The Learning Forest

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

Issue 12 ● Fall 2022

Editorial Board Message

Managing forests to meet multiple objectives is becoming more challenging. Forest managers must provide valuable wood products and other essential forest materials to a growing population, support local communities, and simultaneously manage for critical ecosystem services in forests that are at risk to climate change. To meet these objectives, managers are constantly seeking innovative, sustainable new management strategies.

Our featured article shows that sometimes, innovative ideas can be discovered by looking to the past. In this month's issue, we focus on how forest engineers in the Olympic Experimental State Forest (OESF) are minimizing impacts on critical riparian habitat and reducing road costs by adapting a strategy that has worked for over 100 years: log stringer bridges. This modern use of an old technology to provide temporary road access may well work for another 100 years.

Our guest article focuses on the new Elliott State Research Forest, and how Oregon State University (OSU) researchers will seek innovative ways to manage forests into the future. Researchers will implement operational-scale studies to provide managers and policy-makers across the Pacific Northwest the information they need to adapt current management strategies, implement new strategies as they emerge, and potentially help shape forest practice rules across the region. "The Elliott" also provides an excellent opportunity for DNR and OSU to exchange knowledge. Although their governance and experimental designs are different, the research goals of the Elliott and the Type 3 Watershed Experiment in the OESF are similar.

These two articles show that innovation is alive in the forest industry, and that by working together, scientists, engineers, and foresters can find solutions to the challenges we face today.

In this Issue

Bill Mehl, DNR

Building a log stringer bridge in the OESF

Featured Article

Reviving a Lost Art

The Log Stringer Bridge

by Cathy Chauvin *with* Bill Mehl and Jeremy Tryall

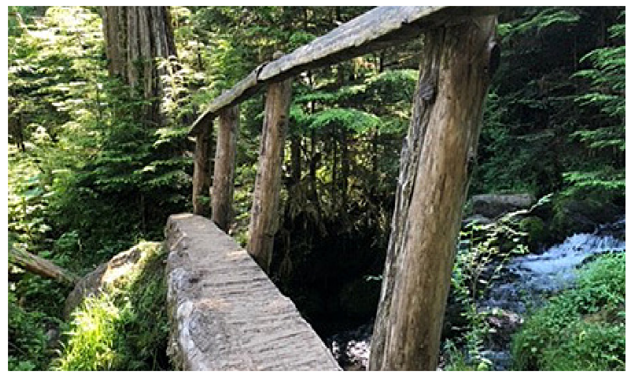
A routine challenge for forest road engineers in the rugged mountains of the Olympic Experimental State Forest (OESF) is how to design road crossings of fish-bearing streams. These roads carry heavy equipment to timber sales in remote areas.

If the stream crossing is on a mainline, or a road accessing several timber sales, an engineer may opt for a long-lasting bridge or a fish-passage culvert (Photo 1). But what about temporary road access? Maybe the road goes to a remote area with a single timber sale. Once the last log is hauled out and the new forest is established, road access for heavy trucks would not be needed for decades.

For this situation, forest road engineers Bill Mehl and Jeremy Tryall of the Washington State Department of Natural Resources' (DNR) Olympic Region recently sidestepped modern methods to implement a solution that would make their predecessors smile: the humble, but still useful, log stringer bridge.

DNR staff

Photo 1. Fish passage culvert.



Cathy Chauvin. DNR

Photo 2. Hiker log stringer bridge in Olympic National Park.

Bill Mehl, DNR

Photo 3. Log stringer bridge in the OESF.

Meet the Log Stringer Bridge

Any hiker in the Pacific Northwest would recognize the log stringer bridge in its simplest form: a large log laid perpendicular to the stream, planed off on one side to create a flat walking surface, and adorned with a rough handrail for those whose idea of adventure does not run to falling off a log (Photo 2).

A log stringer bridge that can support a loaded log truck weighing over 100,000 pounds is similar but much larger (Photo 3). Several large logs (called stringers) are placed lengthwise over the stream, lashed together, and secured to a perpendicular log called the "sill log" on both banks. The sill log can sit on riprap or concrete blocks. A "brow log" is placed on both sides of the deck for safety, and a small-diameter log called a "pole" may be placed between the stringers to help fill the gaps between logs. Rock aggregate is added on both ends to create the bridge approaches. The top of the bridge is covered with chain link fencing, construction fabric, and a layer of rock aggregate to produce a firm driving surface (Figure 1).

Log stringer bridges have a long history in the Pacific Northwest. In an **essay for the Federal Highway Administration**, retired road engineer Rene Wright recalls building these bridges as far back as the 1920s. By then, the supply of timber near water was mostly depleted, so loggers needed roads and bridges to take them farther inland. Being the most expensive part of the road, bridges were "built of the cheapest material possible - forest logs for sills, posts, stringers and planks." The length of the bridge was limited by the strength of the oxen and horses used to haul the logs into place.

Log stringer bridges were still being built as late as the 1970s. However, this stalwart of the woods eventually was overtaken by progress, or more specifically, steel.

Steel bridges were a good option in the 1980s when steel was inexpensive, and for temporary road crossings, Olympic Region engineers often used a modular steel bridge. This bridge consisted of pre-built halves that were bolted together on site (Photo 4). When no longer needed, the halves were loaded onto a flatbed truck and hauled to the next site. DNR's Olympic Region invested in several of these bridges and still uses them today.

But then the price of steel went up. And up. And up. The Olympic Region purchases these bridges when they can, but today's price is steep indeed. A 50-foot steel bridge can cost upwards of $100,000.

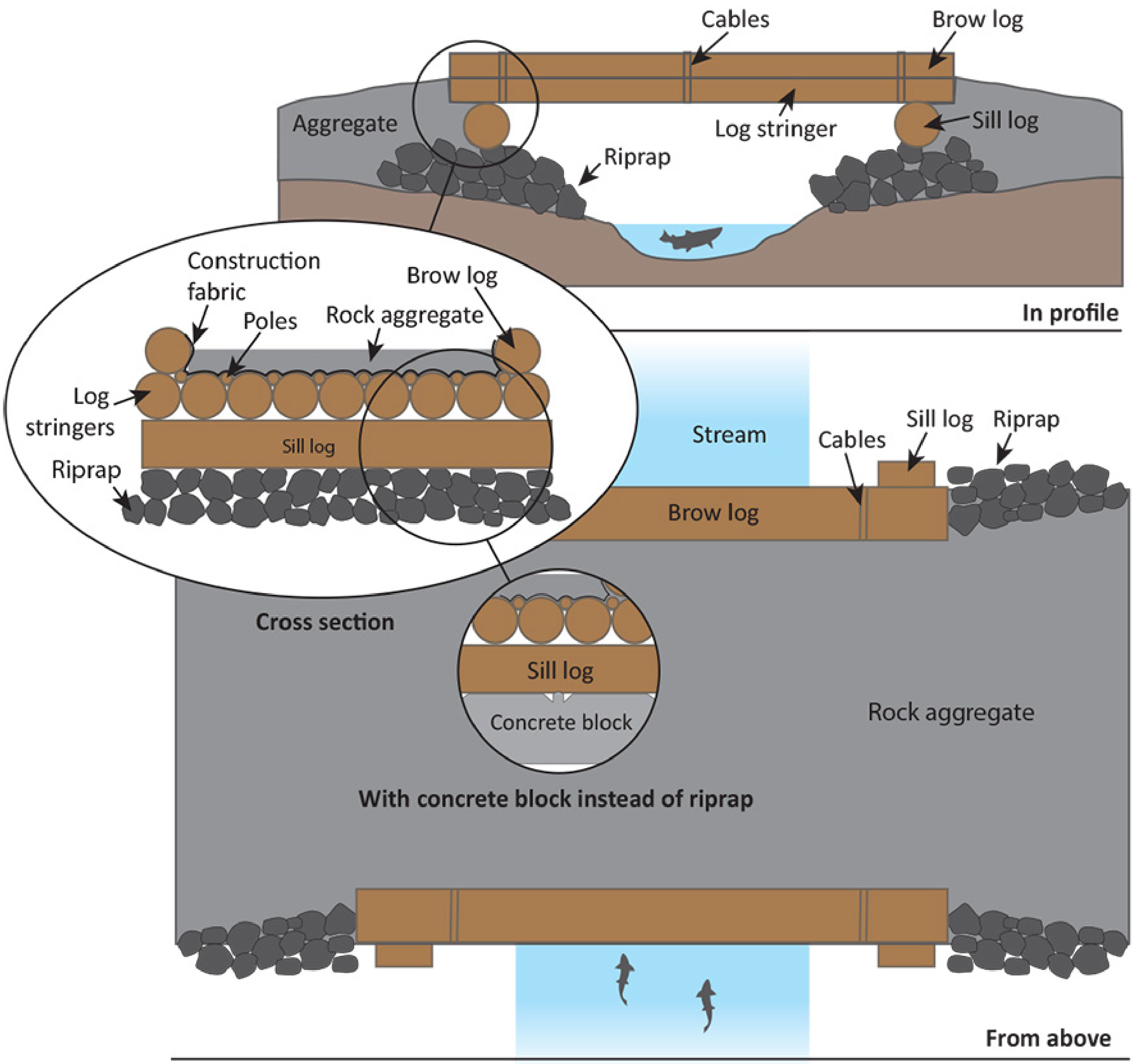


Figure 1. Log Stringer Bridge.

What about other temporary options? Engineers may eschew bridges completely for a log fill with a temporary culvert. The culvert is placed on the stream bed and the channel filled with logs. Similar to a log stringer bridge, the logs are topped with construction fabric and rock aggregate (Photo 5).

But there is one, major drawback to a temporary culvert. Because they typically block fish passage, the culvert cannot be installed until July 1 and must be removed by September 30 to allow salmon to move upstream. Once the culvert is removed, everything beyond the crossing becomes inaccessible to heavy equipment. A window of less than three months requires a miracle of planning and is untenable for larger or more complex timber sales.

These are not minor challenges in a region with a dense network of streams carrying 6 to 15 feet of annual precipitation down rugged slopes to the Pacific Ocean. Faced with over 2,700 miles of streams on DNR-managed lands alone in the OESF, Olympic Region engineers decided it was time to revive the log stringer bridge.

It Takes Planning

Log stringer bridges have distinct advantages. Aside from cables, ropes, staples, and other supplies, the building materials are on site, so costs are minimal. Nor do they require a lot of advanced equipment. A bridge can be built with a log loader to lift the logs, an excavator, and a gravel spreader. They can be built in a single day, and can be as long as 40 feet.

The catch is longevity. In the old days, these bridges were constructed of old-growth logs, which were plentiful because most of the harvest took place in old-growth forests. Old-growth logs are dense and long-lasting, particularly cedar. Some cedar log stringer bridges built in the 1970s in the OESF are still in use today.

Today, DNR does not harvest old-growth forests per its **current policies**. So there is no readily available supply of old-growth logs.

What DNR has in abundance is second-growth logs. Although not as long-lasting as old growth, second-growth logs are fine for a temporary bridge, being

Jeremy Tryall, DNR

Photo 4. Modular steel bridge.

Keith Wyatt, DNR

Photo 5. Temporary culvert and log fill.

plenty strong and large enough to hold up logging trucks and rock-hauling dump trucks weighing up to 200,000 pounds. "The U.S. Forest Service did a lot of work back in the day on these bridges," explained Mehl, including a calculation of load ratings based on log diameter and species.

Bridges are typically built with spruce, although fir or hemlock can be used as well. Cedar is too valuable to tie up in a bridge and tends to attract thieves. A few years ago, **vandals literally hacked chunks of wood from the underside of a cedar bridge in the OESF** to sell on the black market, an eye-popping discovery for those first on the scene.

Olympic region engineers built their first second-growth log stringer bridge in 2017 and have built 10 more since then. Each bridge is inspected every other year, or annually if it is being actively used to haul timber. Engineers check the tightness of the cables, look for cracks or other damage, and search for signs of rot on the outside and inside of the logs. For the latter, they drill the logs with a resistograph (Photo 6) or a drill with a long auger bit.

The first bridge built in 2017 is showing signs of rot and will be decommissioned soon, either blocked from traffic or removed. That gives the bridge a life span of about five years.

Because these bridges are meant to be temporary, that is alright, explain Mehl and Tryall. Five years is plenty of time to complete a harvest, prepare the site, plant the seedlings, and perform young-stand maintenance. The pre-commercial thinning happens between years 10 and 15, long past the life span of the bridge, but no heavy equipment is needed for that treatment, as the cut trees are left on site to decompose. And when the area is ready for its next harvest, another log stringer bridge can be built.

Planning is essential. Explains Tryall, "There can be somewhat of a temptation to add another harvest unit after the initial harvest has been done. After all, the bridge is there. But by the time this next unit might be logged and hauled, the bridge may be starting to get soft." So it is essential to think ahead and ensure that all work can be completed within the bridge's lifespan.

Bill Mehl, DNR

Photo 6. Resistograph. The bit is inserted into the wood to measure resistance. Soft, rotted wood has a resistance near zero.

Building a log stringer bridge will not only work well in the right circumstances, but will keep the knowledge alive. "It's almost a lost art, tying one of these bridges together," says Mehl. Indeed, the U.S. Forest Service guidance for building these bridges is dated 1977. Building these bridges today not only makes sense, but ensures that this piece of logging history retains its place in modern forest management as a simple and economical solution.

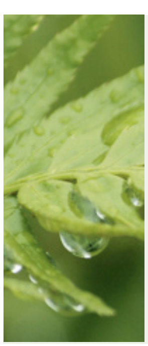
Olympic Region's Road Engineers

Bill Mehl

Bill Mehl is a civil engineer in DNR's Olympic Region. His team develops all the timber sale road plans for the district. Mehl studied forest engineering at Oregon State University and has designed forest roads in Oregon, Washington, and Alaska. He can be reached at **Bill.Mehl@dnr.wa.gov**.

Jeremy Tryall

Jeremy Tryall is the Region Engineer for DNR's Olympic Region. His work includes forest road maintenance, fish passage, rock resources, engineering standards, and the road management and replacement program. Jeremy studied forest engineering at the University of Washington. Licensed since 2008, he has spent most of his career in Forks. He can be reached at **jeremy.tryall@dnr.wa.gov.**



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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Guest Article

The New Elliott State Research Forest

Sustainable Forestry for the 21st Century

by Thomas H. DeLuca, Oregon State University

Our planet is facing unprecedented threats to biodiversity and ecosystem services (such as clean water) as a result of human-induced climate change and degradation of lands from global population growth and consumption demands. At the same time, livelihoods in resource-dependent communities have been declining, particularly in Oregon. Is it possible to support the world's 7.7 billion people without further eroding nature's life support system?

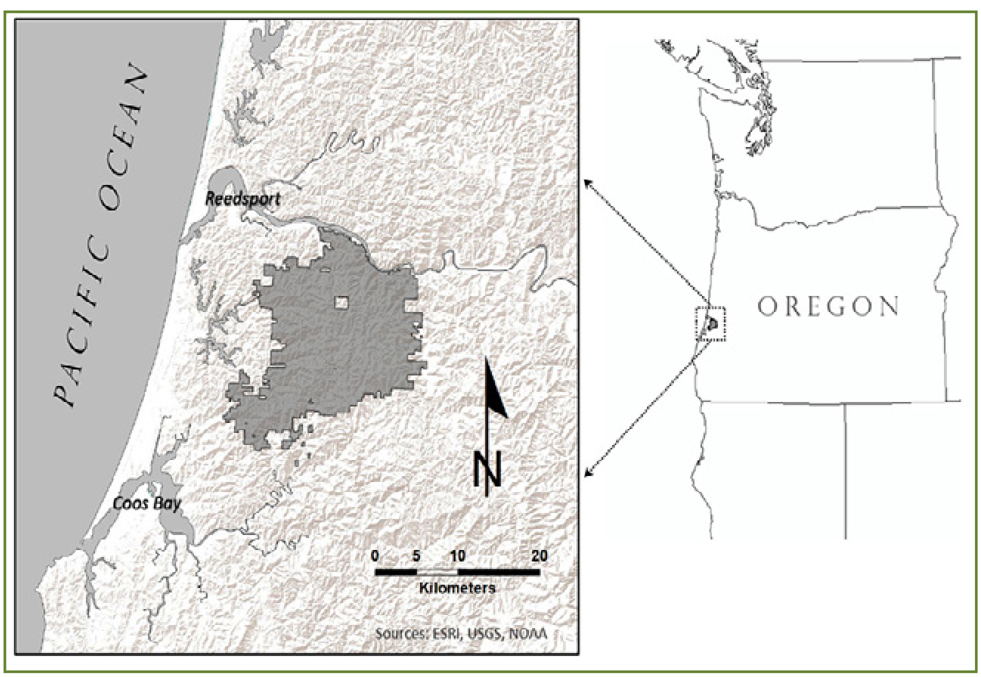
The creation of the publicly owned **Elliott State Research Forest** explicitly seeks to address this question by instituting long-term research. This research is aimed at finding solutions to meeting human resource demand for wood, while combating climate change, supporting the greatest diversity of species, and supporting vibrant rural economies.

Designated in 1930 as Oregon's first state-owned forest, Elliott State Forest is located in Douglas and Coos counties in the Oregon Coast Range (Figure 1). The proposed Elliott State Research Forest includes 82,520 acres of Elliott lands that previously were managed to generate revenue for the Common School Fund. In 2021, the legislature invested $221 million in forestry research by paying off the compensatory obligation to this fund. The legislature also passed **Senate Bill 1546**, which established the forest as a state entity, provided that a forest management plan is completed by June 30, 2023. Assuming all goes through, the research forest will be the result of a four-year collaboration between Oregon State University (OSU) and the Oregon State Land Board, the Oregon Department of State Lands, and numerous advisory committees and stakeholders.

The Elliott resides on steep slopes with unstable, marine-derived soils and is home to numerous endangered species, including marbled murrelets and Oregon Coast coho salmon. The forest had been managed intensively since the mid-1960s, and today about 50 percent of the forest is in plantations, while 50 percent is naturally regenerated from wildfires in the 1800s. These characteristics make the forest challenging to manage for timber, but ideal for research to explore sustainable landscape management.

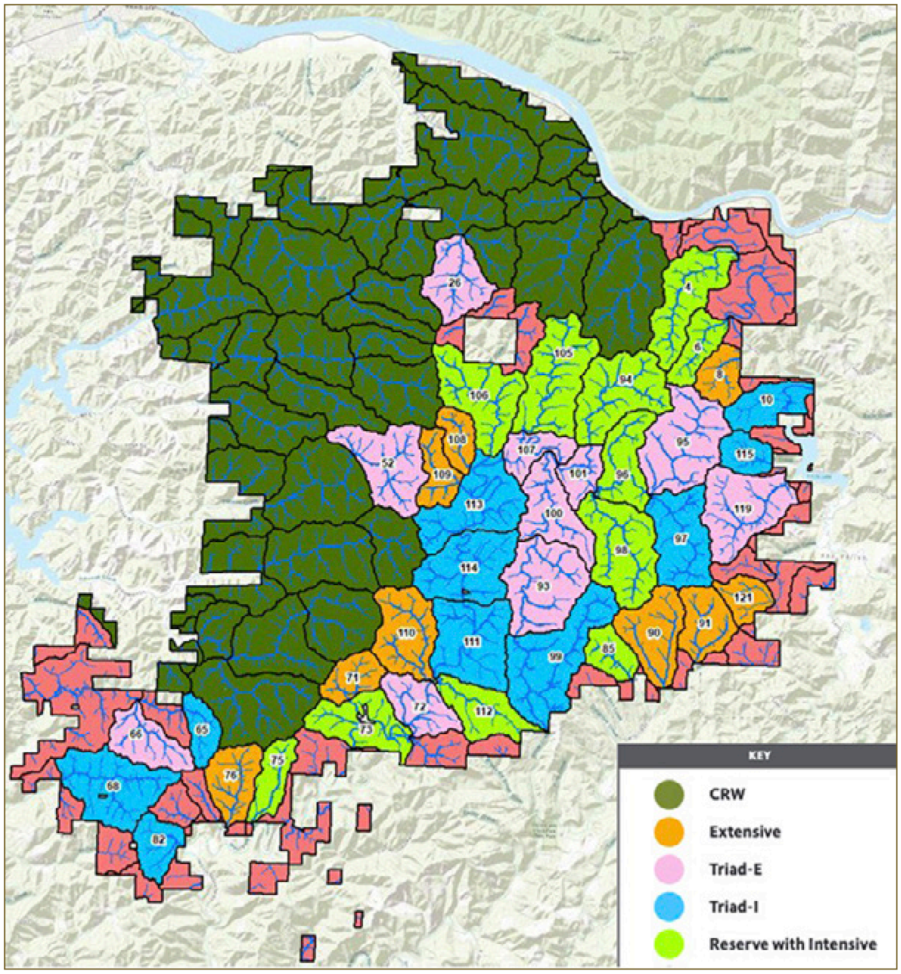
Purpose and Study Design

The purpose of the Elliott State Research Forest is to create an opportunity for operational-scale research to develop principles, practices, processes, and products that improve rural and urban livelihoods while protecting the environment. Research on the Elliott is designed to enable scientific study on how to integrate



Deanne Carlson , OSU

Figure 1. Elliott State Research Forest in Southwestern Oregon



Matt Betts, OSU

Figure 2. Map of the Elliott State Research Forest with the 34,140-acre conservation reserve watersheds to the west and the managed research watersheds to the east.

and enhance biodiversity, support migration and reproduction of wildlife species, develop new approaches for wood production, and provide recreational opportunities.

The overarching study design will seek to determine which strategy makes the most sense from a conservation and production trade-off perspective: 1) Balance the creation of reserves with an equivalent acreage of intensive tree plantations, or 2) reduce harvest impacts using ecological forestry, but expand these harvests across the landscape to meet wood demand.

OSU will manage the forest in two large blocks (Figure 2). A 34,140-acre contiguous block on the western side of the forest (the Conservation Research Watersheds [CRW]) will be a permanent forest reserve, one of the largest in the Oregon coastal range. About 65 percent of this area regenerated naturally from wildfires in the mid- to late-1800s (a portion of which was thinned between 1950 and 1970) and the remainder is in plantations in some stage of regeneration after clear-cut harvesting. All naturally regenerated stands in the CRW will remain unmanaged; however, treatments will be implemented in plantations in the CRW to increase structural complexity and species diversity.

In the remaining 47,500 acres of the forest (the Management Research Watersheds [MRW]), OSU will implement research treatments organized around sub-watersheds (Figure 2) and accounting for about 65 percent of the MRW and about 38 percent of the forest. Each sub-watershed will be assigned a different combination of three types of stand-level management: intensive, extensive, and reserve, arranged as the Triad Design (Figure 3). Intensive means a minimum 60-year harvest rotation to maximize wood production. Extensive involves a minimum 100-year rotation that incorporates partial and regeneration harvests such as variable retention harvests, with a wood production goal that is 50 percent lower than intensive management. Reserve treatments will be similar to those in the CRW.

Riparian Conservation Areas (RCAs) are managed separately from the uplands in the two blocks and consist of the streams and their buffers. RCAs play a key role in integrating aquatic and terrestrial systems. Management and research in the RCAs, including in steep headwalls and other sensitive areas, will focus on maintaining and restoring ecological processes.

To reduce uncertainty and ensure the viability of the research through time, OSU will use a phased research implementation plan coupled with adaptive

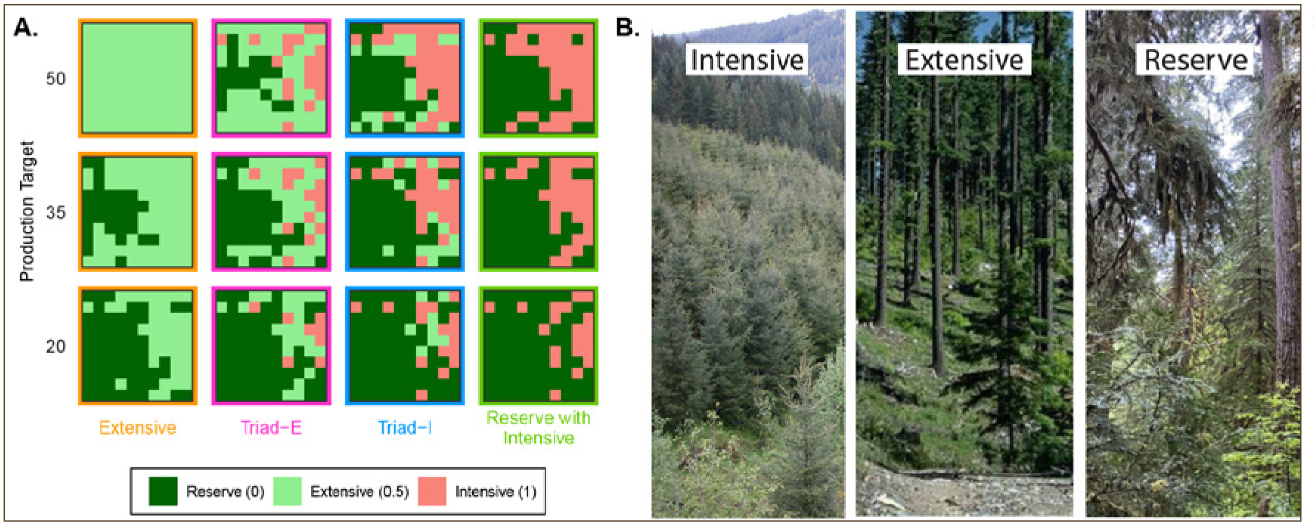


Figure 3. Conceptual illustration of contrasting approaches to managing landscapes for timber production and biodiversity conservation in mixed-wood-yield landscapes.

In (A), each of the nine panels is a schematic map of a region with reserve (unmanaged habitat), ecological forestry (extensive management), and high-yield forestry (intensive management). (B) shows examples of each type of management.

management protocols, modeling, stakeholder input, and ecosystem assessment and monitoring. Scientists will measure water quality, ecosystem carbon storage, endangered and other species populations, total system biodiversity, soil stability and landslides, and socioeconomic values such as timber production and recreation. Monitoring efforts will be key in the implementation of an adaptive management approach to decision making on the forest. OSU also will work with regional Tribal communities to identify specific values of social, spiritual and cultural significance and design experiments to explicitly understand how to best meet these objectives through forest management.

Influencing the Future of Forestry

Research in the Elliott could have value and impacts well beyond its borders. Ideally, forest managers throughout the coastal forest region will implement strategies that are tested on the Elliott, and influence future forest practice rules for the Pacific Northwest. OSU also is exploring the potential for the Elliott to be part of larger experimental networks such as the multi-region **Adaptive Silviculture for Climate Change** project. In addition, the Elliott is starting to attract international interest. In time, research results could lead to wholescale change in how we manage forests, throughout the Pacific Northwest and beyond. ☙

About the Author

Thomas H. DeLuca is dean of the College of Forestry at Oregon State University. He holds a doctorate from Iowa State University, a master's degree from Montana State University, and a bachelor's degree from the University of Wisconsin-Madison, all in soil science. He has lived in both Sweden and the United Kingdom during his research career. Prior to joining Oregon State University, he was dean of the University of Montana College of Forestry and Conservation for over three years and spent five years as director and professor at the University of Washington's School of Environmental and Forest Sciences. Before that, he held faculty and research positions at Bangor University in North Wales, the Wilderness Society, and the University of Montana. He can be reached at **tom.deluca@oregonstate.edu.**

Type 3 Watershed Experiment Update

The **Type 3 Watershed Experiment** tests and compares alternative forest management treatments, standard management on state trust lands, and no-action control treatments in riparian and upland areas within 16 DNR-managed experimental watersheds in the Olympic Experimental State Forest (OESF). The purpose of the study is to develop management strategies that benefit both rural communities and forests.

Pre-treatment Monitoring

DNR technicians, interns, research staff, and contractors have completed the third year of pre-treatment (baseline) monitoring for this study:

- Soil samples were collected on 120 plots in which the cedar-alder polyculture treatment is expected to increase soil nitrogen levels and change the composition of other nutrients. Bulk density and nutrient content of these samples will be analyzed in the **U.S. Forest Service Pacific Northwest Research Station** laboratory.
- Fish, habitat indicators such as in-stream wood and channel substrate, water chemistry, water temperature, photosynthetically active light, and leaf input from the riparian forest were sampled in the 32 monitored stream reaches.
- Remote surveys of upland vegetation were conducted using a light detection and ranging (LiDAR) system mounted on an unmanned aerial vehicle (drone). **West Fork Environmental** performed the flights and processed the initial data. Pacific Northwest Research Station and University of Washington researchers are analyzing the datasets to quantify understory cover and identify tree species and other silviculture and forest habitat characteristics.
- Vegetation was sampled from 21 circular, 35-meter tree plots and 13 square, 3-meter understory plots. These ground-based assessments are being paired with the drone-collected LiDAR data to quantify stand structure and species composition.
- Acoustic monitoring (using sound recorders to passively monitor bird presence) was performed in the experimental and control plots for the structurally complex, early-seral treatment. Habitat surveys continued across the 213 established monitoring stations to evaluate the bird/habitat relationships in all forest seral stages. Audio files are being processed by capstone students from University of Washington and Omfishient Consulting.

Teodora Minkova, DNR

Charles Stearn, intern from Oregon State University, collects water chemistry data from one of the 32 monitored stream reaches.

Teodora Minkova, DNR

Interns from the University of Washington and Doris Duke Conservation Program collect soil samples for the cedar-alder polyculture treatment.

For more information on these monitoring projects, contact **Teodora Minkova**.

Upland Silviculture Study Plan

The study plan describes the new silvicultural tools that are being compared to DNR's standard practice and no-action control treatments in the uplands across the 16 experimental watersheds. Previously reviewed by stakeholders, the study plan underwent scientific peer-reviewed this summer coordinated by Thomas DeLuca, Dean of the College of Forestry, Oregon State University. The research team is revising the plan and compiling comment responses for reviewers. The final study plan will be posted on the **DNR** and **ONRC** websites. For more information, contact **Bernard Bormann**.

Learning Groups

A key component of the Type 3 Watershed Experiment is learning-based collaboration. In this iterative process, three distinct groups ask and answer questions about the options for, and effects of, management choices. The three groups are natural resource managers; natural, social, and policy researchers; and other collaborators, including Tribes and stakeholders. Communication comes through formal and informal exchanges and activities.

As part of learning-based collaboration, eight learning groups were formed in May 2022. Each group is focused on a different topic: aquatics, carbon, cedar browse, history, tribal, invasive species, remote sensing, and economics and operations.

Over the summer and fall, every learning group met remotely at least twice. The cedar browse group is working on a small-scale research project, the invasive species group is planning specific monitoring activities, and the history group is identifying information-gathering activities, such as interviews and review of DNR archive materials.

For more information or to join a learning group, contact **Courtney Bobsin**.

Education and Outreach

Type 3 Watershed Experiment Learning Groups Field Tour

On October 3, learning group members, study researchers, and DNR foresters had a chance to connect in person, exchange updates on their group's activities, and view the study areas in the Olympic Experimental State Forest (OESF). Under unseasonably warm and sunny skies, 22 people visited stream sites to discuss the experiential treatments in riparian areas and the expected aquatic responses. They also visited an upland forest to discuss the upland experimental treatments and the challenges of their implementation. The Forks Timber Museum organized a private tour the evening before the field visit.

DNR researcher Warren Devine (right) explains a display of field monitoring equipment to Commissioner of Public Lands Hilary Franz (front left) and Duane Emmons, DNR's Acting Deputy Supervisor of State Uplands (left) at the Board of Natural Resources Retreat.

Board of Natural Resources Retreat

Board of Natural Resources members, trust beneficiaries, and members of the public participated in a **Board Retreat in the OESF** on August 17th, after spending the previous day touring state trust lands near Port Angeles. In the morning, participants learned about thinning in the riparian management zone, and about log stringer and modular steel bridges. The afternoon was focused on the **OESF Research and Monitoring Program and the Type 3 Watershed Experiment.** The event was a success, and many participants said they found the tour and information valuable.

Student summer internships and capstone projects

A large cohort of students joined DNR field technicians in the OESF this summer to conduct field sampling on multiple upland, riparian, and aquatic projects. The experience provided hands-on learning about ecology and land management.

Six interns from the University of Washington (UW) School of Environmental and Forest Sciences and two scholars from the Doris Duke Conservation Scholars Program rotated through bird habitat surveys, upland vegetation monitoring, soil sampling, and electrofishing. A capstone student from the UW Program on the Environment helped with the bird acoustic monitoring project. An intern from Oregon State University conducted stream habitat surveys, installed plots for riparian leaf input in streams, and sampled water chemistry. Two students from Oregon State University conducted a pilot study on measuring the productivity of harvest operations as part of a larger study led by Dr. Woodam Chung.

DNR is currently creating a video in which students share their experiences doing field work in the OESF. The video will be released on DNR's social media sites this fall.

Featured Photos

Teodora Minkova, DNR

2022 OESF Field Crew with OESF Research and Monitoring Program Manager Teodora Minkova (back row, middle) and DNR Coast District Planning Forester Kevin Alexander (front row, left).

Teodora Minkova, DNR

DNR's Tracy Petroske and Oregon State University students Parker Turk and Jeffrey Niquette (left to right) before a day of fieldwork in the OESF. The students were participating in a harvest operations productivity study led by Dr. Woodam Chung. The workday starts at dawn, which is 5 a.m. this far north in the summer.