The Learning Forest

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

Issue 6 • Fall 2019

Editorial Board Message

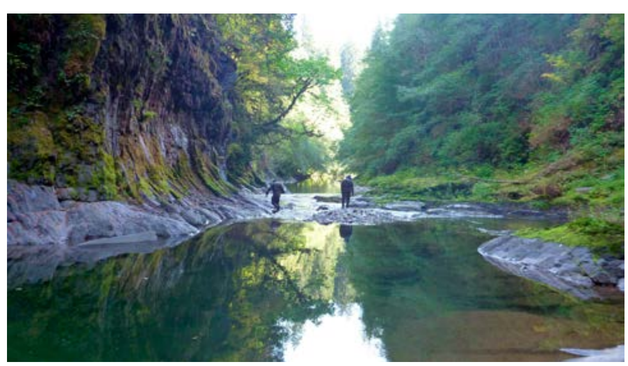
"If we build it, they will come" is the working hypothesis of many habitat conservation strategies, the assumption being that habitat, once restored, will be occupied by the species targeted for protection. Testing this working hypothesis is expected but rarely done. Monitoring fish and wildlife is expensive, the methods are relatively complicated, and, in many cases, data collection must be repeated over long periods of time. Migrating species present additional challenges because the changes in their populations may be caused by ecologically different and geographically distant environments. Anadromous salmon, for example, can be affected by the forested watersheds in which they spawn and begin their life, or by the ocean conditions in which they mature.

This issue's featured article describes the Riparian Validation Monitoring program in the Olympic Experimental State Forest (OESF). This ambitious program monitors how salmonids such as salmon and trout respond to forest management on state trust lands, with an ultimate goal of validating the riparian conservation strategy of DNR's *State Trust Lands Habitat Conservation Plan*. This program is a deliberate effort that started with years of monitoring the distribution, abundance, and habitat associations of salmonids across the OESF.

The noise monitoring study described in the guest article seems to be a very different topic, in that it records the timing, duration, and loudness of the military jets flying over the Olympic Peninsula. Yet gathering this data is a necessary first step in assessing the effects of military jet noise on local wildlife. This is the only study that has analyzed large quantities of sound data in Washington in a structured way, independent from the U.S. Navy.

Scientists, land managers, and policy-makers have come a long way in understanding the habitat needs of fish and wildlife species, designing and implementing conservation strategies, and tracking habitat responses. Monitoring species response to these strategies is the ultimate test of these conservation efforts.

In this Issue



Warren Devine, DNR

DNR technicians walk up the Clearwater River to gather data for OESF Riparian Validation Monitoring

Featured Article

Understanding Cause and Effect

Riparian Validation Monitoring

by Cathy Chauvin *and* Kyle Martens, Washington State Department of Natural Resources (DNR)

DNR

Figure 1. A salmonid collected from an OESF stream

Three DNR field technicians are standing shin-deep in a stream in the Olympic Experimental State Forest (OESF) when a young fish suddenly changes course and swims straight towards them. One technician lunges with the net and comes up with the small, wiggling fish, which he transfers gently to a waiting bucket filled with the rest of the morning's catch.

A few minutes later, the technician lifts the little fish from the bucket (Figure 1), weighs it, measures it, notes its species and condition, and then releases it back to the stream. Soon, the little fish is on its way, unaware of the information it has just imparted.

What kind of information? The status of the fish population for starters, but combined with information on the stream and the riparian (streamside) forest, this little fish and others like it will impart far more than that.

The program is called Riparian Validation Monitoring, and it is a complex exercise in cause and effect.

The Riparian Conservation Strategy

Historic harvests in the Pacific Northwest were often clearcuts of old-growth forests that went right to the banks of the stream. In most cases, none of the riparian forest was left standing. Such practices were common and widespread in the OESF and elsewhere, as evidenced by the number of young riparian forests on the landscape today.

Riparian forests have a close relationship with streams and fish. The forest shades the stream and keeps the water cool enough for salmonids like salmon and trout. Wood that falls into the stream provides places for fish to hide from predators and creates pools where fish can rest and find refuge during periods of low stream flow. Leaves and needles that fall into the water feed the aquatic insects that feed the fish. Clearcut the riparian forest, and most of these functions are impaired, at least until the new forest matures. The long-term result can be declines in fish populations.

In 1997, DNR addressed this issue in the OESF by developing a riparian conservation strategy specifically focused on improving salmonid habitat. Along with protection of wetlands and careful road management, the strategy involves retaining areas of riparian forest called a riparian buffer along both sides of the stream when conducting harvests near streams. Riparian buffers are widened to include areas at risk of landslides.

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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If needed, an additional area of forest called a wind buffer is added to the outer edge of the riparian buffer.

The idea behind the riparian buffer is simple. In addition to protecting the stream from the effects of harvest, the forest within the buffer will mature and recover, either on its own or with active management like thinning to nudge it along. And as it does, stream habitat conditions will improve.

Or will they? To answer this question, DNR conducts **Status and Trends Monitoring of Riparian and Aquatic Habitat**, which was described in the **spring 2019 issue** of this newsletter. For this stream habitat study, DNR gathers data on nine indicators of riparian function in 62 watersheds in the OESF: 50 watersheds being managed for timber harvest and habitat conservation, and 12 unmanaged watersheds with older forests (80 years old or older). Data are collected from a stream reach located near the outlet of each watershed. All streams are "Type 3," which are the smallest of the fish-bearing streams.

However, the ultimate test of the riparian conservation strategy is whether it is benefiting salmonids. That is where the Riparian Validation Monitoring program comes in. This program involves ongoing fish sampling to understand the distribution, life histories, and density of salmonids across the diverse landscapes of the OESF. Data collected through this program, in combination with data gathered through the stream habitat study, is used to understand the cause and effect relationships between current and past forest management, riparian and aquatic habitat conditions, and fish, and ultimately is used to determine how management can be improved.

Understanding Effects: Fish Populations

For the monitoring program, fish are collected (sampled) from the same streams as the stream habitat study (Figure 2). In addition, fish and habitat data are collected from a 12-kilometer (7.5-mile) section of the Clearwater River that is entirely surrounded by DNR-managed lands. Data from the Clearwater River give DNR an understanding of how its management affects large streams and how large streams interact with smaller ones.

On summer days, when rain is infrequent and streams and rivers are running low, technicians net both ends of a 100-meter (328-foot) stream reach and catch fish by "electrofishing." A device worn in a backpack sends an electrical current between electrodes mounted at the end of two long poles. The electrodes are kept submerged. When the fish encounter the electrical current, their muscles contract in a way that draws them to the poles and momentarily stuns them, making them easier to catch. Two technicians stand by with nets (Figure 3 on Page 4). The technique typically does not harm the fish if done correctly.

Sixty-two watersheds are a lot to sample in a short Pacific Northwest summer. So for the 100-meter stream

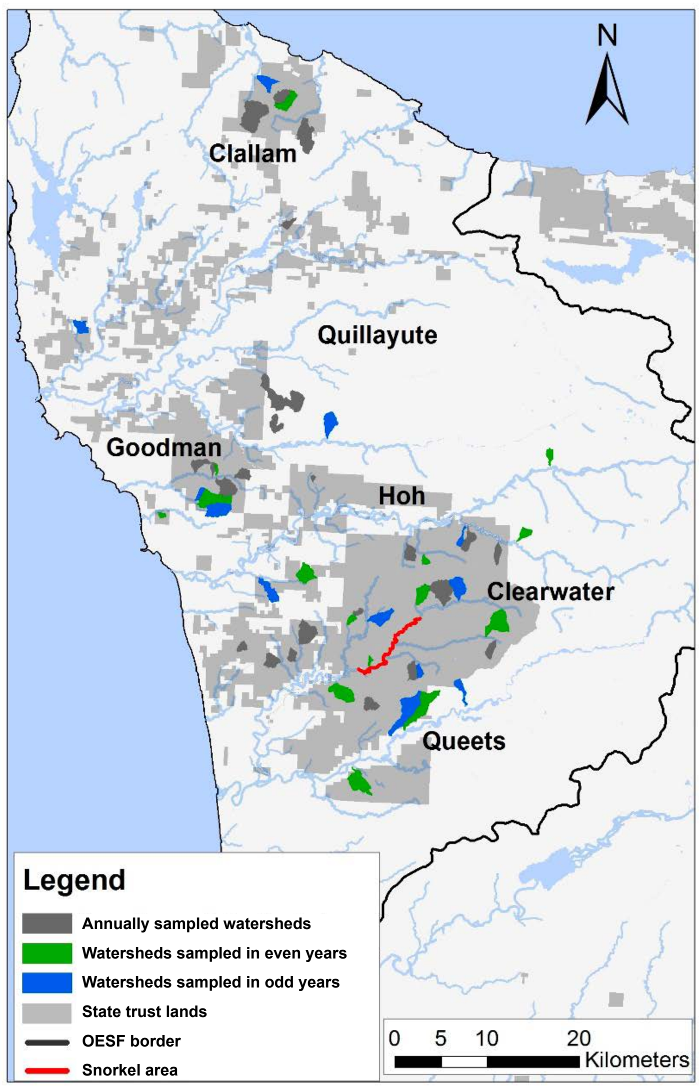


Figure 2. Sampled watersheds

reaches, DNR samples fish from roughly 45 watersheds per year. Twenty watersheds are sampled every summer, including six of the 12 unmanaged watersheds, and the remainder are split between even and odd years. The 12-kilometer stretch of the Clearwater River is sampled every summer via snorkeling (Figure 3). If that sounds like fun, it is.

Distilling Cause: The Conceptual Model

Translating fish data into insights about management is no easy task. Some of the factors that affect habitat, such as shade from overhead trees, can be influenced by management, but some, like the steepness of the channel, cannot. Which of these factors is more important? How do they interact? And how do they affect fish?

Nothing distills complexity quite like a flowchart, so DNR began by drawing one. It is called the "conceptual model" of how management affects fish (Figure 4).

The model is specific to the small streams and is structured around three pathways through which forest management can affect riparian conditions, stream conditions, and, ultimately, fish. These pathways are instream cover, light, and hydrology. They were chosen based on studies done outside of the OESF.

Light supports photosynthesis in the water, mainly by algae. Photosynthesis contributes to the aquatic food web ("primary productivity") along with leaf and needle litter. Light also affects stream temperature; too much light can make the water too warm for salmonids. The amount of light that reaches the stream is influenced by the density and composition of the forest canopy. Instream cover refers to rocks and

Warren Devine and Kyle Martens, DNR

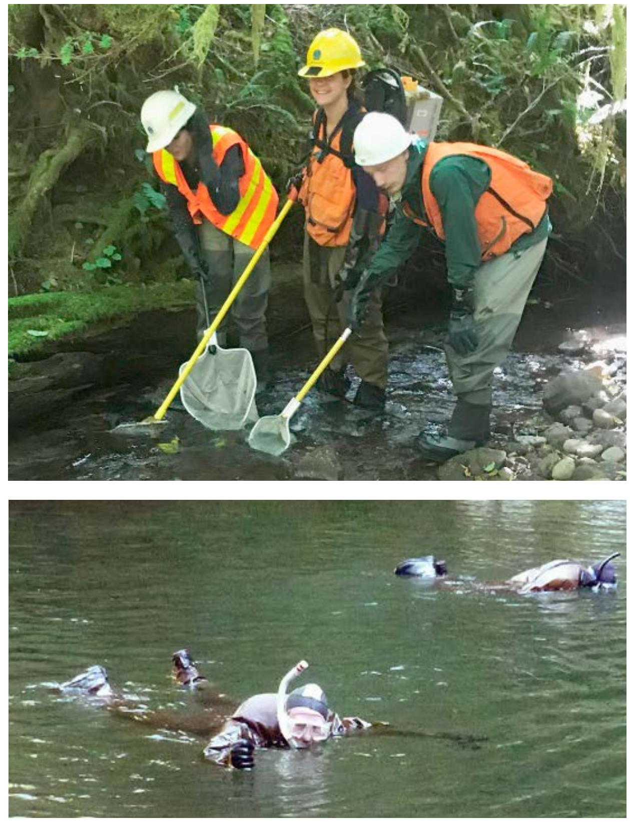


Figure 3. Electrofishing (top) and snorkeling (bottom)

In the top photo, one of the electrodes is on a long cable that hangs in the water. DNR has since moved to a two-pole system.

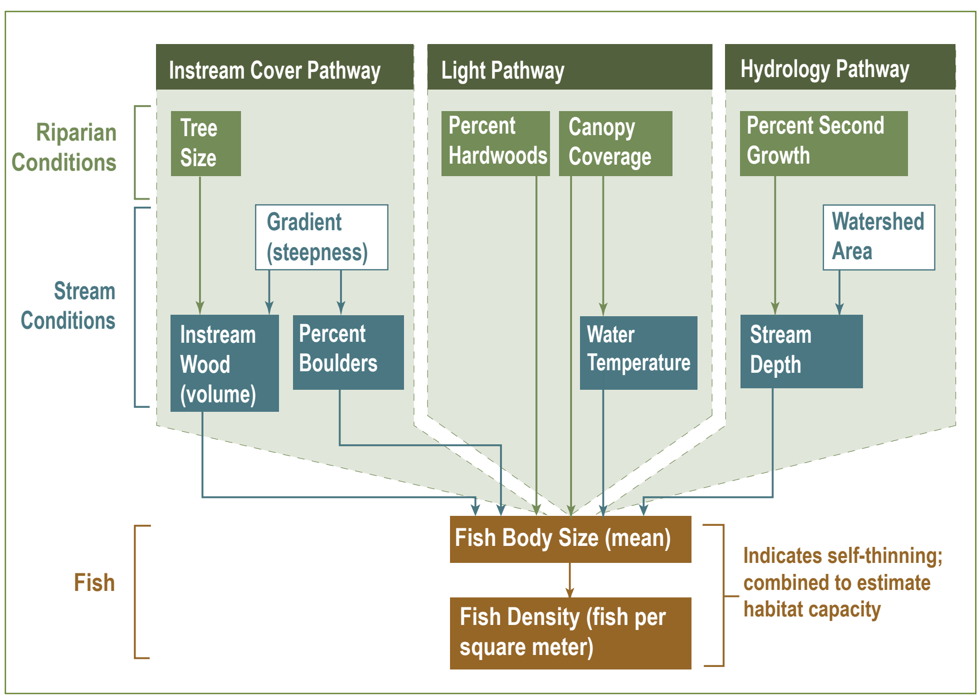


Figure 4. The Conceptual Model

logs in the water, the latter of which comes from the riparian forest. Hydrology refers to the amount of water in the stream and is measured as stream depth. Some studies (such as **this one** from Oregon State University) suggest that stream depth is affected by forest age across the watershed. During the summer, younger trees draw more water from the soil and transpirate it through their leaves, which results in more water being drawn from the streams.

Is the conceptual model accurate? To find out, DNR tested each relationship in the model through statistical analyses using both stream habitat and fish data. For example, DNR analyzed stream habitat data to look for a relationship between tree size and instream wood. DNR then used fish and stream habitat data to look for a relationship between instream wood and habitat capacity.

Habitat capacity is the ability of the stream to support fish, but how should it be estimated? By the density of fish in the stream (fish per square meter)? What about fish size (Figure 5)?

To answer that, DNR first conducted statistical analysis to determine if there was a relationship between fish size and density. DNR used data on age-1 or older cutthroat trout, which are the most abundant of the salmonids in the OESF and spend anywhere from a year to a lifetime in these small streams.

DNR found that in some streams, populations of cutthroat trout are "self-thinning." Streams can hold only a certain amount of fish, so as dominant fish grow larger, smaller fish are eaten or move to maintain the capacity of the stream (Figure 6). The presence of self-thinning in these streams told DNR two things. One, both fish size and density are important; and two, habitat capacity can be estimated by combining these two metrics (Figure 4 on Page 4).

Results

Using statistical analyses, DNR found the strongest relationship between habitat capacity and hydrology (stream depth). Age-1 and older cutthroat salmon were most abundant in deeper streams. There was no evidence that the amount of younger forest in the watershed ("watershed area" in the model) was affecting stream depth, as found in other studies.

Ellis Cropper, DNR

Figure 5. Small fish in a sampled stream reach

DNR gathers data on both fish size and density and combines this data to determine habitat capacity.

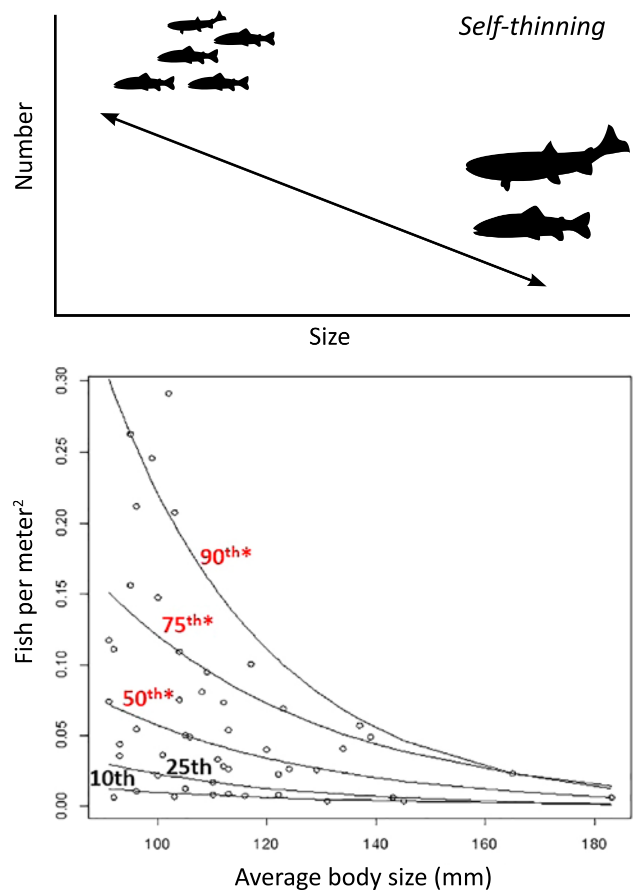


Figure 6. Relationship between fish size and abundance

DNR found significant relationships in the 90th, 75th, and 50th quantiles. These different quantile regressions were run to look at how fish may react based on different levels of habitat capacity. DNR found that as habitat capacities increased, so did the amount of self-thinning.

Habitat capacity was higher in steeper streams that had more instream boulders. This result could mean that steeper streams recover from disturbance (such as wind or timber harvest) more quickly than other streams. Or, it could mean that these streams are more resistant to disturbance because they have instream boulders, and cutthroat trout can use instream boulders for cover in a similar manner as instream wood.

DNR did not find strong relationships between habitat capacity and either light or instream wood, however. The reason may have less to do with these pathways than the watersheds themselves. All watersheds were deeply shaded and had limited amounts of instream wood, so forest conditions across the watersheds may have been too similar to yield meaningful results for this statistical analysis. Because the importance of both is well established in the literature and a separate analysis of data from the Clearwater River snorkel survey found that fish abundance was higher when instream wood was present, these pathways warrant further study.

Next Steps

By design, the fish monitoring program so far has focused on observation. Observation gives DNR a crucial understanding of fish and habitat conditions, and their variability across space and time. That information provides a foundation and focus for the next phase of the program, experimentation.

The OESF is uniquely situated for this phase because it is an experimental forest. DNR has both the management flexibility it needs to test new ideas and the ability to do so.

DNR currently is seeking funding for a thinning study to test the light and instream cover pathways. The study will test whether it is better to allow riparian forests to grow on their own, conduct thinning, or thin the riparian forest and add instream wood.

In the meantime, DNR technicians will continue to snorkel the Clearwater River and walk up small streams with nets and buckets. What DNR learns from ongoing observation and upcoming experiments should help it better understand cause and effect, and will be shared with other land managers. Such knowledge ideally could lead to smart, targeted ways to help salmonids thrive, in the OESF and elsewhere.

More to Explore

Visit DNR's **OESF website** for more information on the Riparian Validation Monitoring program, including the **study plan**, the latest **status report**, and the **story map.**

Status and Trends Monitoring of Aquatic and Riparian Habitat was featured in the **spring 2019 issue** of *The Learning Forest.* Additional information on this study is available at this **link**.

Refer to **the first issue** of *The Learning Forest* for an overview of the OESF and its experimental nature.

About the Author

Kyle Martens (**Kyle.Martens@dnr.wa.gov**) is a fisheries biologist and natural resource scientist within DNR's Forest Resources Division. He has 20 years of experience conducting research on fish populations, life history strategies, and the impacts of various types of restoration and management techniques on fish. Kyle has a master's degree from Oregon State University and an undergraduate degree from the University of Idaho. He is currently the principal investigator for DNR's Riparian Validation Monitoring program.

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**.

Guest Article

Tracking the Wild EA-18G

Growler Flights on the Olympic Peninsula

by Lauren Kuehne, Research Scientist, University of Washington

Josef Abraham

Figure 1. Growler

From a distance, the first indication often is barely audible but distinct nonetheless: a persistent, low rumble that signals the start of another day of training by EA-18G jets (commonly dubbed as a "Growler") in the military operations area that sits over a good portion of the western Olympic Peninsula (Figure 1 on Page 8). As Growlers traverse the area doing training maneuvers using the jet's electronic warfare capabilities, noise can range from the low rumble of far-off aircraft to the throbbing roar of a jet flying just overhead.

The U.S. Navy has conducted aircraft operations in the military operations area for decades, including for the Growler's predecessor, the EA-6B Prowler. Noise from these jets has become a familiar experience for residents, visitors, and people who work in the area. However, over the last five to six years, aircraft and operational changes at the naval base on Whidbey Island have led to an overall increase in training activity on the Olympic Peninsula. Even more importantly, the recent **Northwest Training and Testing (NWTT) Environmental Impact Statement (EIS)** from the U.S. Navy proposes increased activity in the military operations area beginning in 2020, in particular a 62 percent increase in electronic warfare training, the primary activity of Growlers on the Olympic Peninsula. So whatever the noise levels are now, they are certainly going to increase if the proposed increase is approved.

The fact that the impacts of the noise and aircraft activity on people and wildlife are virtually unstudied is what inspired the current research project. This project began in 2016 with an email to the University of Washington (UW) School of Aquatic and Fishery Sciences from a resident in the San Juan Islands (another area affected by Growler activity). The resident wished to know about the impacts of military aircraft on local wildlife, and the answer was that, basically, no one knows. Noise pollution in general is understudied, even more so in rural and wilderness areas. Further, when noise is studied, it is typically more continuous sources like commercial aircraft (around airports) or road noise; intermittent and impulsive noise more typical of military operations is examined only rarely.

That email exchange led to a chain reaction culminating in small grants that were scraped together (totaling $7,800) to monitor several locations on the Olympic Peninsula over a yearlong period. The primary project goal was to characterize baseline noise levels from aircraft in and around the military operations area. This baseline would create a more tangible foundation to evaluate the implications of proposed increases in aircraft training for wildlife (and humans). In other words, it is very difficult to say if an increase will be "too noisy" if current noise levels are unknown.

But why do we need to characterize noise? While many people prefer quiet areas, quiet can be critical to wildlife that rely on acoustic signals. Other research has shown that, for many animals, silence (or the lack of it) can affect whether or not they find a mate, detect a predator, or catch their next meal. For example, **one study** found that exposure to vehicle noise increased stress levels in nesting northern spotted owls, and that northern spotted owls near noisy roads raised fewer young (successfully) than those near roads that were less noisy.

Understanding the impacts of noise on people could be a straightforward endeavor of measuring things like the number, duration, and loudness of flights. Understanding the impacts of noise on wildlife usually requires extensive research that can evaluate a range of different behavioral responses. Measuring the basic noise exposure that wildlife are likely to experience is an important first step in that research.

Passive Acoustic Monitoring

This project utilizes passive acoustic monitoring, which means using recorders to collect audio data that can be analyzed later. A major benefit of passive acoustic monitoring is that large amounts of data can be collected for relatively low cost; for example, the audio recorders used on this study (Songmeter4, made by Wildlife Acoustics) can collect 500 hours of data with only four D-cell batteries. Another benefit is that a single researcher can realistically monitor multiple sites across larger geographic areas and longer time periods than is possible without recorders.

Permission was sought from land owners and managers to record at five locations in and around the military operations area (Figure 1). The recorders were placed on site two to four times between June 2017 and April 2018, with three units recording simultaneously for two weeks at a time. In addition to aircraft and other human-generated sounds, the recorders also captured biological sounds of birds, mammals (like elk, squirrels, and coyote), and even insects.

There were many unknowns for this ambitious acoustic sampling project. Would a randomly placed audio recorder "hear" enough military aircraft events to allow for substantive conclusions? Could different aircraft be distinguished reliably? Could automated methods be used to identify flight events, or would thousands of hours of audio have to be processed manually?

As it turns out, the first two concerns were unfounded. Because the audio recorders have sensitivity similar to human ears, it is possible to distinguish different types of aircraft by listening to and visually inspecting the audio data (figures 2 and 3). Commercial aircraft have a consistent signal as they are flying at a constant speed and elevation. By contrast, military aircraft have more power in the lower frequencies (which gives the

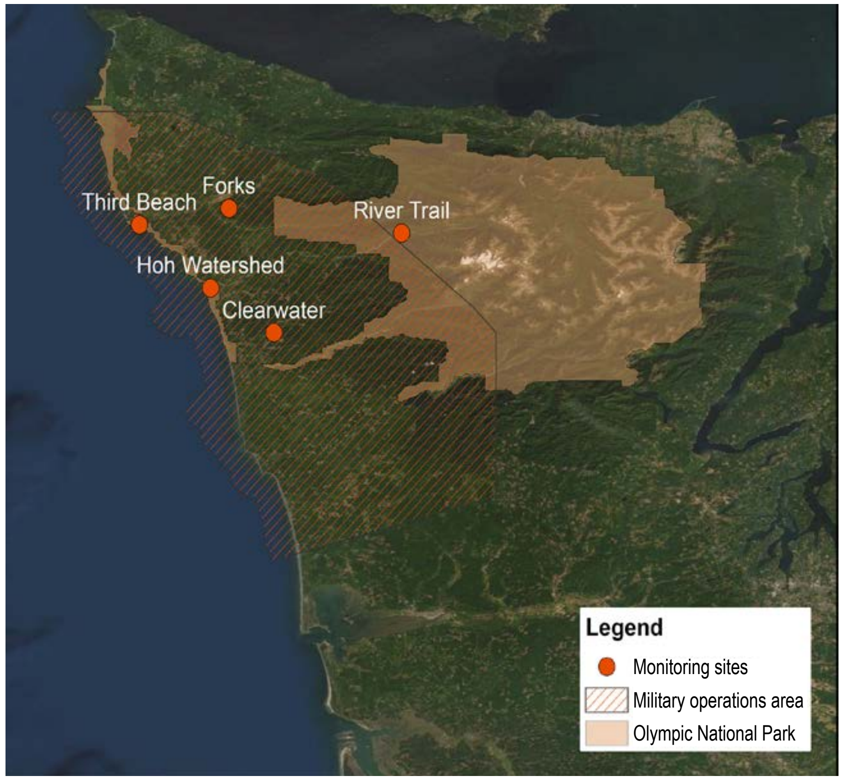


Figure 1. Monitoring locations and the Olympic Peninsula Military Operations Area

The Third Beach and River Trail sites are within the Olympic National Park and were monitored by the National Park Service as part of a soundscape inventory in 2010 and 2011.

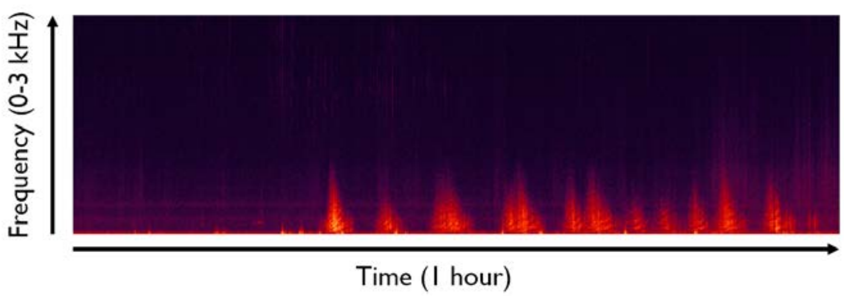


Figure 2. Contrasting spectrogram showing an hour of audio data recorded in June 2017 on the Olympic Peninsula

A spectrogram is a visual rendering of audio data across time (on the x-axis) and frequency (on the y-axis). Color is used to show the power of the acoustic signal, which is measured in decibels. Eleven Growler flight events are visible as louder (red-orange) peaks against a quiet (purple-dark purple) background. Human-generated sounds are typically low frequency, occurring in the 0 to 3 kHz range. Biological sounds from birds and other wildlife can be low or high frequency, depending on the species and type of behavior being signaled.

Growler its characteristic "rumble"), are flying at faster and more variable speeds, and often will repeat maneuvers several times in an hour.

The third concern was founded, however. Due to the variability in flight events, it proved difficult to use automated approaches that can scan hours of audio in minutes and identify likely events. So it was necessary to manually process thousands of hours of audio data. This daunting task was largely accomplished with the help of two undergraduate interns, one from UW's Program on the Environment (Sally Kamei) and one from The Evergreen State College (Laura Giannone). In all, over a three month period, 40 days of monitoring data from three of the sites were completely processed.

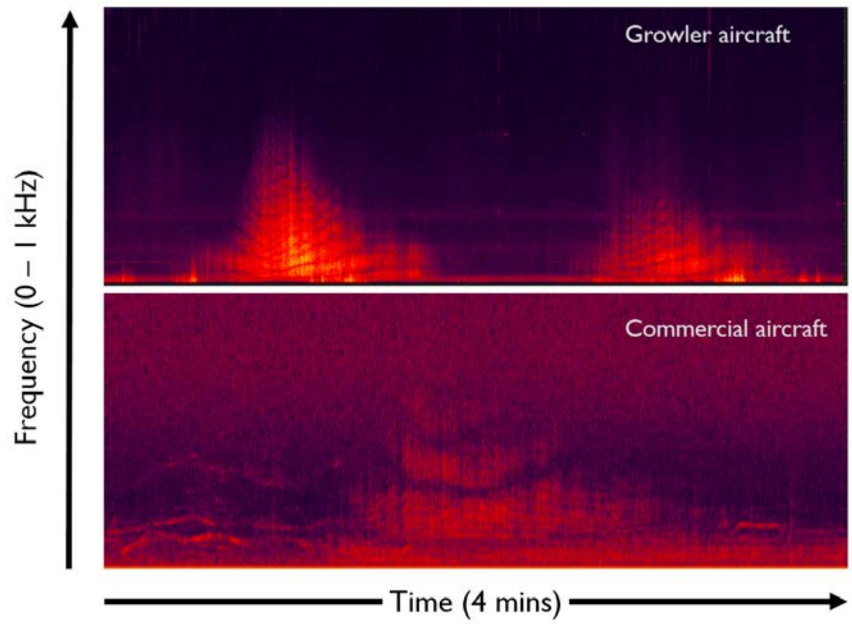


Figure 3. Contrasting spectrograms of Growler vs. commercial aircraft flight events

Growler events typically have more power in the lowest frequencies, variable and irregular speed and duration, and sudden onsets, often occurring in clusters. The Doppler signal also is typically compressed, compared with commercial aircraft that travel at more continuous speeds.

Results

Preliminary results show that it is possible to track noise and activity of different aircraft on the Olympic Peninsula using audio monitoring. One of the most important results to date is that 85 percent of all aircraft noise that we detected is military; only 8 percent and 7 percent are attributable to commercial and propeller aircraft, respectively (Figure 4). When we converted the time that all aircraft were audible in our recordings, we also found consistent daily patterns to flight activity, with average time audible of 5 to 17 percent across the three locations during daytime hours. These results demonstrate that the U. S. Navy's decisions about aircraft training in the military operations area are going to play a dominant role in the soundscape of the Olympic Peninsula.

Results also tell us *when* noise is currently experienced. That information gets us closer to evaluating how the proposed increases in noise may play out, and what kinds of specific impacts may warrant further investigation. For example, our data shows that military activity mainly is occurring during the day, with 74 per-

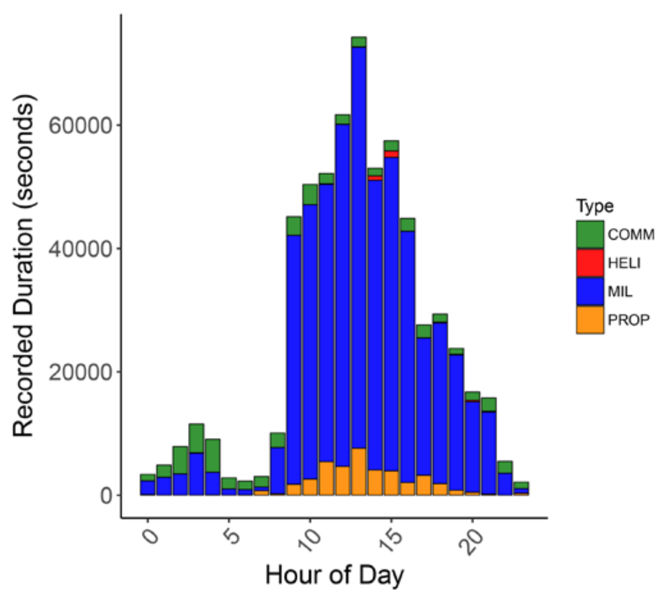


Figure 4. Contribution of different aircraft to the total duration of seconds of recorded audible time by hour of the day (total duration is across all three locations and four sampling periods)

Aircraft types are coded as commercial (COMM), military (MIL), helicopter (HELI), and propeller (PROP).

cent of military traffic detected between the hours of 9 a.m. and 5 p.m. (Figure 4). Activity also corresponds with published flight operations on Whidbey Island; 92 percent of flights were detected on weekdays. Although it helps people to know that most flight activity will occur during a normal workweek and when it will occur, noise impacts also become more concentrated. Given that the NWTT EIS indicates a 62 percent increase in electronic warfare training, it will be important to understand if those increases will result in more hours each day, more days, or higher levels of noise overall.

Future Study

There is still much to be learned from the year of monitoring data. The current focus of this analysis is to extract estimates of decibel level or loudness of flight events from the audio data. At that point, it will be possible to compare the dominant characteristics of noise (volume, number of flight events, frequency range impacted) to what we know about the ecology of valuable and/or sensitive wildlife to consider how vulnerable they may be to noise disturbance. In the future, on-the-ground monitoring studies like this one likely will be the best option to monitor the impact of increased military activity on the Olympic Peninsula soundscape. ☙

More to Explore

The full report of this study is available from the author. Visit this **link** for the U.S. Navy's NWTT EIS.

About the Author

Lauren Kuehne (**lkuehne@uw.edu**) is a research scientist in the School of Aquatic and Fishery Sciences at the University of Washington. She has led and worked on acoustic research related to urbanization and aircraft in urban freshwater lakes, Puget Sound, and Olympic Peninsula forests. She is looking forward to a collaborative project with DNR starting in 2020 which will engage citizen-scientists in acoustic monitoring.

Recent Publication

A Structured Framework for Adaptive Management: Bridging Theory and Practice in the OESF

Forest Science

Teodora Minkova, DNR and Jennifer Arnold, Reciprocity Consulting

To quote Crawford Stanley Holling, one of theorists behind adaptive management of natural resources, "Adaptive management is not really much more than common sense. But common sense is not always in common use." Thirty years after this quote, the systematic approach to learning from outcomes to improve natural resources management continues to be rare. This paper compares regional experiences from private, state, and federal lands in the Pacific Northwest (United States and Canada) and finds that the questions addressed by private organizations tend to be more specific, associated with a narrower scope of uncertainties, and addressed in a shorter time frame with limited stakeholder involvement. On publicly managed lands, questions tend to be more complex and open-ended, usually driven by their mandate for multiple use and high levels of stakeholder engagement. The authors present a structured adaptive management framework developed for the OESF that translates theory into action by describing an implementation process and organizational structure, explicitly linking learning to management planning and implementation, and integrating the technical and social aspects of adaptive management. Forest managers and policy makers can customize this example according to their mandate and management objectives.

Project Updates

Cable-Assisted Logging System Experiment

Cable-assisted or "tethered" mechanized harvesting has recently been introduced to the Pacific Northwest, and is rapidly being adopted by forest industries. Researchers from Oregon State University will compare this system to conventional, manual tree felling with cable yarding. Study objectives include the following:

- Quantify soil disturbance of each harvesting scenario;
- Quantify the differences in the capacity of the soil to hold water between the two harvesting scenarios;
- Quantify a potential increase in yarding productivity by pre-bunching trees after mechanized felling; and
- Quantify the likelihood of hazard exposures in different harvesting systems to address potential improvements in workers' safety.

Using this data, practitioners can do a cost-benefit analysis of productivity and operational costs (including labor and industry fees) and make an informed choice about timber harvesting techniques, given the estimated environmental impacts.

The experiment will be implemented as part of a Washington State Department of Natural Resources (DNR) timber sale sold in July 2019 in the Clearwater landscape of the Olympic Experimental State Forest (OESF). Oregon State University research staff will conduct pre-treatment sampling in January 2020 and will work with the purchaser (Interfor Inc.) to synchronize further data collection with logging operations. For more information, contact the project's principal investigator, **Dr. Woodam Chung,** at **Woodam.Chung@oregonstate.edu**.

Brett Morrissette, Oregon State University

An example of cable-assisted logging

Bird Songs of the Olympic Peninsula

Habitat survey

This project 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, change in response to different forest management practices. Results will help DNR determine if its upland habitat conservation strategies are effective.

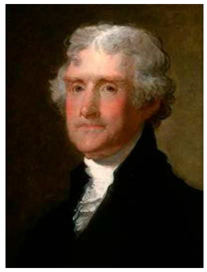
Researchers from DNR and the University of Washington will work with volunteers to collect and analyze sound recordings of several bird species and pair them with forest habitat surveys. The study will be implemented in the Clearwater landscape in the OESF across 16 watersheds designated for experimentation with different harvest practices.

EarthWatch Institute has developed a **project webpage** and started recruiting volunteers. Participants in the first of six annual expeditions are expected to arrive in April 2020.

Researchers have completed field reconnaissance of prospective sampling locations, which include some spectacular old-growth forest patches (refer to "featured photos" on Page 12). Over the summer, they also tested the detection ranges of three models of recording units to select the most appropriate equipment.

This project was described in our Spring 2019 newsletter as "Using Passive Acoustic Monitoring to Evaluate Sustainability of Forest Management in the 21st Century." For more information on this project, contact the project's principal investigator, **Teodora Minkova,** at **Teodora.Minkova@dnr.wa.gov**.

Event Recap: Jeffersonian Dinners on Climate Change



Thomas Jefferson

On Sept. 25, the Olympic Natural Resource Center (ONRC) hosted and helped facilitate one of three climate change "Jeffersonian" dinners. A Jeffersonian dinner is one in which all members participate in discussing a single topic selected in advance, and all statements are accepted and heard. These dinners were initiated by Clallam County Commissioners Bill Peach, Randy Johnson, and Mark Ozias to address growing community concerns about climate change. Joining the commissioners were a diverse group of county residents.

To begin the discussion, ONRC Director Bernard Bormann provided an overview and asked participants how to make the best of the Anthropocene, which is a proposed geologic epoch dating from the commencement of significant human impacts on the environment. He also offered potential solutions that made sense for rural Washington for reducing carbon in the atmosphere.

A report is being prepared that will summarize the results of the three dinners, and will be made available to the public. Contact the Clallam County Commissioners Office at 360.417.2233 for further information. To learn more about this topic, review the *Climate Change Report* prepared by the North Olympic Development Council. This report summarizes the best available science collected from 2014-2015 to assess the north Olympic Peninsula's vulnerabilities and priorities for climate change preparedness.

Featured Photos

Teodora Minkova, DNR

Teodora Minkova, DNR

Within 200 feet but more than 200 years apart

These old-growth and second-growth forest stands (left and right, respectively) were visited as part of field reconnaissance for the "Bird Songs of the Olympic Peninsula" project. Notice the difference in forest structure.