The Learning Forest

Sharing scientific knowledge on sustainable land management in the Olympic Experimental State Forest and beyond

Issue 5 • Spring 2019

Editorial Board Message

Should habitat conservation strategies target a specific future condition or a range of conditions? Should they focus on a single species or the whole ecosystem? And can these efforts also benefit rural communities? These are difficult scientific questions and even more difficult land management and policy decisions.

The Washington State Department of Natural Resources (DNR) continues to restore watersheds in the Olympic Experimental State Forest (OESF) to achieve a range of habitat conditions for salmon and other species. Our featured article describes an ongoing project in which DNR is monitoring habitat attributes as a proxy for riparian functions important to salmon. Results raise an important question: whether the current passive restoration approach, which involves little or no management in riparian areas and could take 50 years or longer, is working, or if thinning or other active treatments are needed to speed recovery. Given that riparian forests comprise approximately one-third of the land DNR manages in the OESF, the answers to this question may have consequences for salmon and rural communities.

Land managers across the Pacific Northwest are preserving mature and old-growth forests as habitat for the northern spotted owl (*Strix occidentalis caurina*). Our guest article is a precursor to what may be a final epitaph for this owl on the Olympic Peninsula. Monitoring has shown that conservation efforts have been insufficient given competition from the barred owl (*Strix varia*), a related species that spread here from the eastern U.S.

Where should we go from here? Old-growth forests provide ecosystem services even without the northern spotted owl, but so do early seral and mature conifer forests. On lands managed for multiple uses, active management could be used to create a mosaic of forests ranging from early seral to old growth. The result may be a resilient ecosystem in which forests and rural communities can thrive together.

In this Issue

Teodora Minkova, DNR

Stream in the OESF

Featured Article

Beauty and Function

Watershed Restoration in the Working Forest

by Teodora Minkova and Cathy Chauvin

In a small stream in the Olympic Experimental State Forest (OESF), water flows clean and cool. An emerald canopy casts shade over plants growing along the banks, and moss clings to rocks half-submerged in the flow.

The stream is undeniably beautiful. But beneath all the beauty is a concern: The stream is not functioning well as habitat for one of the Northwest's most important native species, salmon.

Stream function is closely related to forest conditions, and this streamside (riparian) forest is young. Trees are closely spaced. The forest canopy has few gaps. Large trees and snags are absent. As a result, the water is too deeply shaded. Lack of light can reduce photosynthesis in the water, which **affects primary productivity** and thus the entire aquatic food web, including salmon. Also, there are few pieces of wood in the stream channel (in-stream wood) to create pools and other habitat features that salmon need.

Such conditions are common across the OESF. Prior to 1990, upland clear cuts often went all the way to the water's edge, leaving a legacy of young riparian forests.

The Washington State Department of Natural Resources (DNR) is tasked with maintaining or restoring streams and riparian forests like these as habitat for salmon, trout and other aquatic and riparian species. Its approach is largely passive. Along streams, DNR maintains a forested "riparian buffer" that is wide enough to provide wood, shade, and other ecological functions to the stream. As harvest and other management activities continue in the uplands, the riparian forest within the buffer will mature through forest succession and natural disturbances, which should improve salmon habitat conditions. For example, trees will grow larger and some will fall into the stream to create pools.

As riparian forests mature, more watersheds should reach a fully functional condition, meaning they are providing the full suite of functions needed to support salmon habitat in fish-bearing streams. As they do, the range of watershed conditions in the OESF is expected to widen (Figure 1). In time, the OESF should more closely resemble an unmanaged forested landscape with its mix of young, mature, and old-growth forests and corresponding stream habitat conditions.

Although DNR performs some active management within the buffers, most buffers have remained unmanaged since this approach began in 1997. Which begs

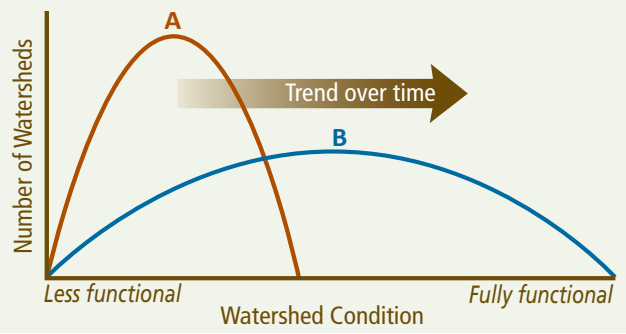

Figure 1. Hypothetical watershed distribution. In A), many watersheds are in a less functional condition; in B), the entire distribution is wider as more watersheds become fully functional.

The Learning Forest is an electronic, biannual newsletter published jointly by the **Washington State Department of Natural Resources** (DNR) and the **Olympic Natural Resources Center** (ONRC).

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two questions: Has this approach been effective? And should DNR restore salmon habitat more quickly, for example by thinning the riparian forest or felling trees into the water?

Looking for Answers

In 2012, DNR launched an observational study to answer these questions. Called "Status and Trends Monitoring of Riparian and Aquatic Habitat in the OESF," the study is being led by DNR with help from the U.S. Forest Service.

In this study, DNR is not comparing streams to a "desired future condition" measured by specific percentages of shade or other thresholds. Instead, DNR is comparing streams in managed watersheds to those in *un*managed (reference) watersheds over at least one decade. This comparison will help DNR understand natural conditions and processes, including natural disturbances, and draw inferences about how well its approach to restoration is working.

This study requires a large sample size. DNR is monitoring 12 watersheds in Olympic National Park and Olympic National Forest as reference sites, and 50 watersheds in the OESF that are now, and have been for decades, managed for both timber harvest and habitat conservation (Figure 2). Activities in the managed watersheds include thinning, stand replacement harvest, and road management. All watersheds average 161 hectares (400 acres) in size and are drained by the smallest of the fish-bearing streams ("Type 3" streams). The Type 3 streams in this study range from 2 to 10 meters (6.5 to 33 feet) wide.

In each watershed, DNR identified a stream reach that is at least 100 meters (328 feet) long and located near the outlet of its respective watershed (Figure 3). In the stream and riparian forest along this reach, DNR is monitoring nine indicators of habitat function: channel morphology (confinement, depth, width, and steepness), channel substrate (such as gravel), in-stream wood, habitat units (such as pools), stream shade, water temperature, stream flow (measured in 10 stream reaches only), riparian microclimate (localized climate zone, measured in 10 stream reaches only), and riparian vegetation. The project team now has millions of data points and a **first snapshot** of habitat conditions in the OESF.

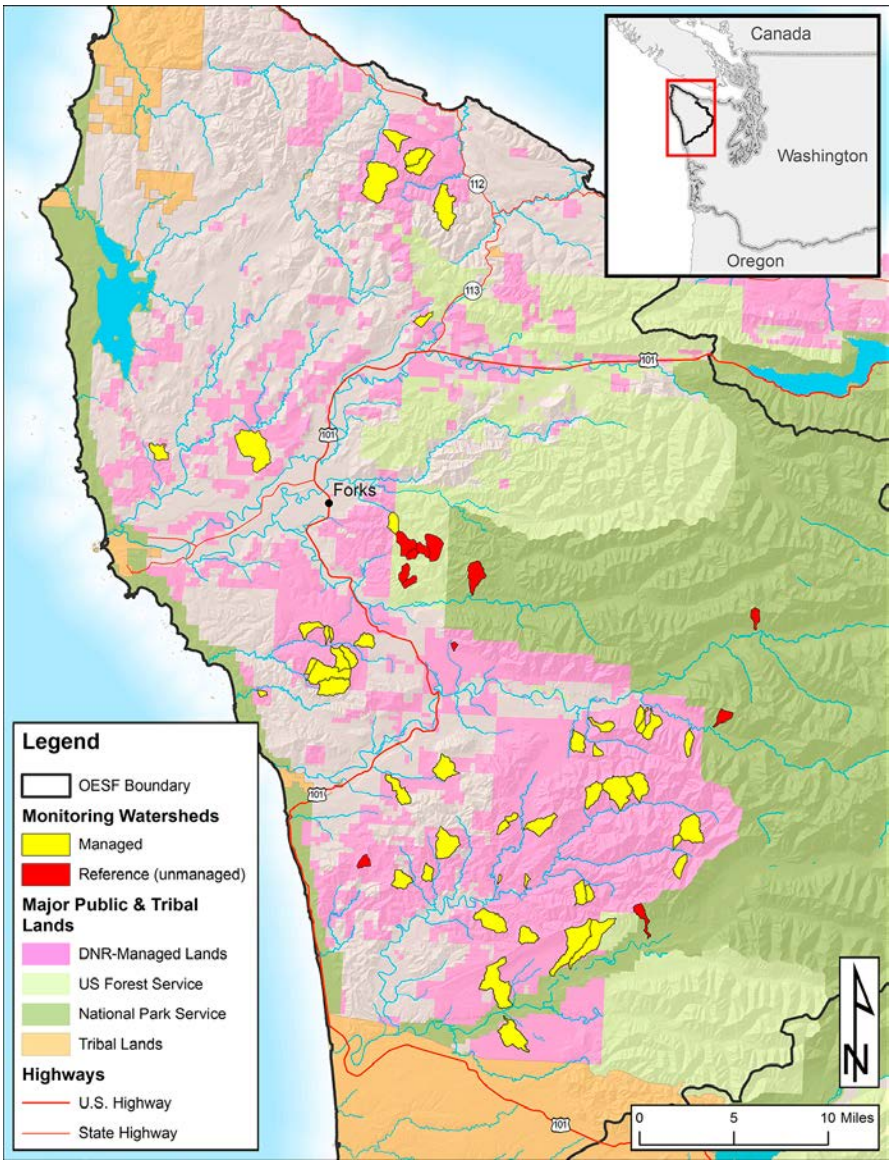

Figure 2. Location of 50 Managed and 12 Reference Watersheds

Temperature

DNR measures stream (and air) temperature hourly throughout the year. Using this data, DNR calculates different metrics to characterize the annual temperature regime (Figure 4). For example, DNR is calculating minimum stream temperatures on the 20 coldest days of the year and determining how those temperatures vary by location and change over time. These metrics provide insight into forest management and climate change and their effects on salmon.

DNR also is calculating a common metric of stream health, the 7-day average of maximum daily stream temperature (7-DADmax). The 7-DADmax should not exceed 16°C (61°F), which is a regulatory standard for maximum summer water temperature in salmon habitat. In the OESF, the 7-DADmax occurs in late summer.

From 2013 to 2017, the 7-DADmax in the 50 managed watersheds remained below 16°C 92 percent of the time. These stream reaches were at least as cool as the reference streams. They also were cooler than streams measured in **a separate study** done in the same area in 2004. In that study, 24 of the 49 streams (49 percent) exceeded the 16°C threshold.

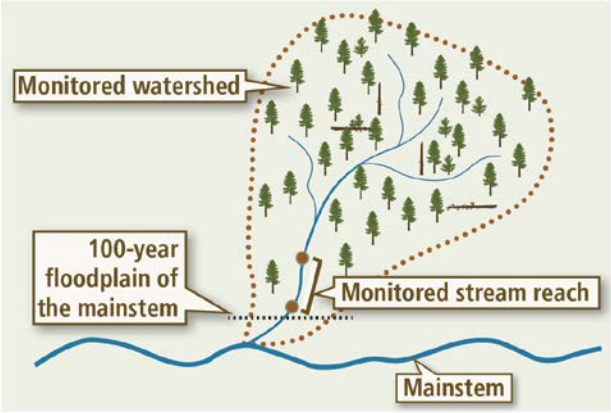

Figure 3. Location of the monitored stream reach

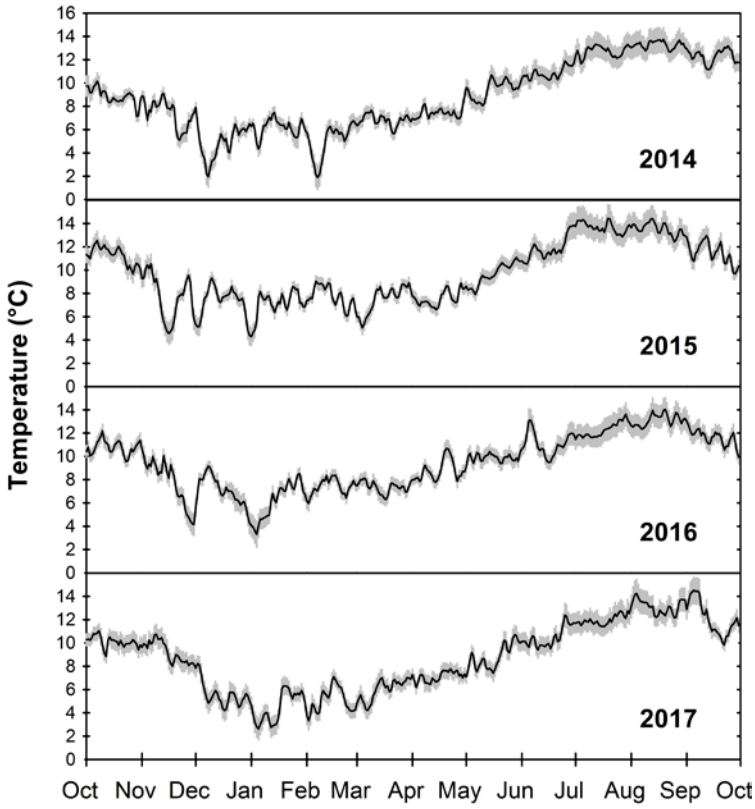

Figure 4. Daily stream temperatures in the 50 managed and 12 reference watersheds. The black line indicates the mean and the grey shading is the standard deviation.

Shade

To measure shade from the riparian forest, DNR takes a 180° photo of the forest canopy at six locations along the stream reach and calculates the proportion of the sky that is obstructed by the canopy (Figure 5). In the majority of the managed watersheds, shade exceeds 90 percent and varies little along the stream reach. Shade keeps water cool, but too much can limit primary productivity and affect the aquatic food web.

The riparian forests in reference watersheds are older and should have more canopy gaps and wider tree spacing, and therefore lower shade levels. For example, **studies of old-growth forests** over 300 years old in the Pacific Northwest document mean shade levels of 82 percent.

Surprisingly, shade levels in many reference watersheds were similar to the managed watersheds (Figure 6). Why? Because many riparian forests in the reference watersheds regenerated from a 1921 windstorm and have not yet developed canopy gaps and other complex structures. DNR continues to analyze the relationship between riparian forest age and shade levels.

Figure 5. Equipment for measuring stream shade

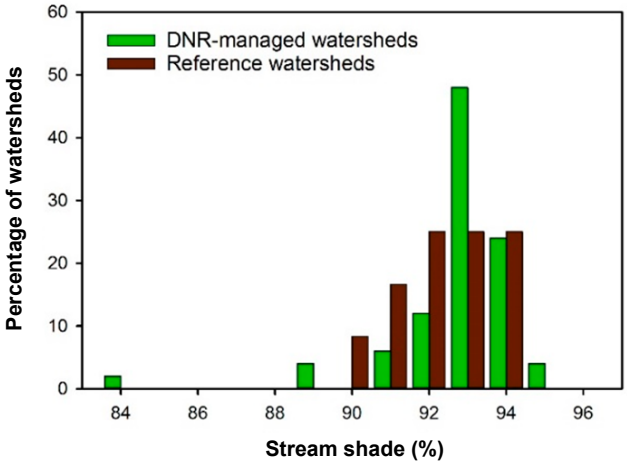

Figure 6. Comparison of stream shade in the 50 managed and 12 reference watersheds

In-stream Wood

For this study, DNR measured pieces of in-stream wood at least 10 centimeters (4 inches) in diameter and 2 meters (6.5 feet) long. In preliminary results, the managed and reference watersheds had a similar range in both volume and number of pieces. However, a large proportion of managed watersheds have fewer key pieces, which are pieces of in-stream wood greater than 45 centimeters (17 inches) wide that have a disproportionately high influence on habitat quality (Figure 7).

DNR currently is analyzing how stream steepness affects these comparisons; wood in steeper streams can more readily wash down the stream network during high flows. DNR also is developing a model for the managed

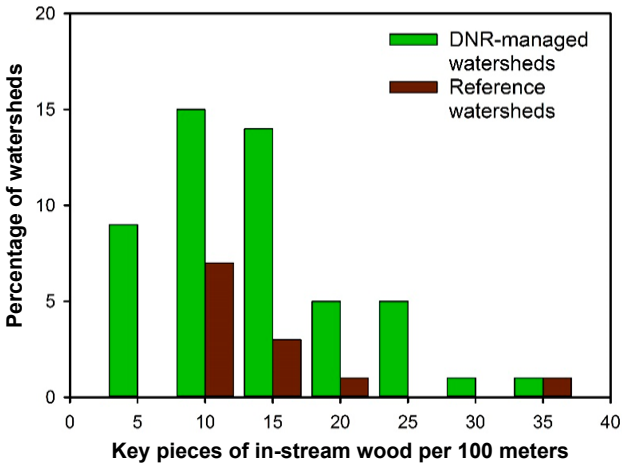

Figure 7. Number of key pieces of in-stream wood in 50 managed and 12 reference watersheds

watersheds that predicts wood delivery to streams based on the condition of the riparian forest.

Stream Flow

Stream flow changes the shape of the channel, redistributes pieces of wood, and concentrates or dilutes chemicals such as carbon and nitrogen. By investigating stream flow in mid-sized streams (larger than headwater streams but smaller than rivers), DNR is filling a critical data gap. Very little research has been done on flow in streams of this size.

OESF streams are placid in the summer, but in the winter, heavy rains turn them into raging torrents that cause the channel to move and change shape. To overcome this sampling challenge, DNR manually measures water flow and channel shape several times a year. DNR also uses permanent gage stations with water level sensors that record data every 15 minutes. All of this data is combined to develop a hydrograph showing changes in flow over time (Figure 8).

A significant challenge of this project is to establish relationships between stream flow and forest management. Trees in a watershed absorb and slow the flow of water to the stream. Yet according to **preliminary results**, the geology of the watershed influences stream flow more than vegetation. For example, gravel absorbs more precipitation than hard rock, slowing the flow of water to the stream. DNR is developing ways to sepa-

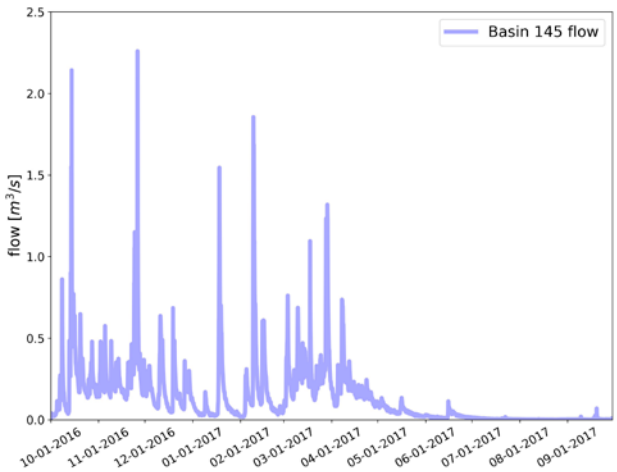

Figure 8. Hydrograph from one of the managed watersheds showing data from one water year

Teodora Minkova, DNR

Figure 9. Middle school students learning about stream monitoring

rate vegetation from geology influences to understand how timber harvest affects hydrologic regimes.

Summary of Findings

Based on this initial snapshot of stream conditions, results are mixed. DNR's passive approach to restoration has improved some habitat functions. For example, shade is keeping the water cool enough for salmon. Other functions are lagging: the number of key pieces of wood appears to be relatively low, and light levels also are too low. This study has many years to go and the picture may change as more data is collected and analyzed. **In a separate effort,** DNR is collecting the ultimate evidence of success or failure: The distribution and abundance of salmon. Abundance has been **low so far**.

DNR will use these results to determine if the passive approach of maintaining forest buffers and allowing forests to mature on their own (which could take 50 years or more) is best, or if a more active restoration approach could speed up recovery.

Yet the value of this study goes beyond DNR's management needs. For the scientific community, the study provides ecological data from numerous sites collected and analyzed through **rigorous procedures**. This study also offers many opportunities for collaboration.

Another value of this study is education (Figure 9). On a recent school visit to the study area, a middle school student learning about stream substrate gazed wide-eyed up and down the long, gravel-strewn channel. "Do you measure *every pebble in the stream*?" This was a teachable moment about statistical study design, and was just one of many. Over the past five years, K-12 students, undergraduate and graduate students, and others have taken an educational walk up these streams. Four graduate students have completed or are working on their theses using data collected here.

These students are the next generation of foresters and scientists. Whatever DNR learns on these streams, it may be their jobs to ensure that OESF streams remain functional as well as beautiful into the future.

More to Explore

Explore **stream habitat conditions** and **salmon monitoring** through interactive story maps, and DNR's riparian management approach in the **OESF Forest Land Plan**.

About the Author

Teodora Minkova, Ph.D (Teodora.Minkova@dnr.wa.gov), is a natural resource scientist with DNR and an affiliate assistant professor at the University of Washington's School of Environmental and Forest Sciences. She manages the research and monitoring program for the OESF and is the principal investigator on this study.

Guest Article

Northern Spotted Owl Monitoring in Olympic National Park

by Scott Gremel, Wildlife Biologist, National Park Service

At the end of each seven-day field tour, the monitoring crew at Olympic National Park (ONP) meets to review the previous week of visits to northern spotted owl (*Strix occidentalis caurina*) sites, some of which can be as far as 28 miles into the park's backcountry (Figure 1).

Scott Gremel, National Park Service

Figure 1. Northern spotted owl at a site in ONP

This meeting provides an opportunity for our eight-person crew to share details of everything from snow conditions and the location of potential river crossings to the best route to climb 2,500 feet in elevation to access a northern spotted owl roost site. But in recent years, one detail has been missing: owl encounters. As we wrap up the 2018 field season with the fewest detections of these owls to date, it is a good time consider the future of this iconic species on Washington's Olympic Peninsula.

The northern spotted owl became well known in the 1980s due to its association with mature and old-growth forests and the controversy surrounding the harvest of those forests. The listing of the northern spotted owl as threatened under the Endangered Species Act in 1990 triggered years of legal gridlock and ultimately led to the passage of the Northwest Forest Plan (plan) in 1994. The plan served as the conservation strategy for the northern spotted owl on federal lands, but its overall purpose was to maintain the biological diversity of these forests while providing a predictable source of timber for the rural communities whose economies depended on it. It also mandated monitoring to determine if the goals of the plan were being met. One component of this "effectiveness monitoring" was to assess trends of northern spotted owl populations across Washington, Oregon, and California.

The areas being monitored under ONP's monitoring program are part of the Olympic Peninsula study area, which is one of eight federal study areas in western Washington, Oregon, and California designated by the plan. Monitoring within the study area is a collaborative effort. The National Park Service monitors northern spotted owls in ONP and the U.S. Forest Service's Pacific Northwest Research Station monitors these owls in Olympic National Forest. Although the two monitoring programs are run separately, the methods are standardized and the data from both are pooled in analyses that occur every five years. Banded owls are tracked over time at roughly 100 historically occupied territories in the study area to estimate rates of survival, occupancy, and the number of offspring produced. These rates inform population trend estimates across the range of the species.

Located in the center of Washington's Olympic Peninsula, ONP contains just under 500,000 acres of forest suitable for northern spotted owls, which is by far the largest block of habitat un-fragmented by timber harvest within the owl's range. ONP crews have monitored 52 northern spotted owl territories for an average duration of 26 years.

What have we learned? Despite almost no obvious changes in forest conditions, northern spotted owl populations have been declining since the program began (Figure 2). In the Olympic Peninsula study area (including ONP and Olympic National Forest sites), estimated rates of territory occupancy declined from 81 percent in 1995 to 21 percent in 2013. In the 2018 field season our crew was only able to locate six northern spotted owls, suggesting these declines have continued since the 2013 analysis (Figure 3). Annual declines of about 4 percent since the early 1990s have brought the northern spotted owl to the brink of extirpation (local extinction) on the Olympic Peninsula, even in the high quality habitat of ONP where over 200 pairs were estimated to exist 25 years ago (for more information,

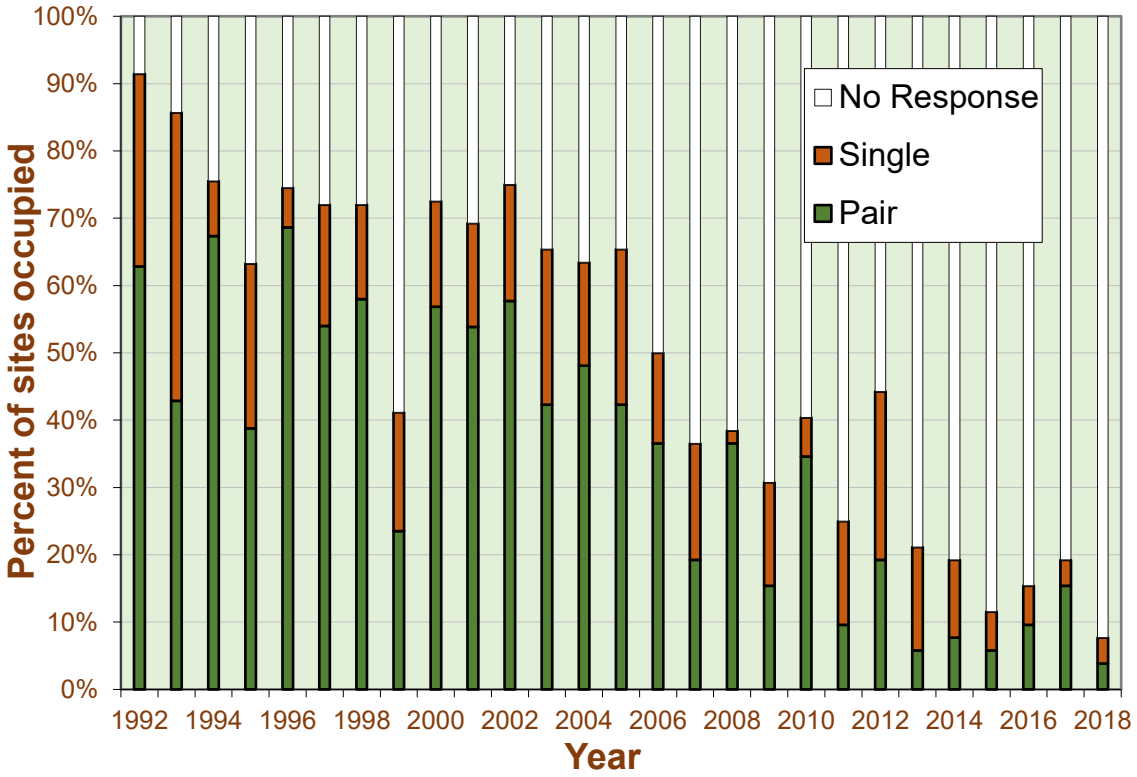

Figure 2. Percent of monitored spotted owl sites with 0, 1, or 2 adult owls detected, ONP, 1992-2018

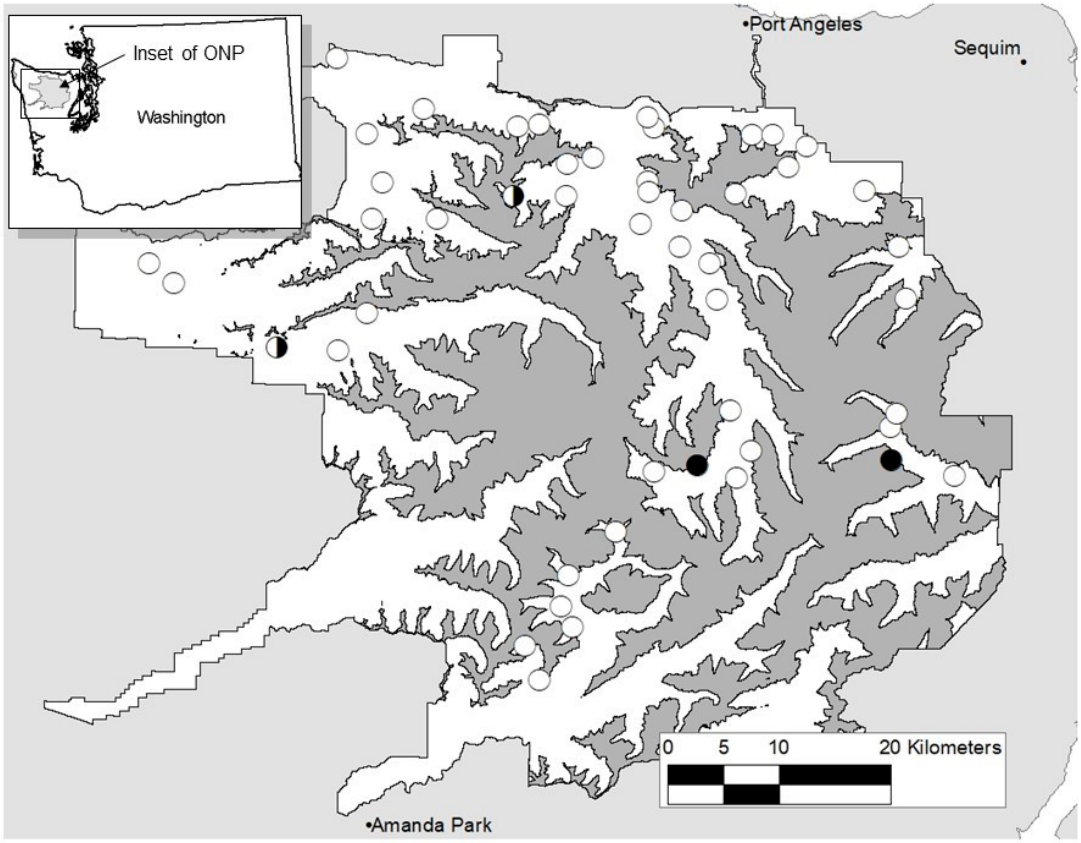

Figure 3. General location and occupancy status of 52 monitored spotted owl territories in ONP, 2018. Black circles are spotted owl pairs, half-filled circles are single owls, and white circles are monitored sites with no response. Shaded area within the park boundary is high elevation non-habitat.

refer to **annual reports** and to **archived reports and reports from cooperative studies**).


Cathy Chauvin, DNR

Figure 4. Barred owl

The most probable cause of these declines is the range expansion of a larger and more aggressive relative of the northern spotted owl, the barred owl (*Strix varia*) (Figure 4). This species was first documented in ONP in 1985, and has now been detected at nearly all the monitored northern spotted owl sites in the park. Originally found in eastern North America, barred owls spread to the west coast in the 20th century, most likely due to a human-caused increase in forest cover in the Great Plains and Canadian prairies.

In nearly all cases observed at ONP, northern spotted owls have shifted their activity centers or simply disappeared when barred owls have moved into an area. Although barred owls occur in all forest types at ONP, they are most abundant in productive, low-elevation forests, so competition with northern spotted owls is most intense in these areas. The remaining northern spotted owls are found at the steepest, high-elevation portions of their former range.

Trend estimates from this study reflect these observations. There is strong evidence from the Olympic Peninsula and other study areas across the owl's geographic range that barred owls are displacing northern spotted owls from their territories.

Owing to the small number of sites in which northern spotted owls remain, the Olympic Peninsula study will transition to an occupancy study using passive acoustic monitoring beginning in 2019. Sound recorders will be deployed at random sites in both ONP and Olympic National Forest. The recordings will be processed in collaboration with the U.S. Forest Service Pacific Northwest Research Station to identify the calls of northern spotted and barred owls. This method will not require multiple visits to the sites every year and will allow reduced sampling intensity over time when owls are not present at a site. Acoustic recordings also will provide better data on barred owls. Currently, we rely on incidental detections (barred owls responding to spotted owl calls) to track the species. Acoustic recordings also can be used as a monitoring tool for any other species detectable by sound. The disadvantages are that techniques for analyzing the large volume of recordings are still being developed and will need to have considerable data checking until they are proven reliable.

The unfortunate lesson from the case of the northern spotted owl in ONP is that providing suitable habitat is necessary but not always sufficient for the conservation of a threatened species. The plan addressed the habitat loss and modification that was the primary threat to the species in the early 1990s, but the range expansion of the barred owl has made much of that habitat unavailable to northern spotted owls. The monitoring program worked as designed to alert managers to the sharp decline in northern spotted owls and the likely cause, but there is no obvious management solution to address it. Barred owl removal is being tested in a number of experimental studies to look at the effectiveness and feasibility of this strategy, but even if it is shown to be effective, removing barred owls from parts of a large wilderness park like ONP would be controversial and difficult to implement at the scale needed.

The most positive development to come out of the monitoring program is the evolution away from tracking a single species to a method that will provide information on many. But without a management intervention or an unexpected change in the status of barred owls, it is unlikely that the distinctive call of the northern spotted owl will continue to be among the chorus of sounds found in the forests of Washington's Olympic Peninsula.

About the Author

Scott Gremel (scott_gremel@nps.gov) is a wildlife biologist for ONP. He has worked with over 100 seasonal field biologists monitoring the northern spotted owls in the park since 1994. He currently is working with U.S. Forest Service researchers to implement an acoustic monitoring strategy for owls and other species of interest across federally managed lands on the Olympic Peninsula.

Project Updates

Using Passive Acoustic Monitoring to Evaluate Sustainability of Forest Management in the 21st Century


Angela Cahill

Marsh wren

This project recently received a grant from the **EarthWatch Institute** and will start in the spring of 2020. The primary research question is how habitat quality, diversity, and function, indicated by the occupancy rate of key bird species, changes in response to different forest management practices. Results will help the Washington State Department of Natural Resources (DNR) determine if its habitat conservation strategies are effective and also should help other land managers.

Researchers from DNR and the University of Washington will collect and analyze sound recordings of several bird species and pair them with forest habitat surveys. The study will be implemented in the Clearwater landscape in the Olympic Experimental State Forest (OESF) across 16 watersheds designated for experimentation with different harvest practices. Several locations representing forest developmental stages ranging from early seral to old-growth will be sampled in each watershed. Each location will be sampled at least once before and after treatment. Depending on funding, the after-treatment sampling will be repeated at years 5 and 10. For more information, contact the project's principal investigator Teodora Minkova at teodora.minkova@dnr.wa.gov.

Ethnoforestry

In our **Fall 2018 issue**, we included an update on the ethnoforestry project. (Ethnoforestry is using traditional ecological knowledge by local people and applying it to the forest management process.) Following is a description of work being completed under grants from the U.S. Department of Agriculture (USDA) and the University of Washington's (UW) Population Health and EarthLab Departments. For questions, contact Courtney Bobsin at cbobsin@uw.edu.

Wildcrafting

The Olympic Natural Resources Center (ONRC) and the Center for Inclusive Entrepreneurship (CIE) have been creating and implementing a sustainable wildcrafting (foraging for native plants) and small business development program over the last eight months through a USDA Rural Business Development grant. CIE and ONRC have hosted eight free, two-day workshops to teach attendees how to create their own small business around wildcrafting. Those who complete the workshop also receive free, one-on-one training from CIE and ONRC staff members to ensure their business is off to a successful and sustainable start. So far, over 40 community members have attended workshops to build their network, develop skills, and ensure they are harvesting sustainably. Additionally, ONRC has been studying plant propagation and production of important plant species such as bear grass that are difficult to grow in large volumes or that local people would like to see back in their forests.

Population Health

A grant from UW will allow ONRC to develop a project proposal to create and implement ethnoforestry field studies in the OESF **Large Scale Integrated Management Experiment**, which is based on a new model of ecosystem sustainability that gives equal weight to both community and environment wellbeing. Ethnoforestry plots will be installed in winter 2020 to study browsing of understory plant species by wildlife, success of planting culturally important species, and response of plants to harvesting over the next several years. Additionally, this grant will be used to conduct interviews with community members to understand which plant species are culturally valuable to them, how they currently use public lands, and how they define sustainability for their community.

You are Invited to Participate

The Washington Department of Natural Resources (DNR) and the Olympic Natural Resources Center (ONRC) invite researchers and stakeholders to participate in research, monitoring, and other learning activities in the Olympic Experimental State Forest (OESF). Contact Teodora Minkova at teodora.minkova@dnr.wa.gov or Franklin Hanson at fsh2@uw.edu. Information on past and current projects in the OESF can be found at this **link**.

Recent Publications

Stream Conditions After 18 Years of Passive Riparian Restoration in Small Fish-bearing Watersheds

Kyle Martens, Warren Devine, and Teodora Minkova, DNR; Alex Foster, U.S. Forest Service

The authors evaluated the results of 18 years of passive restoration in the Olympic Experimental State Forest (OESF) by comparing managed and unmanaged (reference) watersheds using four common indicators (stream temperature, shade, in-stream wood, and salmonid densities). Over the analysis period, summer stream temperatures decreased and shade levels increased in the managed watersheds as compared to the reference watersheds. In-stream wood and age 1 or older salmonids in the managed watersheds appeared to be either stable at reduced levels or declining. The conclusion is that second-growth riparian forests need more time to develop. As forests mature, they should allow more light into streams to increase primary productivity and provide larger pieces of in-stream wood to improve habitat for salmonids. **Environmental Management**, 2019.

Assessment of the Causal Linkages Between Forests and Fish: Implications for Management and Monitoring on the Olympic Experimental State Forest

DNR 2016-2018 Riparian Validation Monitoring Program Status Report

In this analysis, DNR researchers used field data from ongoing fish and stream habitat monitoring programs in the OESF to evaluate how forest conditions can affect streams and fish. Evidence from this analysis indicates three ways that salmon can be affected by forest practices: in-stream cover (wood or boulders), light (forest canopy coverage), and hydrology (stream depth). Stream depth was the most important factor for determining age-1 or older cutthroat trout populations in the OESF; cutthroat prefer deeper streams. Lessons learned from this effort are intended to inform future monitoring and riparian management on state trust lands. A copy of the report can be found on **DNR's website**.

Jeff Keck, DNR

Stream in a young OESF forest

Kyle Martens, DNR

Measuring salmon

Upcoming Events

Olympic Natural Resource Center (ONRC) Evening Talk: The Impact of Growler Jets on the Olympic Peninsula Soundscape

Friday, May 31, 7-9 pm
Hemlock conference room, ONRC, 1455 S. Forks Avenue, Forks, WA

Lauren Kuehn, a research scientist from the University of Washington, will present the results of a yearlong project to monitor current levels of noise from military aircraft and estimate the impact of Growler jets on the "soundscape" of the Olympic Peninsula. Lauren also will discuss current policy and regulatory processes related to growler jets. Laura Giannone, an Evergreen State College sound engineering student, will present her recent research on automated approaches to identifying jet flight events and citizen-science based approaches to documenting the number and impact of military flights on wilderness areas.

Olympic Forest Collaborative Public Meeting

Tuesday, May 28, 6:30-8 pm
Lecture Hall J47, Peninsula College
1502 E. Lauridsen Blvd., Port Angeles, WA

The **Olympic Forest Collaborative** (collaborative) is focused on increasing habitat restoration thinning and aquatic restoration projects in the Olympic National Forest, consistent with the 1994 Northwest Forest Plan, to increase economic opportunities on the Olympic Peninsula. In this meeting, the collaborative will highlight their accomplishments, discuss upcoming plans, and ask for ideas and feedback from attendees on new projects and ways to increase their representation and involvement.

Featured Photos

Conference attendees listen to a talk on forest canopy gaps presented by Dan Donato of DNR

More than 100 people attended DNR's annual Olympic Experimental State Forest (OESF) Conference in Forks on April 24. In the morning, presenters from DNR, the University of Washington, and The Evergreen State College discussed ongoing research projects in the OESF that link science to management. A poster session during the break profiled stream conditions, forest road design, and ethnoforestry. In the afternoon,

Justin Long with DNR discusses a poster about alternative pavement design and reinforcement of forest roads

DNR staff discussed using models and cutting edge remote sensing technology to manage a large, forested landscape. Attendees came from the local community, tribes, non-profit organizations, schools, universities, and government agencies. Videos of the morning and afternoon talks are posted to **DNR's YouTube channel** (click on "playlists").