FORESTS AND FISH
PROTECTING AQUATIC HABITAT IN OREGON'S FORESTS

Oregon Forest Resources Institute

THE OREGON WAY

COMPLEX HABITAT

This term refers to logs, boulders and side channels that create refuge for fish. It's an important part of fish habitat that has not always been well understood. These logs were placed in a stream in the Coast Range near Lincoln City as part of a voluntary habitat improvement project by Hancock Forest Management, the Oregon Department of Fish and Wildlife and the Salmon Drift Creek Watershed Council.

FORESTS AND FISH:

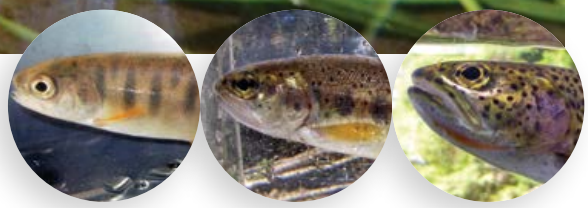
The story in Oregon

As the Northwest is known for forests, it is also known for salmon. The two are inextricably linked. Adult salmon, as well as steelhead, return from the ocean to spawn in forest streams that are sometimes small enough to jump across.

After years of difficulties, including overfishing and loss of quality habitat, several populations of Pacific oceangoing fish were listed under the Endangered Species Act – including, in 1998, the Oregon coastal coho salmon. Today state fisheries biologists say coho, while not fully recovered, are holding their own.

Oregon's unique, steady approach to preserving and improving habitat in forest streams is paying off, not only for coho, but also for other species such as steelhead and cutthroat trout. And it has happened while the state has maintained a timber harvest that supports more than 70,000 jobs.

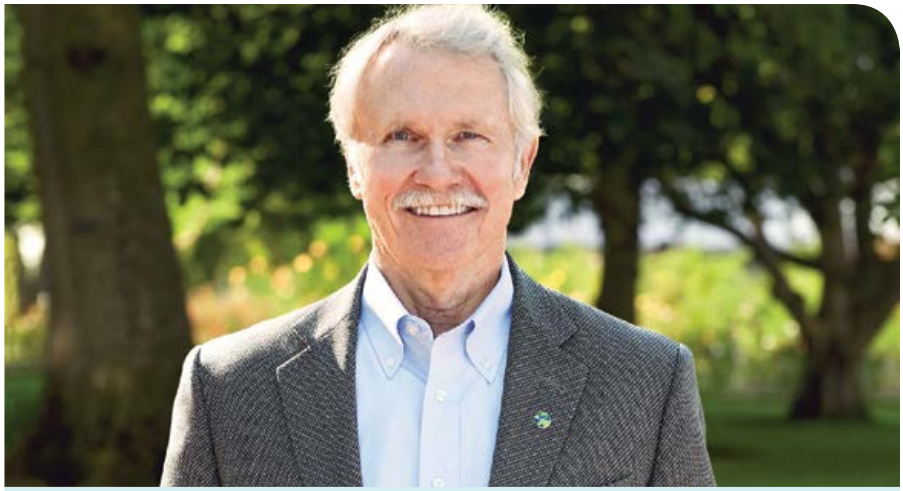
On the cover:
Flyfishing on the McKenzie River
Photo by Brian Becker



Fish photos: David Leer

This report explains how that work is being done. Oregon relies on:

- conservation of forests, through comprehensive land use laws
- increased understanding of private forest management's effects, through repeated investments in long-term scientific research
- continual improvement in forest practices, through an evolving set of strong rules and technological innovations that have significantly changed how private timber is harvested
- voluntary habitat restoration projects, through a unique and innovative state program that offers incentives and encourages collaboration



THE OREGON WAY

A message from Governor John Kitzhaber

Oregon is home to salmon, steelhead, trout and other species. Some of these fish spend years in the ocean, but their lives begin and end in Oregon's lush, green forests. Sustaining their habitat for present and future generations is not only our civic responsibility, but is central to what it means to be an Oregonian.

Protection takes many forms. In Oregon, we rely on a unique, three-pronged approach: centralized land use planning, a strong regulatory framework, and an innovative stream and watershed improvement program.

In 1973, the Oregon Legislature passed the Land Conservation and Development Act. Thanks to local and state implementation, Oregon has lost little of our valued forest and agricultural lands to development. Some of the best-quality water comes from our forests, so keeping them as forests is important.

The Oregon Forest Practices Act, passed in 1971, is designed to adapt as new science emerges, and over time it has pointed the way to improved management practices. Changes are made through a democratic process, where all parties have a say in rule-making, and where scientific data is central to decisions aimed at protecting natural resources, maintaining the forest sector's competitiveness, and supporting rural economies.

In addition to laws and rules, we offer incentives through the Oregon Plan for Salmon and Watersheds, created in 1997 during my first term as governor. This voluntary program advances public and private collaboration to identify and fix habitat problems. Oregonians ratified the spirit of the Oregon Plan in 2010, when they resoundingly passed Ballot Measure 76, constitutionally dedicating 15 percent of net Oregon Lottery dollars to state parks and to the restoration and protection of native salmonids, watersheds, fish and wildlife habitats, and water quality.

Oregon's tiered approach to habitat conservation, while unique, may not be perfect. However, it is a good reflection of the people of this state: adaptive, responsive, inclusive, innovative – and committed to protecting our rich natural resources, for Oregonians and fish alike.

That, I believe, is what is meant by "The Oregon Way."

LAND USE PLANNING:

Why it's important to keep working forests working

Streams with good or excellent water quality

On all Oregon forestland:

91%

On private industrial forests:

87%

The water quality index incorporates measures of temperature, nutrients, oxygen, pH and sediment.

Photo: Kelly James

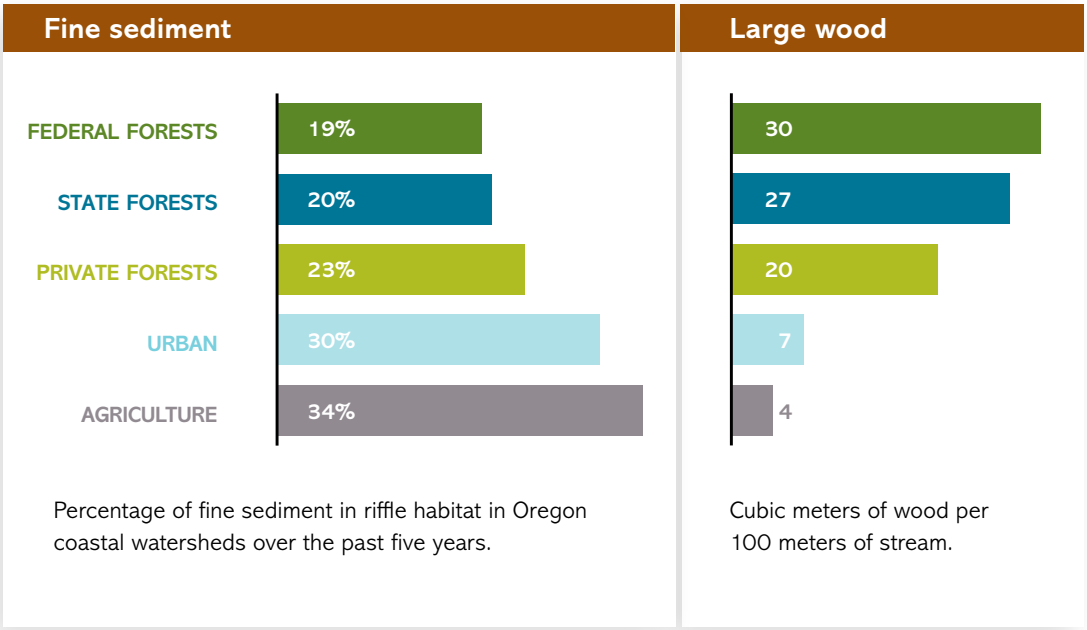
Source: "High Level Indicators of Oregon's Forested Streams," Oregon Department of Environmental Quality, 2009.

The first step in keeping fish populations vibrant is to ensure that forestland remains forestland. The watersheds in Oregon's forests are better places for fish – especially troubled species such as coho salmon – than waterways in farmland, cities or rural housing developments.

"There's no question that the better water quality is in upland forested areas," says Dick Pedersen, director of the Oregon Department of Environmental Quality.

While many experts agree that aquatic habitat in all land types still needs improvement, forest streams on the whole have cooler water and less sediment. They also have more logs in the streams, essential to creating the kind of complex habitat fish prefer.

Egg survival rates are best when fine sediment levels in undisturbed gravel fall in a range of 15 to 25 percent and less. The presence of large pieces of wood in streams creates complex habitat, which is beneficial for fish.



Percentage of fine sediment in riffle habitat in Oregon coastal watersheds over the past five years.

Cubic meters of wood per 100 meters of stream.

Source: Oregon Department of Fish and Wildlife, Kim Jones, Aquatic Inventories Program Leader

LITTLE FOREST LOSS IN OREGON

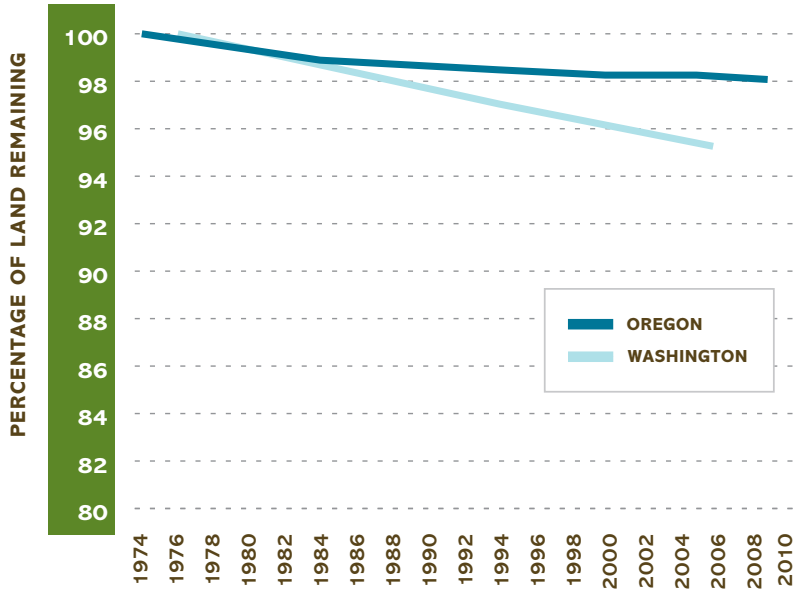
So, it makes sense to prevent the loss of forestland to development.

You hear astounding figures about global deforestation: In 2010, the United Nations estimated 30 million acres of forest around the world is lost annually, mostly to agriculture or other development.

Yet Oregon has lost little over the past few decades. That's due primarily to the state's Land Conservation and Development Act, passed in 1973.

The 10.5 million acres of sparsely populated non-federal forest in Oregon has decreased only 2 percent since 1974. And most of that loss occurred in the 1970s and '80s, before the law took full effect. Washington state has more lenient laws, and its loss of forestland has been twice as great, according to "Land Use Change on Non-Federal Land in Oregon and Washington," a 2013 study coordinated by Gary Lettman, retired principal forest economist at the Oregon Department of Forestry. Most of the lost forestland went to residential development.

Forest loss: Oregon vs. Washington



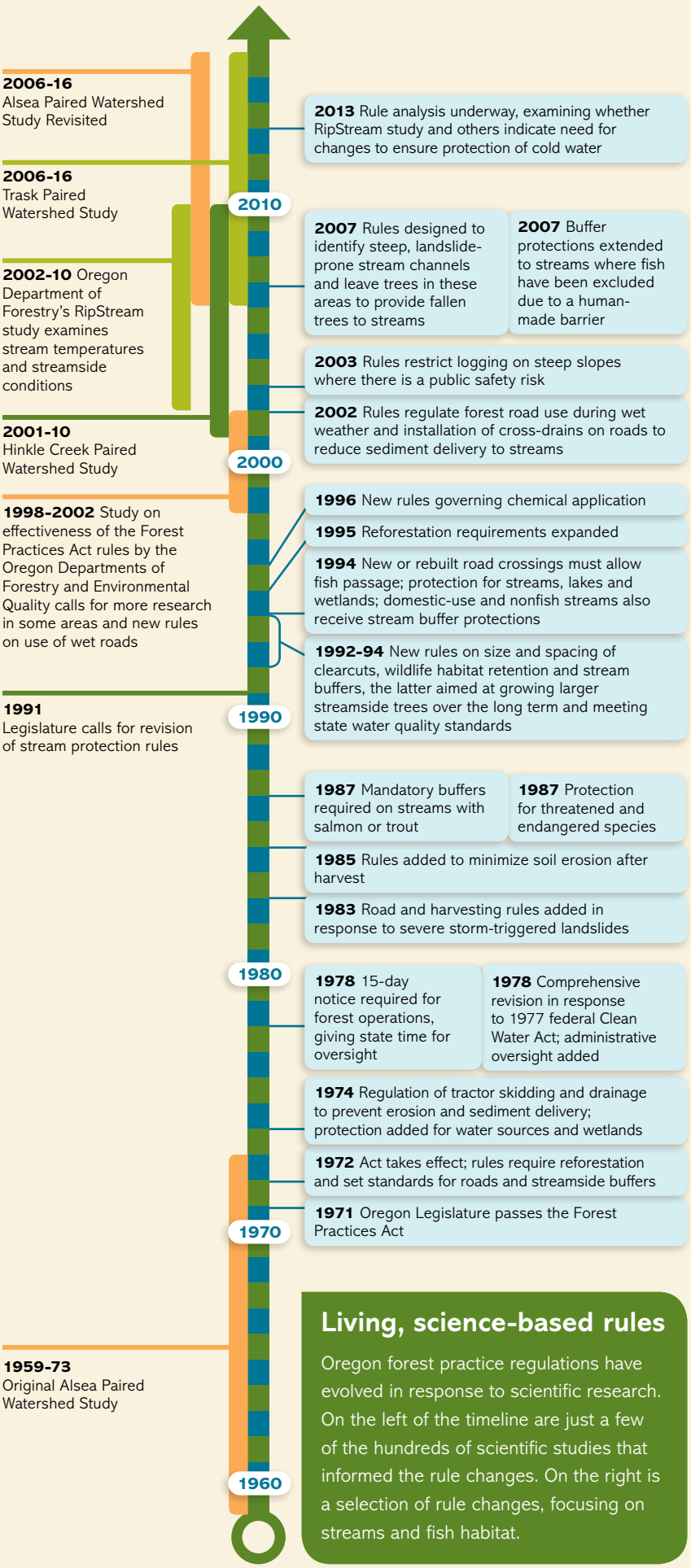
Populated areas are tough places for creeks, such as Amazon Creek in Eugene. "The water quality and habitat the creek once provided … have been greatly diminished [by] high water temperature and low dissolved oxygen in summer and high E. coli, turbidity and nutrient levels," according to the Long Tom Watershed Council. Likewise, a 2002-10 study of the heavily forested McKenzie River Basin* reported that the most common source of pesticide detections in the river were urban stormwater drains.

Most Oregonians today still support the values behind Oregon's 1970s-era land use law, according to the statewide 2013 Oregon Values & Beliefs Survey done by DHM Research and Policy Interactive Research:

66% say population growth should be directed to existing cities and towns.

26% say development should be allowed outside urban growth boundaries.

*Source: "Reconnaissance of Land-Use Sources of Pesticides in Drinking Water, McKenzie River Basin, Oregon," published in 2012.



STRONG

Evolving laws protect water and habitat

In 1957, the Oregon Legislature appropriated $50,000 to begin a long-term scientific study into how logging practices of the day were affecting streams and fish. So began the Alsea Paired Watershed Study in Oregon's Coast Range. It lasted 14 years and helped lay the foundation for today's forest practices in Oregon.

Not only did the study analyze changes evident after a typical 1960s clearcut, but it also tested practices that were innovative at the time: leaving forests intact along streams, limiting clearcut size and not dragging logs through streambeds.

The study informed a debate that led to the Legislature adopting the Oregon Forest Practices Act in 1971. The act and associated rules govern private forest management in Oregon, including road building, harvest, planting and protection of natural resources. Since its initial passage, the rules, overseen by the state Board of Forestry, have been significantly revised nearly 30 times as science has improved understanding of the ecosystem – and pointed the way to better forest practices.

TIMBER HARVEST TODAY

The way timber is harvested today is far different than it was two or three decades ago. This is not only because of forest practice rules but also because of technological advances that have helped loggers operate with a lighter footprint.

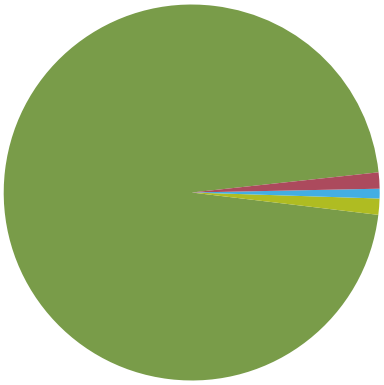
LAWS:

SKYLINE LOGGING
Cables lift trees to a landing during harvest as part of the Trask Paired Watershed Study.

Photo: Kelly James

- Skyline logging, used in many harvests, employs cables to carry felled trees through the air to an area away from streams, where they are processed. This reduces the potential of sediment runoff, because logs are not dragged on the ground, and because fewer roads are required.
- To reduce sediment being carried from roads to streams, rules require that stormwater draining from roads cannot be channeled into streams as it once was, but rather must be diverted onto the forest floor, which acts as a filter.
- Where roads cross streams, it is standard practice to install bridges or large culverts that mimic natural stream bottoms to allow fish to move up- and downstream.
- Buffers of trees must be left alongside fish-bearing streams. This ensures there will be trees that one day fall into the stream, improving habitat. They also provide shade that helps keep water cool.
- Rules limit herbicide spraying over and near fish-bearing streams. The width of the buffered area depends on the type of chemical, and is a minimum of 60 feet if applied by air or 10 feet if applied from the ground.
- Replanting is required within the first two planting seasons after harvest.

Compliance with Oregon water and stream rules



INSTANCES OF RULES BEING APPLIED

13,004	Successfully complied with
185	Documentation or process violations
147	Violations that had potential impact on streams or water
170	Violations that had direct impact on streams or water
13,506	TOTAL

COMPLIANCE IS HIGH

"We expect that we'll have good compliance because of our proactive approach," says Peter Daugherty, who heads the Oregon Department of Forestry's Private Forest Division. "If we have to take enforcement action, we've had a failure in our partnership. We'd rather help them be successful the first time around."

A 2002 audit tallied the number of times Forest Practices Act stream and water rules applied at nearly 200 forest operations in Oregon. Operators complied in more than 96 percent of the instances.

Oregon Department of Forestry, Best Management Practices Compliance Monitoring Project, 2002. Following recent legislative funding, ODF began conducting annual compliance audits, with the first results expected in 2014.

Photo: Kelly James

Photo: David Leer

Photo: David Leer

RESEARCH:
How science drives rule-making in Oregon

In the 40 years since the original Alsea Paired Watershed study ended in 1973, hundreds of scientific studies have identified various ways forest management can affect fish habitat and water quality.

Among these are three new paired watershed studies run cooperatively by Oregon State University, state agencies and industry. These are testing the effectiveness of today's rules for protecting water quality and fish habitat.

In a typical paired watershed study, two adjacent or nearby watersheds are monitored for a number of years. At one or more points during the study, one of the basins undergoes logging and the other does not. Scientists can then observe changes both before and after the logging and between the two basins – and thereby assess the effect of the timber harvest.

SO WHAT ARE THEY FINDING?

OSU associate professor Arne Skaugset leads the Watersheds Research Cooperative, which oversees the three studies.

The recently concluded Hinkle Creek study showed that the effects, while detectable, were subtle and similar in magnitude to the range of natural variability, Skaugset says. There were some effects that were outside the natural range of variation, compared to the control watershed, but these were far smaller than what was measured in the original Alsea watershed study in the 1960s.

George Ice, a scientist who was drawn to Oregon State University in the 1970s for his Ph.D. work, spent decades studying forestry and streams and was forest watershed program manager for the National Council for Air and Stream Improvement before retiring in 2012.

He says of current forest practices: "We have dramatically reduced the impact. The rules aren't perfect, but they have made the effects very small."

Doug Bateman is one of the lead researchers looking at fish response to logging in the watershed studies.

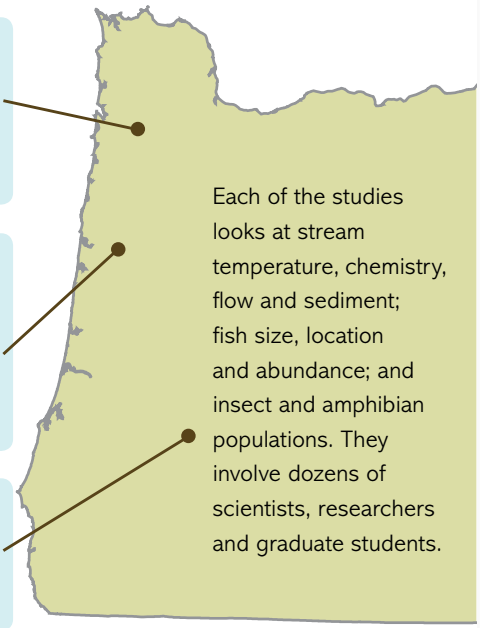
"At Alsea, the current rules have resulted in a very different response from what was

What and where

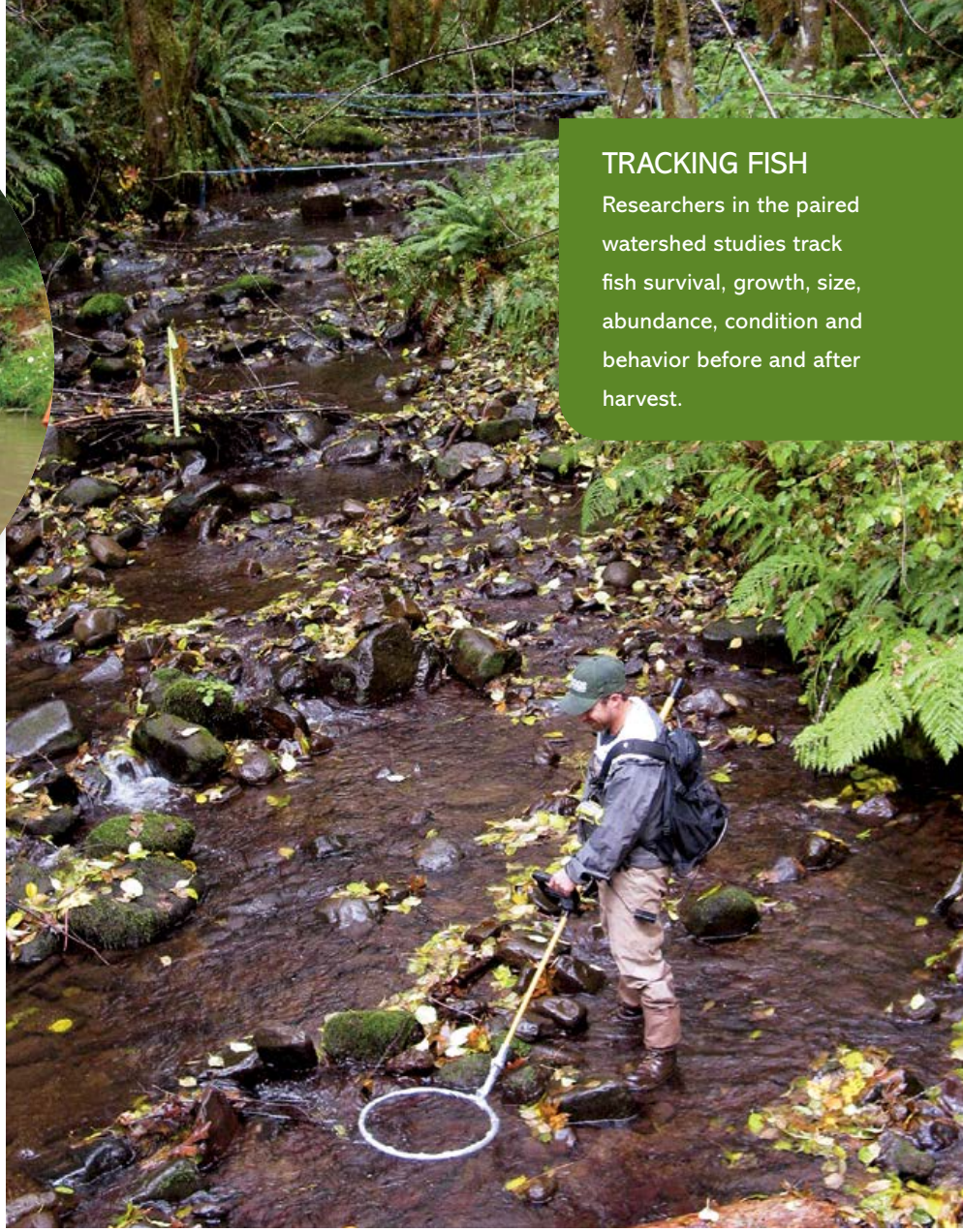
2006-16 Trask Paired Watershed Study: Includes private, state and federal land and looks at the effects of harvest under today's varying practices for each landowner.

2006-16 Alsea Paired Watershed Study Revisited: Makes a general comparison of effects of today's practices with findings from the original 1960s Alsea study.

2001-10 Hinkle Creek Paired Watershed Study: Examines the effects of today's practices, as outlined by the Forest Practices Act.



Each of the studies looks at stream temperature, chemistry, flow and sediment; fish size, location and abundance; and insect and amphibian populations. They involve dozens of scientists, researchers and graduate students.



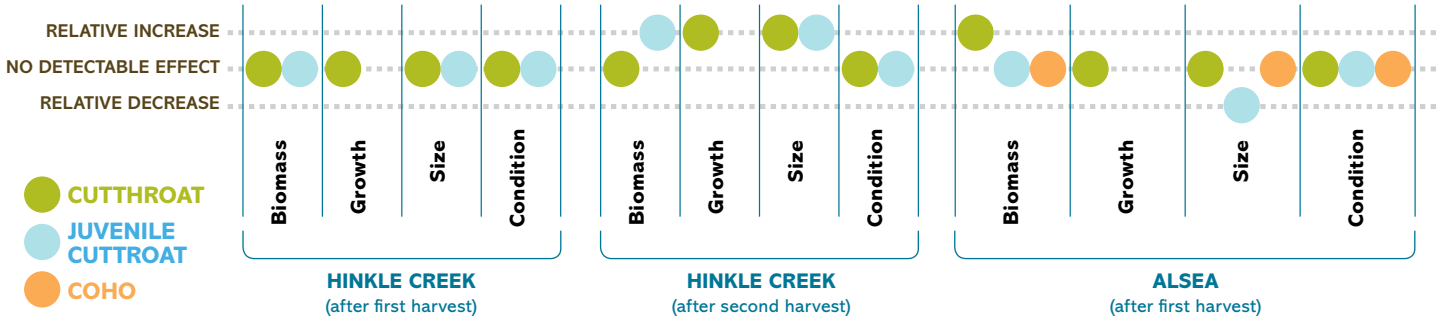
TRACKING FISH

Researchers in the paired watershed studies track fish survival, growth, size, abundance, condition and behavior before and after harvest.

seen during the original study in the '60s, which is encouraging," he says. "The fact that we've not observed short-term negative effects on fish or habitat at Hinkle Creek or Alsea suggests we have time to consider what the next set of changes in forest practice rules should be."

Looking ahead, and noting that effects vary from location to location, Bateman says, "We need to understand how to reliably distinguish which watersheds are more at risk and which are not."

Fish response to logging



The chart shows how fish responded to logging in the Hinkle Creek and Alsea watershed studies, according to data collected by Bateman's team. For a discussion of why fish are often bigger and more abundant after harvest, see page 10. Why juvenile cutthroat in Alsea were smaller isn't clear, but Bateman speculates it may be that the increased population of older fish created more competition for food.

TRADEOFFS:
The effects of shade and sunlight

STREAM BUFFERS
Trees remain alongside a stream after a harvest in the Trask study area.

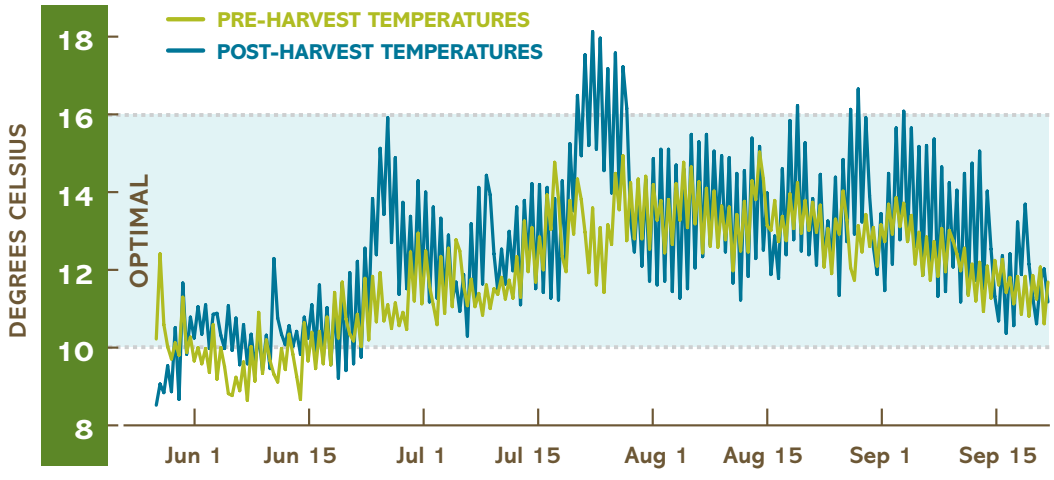
Photo: Kelly James

Forest streams are usually well shaded by the canopy. So what happens if you reduce the shade by harvesting timber?

The research shows that this is a risk-reward proposition. On one hand, it can lead to increased stream temperatures, and water that is too warm can harm fish or drive them away. On the other hand, more sunlight can boost food production and help fish feed more efficiently. This leads to more and larger fish. Can the latter benefits be realized without the adverse effects of temperature increases?

Steve Cramer, founder of the consulting firm Cramer Fish Sciences and formerly with the Oregon Department of Fish and Wildlife, has invested most of his 40-year career in researching how fish respond to human uses of natural resources. In 2013, his firm completed a review of studies evaluating the effects of current forest practices on streams in the Pacific Coast region.

Variability in stream temperatures before and after harvest



The graph shows daily stream temperatures at RipStream site 5556 pre-harvest (green line) and post-harvest (blue line). This site had one of the highest peak temperatures among the 33 harvest units monitored during the study period, 2002-10. The water temperature went out of the optimal range for parts of 10 days during the summer.

His review concludes, "The RipStream and paired watershed studies in Oregon, as well as logging studies in British Columbia, Washington and northern California, consistently show that today's riparian protection rules have achieved a balance that is beneficial to fish within the logged area, and have little effect on fish more than 300 meters downstream."

Studies in Oregon and Washington show that today's logging practices preserve 70 to 80 percent of the shade over streams. Those streams receive an average of 10 percent more sunlight after logging. In most cases, this has led to more insects, increased growth of fish and increased numbers of fish.

In Cramer's opinion, "Gains for fish due to post-logging increases in sunlight substantially outweigh the challenges of increased temperatures during the warmest days of the year." A key reason, Cramer says, is that, "following logging, temperatures for nearly the entire summer remain within the 10- to 16-degree C optimal range for salmon and trout."

RIPSTREAM: A CASE STUDY IN OREGON'S FOREST PRACTICE RULE-MAKING PROCESS

An example of how science drives rule changes in Oregon is the Board of Forestry's ongoing deliberation over the Private Forests Riparian Function and Stream Temperature monitoring project, known as the "RipStream" study. Conducted by the Oregon Department of Forestry, it looked at stream temperature and other riparian conditions at 33 sites on state and private timberland, from 2002 to 2010.

It found that water usually stayed cold enough after harvest to be within a range considered optimal for fish – 10 to 16 degrees Celsius. However, it also found that on private land the average increase in stream temperature after harvest, 0.7 degrees C, exceeded the Oregon Department of Environmental Quality's standard that any human activity shouldn't warm water more than 0.3 degrees C. In comparison, Oregon's state-owned forestlands, which are administered under different management practices, experienced no change in maximum temperature, on average, after harvest.

One goal of DEQ's standard is ensuring adequately cold water downstream, where water temperatures can rise to thresholds that stress and injure fish.

The Oregon Forest Practices Act requires forest practice rules to meet DEQ's water quality standards. It also directs the board to assess economic impacts of any potential rule change and to consider alternative, nonregulatory measures that could achieve the intended results with the least economic burden. And in both determining that a problem exists and developing proposed rule changes, the law obligates the board to use the best science and information available.

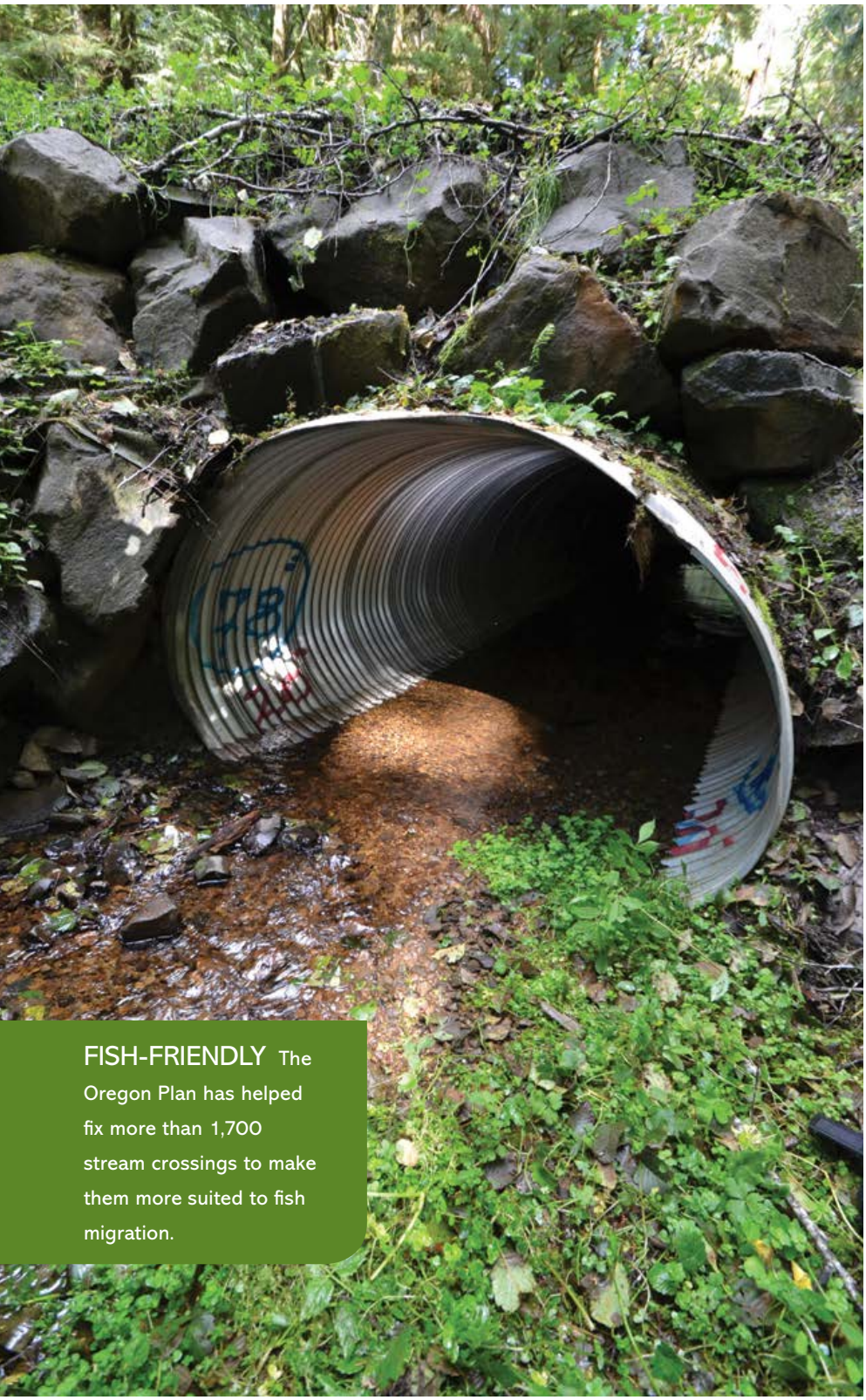
The Board of Forestry has been working on these questions for a couple of years, and is expected to decide in 2014 what, if any, rule changes are necessary to meet the temperature standard on fish-bearing streams. This process – scientific study followed by state agency recommendations followed by citizen board action – is an Oregon hallmark, not just for forestry, but for agriculture, fishing and hunting, and the environment.

Aftermath of 2012 Pole Creek Fire, Deschutes National Forest.
Photos: Mike Riehle, US Forest Service

Wildfire can have major effects on aquatic habitat. It may burn away the forest canopy, allowing stream temperatures to increase. It also removes plants and other organic matter covering the soil, increasing erosion and sediment flow into streams in the short term.

THE OREGON PLAN:

Encouraging voluntary efforts to improve habitat



FISH-FRIENDLY The Oregon Plan has helped fix more than 1,700 stream crossings to make them more suited to fish migration.

Besides laws and rules, Oregon relies on voluntary local efforts to restore and improve fish habitat. It's using the carrot, as opposed to the stick.

On forestland, two major habitat concerns have been culverts at road crossings that prevented fish from swimming up- or downstream, and a lack of large logs in streams, which create complex habitat preferred by fish.

Both concerns were a legacy of earlier days, before improved stream crossings and streamside buffers of trees became routine. Then also, scientists once thought that streams free of logs and large wood were ideal for fish swimming upstream, so state-required "stream-cleaning" took from streams the very structure needed for good fish habitat.

In the early to mid-1990s, when the federal government was moving toward listing coho salmon under the Endangered Species Act, Oregon Gov. John Kitzhaber began forging an alternative plan – one that would prevent the listing and keep local communities involved in decisions about their watersheds.

The idea became the Oregon Plan for Salmon and Watersheds in 1997. It was designed to encourage watershed councils and private landowners to work with the

state to identify and fix habitat problems that sometimes cross property lines. The state would award grants to help pay for worthy projects, and landowners would also contribute – usually by providing access, expertise, labor, equipment and materials.

The federal government listed the coho as endangered in 1998 anyway, but the Oregon Plan continued. In 2010, voters passed Measure 76, which gave the Oregon Plan a more stable source of funding from sales of lottery products and salmon license plates.

"Many of the early adopters of the Oregon Plan were industrial forestland owners," says Renee Davis-Born, senior policy coordinator for the Oregon Watershed Enhancement Board, which administers the plan. They used the program to work on the two major concerns, as well as other road improvements.

OWEB Executive Director Tom Byler says the Oregon Plan "probably wouldn't exist today without private forestland owners' cooperation and leadership."

From the plan's beginning in 1997, private forestland owners have contributed more than $96 million to such projects through 2011, according to OWEB. Much good work has been done. Citizens, state agencies and forestland owners continue their work to identify and improve problem areas.

BY THE NUMBERS

Accomplishments of the Oregon Plan on private forestlands:

Road miles surveyed	**16,458**
Road miles improved	**3,289**
Road miles vacated, closed or relocated	**550**
Number of peak flow improvements (increase culvert or bridge size to accommodate high flows)	**7,981**
Number of surface drainage improvements	**18,505**
Number of stream crossings improved for fish passage	**1,749**
Number of large wood placement projects	**569**
Number of other in-stream projects (boulder placement, side channels and alcoves)	**168**
Number of conifer restoration projects	**65**
Number of riparian management projects (voluntary tree retention)	**2,651**

Hancock Forest Management engineer Seth Sanders and Salmon Drift Creek Watershed Council Executive Director Catherine Pruett discuss the installation of a new culvert on a tributary of Schooner Creek on Hancock land near Lincoln City. It replaced a small, obsolete culvert that prevented fish from moving farther upstream. The project opened up about a quarter-mile of new fish habitat. The watershed council paid for the new culvert and other materials with an OWEB grant. Hancock supplied Sanders' time to engineer the installation, as well as the heavy equipment and labor to install it.

THE FUTURE:
What's next for forests and fish?

For now, the Oregon coho remains on the federal threatened species list. Yet Kim Jones, who leads the Aquatics Inventories Program for the Oregon Department of Fish and Wildlife, has hope.

"We don't feel we're in the endangered/threatened status anymore, despite the federal listing," he says. "But the numbers aren't where we want to see them."

"The increasing trend in coho abundance, though cyclic, reflects changes in ocean conditions, harvest management, hatchery reforms, and habitat protection and restoration," he says.

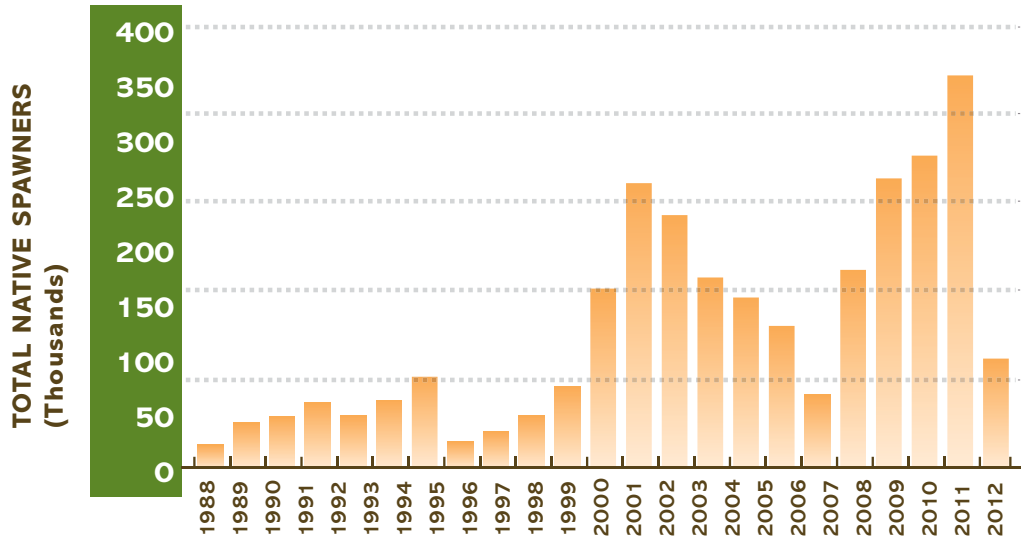
Jones adds, "The question isn't the current status. It's how you manage fish and habitat to reach your goals."

For coho, many of the variables, such as cyclical ocean conditions and survival, are out of the realm of the forest. But Jones says the primary challenge now for forestland – for trout and steelhead, as well as salmon – is a continued effort to create more complex habitat in streams. Both the voluntary Oregon Plan and the 1994 change to the forest practice buffer rules are designed to make cumulative improvements over time.

Photo: Oregon Department of Forestry

RIGHT DIRECTION
Oregon coastal coho spawning numbers have been generally trending upward.

Spawning coho salmon in Oregon's coastal watersheds



Where do we go from here? Some suggestions:

CONTINUE TO PROMOTE PUBLIC-PRIVATE COLLABORATION. Plum Creek Timber Co. hydrologist Jeff Light says one of Oregon's advantages with regard to aquatic habitat in the forest is the cooperation between landowners and state agencies such as the Oregon Department of Forestry. "The partnerships we have between agencies and landowners are something Oregon does very well," he says. "And that's what makes it safe for industry to support and help pay for scientific research and be confident that it's going to be used in a constructive way. We're all pulling in the same direction, and that's something to be encouraged."

MAINTAIN THE ECONOMIC INCENTIVE. While Oregon's land use laws have successfully slowed the loss of forestland over the past few decades, the economic pressure to sell forestland for housing development will remain, says retired ODF economist Gary Lettman – especially when family forestland is inherited by a new generation that may not be interested in managing a woodlot. "To keep forestland in forest uses, it has to pay for itself."

INCENTIVIZE LANDOWNERS TO PROTECT ECOLOGICAL VALUES. OWEB director Tom Byler sees a future where landowners have more incentives to emphasize the ecological values of their land. "In a manner, we're paying for these 'conservation values' now as grants to restore stream habitat or fix a road," he says. "But we want to get better at test-driving some new ideas that might reach more landowners."

REGULATORY FLEXIBILITY. Timberland owners envision forest practice rules that are more capable of being tailored to specific sites. "We're getting better at finding those specific places where you might have an impact," says Chris Jarmer of the Oregon Forest Industries Council. If foresters can mitigate the impact on such a spot by, say, leaving a wider buffer, would they be able to leave a narrower buffer in a less sensitive area? "That's the kind of thinking we'd like to evolve to."

LONG-TERM RESEARCH. Scientist and WRC leader Arne Skaugset sees the need for a very long-term project – longer than the 10-year paired watershed studies – to monitor the kinds of intensively managed private timberlands that supply most of the commercial timber in Oregon today.

DISTURBANCE-BASED MANAGEMENT. Joshua Seeds, an analyst with the Oregon DEQ, suggests that landowners and managers adopt this approach to forestry, which emulates aspects of natural disturbance processes. For example, "Managing for longer or uneven-aged rotations, maintaining hardwoods in riparian zones and uplands, and increasing the number and species of trees left across harvest units all might be used to reduce ecological risk and broaden landowners' management options," he says.

Photo: Watersheds Research Cooperative

Photo: Kelly James


Photo: David Leer

Photo: Oregon Department of Forestry

TO LEARN MORE

Oregon Watershed Enhancement Board: **Oregon.gov/OWEB**

Watersheds Research Cooperative: **WatershedsResearch.org**

Oregon Department of Forestry: **Oregon.gov/ODF**

Oregon Department of Fish and Wildlife: **dfw.state.or.us**

Oregon Department of Environmental Quality: **Oregon.gov/DEQ**

Oregon Forest Resources Institute: **OregonForests.org**

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ABOUT OFRI

The Oregon Forest Resources Institute was created by the Oregon Legislature in 1991 to advance public understanding of forests, forest products and forest management and to encourage sound forestry through landowner education. A 13-member board of directors governs OFRI. It is funded by a dedicated forest products harvest tax.

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