The **Learning Forest**

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

Issue 11 • Spring 2022

Editorial Board Message

Wherever you live, we hope you have enjoyed the beautiful spring season.

This issue of The Learning Forest focuses on research studies ranging from small streams to wildlife, and how monitoring from afar, with the help of field sensors and wildlife cameras, can provide scientists with continuous data.

The featured article describes how the data collected by water temperature and air sensors, routinely deployed in the Olympic Experimental State Forest (OESF), can be used to develop a baseline for streams, answer key ecological and management questions, and inform management practices. For example, data collected as part of the **Type 3 Watershed Experiment** provides insight into how the June 2021 heat dome affected stream health. This data also informed novel, active restoration treatments designed to address the observed lack of large woody debris and excessive shade levels along monitored streams.

This issue's guest article highlights a collaborative study between several Olympic Peninsula tribes and the conservation organization Panthera to track and study wildlife movement and habitat of culturally important species, including black-tailed deer, Roosevelt elk, bobcat, cougar, bear, and coyote. With the help of a network of volunteers, researchers are using a variety of data-gathering methods, such as wildlife cameras and scat-detecting dog teams, and cutting-edge analytical methods to complete this work. This ongoing study will help with the preservation of these species going forward.

In this Issue

Courtney Bobsin, UW

New growth and towering trees in the OESF

Featured Article

Keeping Cool

Riparian Buffers and Stream Temperature in the OESF

by Cathy Chauvin and Warren Devine, DNR

In late June 2021, the normally-cool Pacific Northwest came under the influence of a massive, persistent ridge of high pressure. Each sweltering day, the ridge forced hot, rising air to subside. As the air fell, it heated even more through compression. This meteorological misery is aptly dubbed a "heat dome."

While residents of Forks, Washington on the western Olympic Peninsula gasped in temperatures as high as 110° Fahrenheit (F), a small sensor hanging from a tree near a small stream in the Olympic Experimental State Forest (OESF) recorded this extreme heat event as part of its normal job, which is to take an air temperature reading once an hour, all day, every day (Photo 1). Another sensor anchored in the stream below did the same for stream temperature.

Later that summer, field technicians with the Washington State Department of Natural Resources (DNR) downloaded the data from this and other sensors across the area and sent it to DNR researcher Warren Devine for analysis. The results of this analysis were interesting, if not unexpected.

Alex Foster, Pacific Northwest Research Station

Photo 1. Air temperature sensor installed near a stream in the OESF.

Understanding the Secret Life of Streams

Fish-bearing streams in the OESF flow beneath the evergreen canopy of the riparian (streamside) buffer, a forested area that extends outward from both sides of the stream. DNR manages riparian buffers to meet the ecological objectives of DNR's **State Trust Lands Habitat Conservation Plan** (HCP).

Many OESF riparian forests are recovering from past timber harvests, when current riparian protections were not in place. The working hypothesis behind the buffers is that over time, stream habitat conditions will improve as the riparian forest develops through natural processes. For example, trees will grow larger, and some will die and fall into the stream. This "large woody debris" will create pools and other habitat features needed by salmon and other aquatic species.

To probe this hypothesis, DNR and its research partners began an ambitious project in 2013 called **Status and Trends Monitoring of Riparian and Aquatic Habitat**. As Devine explains, a major purpose of the project is "to verify that management under the HCP is producing the type of riparian and aquatic habitat conditions that it was intended to produce."

The Status and Trends project involves gathering and analyzing empirical data for nine stream habitat indica-

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tors, including stream temperature, shade, channel shape, and others. Data is collected from 50 Type 3 streams (the smallest fish-bearing streams) in watersheds being managed for timber harvests. These DNR-managed watersheds were selected to represent the full range of ecological conditions in the OESF. Data also is collected from streams in 12 reference (unharvested) watersheds on state and federal land. Given the large number of streams, field technicians collect data on a rotating basis, such that all streams are visited within a two-year period (Photo 2).

DNR now has five years of data for all the streams in the study, and has recently published its first **summary of the results**. Although the data provides a comprehensive understanding of stream conditions, it is too soon to establish trends over time for all nine indicators, especially those that are closely linked to forest development. "With data so far from a relatively brief period of time, it can be challenging to detect long-term change," explains Devine. Yet some indicators are already showing the benefits of riparian buffers, and the most obvious of these is stream temperature.

Cool Beneath the Canopy

DNR monitors stream temperature because of its importance to stream health. High temperatures not only affect cool-water fish like salmon, but also have ripple effects through the entire system. "The aquatic system is a timed system: when insects hatch, when algae grows on rocks, when tadpoles develop into frogs, when fish hatch and how they grow. Heat can speed up growth and metamorphosis, which can throw the system out of sync," explains U.S. Forest Service Pacific Northwest Research Station ecologist Alex Foster. For example, blue-green algae that develops too early can affect the diversity of insects, which in turn affects the growth of fish and amphibians and their ability to mate and survive.

In the OESF, DNR also tracks air temperature at each monitored stream. Why?

Air temperature helps researchers understand how summer heat affects streams, an important consideration in a warming world. It also indicates whether the water sensor is dewatered, or exposed to air, during the dry months of summer, when stream flow gets very low (Photo 3). Stream and air temperature readings

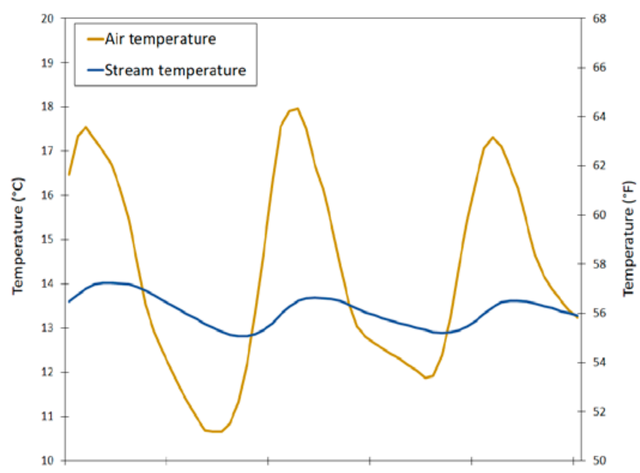
Teodora Minkova, DNR

Photo 2. DNR field technician checking the water temperature sensor.

Alex Foster, Pacific Northwest Research Station

Photo 3. A dewatered stream temperature sensor.

Figure 1. Example of a temperature readings from an OESF stream with no dewatering of the stream temperature sensor



are normally quite different, with the air temperature showing much greater fluctuation between day and night (Figure 1). However, when a stream temperature sensor is dewatered, its readings will be similar or even the same as the air sensor. Dewatered readings are removed from the analysis to avoid skewing the results.

For this analysis, Devine calculated the 7-day average daily maximum (7-DADmax), which is the average of the seven daily, peak water temperatures during the warmest week of the summer in each year of the study. Commonly used to analyze stream temperature, this metric was calculated only for those streams with no periods of dewatering. In each year of this study, the number of streams that had a complete summer temperature record ranged from 37 to 46 out of the 50 DNR-managed watersheds.

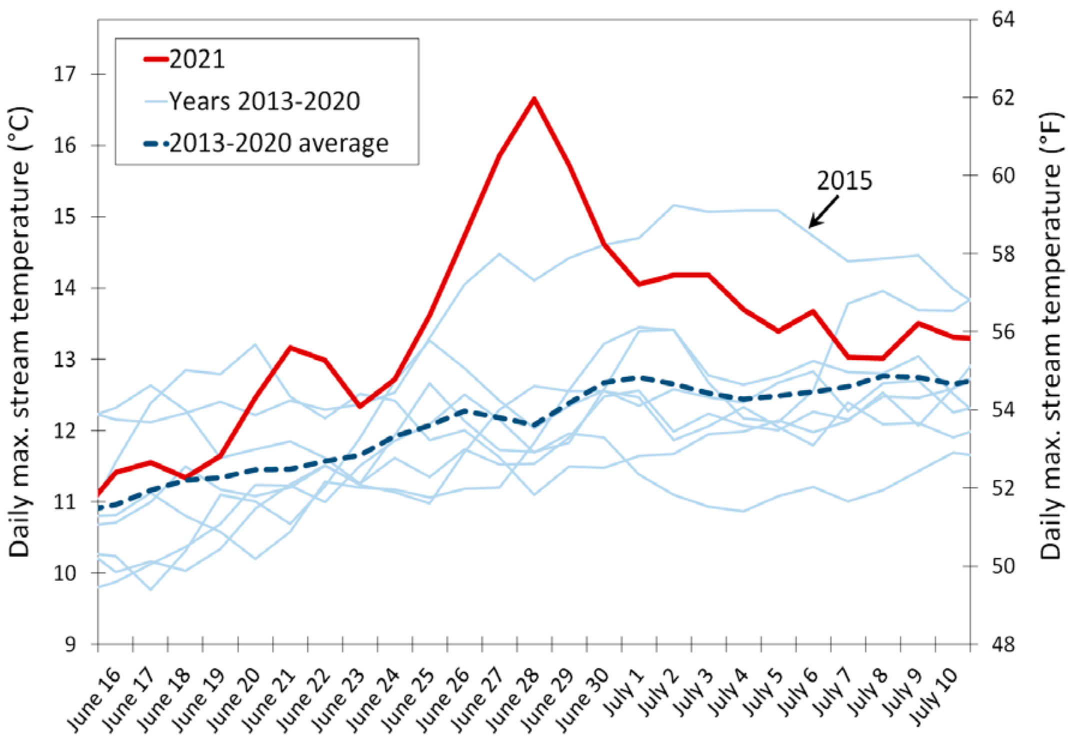
From the results, "You can clearly see that buffers are consistently effective at creating uniformly cool conditions," says Devine. The 7-DADmax for all streams averaged together was only 57.9° F, which is below the regulatory threshold of 60.8° F set by the Washington Department of Ecology for these Type 3 streams in the OESF (14.4° Celsius [C] and 16°C, respectively). Individually, the streams with complete temperature records exceeded this regulatory threshold less than 5 percent of the time, which is below the 10 percent regulatory limit.

This analysis included those days in late June when the heat dome was melting asphalt in mountain passes. To better understand the effects of that event, DNR did a separate analysis of daily temperatures from late June and early July of 2021. The temperatures were averaged across all streams, including the reference streams and excluding any dewatered readings.

At the peak of the heat dome, the air above streams stayed in the mid-80s, roughly 25° F cooler than Forks. Some individual readings for stream temperature reached as high as 66.2° F (19°C); yet, the average stream temperature during the heat dome topped out around 61.7° F (16.5°C) (Figure 2). To be fair, "The heat dome was only a few days, so the streams just didn't have enough time to warm considerably" explains Devine. It also happened fairly early in the summer. "Had it been August, which is generally much warmer, the result might have been different." Even so, it is a fairly muted effect of an extraordinary heat event. For comparison, Figure 2 includes the average temperature during this period in 2015, one of the hottest and driest summers in recent memory.

So why do OESF streams stay so cool, even under extreme conditions? For one thing, the maritime climate in the OESF is cool to begin with. Another factor is humidity near the streams, which helps to keep air and stream temperatures low. And a third factor is shade. The stream shade analysis showed that canopy closure,

Figure 2. Daily maximum stream temperature during the heat dome, averaged across all streams in the study with no dewatered readings (47 streams total, including 4 reference streams)



the amount of sky blocked by branches and foliage, averages 93.7 percent over streams in the 50 DNR-managed watersheds (Photo 4). Many of these forests are in the "stem exclusion" stage of forest development, when the overstory trees are crowded together and little light reaches the forest floor or the surface of the water.

Another factor was watershed solar exposure: streams in sunnier watersheds tended to be warmer. The amount of sun a watershed receives is influenced by slope, aspect, and shading from nearby topography.

Year-to-year variability in the weather also influenced stream temperature, as streams are sensitive to weather and some years are warmer than others. Trends in the data also indicated that wider stream channels were generally warmer than narrower ones, likely because more of the water was exposed to the air, and narrower streams were often at higher elevations and more influenced by ground water.

The analysis of the heat dome data brought another factor into focus: the amount of exposed bedrock. In streambeds composed of gravel, cobbles, and other substrate, the water flows not only above the substrate but beneath it. This flow helps buffer the stream from temperature increases. During the heat dome, the streams that heated the most had high levels of solar exposure and more exposed bedrock.

Looking Ahead

The overall results of this analysis help to verify the effectiveness of OESF riparian buffers, especially for keeping the water cool. These results also give DNR

Photo 4. Hemispherical photo showing high levels of shade.

some latitude to experiment. Too much shade can reduce the food supply in the stream by reducing in-stream photosynthesis. DNR is also concerned about the lack of structural diversity in these young riparian forests. As part of the **Type 3 Watershed Experiment**, DNR will address both issues by thinning buffers and felling some trees to create gaps in the canopy on small sections of a limited number of streams.

In the meantime, DNR technicians will continue to push their way through salal, sword fern, and devil's club to collect data each summer. Their efforts will help DNR verify that the riparian buffers are continuing to take the edge off summer high temperatures, as high pressure comes and goes and climate change nudges up the thermostat in the Pacific Northwest.

About the Author

Warren Devine is a natural resource scientist in DNR's Forest Resources Division. Devine manages and analyzes research and monitoring data collected on the OESF and elsewhere, and is doing data analysis and reporting for this study. He can be reached at **warren.devine@dnr.wa.gov.**

For More Information

- **Status and Trends Monitoring of Riparian and Aquatic Habitat, 2013 to 2020 Results (2022)**
- **Beauty and Function: Watershed Restoration in the Working Forest, The Learning Forest, (2019)**
- **First habitat status report (2016)**
- **Monitoring protocols (2017)**
- **Study plan (2012)**

Visit the **OESF research project page** on DNR's website for more publications related to this study.

Guest Article

The Olympic Cougar Project

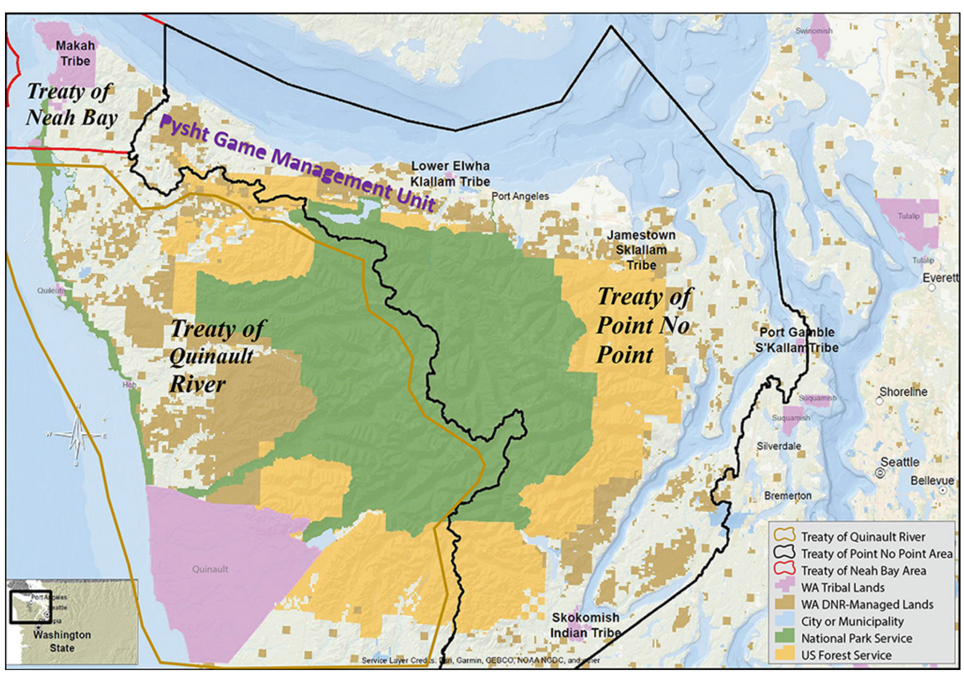
A Multi-partner Collaborative Approach to Studying Culturally Important Wildlife Species on the Olympic Peninsula

by Kim Sager-Fradkin, Lower Elwha Klallam Tribe

Tribes of Washington State's Olympic Peninsula are unique sovereign nations, but many of our communities share goals and aspirations related to the protection and use of wildlife resources for current and future generations. Our similarities are stronger than our differences, and we have deliberately chosen to unite and work together to study cougars and other culturally important wildlife across the Olympic Peninsula.

Established in 2018, the original goal of the Olympic Cougar Project was to study cougars on the north Olympic Peninsula and to use them as an umbrella species to help us understand important habitats, travel corridors, and impacts of predation on other wildlife. An umbrella species is one with the widest range and most intensive requirements (habitat, food) compared to surrounding species, so that if requirements are met for the umbrella species, they are also met for co-occurring species. On the Olympic Peninsula, cougars are the largest and widest-ranging predator, using habitats that are shared by all other species. Each of these species interacts with cougars in a unique way, whether as prey or by benefiting from the meat left behind at cougar kills.

At its inception, the Olympic Cougar Project was conducted primarily by the Lower Elwha Klallam Tribe and our principal partner, the research and conservation organization **Panthera**. It has since grown to a multi-tribe, Peninsula-wide project (Figure 1) with one over-arching goal. This goal is to pursue shared cultural preservation and natural resources management priorities by creating a coordinated, multi-partner approach to monitor and conserve the Olympic Peninsula's diversity of wildlife, particularly six terrestrial mammalian species of cultural importance and their habitats: deer, elk, cougars, bobcats, bears, and coyotes. Species such as Columbian black-tailed deer and Roosevelt elk are important for tribal subsistence and ceremonial harvest, and cougars, bobcats, black bears, and coyotes also hold cultural significance to the tribes and are essential components of the Olympic Peninsula ecosystem. Meeting our goal will enhance the ability of each tribal community to provide long-term stewardship over these culturally important species and essential habitats.



Kim Sager-Fradkin, Lower Elwha Klallam Tribe

Figure 1. Tribal treaty areas of the Olympic Cougar Project, including the Pysht Game Management Unit (GMU).

Study Design

To meet our project goal, we have identified specific objectives and employed diverse research methodologies.

To estimate the abundance of cougar and bobcat populations on the north Olympic Peninsula, we used scat-detection dog teams to collect bobcat and cougar scat from 2018 to 2020. Individual identification is ongoing in a genetics lab at the University of Idaho, and this genetic analysis ultimately will lead to a population estimate for both cougars and bobcats on the north Olympic Peninsula.

Another method we are using to study all six species of cultural importance is image recognition from photographs. We have deployed over 350 cameras across a large portion of the Olympic Peninsula and are using citizen science volunteers to help us monitor those cameras. To identify wildlife in photos, we are using Panthera IDS, a software that uses artificial intelligence to categorize hundreds of thousands of images recorded at cameras. We will use these images to calculate population estimates for all six species using contemporary statistical modelling. These images also will provide insight into important habitats, travel corridors, and highway crossings, and will be used as the basis for long-term monitoring programs.

Finally, we are capturing cougars to deploy GPS tracking collars, which will help us monitor their movements, habitat use, and prey selection, and the dispersal patterns of sub-adult cougars when they strike out on their own (Photos 1 through 3). Ultimately, studying cougars will help us identify critical safe passages, bottlenecks, and blockages in existing wildlife corridors, and ensure that wildlife on the Olympic Peninsula are healthy for future generations.

Dave Shreffler, Lower Elwha Klallam Tribe

Mark Elbroch, Panthera

Dave Shreffler, Lower Elwha Klallam Tribe

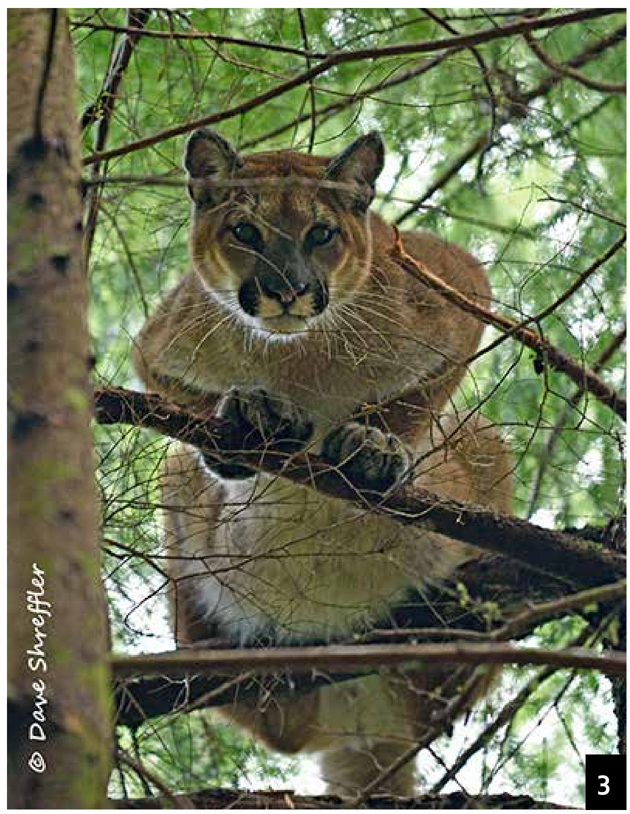


Photo 1. Moses, which at 176 pounds was the largest male caught on the project to date. Named for the grandfather of a tribal member, Moses was studied for two years before his collar dropped off.

Photo 2: Apollo, the first full-grown adult male cougar radio-collared and tracked on this project. Apollo was tracked for nearly two years before his collar dropped off.

Photo 3: Lilu, a female cougar radio-collared on this project. Lilu means salmonberry and is also a term of endearment in the Klallam language (líluʔ).

Preliminary Research Findings

From 2018 to 2020, scat-detection dogs and handlers collected 665 scat samples on the Pysht Game Management Unit (GMU, refer to Figure 1). Our project graduate student, a member of the Lower Elwha Klallam Tribe, was able to successfully identify scat to species (confirming bobcat or cougar identity) for 89 to 94 percent of scat samples. She further was able to identify unique individuals for 47 to 53 percent of scat samples, preliminarily identifying a minimum of 25 unique cougars on the Pysht GMU between 2018 and 2020. Bobcat analyses are ongoing, as are population estimates for both cougars and bobcats.

Using cameras, we have collected over 400,000 images of wildlife, including all six species of cultural importance (deer, elk, cougars, bobcats, bears, and coyotes). Analysis of these images is ongoing, but early results show promise that cameras may provide a viable method for population estimation and long-term monitoring of culturally-important wildlife species.

Collectively, we have captured and radio-collared over 90 cougars on the Olympic Peninsula, gaining valuable data on habitat use, home ranges, dispersal patterns, and diet (Photos 1 to 3). We have visited 3,422 cougar clusters (concentrations of GPS points gathered by the collars) and located 959 kills, 1,601 bed sites, and eight dens. Cougar prey species are diverse, ranging from opossum and mountain beaver to beaver, raccoon, bobcat, coyote, deer, and elk. Several young cougars have dispersed after leaving their mothers, traveling up to 93 miles (150 kilometers) (straight line distance), with one bumping into the Columbia River and crossing back and forth over Interstate 5 before he was legally shot by a hunter during elk season. Cougars have used lands across a variety of land management regimes, from industrial and state-owned timberlands to wilderness areas inside Olympic National Park and Olympic National Forest.

Next Steps

This year, our group of researchers, including wildlife biologists from six tribes (Lower Elwha, Port Gamble, Jamestown, Makah, Skokomish, and Quinault) and Panthera is radio collaring cougars and expanding our camera grid to include the southern Peninsula, bringing the number of cameras deployed on the landscape to 450. We continue to analyze existing camera data, calculate population estimates from camera data, and finalize cougar and bobcat population estimates from scat-derived genetic data. Funding for this project will carry us through 2023. In addition to long-term monitoring and management of these six species, we hope to continue outreach and education activities surrounding the importance of these wildlife on the landscape. Moreover, we intend to contribute data to protect important wildlife corridors around the Olympic Peninsula, with a special focus on helping to identify a location for a potential future wildlife bridge across Interstate 5, ultimately allowing wildlife to move between the Olympic Peninsula and the southern Cascades. ☙

About the Author

Kim Sager-Fradkin is the Wildlife Program Manager for the Lower Elwha Klallam Tribe in Port Angeles, Washington. She holds a B.S. in Wildlife Biology from Humboldt State University and an M.S. in Wildlife Resources from the University of Idaho. Sager-Fradkin's work has two primary tracks: the first to explore wildlife response to removal of the Elwha dams, and the second to contribute to tribal subsistence harvest activities by monitoring elk and deer populations, and the predators that rely upon them, across the north Olympic Peninsula. At present, she co-leads the Olympic Cougar Project with Dr. Mark Elbroch from Panthera, with research focusing on cougar genetics, dispersal patterns, and diet. Sager-Fradkin has lived in Port Angeles since 1999, and along with her husband is raising two young children in the community. She can be reached at **kim.sager@elwha.org**.

Project Update

Type 3 Watershed Experiment: Uplands Plan

Teodora Minkova, DNR

Type 3 Watershed Experiment Field Tour in October, 2020.

The **Type 3 Watershed Experiment** seeks to expand Washington State Department of Natural Resources (DNR) forest management toolbox to better meet the needs of the people who love and depend on the wellbeing of forests and rural communities.

The uplands study plan for the Type 3 Watershed Experiment currently is undergoing scientific peer review under the direction of Thomas DeLuca, Dean of the College of Forestry, Oregon State University. The uplands plan describes a variety of new silvicultural tools that are being compared to standard practice and no-action controls in the uplands across 16 DNR-managed watersheds on the outer Olympic Peninsula. These experimental treatments seeks to address many important questions at different spatial scales: entire watersheds, operational prescriptions, and smaller research trials. Final changes to the plan are expected by mid-summer.

The uplands plan culminates four years of learning-based collaboration, bringing together perspectives and commitments from rural communities, trust beneficiaries, stakeholders, tribes, forest managers and decision makers, and researchers from a wide range of natural and social science disciplines. Anyone interested in this study is encouraged to get involved. Refer to "Education and Outreach" on page 11 to learn more.

Recent Publications

Status and Trends Monitoring of Riparian and Aquatic Habitat in the OESF: 2013 to 2020 Results

Warren Devine, Teodora Minkova, Jeff Keck, and Kyle Martens, DNR; Alex Foster, U.S. Forest Service Pacific Northwest Research Station

The **Status and Trends** project involves collecting empirical data on nine stream habitat indicators to evaluate the effectiveness of the riparian conservation strategy in DNR's **State Trust Lands Habitat Conservation Plan** (HCP). The data collected in this study also will document long-term changes in habitat conditions, inform habitat models used for planning purposes, and reduce scientific uncertainties regarding the integration of habitat conservation and timber production across the Olympic Experimental State Forest (OESF).

As mentioned in the featured article, DNR recently completed a five-year sampling period for all streams, and **published a report** that summarizes the results. Results clearly show that stream buffers are keeping streams well-shaded and cool. Pre-HCP harvest, however, appears to have interrupted the supply of large-diameter wood to many of these streams. Though large pieces are still present in streams, the majority of these pieces are in the later stages of decay, reflecting a lack of new, large pieces of wood in the stream from riparian forests.

The report also includes a habitat condition assessment that integrates the nine indicators into a habitat condition score for each monitored stream. Streams ranking high in salmonid habitat quality were those with many large pieces of in-stream wood and wide, complex stream channels with deep pools.

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**. Information on past and current projects in the OESF can be found at this **link**.

Chapter 12 *in* Biological Responses to Stream Nutrients: a Synthesis of Science from Experimental Forests and Ranges

Teodora Minkova and Kyle Martens, DNR and Mark Hicks, Washington Department of Ecology

The Olympic Experimental State Forest (OESF) is featured in **Chapter 12 of a report** published by the USDA Forest Service's Pacific Northwest Research Station. This report synthesizes studies of the biological responses to stream nutrients from 17 long-term research sites across the U.S. Intended to be used by regulatory agencies, the report identifies future research that could be conducted to fill important regulatory knowledge gaps.

The OESF chapter summarizes and interprets past and ongoing research on stream quality and nutrients, including nitrogen and phosphorus. It also synthesizes information about the effects of climate change and atmospheric deposition on forest streams. For example, air masses arriving from East Asia could be depositing mercury on the Olympic Peninsula. Most importantly, this chapter includes information that is helping to fill one of the highest-priority knowledge gaps of regulatory agencies: the effects of alternative forest management activities on ecological conditions.

Using Airborne LiDAR to Map Red Alder in the Long-term Ecosystem Productivity Study near Sappho, Washington

Ally Kruper, Sara Crumrine, Bernard Bormann, Keven Bennett, and Courtney Bobsin, University of Washington and Robert McGaughey, U.S. Forest Service Pacific Northwest Research Station

In **this study**, researchers combines airborne light detection and ranging (LiDAR) data with extensive field data from the **Long-Term Ecosystem Productivity study** site located near Sappho, Washington to increase the accuracy of GIS data. These data were used to create a random-forest statistical model that discriminated between red alder (*Alnus rubra* Bong.) and conifer species with an accuracy of 96 percent. This study highlights the need for precise locations of ground plots and reliable ground data.

This study is part of the work being completed by the Type 3 Watershed Experiment remote sensing group, with the key leadership and expertise of Bob McGaughey of the U.S. Forest Service Pacific Northwest Research Station. It has real potential to assist in the monitoring of Type 3 watersheds and may help address questions about species composition, tree growth, understory biomass, and more.

Announcement

Welcoming Bill Wells to The Learning Forest Editorial Board

After 5 years and 10 issues of The Learning Forest, DNR's Olympic Region Manager Mona Griswold is stepping down from the Learning Forest editorial board. We would like to extend heartfelt thanks to Griswold for her service to this publication.

Replacing her on the editorial board is Bill Wells, State Lands Coast District Manager for the Olympic Region. Wells brings to the board practical experience, technical and scientific expertise, and local knowledge from living and working on the Olympic Peninsula for nearly 20 years. Wells has a B.S. in Forest Resources from the University of Washington and a Master in Natural Resources from the University of Idaho. He is currently serving on the Olympic Natural Resource Center (ONRC) Advisory Board and is one of the Principal Investigators on the Type 3 Watershed Experiment. Welcome aboard!

Teodora Minkova, DNR

Bill Wells leading an OESF field tour for University of Washington Students

Education and Outreach

The 5th annual **OESF Science Conference** took place virtually on May 4th. Unique from previous conferences, the entire event was dedicated to the **Type 3 Watershed Experiment**, with the goal of launching learning groups with stakeholders, tribes, researchers, practitioners, and land managers. Part of the study's focus on learning –based collaboration, these groups will address topics such as invasive species, carbon, and economic projections of the experimental treatments. The conference included six sessions on topics of interest to stakeholders, and each included a presentation by an expert in the field and a guided discussion. Recordings of the conference are available on **DNR's YouTube channel**.

In total, 129 people attended the virtual event, which is the highest conference attendance so far. The professional affiliation of the participants was similar to previous years:

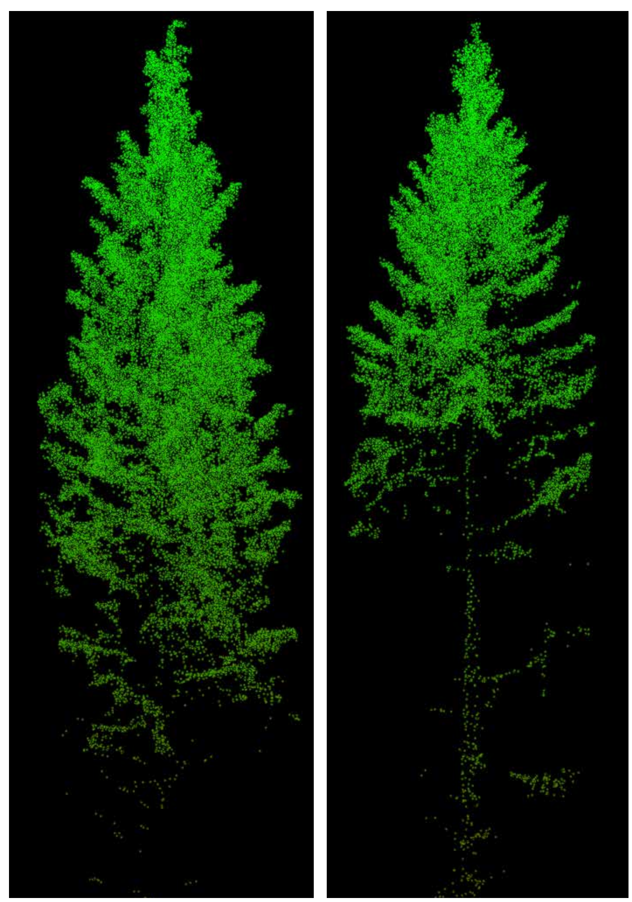
- DNR, 33%
- Other, 15%
- University/college, 14%
- Tribe, 11%
- Other public agency, 10%
- Federal agency, 9%
- Non-profit, 5%
- Private sector, 3%

Between 60 to 90 people attended and actively participated in each session.

Learning groups are still forming, so it is not too late to join. Everyone is invited! If interested, send an email to **t3team@uw.edu**.

Featured Photos

Light Detection and Ranging (LiDAR)-derived Images of a Western Hemlock Tree (left) and Douglas-fir Tree (right)



Data for these images was produced using an unmanned aircraft system (UAS or drone) mounted with a LiDAR scanner operated by **West Fork Environmental**. The UAS was flown over areas with corresponding field measurements.

Researchers in the U.S. Forest Service Pacific Northwest Research Station and at the University of Washington School of Environmental and Forest Sciences are using these data to develop and test methods to identify species and extract metrics such as height, height-to-live-crown ratio, and crown area for individual trees.

The high-density point cloud and coverage from multiple viewpoints provided by the UAS-lidar system (data from several flight lines are aggregated to provide data for each individual tree) produces detailed information for individual trees. Researchers hope to aggregate individual tree data to produce stand data that helps managers develop silvicultural prescriptions and monitor their effectiveness.