Expanding the Forest Management Toolbox

A team of researchers and forest practitioners has been developing a landscape-scale experiment to identify land management strategies that benefit both communities and forests. Led by Washington Department of Natural Resources (DNR) and University of Washington's Olympic Natural Resources Center (ONRC), this project aims to inform state and other land managers how alternative forest management practices compare to the current ones in providing environmental, economic, and social benefits.

Why Should we Expand the Toolbox?

From conversations with stakeholders, Tribes, and forest practitioners, researchers heard a desire to manage forests more effectively for elk and deer, birds, fish, insects, and a variety of forest products, as well as to benefit local communities. Recent ecological research offers new approaches for managing lands for multiple objectives. Organizing these ideas in a scientific experiment and testing them at an operational scale offers unparalleled opportunity to identify new management strategies that improve both ecosystem and community wellbeing. If proven useful, these strategies may expand the forest management toolbox of DNR and other land managers.

What is the Type 3 Watershed Experiment?

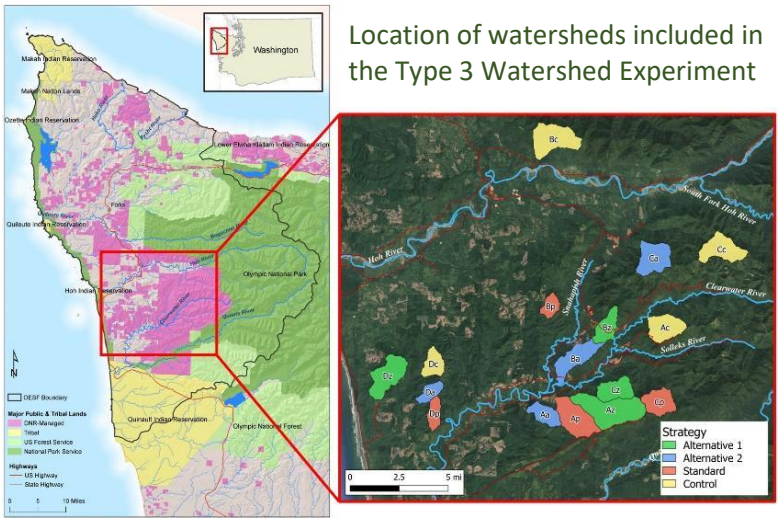
The Type 3 Watershed Experiment will test and compare alternative forest management treatments, standard management on state trust lands, and control treatments in both riparian and upland areas. Researchers will measure how the treatments impact streams and forests for years into the future. Operational costs of treatments and the timber revenue they produce will be tracked to evaluate their feasibility.

Alternative 1 Based on researcher experience		Alternative 2 Based on stakeholder feedback		Standard Management Based on the 2016 OESF Forest Land Plan		Control No management	
Riparian	**Upland**	**Riparian**	**Upland**	**Riparian**	**Upland**	**Riparian**	**Upland**
Active habitat restoration	Complex early seral Accelerated variable density thinning	Alder rotations under heavily thinned conifers Variable width buffers	Cedar-alder polyculture Ethnoforestry with variable density planting	Fixed, no-entry riparian buffers*	Variable retention harvest Variable density thinning	No entry	No entry

Type 3 Watershed Experiment in the Olympic Experimental State Forest

Where is the Study Happening?

The Type 3 Watershed Experiment takes place in 16 watersheds in the Olympic Experimental State Forest (OESF) in Washington State. The study area covers 20,000 acres on the western side of the Olympic Peninsula in Jefferson County. Each selected watershed is at least 500 acres, drains into a fish bearing stream (Type 3 stream), and is managed by DNR.



Location of watersheds included in the Type 3 Watershed Experiment

Get involved!

DNR and ONRC are committed to ongoing communication with local communities, Tribes, regional stakeholders, and potential research partners, all of whom can all help us get the most value from this ambitious and complex project. A focus on learning together through learning-based collaboration will provide a deeper understanding of sustainable forest management and help identify management strategies that have the greatest benefit for communities and forests. Over the next several years, stakeholders can:

- Join a field tour;
- Help with field data collection;
- Participate in virtual meetings;
- Provide input on study plans, monitoring, and analysis; and
- Join a sub-group to address specific aspects of the study.

To be added to our mailing list or hear more about how you can be involved, email T3Team@uw.edu.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu. Learn more about the OESF at www.dnr.wa.gov/OESF.

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About the Olympic Experimental State Forest (OESF)
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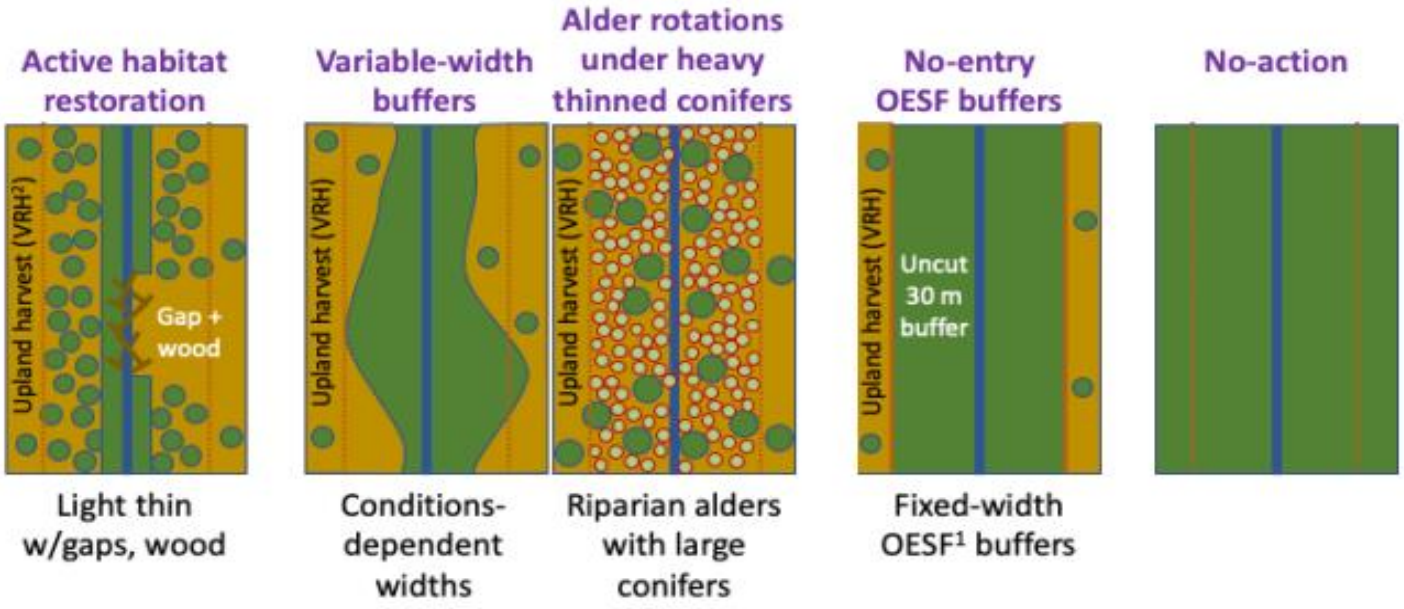
Riparian Investigations

The riparian component of the Type 3 Watershed Experiment will examine how forests, streams, and salmonids respond to standard and alternative riparian management treatments. Researchers and forest practitioners will study five different management treatments, called prescriptions, aiming to expand the DNR toolbox to include new ways to manage public lands and riparian forests to provide environmental, economic, and social benefits.

Riparian Treatments

The Type 3 Watershed Experiment will explore how streams and nearby forests, called riparian buffers, are impacted by five different riparian management treatments.



- **Active habitat restoration:** Lightly thin the outer riparian buffer by removing some of the trees, cut 30-meter gaps in the forest, and place harvested trees in the water to create three log jams. Create a no-entry zone adjacent to the steam outside of the gaps. This treatment is expected to accelerate the restoration of forest and stream habitat by creating more structural diversity and improving stream productivity and habitat.
- **Variable-width buffers**: Change the width of riparian buffers based on the stream size, stream temperature, fish presence, and percent watershed harvested in the last 10 years. This treatment is expected to provide site-specific stream protection and increased revenue from greater harvest in some areas, while maintaining needed environmental protections.
- **Alder rotations under conifers**: Heavily thin the conifer forest, leaving about 30 trees per acre, and plant red alder between the remaining trees. This treatment is expected to accelerate the restoration of forest and stream habitat by increasing existing tree growth and increasing nutrients, leaf litter, and terrestrial insects in streams. It also will provide a repeated, short-rotation crop of alder for increased revenue.

- **No-entry OESF buffers**: Retain unmanaged, 30-meter riparian buffer along streams when harvesting the upland forest. The buffer is a standard width based on the size of the stream and the presence or absence of fish. This treatment is currently used in most riparian buffers on state trust lands and relies on natural (passive) restoration of the forest through growth and disturbance. This natural approach to restoration has been estimated to take 100 years or more to mimic pre-settlement conditions.
- **No action**: No harvest will take place in the entire experimental watershed. While this is not a viable forest management strategy for state lands, this treatment provides a contrast for other treatments and accounts for natural variation in ecological conditions.

Monitoring

A number of environmental indicators will be monitored before and after the harvest to compare the ecological effects of the riparian treatments:

- Salmonids
- Stream temperature and invertebrates
- Periphyton
- Stream channel characteristics
- Instream wood
- Stream sediment
- Riparian vegetation
- Canopy cover

Collecting macroinvertebrate samples in an experimental stream reach

Operational costs of treatments and the revenue from the harvest in riparian buffers will be tracked to evaluate the feasibility of these experimental treatments at operational scale.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu and dnr.wa.gov.

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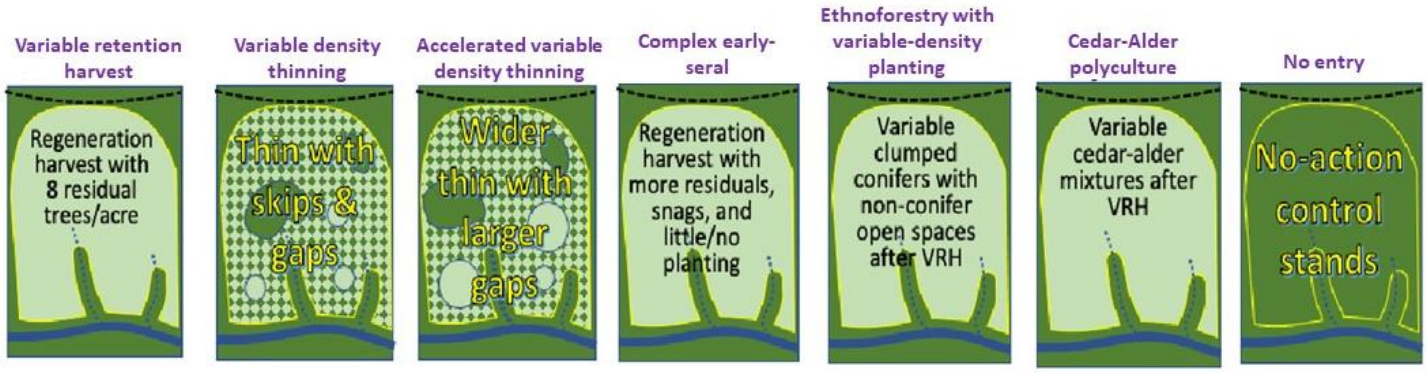
Upland Investigations

The upland component of the Type 3 Watershed Experiment will examine how standard and alternative management approaches for upland forest areas can provide benefits for communities, trust beneficiaries, and the environment, while producing timber. Researchers will study seven different management treatments, called prescriptions, aiming to expand the DNR toolbox to include new ways to manage public lands that provide environmental, economic, and social benefits.

Upland Treatments

The Type 3 Watershed Experiment will examine how upland forests and biodiversity are impacted by seven different management prescriptions.



- **Variable retention harvest:** Leave some large trees, snags and logs in place following harvest and plant more than 300 trees per acre within the next 1 to 2 years. This prescription is currently used in upland forests on state trust lands and includes planting a mixture of bare-root conifers.
- **Variable density thinning:** Moderately thin forest and create some gaps while not harvesting in some areas. This prescription is currently used in upland forests on state trust lands.
- **Accelerated variable density thinning:** Heavily thin much of the upland area, leave some areas unharvested, and create some larger gaps. This prescription is expected to accelerate the development of late seral habitat and processes, while still maintaining revenue from harvest**.**
- **Complex early seral:** Leave more trees, slash, snags and logs behind following harvest and conduct minimal planting to allow for natural regeneration of trees. This prescription aims to emulate wind-disturbed stand initiation. The resulting habitat conditions, avian response, and economic tradeoffs will be studied.
- **Ethnoforestry with variable density planting:** Following harvest, plant Douglas-fir seedlings in clumps that vary in pattern and density. This prescription is expected to make space and time for culturally valuable understory species to grow in interstitial areas and improve wildlife habitat, while producing a timber crop.

- **Cedar-alder polyculture:** Plant trees in a variety of cedar-to-alder ratios ranging from 100 percent cedar to 100 percent alder. This prescription aims to increase cedar and alder production, improve soils and landscape heterogeneity, and support cultural and habitat uses of cedar and alder.
- **No entry:** No harvest will take place in the entire experimental watershed. While this is not a viable forest management strategy, this prescription provides a contrast for other treatments and accounts for natural variation in ecological conditions.

Monitoring

A number of environmental indicators will be monitored before and after the harvest to compare the ecological effects of the upland treatments:

- Tree mortality, growth, and yield
- Net present value
- Understory composition and biomass
- Wildlife use, including deer, elk, and birds
- Impacts to local communities

Bird habitat survey in the experimental watersheds

Operational costs of treatments and the revenue from the harvest in upland areas will be tracked to evaluate the feasibility of these experimental treatments at the operational scale.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu. Learn more about the OESF at www.dnr.wa.gov/OESF.

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Complex Early Seral Prescription

What is Complex Early Seral Habitat?

Early seral, or pre-forest, habitat is the successional stage between a stand-replacing disturbance and subsequent tree canopy closure. It is the only stage in which trees do not dominate the site, and is distinct from young tree plantations, in that it comprises a complex mix of non-tree life forms (for example, shrubs and herbs), regenerating trees, and biological legacies from the previous stand (for example, snags, down wood, and surviving large trees). Structurally complex, early seral habitat is important for wildlife species such as birds and pollinators. Currently, it is the rarest forest habitat in the Pacific Northwest, rarer than old-growth forest.

Rationale and Goal of Early Seral Sub-study

Public land agencies are beginning to actively create early seral (pre-forest) habitats. But for lands managed for timber production, the silvicultural and economic tradeoffs of promoting an early seral stage (potentially affecting tree establishment timing and composition) are not well quantified.

The goal of this sub-study is to quantify the tradeoffs—ecological, silvicultural, economic—of a prescription designed to produce structurally complex, early seral (pre-forest) habitat at the scale of a timber sale unit (<40 acre). The treatment will seek to emulate conditions after a severe wind storm. The intent is to explore the practicality of promoting early seral habitat while still keeping stands on a production trajectory.

Study Design

The study will compare an experimental early seral treatment with a standard variable retention harvest and regeneration (control) treatment implemented on state trust lands, described by the following prescriptions:

Item	Early seral units	Control variable retention harvest units (DNR's conventional practices)
Leave tree density	12 trees per acre across unit	8 trees per acre across unit
Leave tree selection	Broader range of tree sizes and species, plan for some windthrow/breakage	Follows Washington forest practices rules; decisions on specifics made by foresters according to local conditions
Leave tree clumping	60% dispersed; 40% in small clumps of <10 trees	
Leave clump placement	Prioritize spots already having understory vegetation	
Leave trees and unit edges	No additional leave tree density near edges	
Slash management	Cut-to-length and leave all slash as-is on site	As normal (whole tree yarding)
Down wood	Leave down wood in place (for example, cut-to-length)	
Snags	Leave snags when safe; consider girdling some leave trees to create more snags	Not normally retained
Site preparation (vegetation control)	None	If needed
Tree planting	Natural regeneration; augmented by planting if needed	Conventional planting using a conifer mix

Monitoring

Comparisons between the two prescriptions will include the following:

- Habitat conditions, characterized by vegetation structure and composition and woody debris;
- Bird response, sampled through acoustic monitoring;
- Silvicultural response, characterized by stand regeneration; and
- Economics, using operational costs combined with stand growth and yield projections.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu. Learn more about the OESF at www.dnr.wa.gov/OESF.

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Ethnoforestry—Variable-Ratio Polyculture

Prescription Objectives

- Grow crop trees in repeated rotations (2, 30-year rotations of alder and 1, 60-year rotation of cedar) to generate trust revenues across +/- 15 percent of a standard variable retention harvest.
- Provide for species included in the Washington State Department of Natural Resources' (DNR) *State Trust Lands Habitat Conservation Plan* at a landscape scale.
- Provide new benefits at the same time, including the following:
  - Provide more jobs-intensive, value-added manufacturing;
  - Maintain or improve soils and productivity;
  - Increase climate adaptation and resiliency through diversification in stands and landscapes;
  - Meet cultural needs of Tribes and others; and
  - Provide an option for transition to cedar-dominated, late seral stand structure.

A red alder growing in experimental watershed Aa. The tree is 29 years old and 60 feet tall (high site index).

Why This Tool Might Work Well

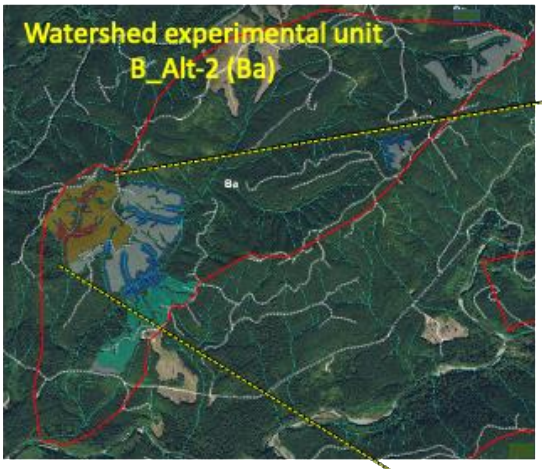
- Alder grows quickly and has a short life span.
- Cedar needs more time than other conifers to reach maximum value.
- Both alder and cedar have higher stumpage values than Douglas-fir and hemlock.
- Cedar is very tolerant of shade from alders.

Important Questions

- Will nutrient and soil organic matter losses from past management be reversed?
- Will alder grow well on upland sites in these watersheds?
- Can excessive cedar browse be avoided?
- Will higher value overcome lower volumes?
- Will cedar height growth be increased by alder?
- Will 60-year-old cedar be ideal for continuing to late seral structure?

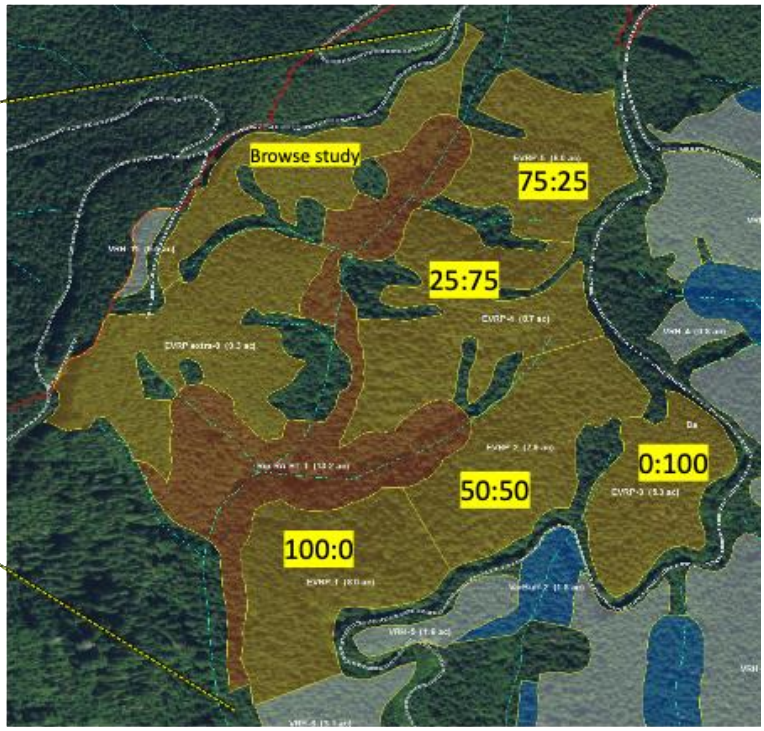
Type 3 Watershed Experiment in the Olympic Experimental State Forest

Ethnoforestry – Variable Ratio Polyculture



Randomized cedar:alder	Sub-study	stand acres
100:0	1	8.0
50:50	2	7.9
0:100	3	5.3
25:75	4	9.3
75:25	5	8.7

Cedar-to-Alder Planting Ratios



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Ethnoforestry—Variable Density Planting

The ethnoforestry-variable density planting treatment will include an operational-scale prescription that follows a standard variable retention harvest, yet includes more elements of community and environment wellbeing, as compared to standard practice. The prescription increases heterogeneity by adding a variety of clumped planting patterns (variable density plantings) combined with a variety of open gaps, or "interstitial" areas, across the operational unit. By extending the early seral stage through the creation of these interstitial areas, we expect to provide longer-term and quality forage for wildlife and non-timber products that have local and cultural value, while also producing a healthy timber crop.

Prescription Objectives

- Address local community concerns over the health and population of elk and deer in the region by creating high quality forage.
- Extending the early seral forest stage to create additional habitat and plants for wildlife and local people.
- Producing a healthy timber crop using a novel planting and interstitial creation approach.
- Expanding the toolbox by trying new approaches to producing timber and managing forests.

University of Washington researcher installing native plants at the ethnoforestry field trials site

Prescription Details

There will be five, novel clumping/interstitial patterns and a control, including the following:

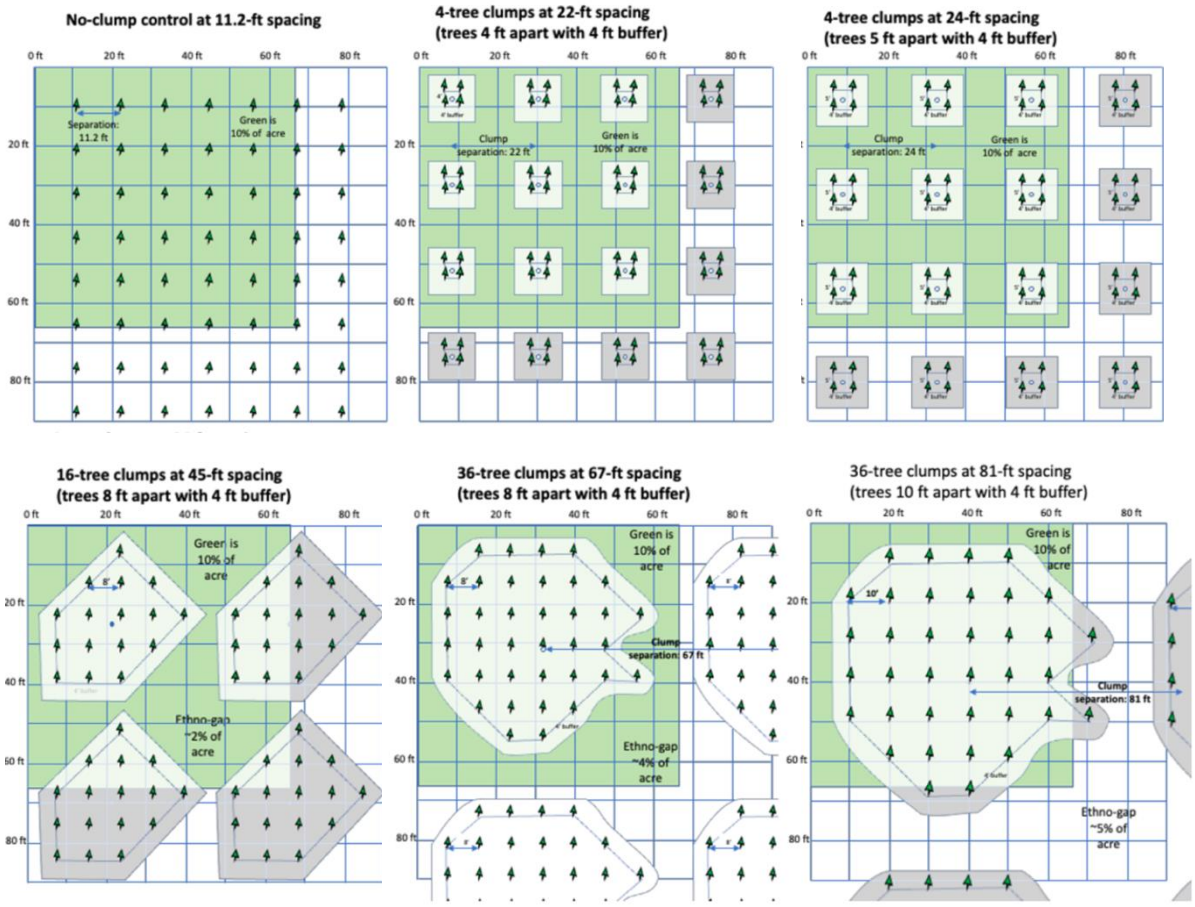
- Control, trees planted at 11-foot spacing (350 trees per acre [TPA])
- 4 tree clumps at 4-foot spacing with 22 feet between clumps (350 TPA)
- 4 tree clumps at 6-foot spacing with 26 feet between clumps (255 TPA)
- 16 tree clumps at 8-foot spacing with 45 feet between clumps (350 TPA)
- 36 tree clumps at 8-foot spacing with 67 feet between clumps (350 TPA)
- 36 tree clumps at 10-foot spacing with 81 feet between clumps (240 TPA)

Important Questions

A number of valuable questions can be addressed through this novel approach. Researchers will explore the following:

- How will tree spacing influence crown development, growth, and mortality?
- How will clump/interstitial patterns affect total and net revenue?
- How will clump/interstitial patterns affect composition, growth and yield of understory plants providing early seral habitat?
- Will selective understory management succeed in favoring ungulate and culturally preferred species?

Type 3 Watershed Experiment in the Olympic Experimental State Forest



The 6 clumping arrangements: an un-clumped control, an intermediate 16-tree clump, and two each 4-tree and 36-tree clumping arrangements with narrow and wider inter-tree spacing. These arrangements will be assigned randomly within the sub-units that constitute the operational-scale unit.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu. Learn more about the OESF at www.dnr.wa.gov/OESF.

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Social Science Investigations

Ecosystem wellbeing has both community and environment elements, which makes people an integral part of our ecosystems. The Type 3 Watershed Experiment aims to consider the social, cultural, and economic wellbeing of local communities, in addition to the needs of our forests and environment. Our learning-based collaboration (LBC) approach includes working directly with local people to inform and shape the study's priorities and treatments.

Learning-based Collaboration

LBC is an iterative process in which natural resource managers, including Tribes and other organizations; natural, social, and policy researchers; and other collaborators engage with one another. Their focus is on asking and answering questions about the options and effects of management choices through formal and informal knowledge exchange and production. Their common goal is to increase ecosystem sustainability as measured by environment and community wellbeing.

The ecosystem wellbeing framework, which includes both community and environmental wellbeing. Both components inherently interact and contribute to the wellbeing of the entire ecosystem.

LBC uses a bottom-up management process and collaborative research design to develop and implement research and management that meets the needs of all involved. It emphasizes that all parties can learn better together, from interactions during the process as well as from study results.

Engagement

In order to ensure stakeholders, Tribes, natural resource managers, and collaborators all have a seat at the table, the Type 3 Watershed Experiment team has created several opportunities for people to lend their expertise, provide feedback, ask questions, and learn from one another. Opportunities have included the Washington State Department of Natural Resources' (DNR) annual Olympic Experimental State Forest (OESF) Science Conference, several engagement zoom meetings, and a field tour. In addition,

Type 3 Watershed Experiment volunteers work with a DNR researcher

Type 3 Watershed Experiment in the Olympic Experimental State Forest

Type 3 researchers have been conducting one-on-one interviews with community members to hear their perspective and gather their feedback.

Sustainability Study

Questions about wellbeing and sustainability overlap in both their social and ecological contexts. Sustainable ecosystem practices simultaneously have ecological and sociological variables. Promoting sustainable policy and practices requires an understanding of what variables promote community wellbeing. Descriptions of stakeholders do not suffice; the focus should be on understanding the perspectives and lived experiences of stakeholders and constituencies, and how they interact (or not) with one another. Monitoring priorities include profiles of behavioral patterns, knowledge, feelings or affect[1], and preferences. Sustainable knowledge production is reciprocal; it is important to empower, engage, and learn from and with communities.

To be added to our mailing list or hear more about how you can be involved, email T3Team@uw.edu.

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[1] In psychology, affect means any experience of feeling or emotion, ranging from suffering to elation, from the simplest to the most complex sensations of feeling, and from the most normal to the most pathological emotional reactions. Often described in terms of positive affect or negative affect, both mood and emotion are considered affective states. (American Psychological Association)

Getting Involved

There are several ways to participate in the Type 3 Watershed Experiment ("T3"). We look forward to working with people with a myriad of backgrounds who want to provide feedback, ask research questions, or discuss/participate in experimental treatments, monitoring, or data collection. To do so, we are embracing a new kind of engagement called **learning-based collaboration** – where managers, researchers, stakeholders, tribes, and community members engage with one another, focusing on asking and answering questions about the effects of management choices through scientifically valid comparisons. We have formed eight **Learning Groups**, each with a separate topic and specific goals. We welcome your participation in any or all.

Aquatics Learning Group

This group is interested in learning more about and supporting the T3 stream and riparian research. Current aquatics work in the T3 includes: stream habitat surveys, riparian vegetation surveys including leaf litter, fish population surveys, analysis of fish diet, surveys of stream invertebrates, algae and periphyton, and modeling the trophic web. To join, contact the group facilitator Angie Thompson at Angie@Thomsonstrategic.com.

Carbon Learning Group

This group is interested in integrating carbon-related research and planning with other regional forests (e.g., Elliot State Forest). In particular, studying how the T3 can add to data for carbon cycle modeling inputs. This group would also like to advance carbon accounting at the timber sale scale rather than only at landscape scale and how to best monetize carbon offsets. Contact the group facilitator Tracy.Petroske@dnr.wa.gov.

Cedar Browse Learning Group

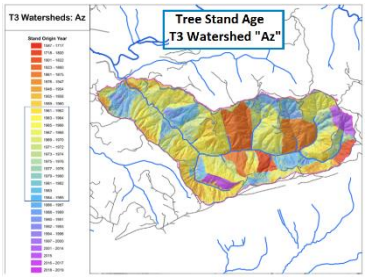
This group will study how browsing animals impact the growth of experimentally planted cedar trees. The focus is on dietary preferences of woodland foragers, how much they consume, and how browsing impacts seedling growth and survival. Contact the group facilitator Angie Thompson at Angie@Thomsonstrategic.com.

Economics and Operations Learning Group

This group will investigate the economic and operational challenges of various forest management practices, such as harvest, planting and vegetation control, which implement the T3 experimental prescriptions. Data gaps in current economic models will be identified (e.g., changing climate, or differing harvest techniques). Contact the group facilitator Angie Thompson at Angie@Thomsonstrategic.com.

History Learning Group

This group meets monthly to establish the historical context for the 16 experimental watersheds in the T3 study. Members identify and gather historical data including photography, land use and timber sale records and oral histories. This will help interpret results from the various experimental prescriptions underway. Contact the group facilitator Tracy.Petroske@dnr.wa.gov.



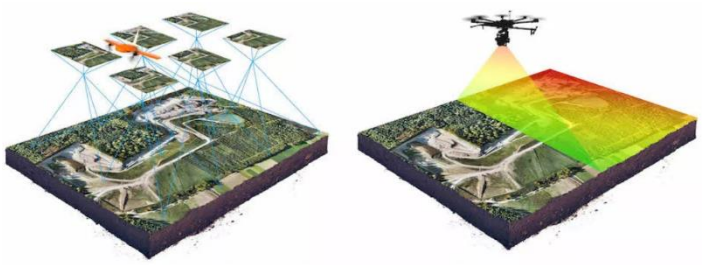
Type 3 Watershed Experiment in the Olympic Experimental State Forest

Invasive Species Learning Group

This group is considering questions such as how soil composition changes after herbicide application, what simple practices can reduce spread of weeds (e.g., mowing in different patterns), and whether remote sensing be used to track understory response to treatments. This group is identifying several auxiliary T3 research projects to address those questions. Contact Tracy.Petroske@dnr.wa.gov.

Remote Sensing Learning Group

This group is largely comprised of professionals already doing remote sensing research on the Olympic Peninsula. The primary goal is to avoid expensive, redundant work by sharing data, coordinating experiments, developing measuring and estimation methods using drone data, and identifying which products are useful for various monitoring applications. Contact Tracy.Petroske@dnr.wa.gov.



Tribal Learning Group

Several tribes have ancestral, ceded, and/or Usual and Accustomed lands that overlap with the T3 study area. In addition, these Tribes (as well as many others in the region) have place-based knowledge of these ecosystems and may have an interest in the research questions, methodology, and data from this study. Their input is vital to ensure that the study is meeting their needs and that key questions are addressed. Contact the University of Washington researcher Courtney Bobsin at cbobsin@uw.edu.

General Contact

In addition to contacting the individual learning group facilitators, we encourage all interested parties to reach out directly to T3 principal investigators or by emailing T3Team@uw.edu to ask research questions, discuss treatments or monitoring methods, or inquire about data collection and sharing.

For More Information

Learn more about the T3 Watershed Experiment and the ONRC at onrc.washington.edu.
Learn more about the OESF at www.dnr.wa.gov/OESF.

About the Olympic Experimental State Forest (OESF)

Located on the western Olympic Peninsula, the OESF is a 270,000-acre state forest designated to learn how to integrate revenue production (primarily timber harvesting) and ecological values (e.g., habitat conservation) across the landscape. Steep terrain and heavy annual precipitation create many streams and wetlands. The mild, maritime climate facilitates high tree growth rates. The OESF is actively managed to under the 1997 *State Trust Lands Habitat Conservation Plan* to protect threatened and endangered animal and plant species. The OESF also manages these forestlands to produce revenue for various trust beneficiaries and undertakes research to explore and advance best management practices.