNAs, with increased abundance, species richness and diversity in more structurally diverse stands. Prescribed fire, which altered habitat in the organic soil layer where many spiders forage, resulted in altered spider assemblages and population declines in most plots. Fire generally reduced spider species richness, evenness, and diversity. Several taxa were potential indicators of fire and old growth structure, and we discovered one species and one genus that were previously unknown. There was evidence that old growth characteristics intensified effects of fire on spider abundance. This outcome probably results from the deep litter layers in high diversity stands and RNAs, which constituted greater fuel loads than low-diversity stands.

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Partners: University of California

Citation: Gillette, N.E., Vetter, R.S., Mori, S.R., Rudolph, C.R., and Welty, D.R. 2008. Response of ground-dwelling spider assemblages to prescribed fire following stand structure manipulation in the southern Cascade Range. In press: Canadian Journal of Forest Research.

Biodiversity management approaches for stream-riparian areas

New research in Pacific Northwest headwater forests, especially the characterization of microclimates and amphibian distributions, is expanding our perspective of riparian zones, and suggests the need for alternative designs to manage stream–riparian zones and their adjacent uplands. Recent recognition that stream-breeding amphibians can disperse hundreds of meters into uplands implies that connectivity among neighboring drainages may be important to their population structures and dynamics. We review forest management approaches relative to headwater riparian areas in the U.S. Pacific Northwest, and we propose focusing habitat conservation in specific headwater areas – where present management allows extensive logging – supporting sensitive target species, such as tailed frogs and torrent

Photo Credit: Alex Foster

salamanders. Offering too-sparse protection everywhere is likely insufficient to conserve headwater habitats and biodiversity, while targeted protection of selected headwaters does not bind the entire forest landscape into a biodiversity reserve.

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Partners: US Forest Service Pacific Northwest Research Station, Pacific Rivers Council, US Environmental Protection Agency

Citation: Olson, D. H., P. D. Anderson, C. A. Frissell, H. H. Welsh Jr., D. F. Bradford. 2007. Biodiversity management approaches for stream–riparian areas: perspectives for Pacific Northwest headwater forests, microclimates, and amphibians. Forest Ecology and Management 246: 81–107.

Using Satellites to Detect Vegetation Changes in National Parks

The USGS recently published a report detailing the use of satellites to monitor vegetation changes in the North Coast and Cascades Network parks. The Landsat series of satellites, a USGS and NASA collaboration, have captured over 2 million images of the Earth's surface since 1972. These images are useful for monitoring areas that are very large, inaccessible, or would benefit from repeated viewing. The report addresses the use of satellite imagery in the Pacific Northwest, which can be challenging due to frequent cloud cover, steep terrain, and dense tree cover. It describes how to implement a novel approach to detect change even when there are no base maps. Chapters include sampling design, methods, data handling, personnel, equipment, and protocols for acquiring images and detecting change. The information is useful for any land manager throughout forested ecosystems.

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Partners: National Park Service, US Forest Service Pacific Northwest Research Station

More Information: http://pubs.usgs.gov/tm/2007/tm2g1/

Citation: Kennedy, R.E., Cohen, W.B., Kirschbaum, A.A., Haunreiter, E., 2007, Protocol for Landsat-based Monitoring of Landscape Dynamics at North Coast and Cascades Network Parks: U.S. Geological Survey Techniques and Methods 2-G1, p. 126.

Vegetation Diversity Important to Forest Wildlife

In the Pacific Northwest, forest management has largely been directed toward commercially valuable conifer trees, often disregarding other vegetation such as shrubs and deciduous trees. Previous studies have shown that this non-coniferous vegetation is vital to ecosystems, but it was unknown how many wildlife species relied on the food and cover this vegetation provided. In a new publication, USGS reviewed accounts of forest-dwelling wildlife species in Oregon and Washington and determined that at least 78 species are associated with non-coniferous vegetation. Given this large number, maintaining habitats that support diverse plant communities, particularly deciduous trees and shrubs, may be an important component of management strategies intended to foster biodiversity.

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Partners: none

More Information: http://fresc.usgs.gov/products/papers/1644_Hagar.pdf

Citation: Hagar, J.C., 2007, Wildlife species associated with non-coniferous vegetation in Pacific Northwest conifer forests- A review: Forest Ecology and Management, v. 246, no. 1, p. 108-122.

Forests Hamper Satellite Tracking of Large Mammals

The use of Global Positioning System (GPS), or satellite-based, telemetry to track animals allows researchers to gather large amounts of information across a wide range of species and environments. However, the information may contain biases and errors, which may hamper the interpretation of wildlife movement and other

Photo Credit: Frank Vanni

activities. Wildlife biologists recently completed a study to quantify information loss and location inaccuracy of GPS in mountainous, old-growth forests of Olympic National Park (Washington). Free-ranging black bears were fitted with tracking collars and the information was compared with stationary test collars at known locations. Collar transmitters located satellites most successfully from areas that had an unobstructed view of the sky. Further, test collar transmitters located satellites more successfully than collars placed on bears. Future researchers in conifer forests may need to consider inherent errors and biases and interpret telemetry-derived patterns cautiously.

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Partners: National Park Service, University of Idaho

More Information: http://fresc.usgs.gov/products/papers/1771_Sager.pdf

Citation: Sager-Fradkin, K.A., Jenkins, K.J., Hoffman, R.A., Happe, P.J., Beecham, J.J., Wright, R.G., 2007, Fix success and accuracy of Global Positioning System collars in old-growth temperate coniferous forests: Journal of Wildlife Management, v. 71, no. 4, p. 1298-1308.

Guide Assists Managers of Rainforest Bird Habitat

The USGS recently published a new guide to breeding bird habitat in young conifer forests in cooperation with the American Bird Conservancy. Questions the guide helps answer include which bird species to prioritize for management and conservation, what habitat conditions and features are needed by approximately 90 breeding bird species associated with young conifer forests, and how do these species respond to particular management activities. The guide includes tables describing the relationship of each species to stages of forest growth, vegetation types, and ecoregions; aspects of bird ecology; and a synthesis of studies on breeding bird response to forest thinning activities. Information in the guide is applicable to the area from southeast Alaska to northwest California.

Contact: Joan Hagar, US Geological Service, joan_hagar@usgs.gov

Partners: American Bird Conservancy

More Information: http://pubs.usgs.gov/sir/2006/5304/

Citation: Altman, B., Hagar, J.C., 2007, Rainforest Birds-A Land Manager's Guide to Breeding Bird Habitat in Young Conifer Forests in the Pacific Northwest: U.S. Geological Survey Scientific Investigations Report 2006-5304, p. 60.

Art Meets Science to Grow Forests

Silviculture, the art and science of growing forest vegetation, is the subject of a new book which is the only silviculture text to focus on western forests, primarily those in Oregon, Washington, and California. Chapters address fire, shrub ecology, density measurements, thinning, stand and tree growth, reforestation, vegetation management, and ecosystem variables such as insects, fungi, soils, and water stress. Managers and scientists will find information about the significance of carefully managing forests by conscious design, providing for a range of forest ecosystems and consumable resources.

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Partners: US Forest Service Pacific Northwest Research Station, Oregon State University

More Information: http://oregonstate.edu/dept/press/s-t/Silviculture.html

Citation: Tappeiner, J.C., Maguire, D.A., Harrington, B.A., 2007, Silviculture and Ecology of Western U.S. Forests: Corvallis, OR, Oregon State University Press, 440 p.

Diverse Forests Provide for Diverse Wildlife

US Geological Service wildlife biologist authored a chapter about key wildlife elements in the U.S. Forest Service report "Managing for Wildlife Habitat in Westside Production Forests." The report provides guidelines for integrating wildlife values with timber production. Forests that are managed for timber production typically emphasize even-aged trees, which usually leads to homogeneous structure. As the diversity of tree sizes and species increases, more wildlife species find suitable habitat. Key elements of diverse forests are large-diameter trees, snags, fallen logs, and diverse shrub and tree species, which provide critical habitat, cover, and food for more than 150 species of wildlife in Northwest conifer forests.

Production forests can enhance wildlife habitat through all stages of forest succession by incorporating the key elements, which could make a significant contribution to the maintenance of wildlife diversity.

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Partners: US Forest Service Pacific Northwest Research Station, Washington State Department of Natural Resources, Society of American Foresters, Western Forestry and Conservation Association, University of British Columbia, Oregon State University, University of Washington, Port Blakely Tree Farms, American Forest Resource Council

More Information: http://www.fs.fed.us/Pacific Northwest Research Station/pubs/Pacific Northwest Research Station_gtr695.pdf

Citation: Hagar, J.C., 2007, Key elements of stand structure for wildlife in production forests west of the Cascade Mountains *In* Harrington, T.B., Nicholas, G.E., eds., Managing for Wildlife Habitat in Westside Production Forests: Pacific Northwest research Station -GTR-695, Portland, OR, U.S. Forest Service Pacific Northwest Research Station, p. 35-48.

Photo Credit: Lisa Scott

How effective is federal land management, including the reserve system, in providing for conservation of listed and non-listed species?

Station Washington's wolverine population may be vulnerable to local extinction.

Relatively little is known about the distribution and ecology of the wolverine, one of the rarest mammals in North America. Wolverines once lived in the Sierra Nevada of California, but now the northern Cascade Range in Washington represents the southern extent of their current range along the Pacific Coast, making the species a candidate for listing under the Endangered Species Act.

During the winters of 2005–06 and 2006–07, scientists captured and radio-collared four wolverines in the North Cascades—a pregnant female, a juvenile female, and two subadult males. Using satellite technology, scientists monitored the wolverines' movements and documented areas of use ranging from 900 to 1,200 square miles. Early results from the field study—the first to study the species in the Pacific Northwest—suggest that Washington's wolverine population is small and isolated and may be particularly vulnerable to local extinction.

The study's findings have provided the first empirical evidence of a resident wolverine population in the Pacific Northwest and have helped characterize the species' use of boreal forest habitats in the North Cascades. This work contributes new information critical to the conservation of wolverines in the contiguous United States and to the numerous land management agencies charged with the species' management.

Contact: Keith B. Aubry, US Forest Service, Pacific Northwest Research Station, kaubry@fs.fed.us

Partners: US Forest Service Okanogan-Wenatchee National Forest, Washington Department of Fish and Wildlife

Citations: Aubry, K.B.; McKelvey, K.S.; Copeland, J.P. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. Journal of Wildlife Management. 71(7): 2147-2158.

Ruggiero, L.F.; McKelvey, K.S.; Aubry, K.B. [and others]. 2007. Wolverine conservation and management. Journal of Wildlife Management. 71(7): 2145-2146.

Stream buffers conserve diversity of forest mammals.

The ability to gauge the response of forest-floor wildlife to changes in streamside habitat is critical to determining the efficacy of aquatic conservation strategies. These strategies often involve the creation of buffers—natural areas surrounding streams that protect them and their inhabitants from the effects of land management activities.

To study the effectiveness of buffers in conserving small mammals, scientists compared capture rates of mammal species along streams before and after the creation of buffers. They found that species diversity increased in streams with buffers and was greatest within 3 years of creation. Scientists also noted that capture rates tended to vary greatly among the streams, meaning very large effects would be needed to detect differences following disturbance.

This research supports efforts to develop a long-term stream conservation strategy as part of the Washington Department of Natural Resources' habitat conservation plan and to support the agency's adaptive management strategy.

Contact: M.G. Raphael, mraphael@fs.fed.us and R.J. Wilk, rwilk@fs.fed.us US Forest Service, Pacific Northwest Research Station

Partner: Washington Department of Natural Resources

Citations: Bigley, R.E.; Bisson, P.A.; Raphael, M.G. [and others]. 2007. Establishment of the western Washington forest headwater stream riparian ecosystem management studies (REMS) project: testing alternative headwater stream management options [Abstract]. In: Conference program: riparian management in headwater catchments: translating science into management. Vancouver, BC: University of British Columbia: 18.

Bisson, P.A.; Raphael, M.G.; Bigley, R.E. [and others]. 2007. Approaches, surprises, and lessons learned from 10 years of headwater stream studies in western Washington [Abstract]. In: Riparian management in headwater catchments: translating science into management. Vancouver, BC: University of British Columbia: 19.

No evidence of a downward trend in terrestrial amphibians in northwestern California.

We used data collected across a 12-yr period (sampling from 1984–86 and from 1993–95) to address the question of whether evidence exists for declines among terrestrial amphibians in northwestern California forests. We examined evidence of differences between years in two ecological provinces (coastal and interior) and across young, mature, and late seral forests and with reference to a moisture gradient from xeric to hydric within late seral forests. Overall, we found no compelling evidence of a downward trend in terrestrial plethodontid

Photo Credit: Tom Iraci

Photo Credit:Steve Lanigan

salamanders among terrestrial amphibians in northwestern California forests.

Contact: Hartwell H. Welsh, Jr., US Forest Service, Pacific Southwest Research Station, hwelsh@fs.fed.us

Partners: US Geological Survey

Citation: Welsh H. H.,Jr., G. M. Fellers, and A. J. Lind. 2007. Amphibian populations in the terrestrial environment: is there evidence of declines of terrestrial forest amphibians in northwestern California? Journal of Herpetology 41: 469–482.

Siskiyou Mountains salamander finds its optimal habitat in mature forests.

Our objective was to elucidate key environmental relationships of the Siskiyou Mountains salamander at multiple spatial scales, including landscape-level attributes, macro-environmental aspects of forest stand structure and plant community composition, and micro-environmental aspects such as microclimate and substrate associations. These models showed positive relationships of salamander presence with site conditions and plant assemblages characterizing old, less disturbed forest with closed canopy, moist, relatively warm microclimates, deep litter, and cobble and boulder-sized rock substrates. Our results suggest that mature to late-seral-forest attributes provide optimal habitat for the Siskiyou Mountains salamander.

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Partners: Humboldt State University, Rogue River-Siskiyou National Forest

Citation: Welsh H. H.,Jr., H. Stauffer, D. R. Clayton, and L. M. Ollivier. 2007. Strategies for modeling habitat relationships of uncommon species: an example using the Siskiyou Mountains Salamander (Plethodon stormi). Northwest Science 81: 15-36.

New USGS Report Facilitates Landbird Surveys in National Parks

Landbirds are good indicators of environmental change. National Parks can fulfill vital roles as both refuges for bird species dependent on mature forest conditions, and as reference sites for assessing the effects of changes on bird populations throughout the larger Pacific Northwest region. A new USGS report outlines the rationale, sampling design, and methods for monitoring breeding landbirds in the North Coast and Cascades Network (NCCN) of the National Park Service (NPS). This network, one of 32 in the NPS system, includes three large, mountainous parks and four small historical parks. The sampling design addresses challenges associated with safety concerns, travel costs, navigation, and diverse habitats present in large wilderness areas.

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Partners: NPS North Coast and Cascades Network, The Institute for Bird Populations

More Information: http://pubs.usgs.gov/tm/tm2a6/

Citation: Siegel, R.B., Wilkerson, R.L., Jenkins, K.J., Kuntz II, R.C., Boetsch, J., Schaberl, J., Happe, P.J., 2007, Landbird Monitoring Protocol for National Parks in the North Coast and Cascades Network: U.S. Geological Survey Techniques and Methods 2-A6, p. 200.

USGS Report Assesses Information on Rare Salamanders in Klamath-Siskiyou Region

At the request of the U.S. Fish and Wildlife Service (FWS) office in Yreka, California, the USGS recently completed a literature review and assessment of Plethodontid salamanders that live in the Klamath-Siskiyou ecoregion of southern Oregon and northern California. The report focuses on the Siskiyou Mountains salamander and the Scott Bar salamander, which both have restricted ranges. Information is needed to assist FWS to determine the conservation status of the two species. The report reviews what is known about the biology of the salamanders and identifies information needs that will be useful for resource managers for conserving the species.

Contact: R. Bruce Bury, US Geological Service, buryb@usgs.gov

Partners: US FWS, Oregon State University

More Information: http://pubs.usgs.gov/of/2007/1352/

Citation: Degross, D., Bury, R., 2007, Science Review for the Scott Bar Salamander (Plethodon asupak) and the Siskiyou Mountains Salamanders (P. stormi)- Biology, Taxonomy, Habitat, and Detection Probabilities/ Occupancy: U.S. Geological Survey Open-File Report 2007-1352, p. 14.

Habitat Quantity and Connectivity Critical for Salmon

Widespread declines of freshwater fishes have caused natural resource agencies to put more emphasis on habitat conservation. The question of what constitutes good habitat in terms of quality, quantity, and connectivity is the subject of a new publication by scientists in the U.S. Forest Service and co-authored by USGS scientist Jason Dunham. The researchers examined use of habitats for spawning by Chinook salmon in the headwaters of the Middle Fork Salmon River (Idaho). Salmon were found to consistently occupy larger habitats that were interconnected to similar habitats, especially when the number of spawning fish was low. Other traditional measures of habitat quality, such as substrate and channel form, were much less important. This novel result suggests that both habitat quantity and connectivity are just as critical as quality for spawning habitat of salmon. This study was not within the region managed under the NWFP, but results are relevant.

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Photo Credit: Peter Bisson

Partners: US Forest Service, Rocky Mountain Research Station

More Information: http://www.fs.fed.us/rm/pubs_other/rmrs_2007_isaak_d001.pdf

Citation: Isaak, D., Thurow, R.F., Rieman, B.E., Dunham, J.B., 2007, Chinook salmon use of spawning patches- Relative roles of habitat quality, size, and connectivity: Ecological Applications, v. 17, no. 2, p. 352-364.

Special Journal Volume Highlights USGS Crater Lake Research

USGS scientists contributed to a special scientific volume that compiles the most current information about Crater Lake (Oregon), including water quality, water movement, nutrients, plankton, bacteria, and introduced fish. Crater Lake, the deepest lake in the United States, formed following the eruption and collapse of Mount Mazama nearly 7000 years ago and is known for its deep-blue color and water clarity. In 1982, the U.S. Congress mandated a 10-year study to investigate possible changes following suggestions of degradation in water quality. Key findings from the study were that Crater Lake water quality varied seasonally and annually, but there were few human-caused disturbances. A long-term monitoring program has been established at Crater Lake to insure reliable information to evaluate and interpret the status of the lake in the future, and to take advantage of this pristine natural laboratory to better understand aquatic ecosystem processes.

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Partners: National Park Service, Oregon State University

More Information: http://www.springerlink.com/content/r1q5534x8615/?p=a14bfb7ee2cd4d76af0983a9144f24ac&pi=26

Citation: Larson, G.L., Collier, R., Buktenica, M.W. guest eds., 2007, Long-term limnological research and monitoring at Crater Lake, Oregon: Hydrobiologia, v. 574, p. 1-280.

What are the relationships between northern spotted owls, barred owls, and other stressors that will affect populations of northern spotted owls?

Genetic Techniques Differentiate Similar Owls

Northern spotted owls are legally protected as a threatened subspecies under the U.S. Endangered Species Act (ESA). Rapidly decreasing forest habitat is a factor in the declining population numbers, but an additional threat is competition and interbreeding with barred owls, a similar species that is rapidly expanding its range into territory occupied by spotted owls. Since interbred species (known as hybrids) are not protected under the ESA, it is critical to be able to identify northern spotted owls. USGS and U.S. Forest Service scientists report on genetic techniques that distinguish spotted owls, barred owls, and hybrid birds. Given the difficulty of identifying hybrids in the field, these markers will be useful for hybrid identification and developing management options for spotted owl conservation.

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Partners: US Forest Service Agricultural Research Station

More Information: http://www.blackwell-synergy.com/doi/abs/10.1111/j.1471-8286.2006.01581.x

Citation: Funk, W., Mullins, T.D., Forsman, E.D., Haig, S.M., 2007, Microsatellite loci for distinguishing spotted owls (Strix occidentalis), barred owls (Strix varia), and their hybrids: Molecular Ecology Notes, v. 7, p. 284-286.

Photo Credit: Tom Iraci

How is the distribution and abundance of forest habitat changing as a result of climate change and the interactions with fire, insects, disease, and other disturbances?

Land-use changes affect carbon storage and eco-system goods and services

The ability of trees to store carbon makes conserving forest land an effective way to offset increases in carbon emissions and consequently mitigate greenhouse gas production and resulting climate change. As a result, land-use laws can play a key role in determining the amount of carbon that is stored. Scientists found that Oregon's land-use planning program resulted in substantial carbon storage over the past decade, sufficient to offset more than twice the increase in carbon emissions in Oregon over the same period. Nationally, forest land conservation can contribute significantly to carbon storage as well as enhance other ecosystem goods and services associated with forests. For example, additional research linking land-use projections with forest fragmentation analyses quantifies how land-use changes affect biodiversity in Western States. Forest land conversion and fragmentation are shown to not only reduce carbon storage but also to reduce forest biodiversity. These findings were used by the Oregon

Department of Forestry and the Environmental Protection Agency to develop strategies for addressing global climate change within a multisector economy. More broadly, the research lends support to current interests within the Forest Service in taking a greater leadership role in the conservation of forest land and other open space nationally.

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Partners: Oregon Department of Forestry, Oregon State University, Texas A&M University, US Environmental Protection Agency

Citation: Cathcart, J.F.; Kline, J.D.; Delaney, M.; Tilton, M. 2007. Carbon storage and Oregon's land use planning program. Journal of Forestry. 105(4): 167-172.

Historical climate data and new maps aid predictions of large fires

"Blowup" fires are situations where fuel conditions and the weather at the ground fail to foretell sudden increases in fire intensity or spread. These blowups create extremely dangerous situations for wildland firefighters. Since 1988, fire weather forecasters have used the Haines Index to evaluate the potential for large fires, based on the stability and moisture content of the lower atmosphere. But until now, there has been no information available about what "normal" atmospheric conditions are for a given location. To address this need, Station scientists developed a North American climatology for the Haines Index that summarizes atmospheric information from 1961 to 2000. They produced 7,600 maps (now available at http://www.airfire.org/haines) to provide context for evaluating existing conditions and context for forecast conditions.

Photo Credit: Matthew Horning

Fire behavior analysts, long-term analysts, and the National Predictive Service Group are using the Haines Index Web climatology information. The historical climatology is also an integral part of a recently completed Joint Fire Science Program study to evaluate how climate models predict the Haines Index will change over the next 100 years. This information will help guide long-term resource management and policy decisions.

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Partners: USDA Forest Service Northern Research Station, Joint Fire Sciences Program; Michigan State University; National Predictive Services Group

Citation: Winkler JA, Potter BE, Wilhelm DF, Shadbolt RP, Piromsopa K, and Bian X. 2007. Climatological and statistical characteristics of the Haines Index for North America. International Journal of Wildland Fire. 16:139-152.

Fuel reduction treatments affect elk and mule deer differently

Manipulation of forest habitat via mechanical thinning or prescribed fire for fuels reduction has become increasingly common across western North America. This study evaluated seasonal and spatial responses of North American elk and mule deer to thinning and burning of true fir and Douglas-fir stands that contained high levels of dead fuel. Results indicated that although elk altered their home range to include areas that had been treated, they did not use the treated area within their home range more than untreated areas. Seasonal and multiple environmental factors such as distance to roads, steeper slopes, and topographical complexity also contributed to home range establishment. It appears that manipulating forest habitat with prescribed fire may be of greater benefit to elk than mule deer where these species are found in the same area. Therefore, maintaining a mixture of burned and unburned habitat may provide better long-term foraging opportunities for both species than burning a large proportion of a landscape. This research will help forest managers plan fuel reduction projects in

the future to ensure that habitat values for elk and mule deer are maintained or enhanced.

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Partners: Joint Fire Science Program, University of Idaho, Rocky Mountain Elk Foundation, Idaho State University

Citation: Long, Ryan A., Janet L. Rachlow and John Kie. 2008. Response of two large herbivores to experimental habitat manipulation: Effects of season and scale. Journal of Wildlife Management 72:1133-1142.

Reburn severity differs depending on management history of forest vegetation

Following the massive Biscuit Fire in southern Oregon in 2002, Station scientists had the unique opportunity to study the effects a past fire and subsequent management can have on future fire severity. Parts of the area that burned in 2002 also were burned in 1987 by the Silver Fire and then either salvage-logged, planted, and managed to establish Douglas-fir plantations or left to naturally regenerate. Using satellite and aerial imagery and management records, scientists found that areas burned severely in the Silver Fire tended to burn again at high severity in the 2002 Biscuit Fire, regardless of management treatment. Areas that were salvaged-logged and planted after the initial fire, however, burned more severely than comparable unmanaged areas, suggesting that slash left over from logging and fuel conditions in conifer plantations can increase fire severity for some time despite removal of large woody fuels.

The work also reveals that in mixed fire regimes such as southwest Oregon, the occurrence of one wildfire does not necessarily reduce the severity of a second wildfire burning within a decade or two. This is contrary to what has been found in drier forest types. This study is the first to look at how postfire management can affect vegetation burn severity in a subsequent fire. Continued research is needed to further understand the causes of these results and to better understand the tradeoffs associated with postfire forest management.

Contact: Thomas A. Spies, US Forest Service, Pacific Northwest Research Station, tspies@fs.fed.us

Partner: Oregon State University

Citation: Thompson, J.R.; Spies, T.A.; Ganio, L.M. 2007. Reburn severity in managed and unmanaged vegetation in a large wildfire. Proceedings of the National Academy of Sciences of the United States of America. 104(25): 10743-10748.

Different landscapes have widely different responses to warming climate

Station scientists have found that where large groundwater systems are present, these aquifers are the primary source for rivers in western and central Oregon and northern California during the dry summer months. Scientists traced the source of late summer water in this region to groundwater stored in permeable lava flows in the Cascade Range. These immense groundwater reserves help explain why many large rivers in this region continue to have relatively high flow volumes in the summer when high-elevation snowpacks have receded and when many other rivers throughout the West are quite low.

Using these findings, scientists modeled how regional streamflow will be affected by climate change. They found that different landscapes will have widely different responses to a warming climate because of differences in their groundwater dynamics. Regions of the West fed by groundwater will continue to have streamflow under climate warming, in contrast to areas fed exclusively by snowpack, such as the southern Sierras in California.

Photo Credit: Richard Woodsmith

These same groundwater regions, however, will be most sensitive to a warming climate and will lose a greater proportion of their flow volumes because the annual recession or multimonth decrease in flow will start earlier in the year and last longer for these slow-draining systems.

These findings have significant implications for how rivers, dams, and water supplies are managed in the future throughout the West. They are being incorporated into long-range management plans and strategies developed by public water and energy utilities, and also are helping scientists develop better models for predicting late summer streamflows. Public water and energy utilities are incorporating information about sources of summer water supply in western Oregon into long-range management plans.

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Photo Credit: Steve Lanigan

Partners: Eugene Water and Electric Board; Oregon State University; University of California, Santa Barbara

Citation: Tague, Christina; Grant, Gordon; Farrell, Mike; Choate, Janet; Jefferson, Anne. 2008. Deep groundwater mediates streamflow response to climate warming in the Oregon Cascades. Climatic Change. 86 189-210.

Diversity in chloroplast genomes tracks the prevalence of blister rust resistance in sugar pine

Like all North American five-needle pines, sugar pine is susceptible to white pine blister rust, a serious fungal infection that is one of the most destructive diseases of the Pinus genus. In sugar pine, rust resistance is genetically conferred, and this resistance is more prevalent in the southern latitudes of the sugar pine's range.

To understand the historical forces responsible for this gradient in resistance, scientists conducted a chloroplast DNA survey of sugar pine and its near relatives from North America and Asia. Results revealed two distinct chloroplast lineages, indicating a major historical break in the ancestral gene pool of modern-day sugar pine. Scientists found that the published frequencies of the gene that confers blister rust resistance differs significantly, depending on the chloroplast lineage.

Although chloroplasts, the microscopic components responsible for photosynthesis within plant cells, are not directly linked to resistance, the partitioning of chloroplast diversity between populations showing no resistance and measurable resistance indicates that these genetically distinct groups have only recently come into contact.

These data are being used to develop models that quantify the historical prevalence of blister rust resistance in sugar pine and to understand the molecular genetic basis of blister rust resistance in white pines.

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Partners: Oregon State University; USDA Forest Service, Pacific Northwest and Southwest Regions.

Citation: A. Liston, M. Parker-Defeniks, J. V. Syring, A. Willyard, R. Cronn. 2007. Interspecific phylogeny analysis enhances intraspecific phlogeographical inference: a case study in Pinus lambertiana. Molecular Ecology 16(18):3926-3937.

Tanoak was thriving prior to introduction of sudden oak death pathogen

Sudden oak death in the United States was first observed in California in 1995. Since then, it has spread rapidly through many host species. Several counties in California and one forest site in Oregon are under quarantine, which affects removal of forest products from these areas. Understanding the ramifications of this disease requires a baseline knowledge of the forest conditions before the disease was first observed. Forest inventory data collected between 1981 and 1984 and between 1991 and 1994 from private and public land in California enabled researchers to determine the distribution and abundance of the vulnerable species and to determine the rates of change and mortality prior to the onset of sudden oak death. The study found that host tree species, particularly tanoak, had been increasing in number and size prior to the first observation of the disease. Inventory information continues to be collected annually on private and public forest land to better understand the impacts of sudden oak death on coastal California ecosystems. By understanding mortality rates prior to the introduction of sudden oak death, forest managers will be better able to determine appropriate forest management activities as they try to control and contain the spread of the disease.

Contact: Tara M. Barrett, US Forest Service, Pacific Northwest Research Station, tbarrett@fs.fed.us

Partners: US Forest Service Forest Health Protection

Citation: Barrett, T.M. 2006. Pre-epidemic mortality rates for common Phytophthora ramorum host tree species in California. In: Frankel, S.J.; Shea, P.J.; Haverty, M.I., eds. Proceedings of the Sudden oak death second science symposium: the state of our knowledge. Gen. Tech. Rep. PSW-GTR-196. Berkely, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 371-378.

Regional differences found in homeowners' attitudes toward fuel treatments

Photo Credit: Eric White

Fuel treatments at the wildland urban interface are not universally accepted by the homeowners they are intended to benefit. Without public approval, it is difficult for land managers to effectively reduce fire hazard on neighboring public land or to engage homeowners in activities that would reduce fire hazard on private property. To help managers understand and predict homeowners' attitudes toward different types of fuel treatments and their intentions to approve the use of such treatments, scientists developed a survey that was tested and administered in California, Florida, and Michigan. The survey revealed that California residents tended to have positive attitudes toward mechanical treatments to remove fuel and toward defensible space ordinances that require homeowners to remove flammable vegetation near their homes. Florida residents tended to have more positive attitudes toward prescribed burns, whereas fewer Michigan residents were supportive of mechanical treatments or prescribed burns. Although strong regional differences were observed, nearly all homeowners in the wildland-urban interface were generally supportive of at least one of the fuel management approaches under consideration.

Land managers can use and adapt this survey to poll homeowners living in fire-prone areas around the country. When necessary, managers can follow up with targeted information that may change homeowners' beliefs and attitudes toward fuel management activities.

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Partners: Cornerstone Strategies, Michigan State University, University of California

Citation: Hammer, R.B.; Radeloff, V.C.; Fried, J.S. 2007. Wildland-urban interface housing growth during the 1990s in California, Oregon, and Washington. International Journal of Wildland Fire. 16: 255-265.

Education program changes homeowners' attitudes toward fire risks

A dream house in the western foothills or a tinderbox in a fire-prone area? Too often the unsuspecting homeowner in the wildland-urban interface finds the latter description is more accurate. Every summer, wildfire threatens homes that have been built in areas prone to frequent fires. Station scientists and the Colorado Springs Fire Department developed a study to determine if educating the public about fire risk would influence the local housing market. Before the education campaign, housing prices in Colorado Springs were greatest in areas that also had the greatest wildfire risk. Presumably, prospective buyers valued the view afforded by a house on a ridge and were unaware of the increased wildfire risk in such a location. After the education campaign, scientists observed no correlation between wildfire risk and housing price. This suggests that the education campaign successfully changed homeowners' attitudes toward wildfire risk, although there was some evidence that this effect was fading over time. The Colorado Springs Fire Department has used this study to demonstrate the efficacy of their program and to refine their ongoing educational efforts. The results also may be useful to land mangers trying to raise public awareness about other natural hazards.

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Partners: US Forest Service Rocky Mountain Research Station, National Institute of Standards and Technology, Colorado Springs Fire Department

Photo Credit: Steve Wondzell

Citations: Donovan, G.H.; Champ, P.A.; Butry, D.T. 2007. Wildfire risk and housing prices: a case study from Colorado Springs. Land Economics. 83(2): 217-233.

Donovan, G.H.; Champ, P.A.; Butry, D.T. 2007. Measuring the efficacy of a wildfire education program in Colorado Springs. Journal of Emergency Management. 5(3): 33-37.

Prescribed fire has little effect on erosion in the absence of major storms after treatment

Prescribed fire is often proposed as a treatment for restoring forest health and reducing long-term risk of wildfires. It is generally assumed that wildfires and wildfire-related erosion pose greater threats to water quality and fish habitat than prescribed fires. This study in the Blue Mountains of northeastern Oregon and southeastern Washington was designed to quantify background erosion rates and to examine the effects of prescribed fire on hillslope erosion and stream sedimentation. Preliminary analyses indicated that erosion rates were significantly related to aspect and amount of bare ground but were not significantly influenced by prescribed fire. Vegetative ground cover grew back quickly in the years following fire. Consequently, the window of time during which treated areas are at risk of accelerated erosion following prescribed fire appears to be relatively short. Data from this study have been used to help calibrate the WEPP model for background erosion rates and the effects of prescribed fire on hillslope erosion for volcanic-ash-derived soils. The data and WEPP model also contributed to analysis on erosion and sedimentation for the School Fire salvage logging environmental impact statement and subsequent litigation.

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Citation: Harris, R.M.; Clifton, C.F.; Wondzell, S.M. 2007. Hillslope erosion rates in areas with volcanic parent materials and the effects of prescribed fires in the Blue Mountains of eastern Oregon and Washington, USA. In: Advancing the fundamental sciences: Proceedings of the Forest Service National earth sciences conferences, Gen. Tech. Rep. PNWGTR-689. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 7-19.

Fertilization after severe wildfires can accelerate the development of plant cover and help reduce soil erosion hazards

Slope stabilization treatments often are applied after high-severity wildfires to reduce soil erosion, protect water quality, and reduce risks to human life and property resulting from landslides. The effectiveness of many common slope stabilization treatments remains in question, however, and high costs limit the extent to which some popular treatments, like aerial mulching, can be used. In a study of seeding and fertilization treatment effects following the 2004 Pot Peak Fire near Chelan, Washington, scientists found that fertilizing with nitrogen and sulfur increased plant cover significantly during the first two growing seasons following the severe wildfire. Fertilization alone was more effective than seeding alone; however, spreading fertilizer and yarrow seeds, a native forb, produced the greatest increase in plant cover. If further studies can establish the consistency of these results, fertilization can provide a viable alternative to seeding or mulching as a slope stabilization treatment. Fertilizer is widely available and relatively inexpensive to purchase and apply, and carries low risk of introducing exotic plant species into severely disturbed landscapes. Ongoing studies will help us better understand possible secondary effects (good or bad) of fertilization on vegetation composition and succession.

Photo Credit: Robert Szaro

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Citation: Peterson, David W; Dodson Erich K.; Harrod Richy J. 2007. Assessing the Effectiveness of Seeding and Fertilization Treatments for Reducing Erosion Potential Following Severe Wildfires. In: Butler, Bret W.; Cook, Wayne, comps. The fire environment—innovations, management, and policy; conference proceedings. 26-30 March 2007; Destin, FL. Proceedings RMRS-P-46CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 662 p. CD-ROM.

Native Douglas-fir will be poorly adapted to climates expected by end of 21st century

Climates are expected to warm considerably over the next century, suggesting that today's plant populations will not be adapted to future conditions. Scientists studied the potential risk of maladaption of native Douglas-fir by comparing populations grown together and looking at the relationship of population variation in adaptive traits and the environments of seed sources. They found the risk to be large for most adaptive traits relative to the risk associated with transfers within current seed zones, particularly for the more drastic climate change scenarios. Uncertainty remains, however, with respect to specific climate projections and appropriate timeframes to consider for adaptive responses. Management options to prepare for a warming but uncertain future climate include increasing within-stand diversity by planting mixtures of local seeds and seeds from lower elevations or farther south.

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Citation: St. Clair, J.B.; Howe, G.T. 2007. Genetic maladaptation of coastal Douglas-fir seedlings to future climates. Global Change Biology. 13: 1441-1454.

Excess Nitrogen Depletes Calcium in Unpolluted Forest Soils

Forest growth is often limited by low nitrogen supply, but in highly polluted forests excess nitrogen can lead to calcium depletion that also impairs forest growth. It is often assumed that excess nitrogen is rarely a problem for calcium depletion in unpolluted forests. Oregon State University graduate student Emily Sinkhorn, who was funded and supervised by USGS scientist Steven Perakis, examined nitrogen cycling and calcium depletion in unpolluted forests of the Oregon Coast Range. Results show strong calcium depletion in nitrogen-rich sites, accompanied by a preferential accumulation of calcium in trees relative to soils. Tree conservation of calcium appears critical for sustaining forest productivity in the most nitrogen-rich sites, yet it may also predispose such forests to calcium deficiency when harvested. This information is helping to inform forest managers about sustainable rates of forest growth and tree harvest across a range of natural soil fertility variations.

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More Information: http://ir.library.oregonstate.edu/dspace/handle/1957/6607

Citation: Sinkhorn, E.R., 2007, Non-Linear Nitrogen Dynamics and Calcium Depletion along a Temperate Forest Soil Nitrogen Gradient: Corvallis, OR, Oregon State University--M.S. thesis, 207 p.

Photo Credit: Roger Ottmar

What are the relationships between marbled murrelet status and stressors? How does this affect nesting distribution? Can habitat models effectively predict where murrelets nest?

Historical fragmentation conditions are used to predict current Marbled Murrelet response

Due to time lags, historical rather than recent fragmentation of forests may best predict current habitat use for nesting birds adversely affected by fragmentation. We studied the effect of past fragmentation on current habitat use by the Marbled Murrelet, evaluating if and for how long murrelets delayed abandonment of recently fragmented patches (reduces to < 50 ha). Using statistical habitat models that accounted for imperfect detectability, we related murrelet occupancy to time since fragmentation (up to 20 years) and present-day patch configuration. Probability of occupancy steadily decreased with greater time since fragmentation, suggesting adult murrelets might have strong fidelity to their nesting stands despite poor reproduction and recruitment. Stands fragmented for 5-years had 6 times greater odds of being unoccupied than a stand fragmented a year before the survey. Stands fragmented for 20-years were more than 40 times more likely to be unoccupied than stands fragmented only 1 year ago. The ideal design for maintaining this threatened species on lands managed for timber harvest near the coast of California is to establish or develop long-term reserves of large, low-elevation stands of old-growth redwood containing the largest trees rather than maintain small forest fragments which may be temporary sink habitats.

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Citation: Meyer, C.B. 2007 Does scale matter in predicting species distributions? Case study with the marbled murrelet. Ecological Applications 17:1474-1483

What are the effects of fire on ecosystems, and how can restoration activities (pre-fire and post-fire) reduce the adverse risks of fire to ecosystems and communities, and achieve desired forest habitat conditions?

Effects of Post-Fire Management of Plant Communities

Management agencies mitigate the effects of wildfire on public lands by replanting, salvage logging, and using techniques to reduce soil erosion. Few studies have examined the effects of these post-fire management activities on the composition of plant communities. Results of a study provides forest resource managers with information about the effects of wildfire on tree growth, species composition, wildlife habitat, and nitrogen fixation. The research was funded in part by the Cooperative Forest Ecosystem Research program (CFER).

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More Information: http://ir.library.oregonstate.edu/dspace/handle/1957/7285

Citation: Lopez, M.J., 2007, Plant Community Recovery after High Severity Wildfire and Post-fire Management in the Klamath Region: Corvallis, OR, Oregon State University--M.S. thesis, 133 p.

Long-Term Effects of Wildfire on Streams and Native Species

Previous studies have documented both beneficial and detrimental effects of wildfire on terrestrial species, but few studies have focused on the effects of wildfire on native aquatic species. USGS scientist co-authored a new publication that examined stream temperatures in central Idaho to understand how changes following fire affected the distribution of sensitive species. Results indicated that summer maximum water temperatures can remain significantly elevated for at least a decade following wildfire, particularly in streams with severe channel reorganization. Rainbow trout and tailed frog larvae occurred in nearly every site sampled, but tailed frogs were found in much warmer water than previously reported. This suggests that wildfire may be less of a threat to some native species than human influences that alter the capacity of stream-living vertebrates to persist in the face of natural disturbance. This study was not within the region managed under the NWFP, but results are relevant:

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More Information: http://www.fs.fed.us/rm/boise/publications/fisheries/rmrs_2007_dunhamj001.pdf

Citation: Dunham, J.B., Rosenberger, A.E., Luce, C.H., Rieman, B.E., 2007, Influences of wildfire and channel reorganization on spatial and temporal variation in stream temperature and the distribution of fish and amphibians: Ecosystems, v. 10, p. 335-346.

Photo Credit: John Laurence

Effects of Wildfire on Fish in Headwater Streams

Wildfire is recognized as an agent of disturbance and ecological change in forests, whereas effects on aquatic systems have been less well documented. Oregon State University graduate student who was funded and supervised by the USGS, recently published results about the effects of wildfire on coastal cutthroat trout. Aquatic and terrestrial ecosystems are tightly linked, so profound influences of wildfire were expected in headwater streams. Despite variation in growth and population structure, there was no evidence of decrease in short-term fish fitness following wildfire.

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More Information: http://ir.library.oregonstate.edu/dspace/handle/1957/4599

Citation: Heck, M.P., 2007, Effects of Wildfire on Growth and Demographics of Coastal Cutthroat Trout in Headwater Streams: Corvallis, OR, Oregon State University--M.S. thesis, p. 77.

How well has federal forest management provided for environmental qualities and values associated with late-successional, old-growth, and aquatic ecosystems?

Improved computer-generated images of forested landscapes facilitate better communication

Computer-generated images that illustrate different conditions in forest stands facilitate discussion about prospective management treatments. These images are based on forest inventory data and are used to convey information such as forest age, density, stand size, vertical layering, and fire hazard. Before this study, little research had been done to determine the accuracy of interpretations of forest attributes from computer-generated images. Based on the response of 183 forestry professionals in California, Oregon, and Washington, several factors were identified, that when altered, affected observer perception of forest conditions based on the image. For example, including more visual information, such as groundcover, changed the observer's perception of tree size, age, and stand density. A new nationally consistent forest inventory system has been implemented for 43 states, providing a wealth of inventory measurements that can be used to create images of the diverse forest types found across the United States. Improved computer-generated images provide scientists and managers with another way to communicate and involve the public in forest planning discussions.

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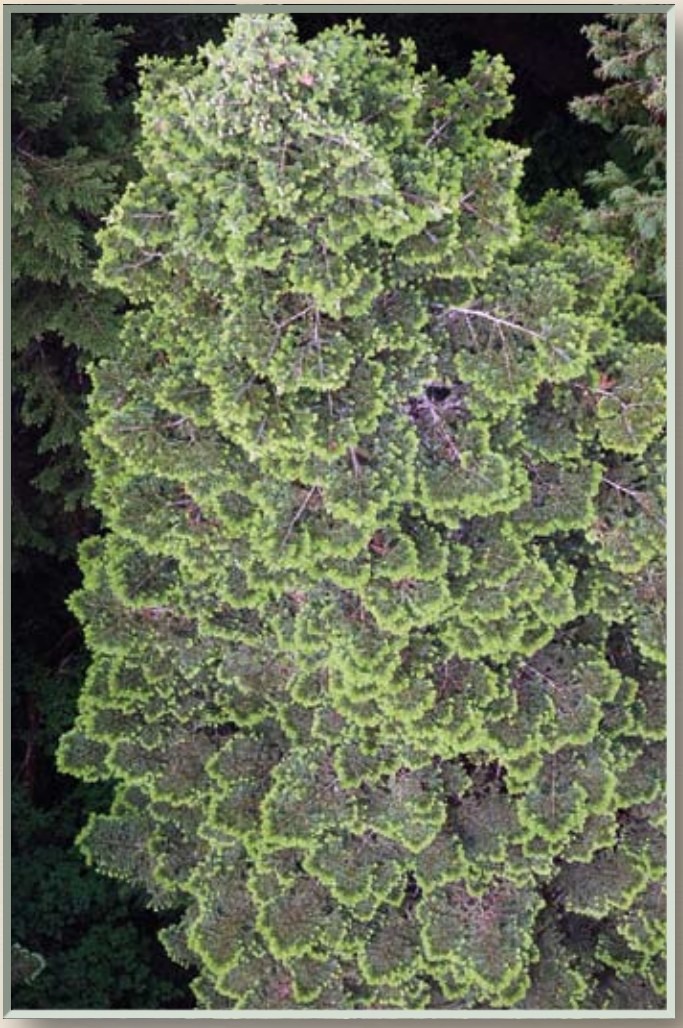
Photo Credit: Tom Iraci



Citation: Barrett, T.M.; Zuuring, H.R.; Christopher, T. 2007. Interpretation of forest characteristics from computer-generated images. Landscape and Urban Planning. 80: 396-403.

Continuous riparian buffers protect aquatic life better than variable-width buffers

Riparian trees and shrubs play an important role in aquatic ecosystems. Stream-side vegetation within a riparian zone shades the stream, while fallen branches and leaf litter provide structure and nutrients in the immediate vicinity and farther downstream. In this study, scientists found that aquatic life in headwater streams of the Washington Coast Range appeared better protected by continuous, fixed-width riparian buffers than by either intermittent, variable-width buffers or no buffers. The quantity and composition of organic litterfall was strongly influenced by the amount of riparian forest retained with fixed-width buffers providing the greater amounts of organic matter, but temperature changes were detected only in streams with no buffers. Fewer mollusks and millipedes were found after timber harvest, especially at sites without springs or seeps, regardless of the type of buffer provided. Buffer information is being used by the Washington Department of Natural Resources to prescribe headwater stream protection requirements in its 50-year habitat conservation plan for managing headwater streams.

Photo Credit: Steve Lanigan

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Partners: Washington Department of Natural Resources, Washington Department of Ecology, University of Washington

Citations: Claeson, S.M.; Wilk, K.I.; Foster, A.D.; Bisson, P.A. 2007. Effect of alternative headwater stream buffers on aquatic macroinvertebrates, detrital export, and riparian litter fall in western Washington [Abstract]. Conference program - riparian management in headwater catchments: translating science into management. Vancouver, BC: University of British Columbia: 21

Bigley, R.E.; Bisson, P.A.; Raphael, M.G. [and others]. 2007. Establishment of the western Washington forest headwater stream riparian ecosystem management studies (REMS) project: testing alternative headwater stream management options [Abstract]. In: Conference program: riparian management in headwater catchments: translating science into management. Vancouver, BC: University of British Columbia: 18.

Non-native Trout Need Good Connections

Increasing attention has been focused on understanding the processes that influence invasions of non-native species. Brook trout are native to eastern North America and are now present in many western streams and lakes. USGS aquatic ecologist and colleagues investigated factors that contributed to invasion of brook trout in Panther Creek, Idaho. The most likely factors included temperature and connectivity to habitats that act as sources for invasion. Overall, brook trout were found more often in areas with good connectivity to these source habitats and where water temperatures were warmer. Whereas brook trout do not seem to pose an imminent threat to native fish in this system, management activities that restore colder water and other factors that benefit native trout and salmon may increase the chances that both natives and non-natives could coexist over the long

term. This study was not within the region managed under the NWFP, but results are relevant.

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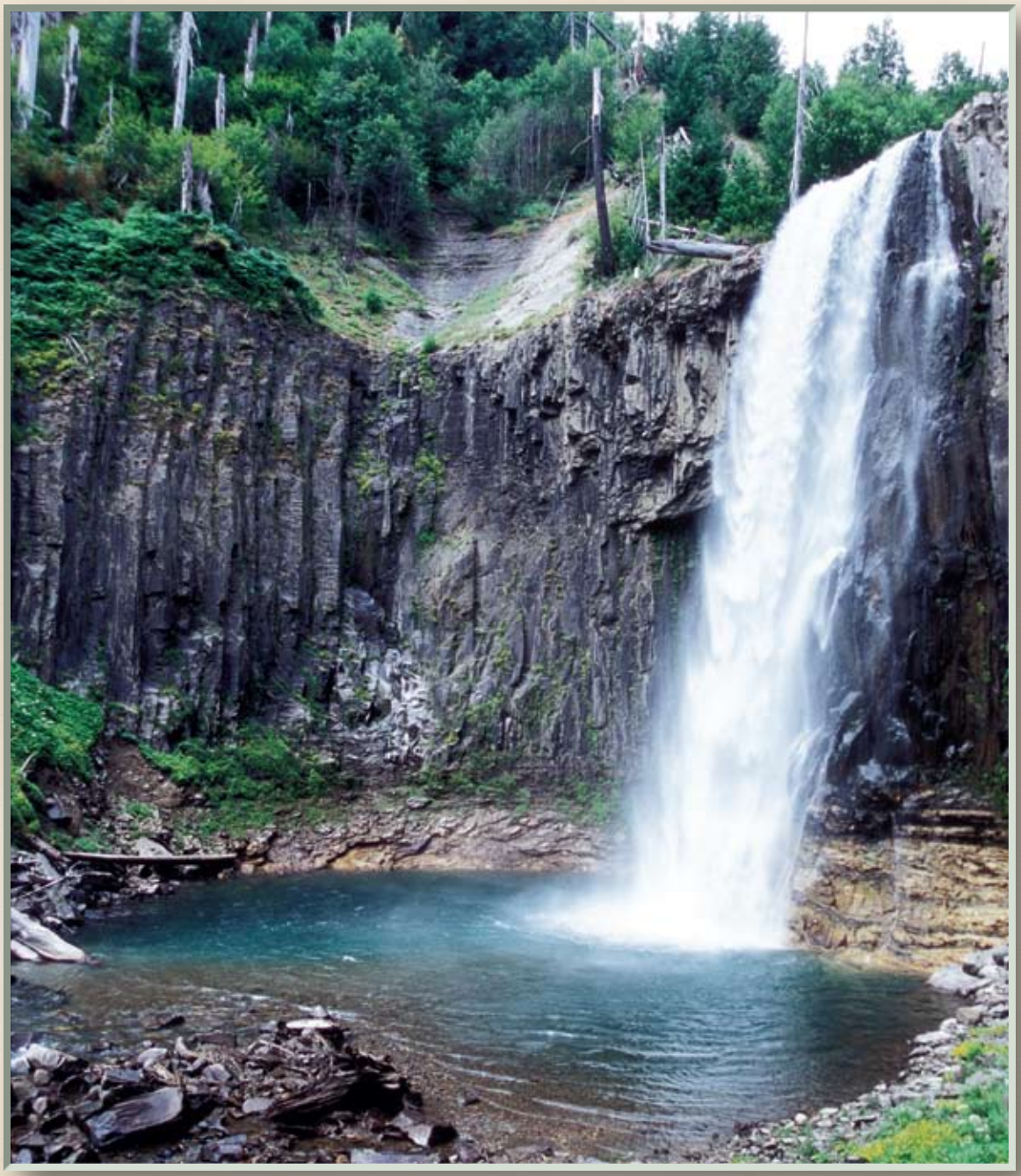
More Information: http://www.fs.fed.us/rm/boise/publications/watershed/rmrs_2007_dare001.pdf

Citation: Benjamin, J.R., Dunham, J.B., Dare, M.R., 2007, Invasion by nonnative brook trout in Panther Creek, Idaho- Roles of local habitat quality, biotic resistance, and connectivity to source habitats: Transactions of the American Fisheries Society, v. 136, p. 875-888.

Photo Credit: Charlie Crisafulli



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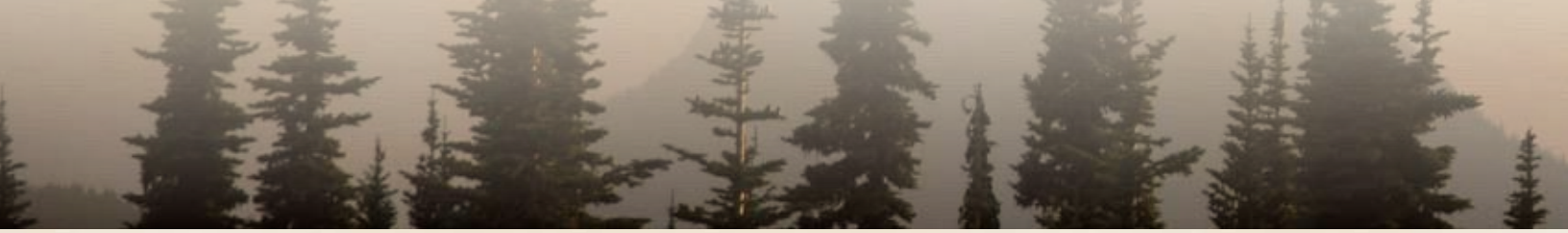

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