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Forest Practices and Salmon: What's the Connection?

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The connection between forest practices and wild salmon declines is complicated.

Timber crisis. Declining wild salmon stocks. Watershed management. All of these issues seem to be in the headlines in Oregon more and more these days. Sometimes they even appear in the same sentence. What's the connection?

It's clear that Oregonians are concerned about salmon, forests, and quality of life. We know that forest ecosystems are complex. Scientists are finding that our knowledge of biological processes and their interactions within forest ecosystems is incomplete, and that we actually know little about the cumulative effect of a wide range of pressures on the ecosystem (Maser et al., 1988).

The connection between forest practices and wild salmon declines is complicated and not completely clear. And yet we need to make decisions about forests and fisheries—and to do that, we need good information. The debate is fierce. Although research at the ecosystem level is occurring as you read this, it's hard for those of us who aren't forest or fish biologists to gain a better understanding of what's going on. This paper briefly provides perspectives from research available about this complicated issue.

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OREGON STATE UNIVERSITY EXTENSION SERVICE

Fish Health Depends on Healthy Watersheds

"Watersheds have been around as long as land and water," writes Paul Adams, OSU forest watershed specialist, "but these days they sure seem to be getting a lot of attention. From the Clinton Administration's Forest Plan to recent local and state debates about forest practices, watersheds are a prominent feature" (Adams, 1993b).

Watersheds are areas of land that collect rain and snow and discharge much of it to a stream, river, or other body of water. They range in size from the area drained by a mile-long creek to the entire Columbia basin. Scientists are beginning to move from narrow studies involving specific areas, or particular biological or geographic features, to a research approach focusing on an entire watershed as a unified system. Even so, knowledge of watershed ecosystems is never complete. But we do know that watersheds must be in good shape for fish to thrive.

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Some of the most important and productive freshwater habitat for many species of salmon are small streams associated with mature coniferous forests. These streams are physically and biologically complex, full of dead logs and limbs—what scientists call "large woody debris." This debris is an important component of healthy fish habitat. In western Oregon, most of the fish-bearing waterways are small streams averaging less than 10 feet in width. Trees hanging over the streams help keep waters cool, and falling tree litter provides nutrients to the stream (Sedell et al., 1988).

Wood-rich environments also offer more productive and diverse habitat for juvenile anadromous fish (Maser et al., 1988). Anadromous fishes are those that begin their lives in the rivers, migrate to the sea and live out their adult lives there, and return to rivers to spawn. Salmon, steelhead, and some other species of trout are anadromous fishes. The density of trees growing alongside streams and the amount of large woody debris in the stream are critical factors in habitat for these fishes (Table 1, page 3).

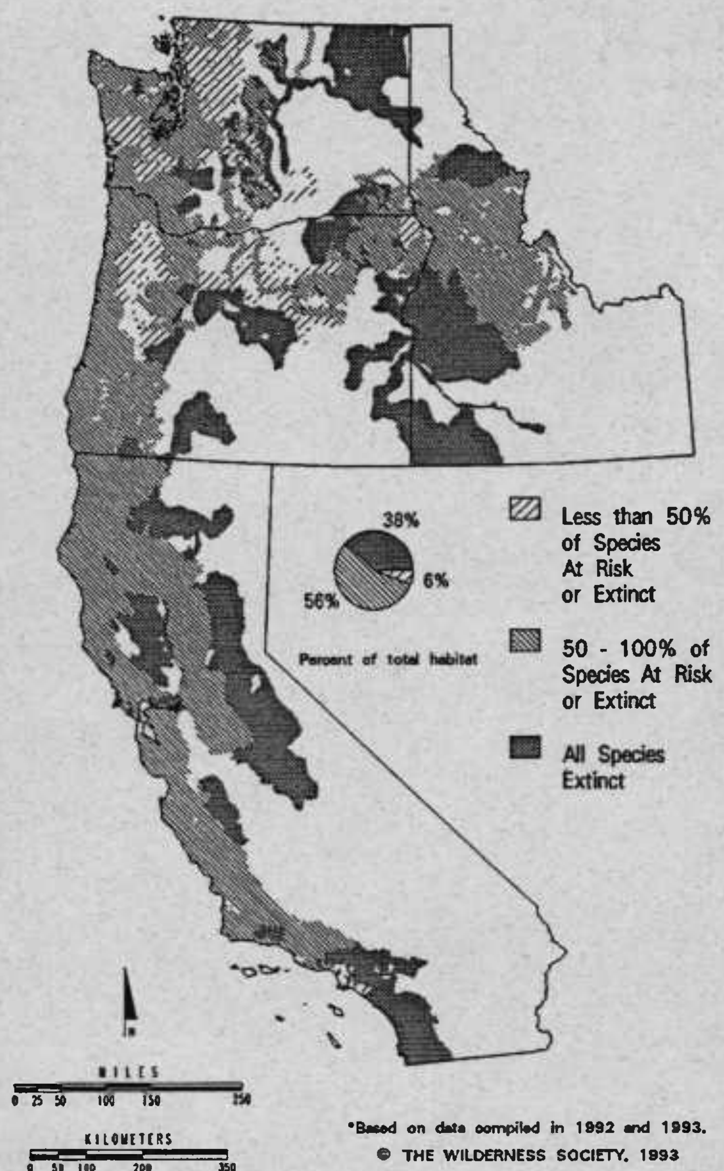
Almost everyone agrees that salmon populations have declined. Figure 1 (page 3) displays the areas of at-risk or extinct salmon in the Pacific Northwest and California.

Most people (including scientists) believe that many factors affect the decline of salmon populations. Changing ocean conditions, dams, agricultural practices, timber and salmon harvest techniques and levels, pollution, predators, loss of habitat, hatchery practices, etc., all have played a role.

Table 1.—*Juvenile chinook and coho salmon densities from different woody habitat types (in the main channels of the Chickamin River, southeast Alaska, March–April 1984) (Maser et al., 1988)*

Woody Habitat Type	Number of Sample Sites	Average Number of Salmon	
		Chinook	Coho
No woody habitat, slack water along edges	3	5	8
Rootwads without boles, stumps	12	56	50
Single downed trees, rootwads and stems	14	87	90
Log jam, several downed trees	7	292	195

Figure 1.—*Areas of At-Risk or Extinct Salmon in the Pacific Northwest and California*



Dams built for hydroelectric power and flood control block the migration of anadromous fish. Dredging for navigation destroyed habitat. Certain mining, forestry, and agricultural practices can lead to increases in water temperature, erosion, too much silt in the water, loss of protective cover, and changes in streamflow.

Early Logging Practices Harmed Fish Habitat

In logging's early days, riparian and nearby upslope areas (the land closest to the streams) were harvested first because of good timber stands, ease of access, and the use of streams to transport logs. As a result, fish habitat along lower mainstem coastal rivers was greatly altered or simplified. Streambanks were stripped of trees, and logs and machinery were dragged through streams. Skid roads, chutes, and flumes were used to transport inland trees or lumber to streams and rivers for subsequent water transport. Streams were cleared of obstructions, and side channels and flood plain wetlands were blocked off to consolidate flow in a single channel. When more than 15 or 20 percent of a watershed was clearcut, streamflow typically increased. All of these things generally impaired fish habitat diversity (Sedell and Luchessa, 1982).

Splash dams (log crib structures that impounded water in the streams) also were built on small streams. Logs were dumped into the created pond and into the stream channel below the splash dam. Once the impoundment was full of logs and water, the dam was released and the water carried the logs downstream in a resulting splash torrent (Sedell et al., 1991). Splash dams blocked upstream access, scoured and widened channels, blocked off secondary channels and fish habitat, and created large amounts of sediment (sedimentation), resulting in significant loss of salmon habitat.

Decreases in large woody debris followed removal of streamside trees. Where logging removed vegetation that had been shading streams, water temperatures likely increased. Sedimentation also occurred where there was erosion and sediment delivery from logged areas or roads. Logging also altered the composition of riparian vegetation (the type and amount of trees and plants growing alongside the stream). Debris from young-growth stands typically has a shorter time in stream channels (Sedell et al., 1988). This could be a problem for decades in second-growth forests (Kaczynski and Palmisano, 1993).

Rivers downstream also were modified for log drives and log rafting. Dredging widened and deepened rivers. The effects of these stream impacts are evident today.

In the 1960s, many fish biologists believed that woody debris in streams was a barrier to fish migration. Accordingly, after the 1964–1965 floods, land management agencies joined forces with fisheries agencies to vigorously remove woody debris from streams (Froehlich, 1971). Although well-intentioned, this removal of large and small woody debris from many miles of streams resulted in widespread loss of stream habitat. During the mid-1970s, some biologists were beginning to question the woody debris removal policy. Today, woody debris is not only left in streams, but sometimes is deliberately put into streams that are deficient in woody debris to enhance fish habitat.

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Today's Forest Practices

Current forest practices are regulated by the Oregon Forest Practices Act, passed in 1972. The purpose of the Act is to minimize the harmful effects of logging on water resources. For example, buffer strips must be left on fish-bearing streams, roads must be engineered and built more carefully, and sizes of clearcuts are limited.

By 1978, requirements for road locations, stream crossings, construction, and maintenance had been significantly strengthened to help prevent road and slope failures and landslides, the major source of stream sediments from the forests. The use of herbicides was restricted, and skidding and yarding of logs across streams was banned. Additional rules were adopted through the 1980s to limit road construction in high-risk landslide areas.

Riparian areas have their own management requirements. In 1987, the state forest practices regulations were revised to require leaving large woody debris in streams and conifers in the riparian zone. By 1991, additional forest practices legislation was passed and a review of stream protection measures was begun.

Because of these laws and regulations, logging generally is more benign than it once was. Rules adopted in 1994 provide for even greater stream protection. Rules, standards, and guidelines provide a framework for significant water quality and stream protection. Implementation has not always met the full intent of the protection rules and guidelines; however, most private landowners and forest operators generally do a good job of complying. Of the 19,304 notifications received in 1990, only 185 violations occurred involving 116 operations (Oregon Department of Forestry, 1993).

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Table 2 (page 6) provides a quick reference for the evolution of the Oregon Forest Practices Act.

Can Logging and Salmon Coexist?

There has been much public and professional debate on the relationship between streams, salmon, and the forest. In discussions on the effects of logging, many people focus on three key water resource features: streamflow, water quality, and fish habitat. But what does this mean to the salmon?

Forest practices—including timber harvesting, logging residue treatment, reforestation, and road building—can damage fish habitat directly and through "nonpoint" sources of pollution that affect water quality (O'Laughlin, 1992). The effects of timber harvesting on streamflows can range from none to a decrease or an increase. Water temperature, cloudiness, and chemistry also can be affected. Water chemistry can be altered if nutrients and other chemicals are leached from slash and soils after timber harvesting (Adams, 1993a).

When logging removes the streamside cover, water temperatures may increase and result in reduced growth efficiency of the salmon. Other results may be an increase in vulnerability to predation, less spawning ground, and reduced

Table 2.—*A brief glimpse at the development of forest practice laws and regulations in Oregon*

Date	What was Happening with Oregon's Forest Practices Act
1972	The 1971 Forest Practices Act went into effect. Forest practice rules began to protect streams and riparian zones of streams. A brushy buffer zone was achieved for state Class I streams, and timber harvest practices were modified to reduce equipment and yarding impacts on streamside vegetation and stream banks. By 1974, some large woody debris was being left in streams.
1978	Standards for road locations, stream crossings, construction, and maintenance had significantly been strengthened to help prevent road and slope failures and landslides. Skidding and yarding of logs across streams was forbidden and chemical applications were restricted.
1983	Rules were revised again to strengthen road construction and planning. Restrictions were added to avoid road construction in high-risk landslide areas. Rules formally evolved through the Forest Practices Forester's Handbook through 1986. Prior to 1987, state statutes indicated that streambeds and streamside vegetation were to be in a near natural condition to minimize damage to water quality and aquatic habitat, and to provide for 75% of pre-operation shade cover. Stream cleaning of small- to medium-sized logging debris was required.
1987	State statutes were revised. Rules were modified for state Class I streams to leave large woody debris in streams and in the riparian zone. Formal riparian management areas (RMA) were created for Class I streams. RMAs were three times the average stream width on each side of the stream, and not less than 25 feet nor more than 100 feet. The 75% post-operation shading rule was retained. A 50% canopy rule was added for the riparian zone. Conifers were to be left in 1/2 of the RMA closest to the stream. For Class II streams, protection measures included a vegetation filter buffer strip for water quality protection, stream crossing and road construction rules, bank protection rules, and directional falling and yarding restrictions, and other measures that the forest officer might impose.
1991	SB 1120 mandated broad changes in forest practice rules, including expanded stream classifications and retention of trees for wildlife habitat and scenic purposes. The Board of Forestry began drafting a new stream classification and protection system. Some Class II streams received additional interim protection. Clearcuts were limited to a maximum of 120 acres with restrictions to adjacent clearcuts. Reforestation rules were strengthened.
1994	Board of Forestry adopted new rules on water classification and protection. Rules focus on maintaining live trees and vegetation along streams and other waters, recruitment of woody debris to provide stream structure resulting in fish habitat, and maintaining adequate fish passage up and down the length of a stream; and create nine different stream and water classifications.

food production. Loss of cover in streams in young-growth forests has the most significant impact on salmonid populations in the winter (Sedell et al., 1988). However, responses may be complex. Some other research has shown increased fish production where streamside logging has increased primary productivity and food availability (Adams et al., 1988).

When timber harvest is from hillslopes, accelerated mass erosion can increase the frequency of debris torrents, cause loss of instream cover and block migration, and reduce winter hiding space and spawning success (Hicks et al., 1991). Logging roads can increase stream sediment loads (Kaczynski and Palmisano, 1993). Landslides associated with roads—especially older roads—have been a major source of stream

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sediments in forests. Debris jams and debris torrents can cause barriers to migration. Road crossings and improperly placed culverts can create physical barriers to adult upstream migration (Hicks et al., 1991).

Pesticide run-off associated with agriculture is a commonly voiced concern related to the decline in salmon populations. Pesticide use in the forest also may have local water quality impacts, but forest use of pesticides accounts for less than 1 percent of the total pesticide use in the U.S. The USDA Forest Service has not used herbicides on its Pacific Northwest lands since 1984 (Norris et al., 1991).

Oregon's watersheds will never again exist in a pristine state. Human use of all kinds has changed them and will continue to change them. There's more work to be done to better define the complex cause-and-effect links between timber harvesting and other influences on salmon and other aquatic resources. Logging effects can be neutral, negative, positive, or in some combination depending on the situation (Adams, 1993b).

Biological processes and their interactions within forest ecosystems need continued study. Streamside protection measures need to be evaluated, both for their economic and biological effects, to monitor how well they protect the water, land, trees, and fish. Advancing technology has improved our ability to detect environmental changes from land use practices. Measurable changes may not necessarily result in resource problems (Adams, 1993b).

Although it is generally accepted that environmental conditions of the habitat site affect fish production, and that improvement in habitat will have favorable effects on resident as well as anadromous fish (Eisgruber, 1992), controversy will continue regarding the relationship between forest practices and salmon. Do the recent, more restrictive regulations go too far or not far enough? On-the-ground tours of stream sites, to better observe how the new rules will be applied, are available by contacting the Oregon Department of Forestry, public affairs office, 503-945-7422.

More research needs to be done. But research alone is not the answer. Concerned citizens must become aware of what constitutes healthy salmon habitat as well as its wide scope and potential influences (e.g., hillside to ocean). As consumers of hydropower, fish, and farm and forest products, we must recognize how our activities affect watersheds and fish, and identify the greatest problems and opportunities regarding salmon populations. And we must ask ourselves what value we are willing to put on healthy salmon habitat, and what trade-offs we are willing to accept to achieve it.

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