A Snapshot of
SALMON IN OREGON

OREGON STATE UNIVERSITY EXTENSION SERVICE

The goal of this publication from Oregon State University is simple: to promote thoughtful conversation among the citizens of Oregon. We hope to do this by providing a "snapshot" of what may be the most complex, far-reaching and dynamic public issue in our state's history—what some have called "the salmon crisis."

At first this seemed like a daunting challenge. There are enough books, articles and tapes on the topic, many of them excellent, to fill rooms (to say nothing of the information available through the Internet). But the OSU Extension Service's public issues education group felt something was missing—a brief, easily understood discussion of this fascinating issue.

They decided to produce a nontechnical publication that would address many topics and present many points of view to give citizens a broad picture of the salmon issue, with its biological, economic and social sides.

So, here's what you'll find in the pages that follow: At the beginning, there are several stories that provide background about salmon and research on salmon-related subjects.

Starting on page 8, there are stories that take you from the fresh water where salmon are hatched to the ocean where many spend a large portion of their lives. Each of these stories presents, briefly, human perspectives on an activity, or a natural phenomenon, that may affect salmon.

In the final pages, you'll find stories that look at human efforts to address the salmon issue, such as the public/private Oregon Plan for Salmon and Watersheds, other government-related efforts, legal actions and rehabilitation projects. Last, we'll tell you where to get more information.

Across our campus and the state, Oregon State University faculty, staff and students are involved in teaching and research linked to the salmon crisis. But another important role our university plays in society is promoting constructive discussion among citizens. We hope this publication does that.

Paul Risser
President, Oregon State University

Lyla Houglum
Dean and Director, OSU Extension Service

Salmon have lived here for millions of years

By Carol Savonen

The earliest fossil evidence for the aneestors of Pacific Northwest salmon and trout dates baek to the Eoeene, about 40 million years ago. About six million years ago, when saber-toothed tigers roamed the landseape, salmon were evolving into the speeies we know today.

Humans have used salmon for food in the Pacific Northwest for thousands of years, sinee the end of the last Iee Age. Commereial harvest data reveals early Pacifie Northwest salmon runs were most likely the most produetive salmon fisheries in North Ameriea.

"The physieal environment of the Pacifie Northwest made all of this possible," explains Oregon State University historian William G. Robbins in *The Northwest Salmon Crisis: A Documentary History*, published by the Oregon Sea Grant program in 1996.

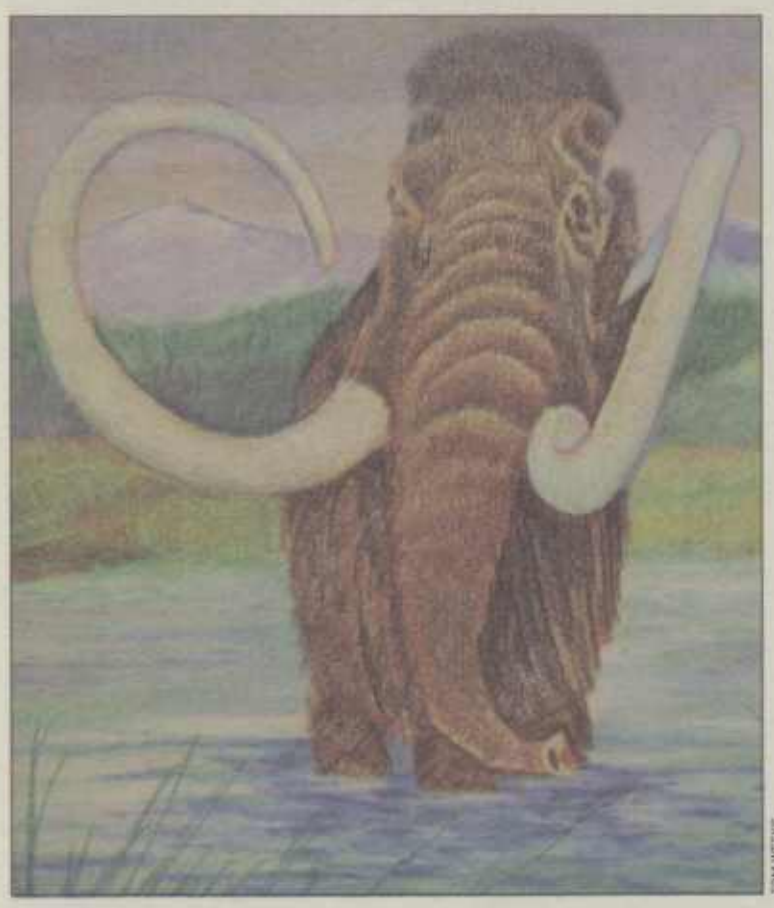
". . . the [Columbia] river serves as a natural funnel, providing a water highway through whieh four varieties of salmon . . . passed upstream to spawn."

This "funnel" also made it relatively easy for humans to eateh them with nets, spears, traps and poles. Salmon supported up to 100,000 people in this region for thousands of years.

Salmon faeed major physieal disruptions long before humans came to North America. Great voleanoes have shaken and erupted for millennia, sending mud flows and pumiee into rivers and streams. Massive iee sheets and their meltwaters influenced many of the familiar landforms in our region: the Columbia Gorge, the scablands of eastern Washington and the flat, silt-filled valleys of the Willamette Valley. Little is known about salmon during the Iee Age. But scientists think that they took refuge in areas not eovered by iee or affeeted by unstable rivers and eoastlines, sueh as southern Oregon, California and the Queen Charlotte Islands of British Columbia.

About 9,000 years ago, after the end of the last Iee Age, the Pacifie Northwest slowly beeame more favorable for salmon. Sea levels stabilized, ereating more stable river mouths and estuaries. Upwelling eurrents in the Paeifie earried nutrients for salmon food.

Archaeologists have studied aneient Indian sites around the Paeifie Northwest. By analyzing and dating piles of elam shells and fish bones, the seientists eoneluded that large numbers of salmon were used by humans as long as 9,000 years ago. The fish probably were more plentiful during eooler, wetter elimate periods and less plentiful during warmer, drier periods.



TOM WEEKS

Oregon's ocean-going salmon

Chinook Salmon (ocean-rearing)

- Distribution includes coast and Columbia Basin mainstem rivers.
- Juveniles migrate to the ocean the first fall after they hatch, rearing briefly in estuaries.
- They rear over a broad ocean area, ranging from northern California to the Gulf of Alaska.
- Adults, typically 3 to 5 years old, return to fresh water in the spring, summer cr fall.
- Spring and summer migrants prefer deep, cool pools where they hold several months before fall spawning.
- Adults spawn in large concentrations on mainstem gravel bars; may use both upper and lower mainstems.

Chinook (stream-rearing)

- In Oregon, they are only in upper Columbia Basin tributaries.
- Juveniles migrate to the ocean as 1-year-olds, in the spring.
- Little is known about the ocean distribution of Oregon's stream-rearing chinook.
- Adults return to fresh water in the spring, when 3 to 5 years old, and require deep, cool pools to hold for several months over the summer before fall spawning.
- They spawn in concentrations on gravel bars in upper tributaries.

Chum Salmon

- Shortest freshwater residence of all salmon. Adults stay only about a week prior to spawning; juveniles migrate to the ocean hours after hatching.
- Juveniles rear briefly in estuaries.
- Most Oregon chums migrate to the Gulf of Alaska for ocean rearing.
- Adults spawn at 3 to 5 years of age.
- Spawning occurs in lower mainstems, concentrated on large gravel bars.
- Adults are unable to pass even minor barriers.

Coastal Cutthroat

- Some coastal cutthroats migrate to the ocean. But others may migrate only to the estuary or river mainstems, or they may not migrate at all.
- Those that do go to the ocean migrate out in the spring, stay only a few months close to shore, then return in the fall.
- The ones that migrate may rear in fresh water for several years before going to the ocean.
- They spawn in the winter and early spring, using small pockets of gravel. They may spawn more than once. The spawning age of cutthroats seems to vary over their distribution area.
- Cutthroat prefer the smallest, highest tributaries in a basin.

Coho Salmon

- Juveniles rear in upper watersheds, spreading out in summer, schooling in pools in the winter.
- Juveniles migrate to the ocean at 1 year, in the spring.
- Most Oregon coho rear just off our coast.
- Adults return to fresh water in the fall and spawn in late fall and winter.
- Adults tend to spawn in concentrations on gravel bars in upper watersheds.
- Most adults spawn when they are 3 years old.

Sockeye/Kokanee Salmon

- There is both an ocean-going form (called sockeye), and a resident form (called kokanee).
- Juveniles rear in a lake, spending 1 to 2 years in fresh water before migrating to the ocean in the spring.
- Columbia Basin sockeye migrate to the Gulf of Alaska for ocean rearing.
- Adults typically spend 2 years in the ocean.
- Loss of Oregon sockeye resulted from blocked access to lakes. Kokanee are thriving in some lakes.

Steelhead

- There are two subspecies of steelhead in Oregon. Each also has a resident form. Coastal steelhead are closely related to rainbow trout. Inland steelhead are closely related to redband trout.
- Most juveniles rear in fresh water for 1 or 2 years and migrate to the ocean in the spring.
- Most steelhead spend 2 years in the ocean. Their distribution is poorly known but appears to be further off-shore than other salmon.
- Most inland steelhead return to fresh water in the summer while most (but not all) coastal steelhead return in the winter.
- Summer-run steelhead require cold deep pools where they hold until spawning. All steelhead spawn in the winter and may spawn more than once.

ILLUSTRATION AND INFORMATION COURTESY: KATHRYN KOSTOW, OREGON DEPARTMENT OF FISH AND WILDLIFE

Oregon has nine salmon-like fish

The word "salmon" brings to mind different things to different people. When you discuss the future of salmon and the Endangered Species Act, it's important to recognize the diverse kinds of fish in the salmon family.

Nine species of salmon-like fish are native to Oregon, but this group includes many subgroups with very different biological characteristics. The species:

- Seven salmon: chinook, coho, sockeye, chum, pink, steelhead and cutthroat trout (all members of the scientific genus *Oncorhynchus*). No breeding populations of pink salmon are left in the state, although one occasionally appears in the Columbia River.
- Bull trout (actually a char and a member of the genus *Salvelinus*).
- Whitefish (genus *Prosopium*).

Biological differences within each of these species and subgroups of them contribute to the complexity of the salmon issue. Different forms of each of the above species have adapted to different aquatic environments.

For example, some forms of a species can be "anadromous," meaning they were hatched in fresh water but spend a large part of their lives in the ocean before returning to fresh water to reproduce. Yet other forms of the same species live in fresh water throughout their lives. For instance, rainbow and redband trout, which remain in fresh water throughout their life cycles, are "resident" forms of the steelhead species.

Also, some groups of anadromous fish travel from the sea into fresh water at different times of the year. Thus, there are "spring chinook" and "fall chinook" in some rivers. Sometimes these are called different "runs."

This publication deals mainly with the anadromous fish—chinook, coho, sockeye, chum, pink and steelhead, and, to some degree, the sea-run form of the cutthroat trout. Yet some of the principles described are relevant to conservation of all the forms of our native salmon-like fish.

The federal Endangered Species Act is meant to protect species, subspecies or distinct population segments. With salmon, maintaining the diverse biology and diverse forms of distinct population segments has been deemed essential to the fish's existence.

Generally speaking, the abundance of various species of salmon in the West varies from north to south. Pink, chum and sockeye salmon predominate in British Columbia and Alaska. Chinook, coho, steelhead and sea-run cutthroat are the major species in Washington, Oregon, Idaho and northern California.

Many have vanished; others are in jeopardy

By Carol Savonen

Wild salmon once filled the rivers of the Pacific Northwest. Scientists estimate that during the mid-1800s, up to 16 million adult salmon returned each year to spawn in the Columbia River drainage alone. In addition, salmon also reproduced in all Oregon coastal drainages south of the Columbia, such as the Nehalem, Alsea, Siuslaw, Umpqua and Rogue.

Today, Pacific Northwest salmon are in trouble. For instance, in the Columbia River drainage fewer than one-tenth of the early historic numbers of salmon return to spawn in rivers and streams. And most of those that come back are not wild. On many streams, hatchery fish can make up 70 percent or more of the population.

Nine of 10 wild salmon runs and 100 distinct salmon stocks have vanished in our region since European settlement. Three times that many are at risk of disappearing. Habitat is disappearing. For example, in the Columbia Basin more than half of the original drainage area salmon once occupied is no longer accessible because of passage barriers such as dams.

In the early 1990s, Sen. Mark Hatfield asked the National Research Council to organize a broad range of leading aquatic and social scientists to share their expertise on "the salmon problem" in the Pacific Northwest.

The questions asked were basic. Which salmon runs are in trouble? What is causing their decline? What are the options to stop the decline?

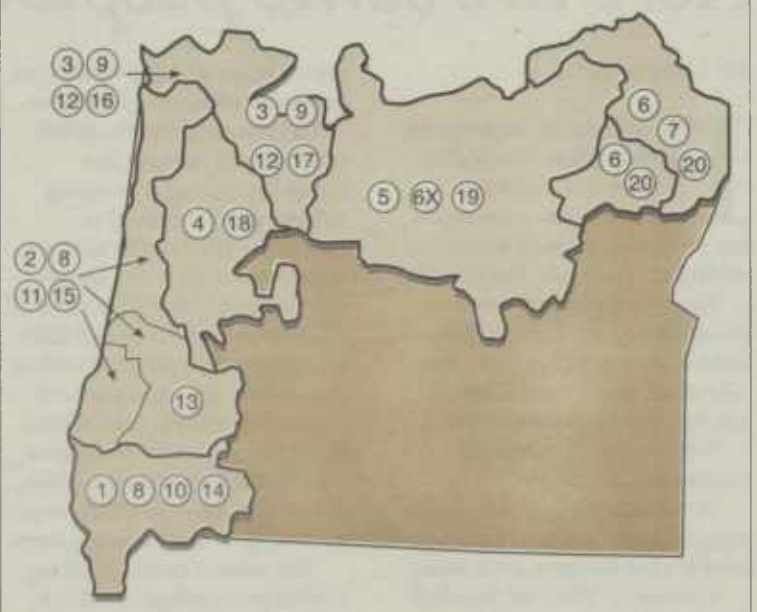
In 1996, the National Academy Press published the scientists' findings in a book called *Upstream: Salmon and Society in the Pacific Northwest*. Overall, the scientists identified the following trends, with a few exceptions:

- Salmon are threatened, endangered or extinct in two-thirds of their previous ranges in Oregon, Washington, Idaho and California.
- Coastal populations are better off than populations that spawn in interior drainages such as the Columbia or the Klamath rivers.
- Populations of salmon are at greater risk in the southern ends of their ranges. For example, coho are in greater trouble in southern Oregon and northern California than they are in Washington.
- Salmon species that spend a greater proportion of their life in fresh water, such as spring and summer chinook, coho, sockeye, sea-run cutthroat and steelhead are generally in greater trouble than those that spend less time in fresh water, such as fall chinook, chum and pink salmon.
- Where runs are as large as they once were, hatchery fish make up the majority of fish in the runs.

"In the 1990s, native, anadromous Pacific salmonids [ocean-going Pacific salmon] are at a crossroads," wrote fish biologists Willa Nehlsen, Jack E. Williams and James A. Lichatowich in their 1991 paper "Pacific Salmon at the Crossroads," in the scientific journal *Fisheries*. "The habitats of these once wide-ranging fishes are severely curtailed, many stocks are extinct and many remaining stocks face a variety of threats."

They go on to say, "In most cases, enough of the native resource remains to allow a variety of remedial actions. If the salmon and their habitat continue to diminish, however, available options for present and future generations will diminish or disappear. The challenge for the 1990s is to take maximum advantage of technical, legal and management avenues available to us now."

Status of Oregon's Pacific salmon under the Endangered Species Act



Chinook Salmon

1. Southern Oregon and California Coasts (Proposed Threatened)
2. Oregon Coast (Not Warranted)
3. Lower Columbia River (Proposed Threatened)
4. Upper Willamette River (Proposed Threatened)
5. Middle Columbia River Spring-run (Not Warranted)
6. Snake River Fall-run (Listed Threatened)

6x. Snake River Fall-run (proposed extension of range of listing)

7. Snake River Spring/Summer-run (Listed Threatened)

Chum Salmon

8. Pacific Coast (Not Warranted)
9. Columbia River (Proposed Threatened)

Coho Salmon

10. Southern Oregon/Northern California Coasts (Listed Threatened)
11. Oregon Coast (Listed Threatened)
12. Southwest Washington/Lower Columbia River (Candidate Species)

Pink Salmon

No distinct population segments identified in Oregon.

Sockeye Salmon

No distinct population segments identified in Oregon.

Sea-run Cutthroat Trout

13. Umpqua River (Listed Endangered)
    Other populations to be defined after completing coast-wide status review.

Steelhead

14. Klamath Mountains Province (Candidate)
15. Oregon Coast (Candidate)
16. Southwest Washington (Not Warranted)
17. Lower Columbia River (Listed Threatened)
18. Upper Willamette River (Proposed Threatened)
19. Middle Columbia River (Proposed Threatened)
20. Snake River (Listed Threatened)

- An Endangered Species is any species in danger of extinction throughout all or a significant portion of its range.
- A Threatened Species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
- A Candidate Species is any species under review but not yet the subject of a listing proposal.
- Not Warranted means a distinctive group of Pacific salmon has been studied and judged not ready for protection at this time.

Illustration courtesy: Steve Stone, National Marine Fisheries Service

Why try to save wild salmon?
Here are some people's views

By Theresa Novak

For centuries, the muscular fish whose life flashes between woodland streams and ocean depths has embodied the bold health and vitality of the Pacific Northwest.

For the past few decades, scientists and average citizens alike have watched as more than 100 of the major West Coast salmon runs have gone extinct.

Now, nine of 10 remaining wild runs are threatened.

Seven out of 10 salmon swimming in Oregon streams were born in a fish hatchery, not a stream.

On Aug. 3, 1998, the National Marine Fisheries Service announced that coastal coho would be added to the list of species under protection of the Endangered Species Act.

Already listed are fall, spring and summer chinook, sockeye, West Coast coho, West Coast steelhead, Umpqua River sea-run cutthroat trout, Mid-Columbia River summer chinook and Deer Creek summer steelhead.

The state of Oregon has developed its own salmon and watershed recovery plan, which it would like to put into action to save coastal coho, avoiding the strong regulations that would come with a formal federal listing. The matter now is before a federal appeals court, with a ruling likely in 1999.

Yet amid all of the impassioned talk surrounding salmon, many Oregonians are asking a good question: How can salmon be near extinction and still be sold as cat food for 60 cents a can?

They hear reports that the cost of saving salmon could mean higher electricity rates, job losses, crop losses, increased wood prices; more land-use restrictions and limits on personal freedom.

Despite such reports, public opinion polls indicate that Northwesterners favor saving salmon. A poll released in December 1997 by the state's largest newspaper, *The Oregonian*, indicated that 85 percent of the 514 Oregonians polled think it's important to preserve salmon runs. About 60 percent believe improving salmon runs should be a higher priority than other commercial uses of salmon rivers. About 38 percent are willing to pay $5 or more a month to help salmon.

But when it comes to taking bold steps on behalf of salmon, such as breaching dams, urban and rural Oregonians have different responses:

In the larger cities of Portland and the Mid-Willamette Valley, 41 percent support breaching or removing dams. But in eastern Oregon, where agriculture depends on irrigation and dams, that percentage drops to 29 percent who favor such a move.

Some ask a good question: Wouldn't it make more sense simply to give up the idea of restoring the natural life cycle of salmon and concentrate on improving production of salmon in hatcheries?

Henry Yuen, a fish scientist for the Columbia River Inter-Tribal Fish Commission, said that the distinction between wild and hatchery fish is debatable after 50 years of aggressive hatchery rearing and intermingling. He suggests that salmon runs can be restored with genetically selected hatchery fish.

"Hatchery fish have descended from wild fish," Yuen said "They have the diversity within them."

But the problem is that hatchery-supplemented salmon runs also have been declining sharply in the past twenty years. Further, Oregon's Wild Fish Management Policy is based on the assumption that some wild fish runs still remain and should be preserved.

It is not a clear case of either hatchery salmon or wild salmon, said Robin Waples, the director of the conservation biology division for the Northwest Fisheries Science Center in Seattle.

"There is no question that there still are wild salmon populations that have relatively little hatchery influence," Waples said "But it is also true that we've seen hatchery fish almost totally replace natural populations."

SANDY RIDLINGTON, OREGON SEA GRANT

Middle school students examine an Alsea River salmon with fisheries biologist Carl Schreck. Oregon Trout, a fish conservation group, sponsored the tour.

The Endangered Species Act requires that wild populations of fish be rescued from the brink of extinction whenever possible. Overshadowing whatever philosophical, scientific, ecological, economic, historic or cultural objections people may have to that idea is a powerful answer:

Knowingly allowing wild salmon runs to go extinct violates federal law.

The 1973 Endangered Species Act requires an all-out recovery effort to save species in trouble from extinction. Once set into motion, a listing under the ESA can have the same effect as it did in 1991, when the listing of the northern spotted owl as a threatened species required changes in forest land management to preserve the old-growth forest habitat of the bird.

Since salmon roam between shallow creeks and the deep oceans, their recovery could mean more changes in human activity everywhere from urban driveways to forests, farms, rivers, coasts and the ocean.

The decline is a concern close to the hearts of many Native Americans in the Northwest. They gave up a great deal to assure that they would always have salmon.

In 1855, the Columbia River tribes signed a treaty giving the U.S. government control of more than 40 million acres of the Northwest in exchange for assurances of their safety, health and continuing access to their traditional salmon fishing areas.

Losing the wild salmon runs will mean a loss of cultural identity, tribal leaders say.

Having watersheds that are able to support salmon means having healthy watersheds and an appealing image for Oregon.

In 1972 when Oregon's former governor, the late Tom McCall, wanted to illustrate the restored health of the Willamette River to a reporter from *National Geographic* magazine, he showed her salmon spawning in the creek behind the governor's residence in Salem. The media-savvy governor knew that image would illustrate the successful reclamation of the Willamette River better than anything he could say.

Healthy salmon are a sign of a robust, livable business climate as well, according to Duncan Wyse, the executive director of the

(continued on page 5)

What makes a salmon wild?

Hearing people talk about "wild" and "hatchery" salmon can be confusing. Under Oregon's Wild Fish Management Policy, adopted by the Oregon Department of Fish and Wildlife in 1992, wild salmon are those that are hatched in a stream and return to a stream for spawning.

Hatchery salmon are released into streams when they're young. They migrate to the ocean and try to return to the hatchery when they're mature. Most are caught by commercial and recreational fishers before they reach the hatchery (many salmon sold in grocery stores and fish markets are hatchery-reared fish). But some hatchery fish stray into streams.

Historically, each wild salmon belonged to a specific genetic clan, which scientists call "local breeding populations," adapted to return or "home" to a particular spawning stream. However, some people now argue that after more than 50 years of hatchery rearing, the distinction between wild and hatchery fish has been blurred because some hatchery fish are straying and interbreeding with wild fish.

A wild fish isn't always a native fish. For example, brook trout in Oregon reproduce in streams and lakes and are wild, but they aren't native to the state. The Oregon Plan for Salmon and Watersheds (see related article, page 20), a statewide public/private effort, is geared to restoring wild, native salmon.

Why save salmon? (continued from page 4)

Oregon Business Council. The group represents the chief executive officers of Oregon's 45 largest companies. Saving the salmon is a practical decision that the CEOs endorsed two years ago.

"(The salmon) are an indicator of the Northwest's biodiversity—its health," Wyse said. Companies locate in the Northwest mainly because it has a reputation as a wholesome place to live and work. Lose the wild salmon, and Oregon's livable reputation is damaged as well. Keeping the salmon is sound business that will take hard-headed management.

"We have to rethink harvest policies both in the ocean and on rivers, so we won't have sole reliance on hatcheries as our strategy (for saving salmon)," Wyse said.

The loss of salmon already has had a significant economic impact, said natural resource economist Hans Radtke. In his 1996 study, Radtke calculated the cost of the salmon decline in the Columbia River Basin compared to the days when catches of 8 million fish were possible.

As of 1996, the decline of fisheries had seen the loss of 25,000 family-wage jobs, according to Radtke. In Columbia River Basin communities, this translated to about $500 million in lost earning power as reflected in closed businesses and people moving elsewhere for work.

In the Klamath Basin in Southern Oregon, which encompasses fisheries in northern California as well, Radtke estimates job losses at more than 1,600 family-wage jobs and economic losses of up to $32 million a year. About 60 percent of those losses were in Oregon.

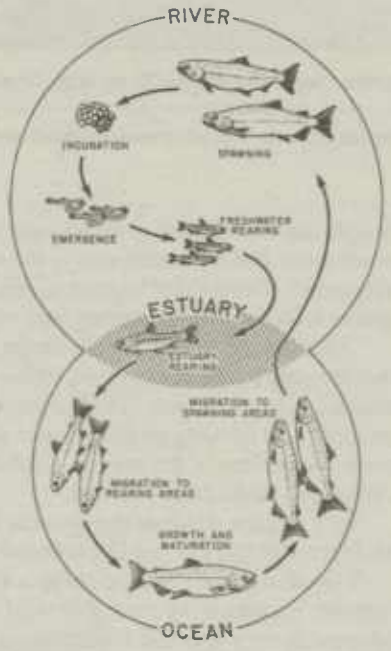
Ken Currens, a fisheries geneticist for the Northwest Indian Fisheries Commission in Washington, said losing salmon amounts to losing the reason why the Pacific Northwest is different from places where the green primordial earth has retreated into memory.

"My best reason (for saving salmon) is that they have been part of everything we think of as the Northwest for hundreds of thousands of years," Currens said. "If we value that landscape, if we value all the things that go into that, salmon are really a key part of that picture."

A salmon's life starts as a 'fry'

Depending on the species, life for a newly hatched salmon, called a fry, begins in a headwater stream or mainstem river, or at the interface of a coastal estuary and freshwater stream. Each female salmon lays hundreds to thousands of eggs in the gravel, where the eggs develop after the male salmon fertilize them.

Beyond the newly hatched stage, young salmon are called juveniles. They may live in fresh water a few weeks or up to 2 or more years. Juvenile salmon ready to migrate to the ocean are called smolts. They make this journey mostly during the spring and summer. Ocean-bound juveniles may spend days, weeks or even months in estuaries feeding and adjusting their body chemistry before they enter the ocean, depending on the species and population.



Once in the ocean, salmon stay there 1 to 5 years, depending on the species. During this time, they eat small fish and tiny animals called zooplankton. Some salmon travel thousands of miles out into the north Pacific. Others remain relatively close to shore.

As adults, the salmon return to fresh water to spawn. Some, such as chinook salmon in Idaho, migrate more than 900 miles to their spawning grounds. Most return to the stream of their birth, although there is some straying. Straying ensures that salmon will colonize new areas if their old streams get destroyed by natural disasters. For example, when the Mount St. Helens 1980 eruption destroyed spawning habitat in the Toutle River in Washington, scientists observed the salmon spawning elsewhere. With the exception of steelhead and sea-run cutthroat, salmon die after spawning.

—Carol Savonen

One study found 22 kinds of birds, mammals feed on salmon carcasses

By Andy Duncan

When some people think about salmon they see more than a fish. They see an ecological system—a long name for a relatively simple concept.

Think of it in terms of your body: The foot is connected to the ankle, the ankle to the knee, the knee to the thigh, and so on. In a way, your body is a system. If any part has problems, other parts, or your entire body, may suffer.

The system salmon are part of is huge. With many species, it stretches from the mountain headwaters of streams all the way to the ocean. With some species, it stretches thousands of miles into the ocean.

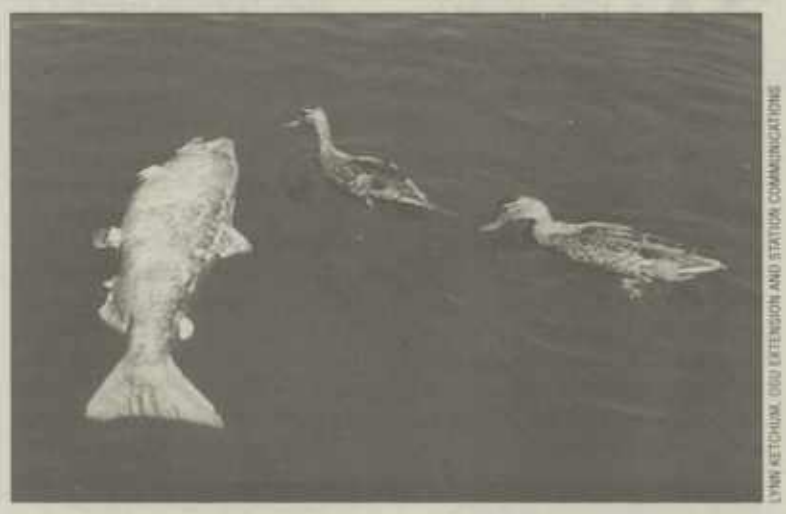
Salmon are hatched in streams that are part of watersheds. A watershed is the area drained by a distinct stream or river and separated from other watersheds by topographic boundaries such as ridgetops. Uplands often make up more than 99 percent of a watershed's area, and the floodplain and stream channel make up the rest. The area immediately adjacent to the water is called the riparian zone.

From the ecosystem perspective, the uplands and floodplain and riparian zone all affect the life in the stream. The surroundings farther down the stream affect it, too.

Generally speaking, a good salmon stream has relatively cool and clean water, although the fish can adapt, within limits. Salmon need gravel to spawn. Too much sediment can disturb their spawning beds, called redds. They need a steady food supply, and structure in streams such as large woody debris and rocks for resting, hiding, feeding and rearing.

When they migrate to the ocean, salmon depend on an adequate flow of water to move them downstream to the estuary, where fresh and saltwater mix. Once in the estuary, they also need relatively cool, clean water and places to feed, hide and rest while they adapt to saltwater.

In fresh water and the ocean, they are part of an intricate food chain. For example, in the ocean, where many salmon species spend most of their lives, the creatures feed on tiny animals called zooplankton, and on small fish and crustaceans. These "salmon foods" need a certain range of temperatures and salinity to thrive, conditions tied to short- and long-term weather patterns.



LYNN KETCHUM, OSU EXTENSION AND STATION COMMUNICATIONS

Ducks move in to feed on a dead salmon in the Willamette River south of Oregon City.

Many people have heard of El Niño, a weather cycle that tends to bring warmer, less nutrient-rich water to the Pacific Ocean areas where Northwest salmon live. An opposite cycle, called La Niña, tends to cause upwellings of colder, more nutrient-rich water that

(continued on page 6)

Wild salmon are hatched and live part of their lives in a watershed. A watershed is the area drained by a distinct stream or river and is separated from other watersheds by topographic boundaries such as ridgetops.

Scientists' views reveal disagreement, but often that generates knowledge

By Andy Duncan

With the salmon issue, why can't we simply turn to science for all the neat, tidy answers we need?

One reason is that some of the questions involve public choices, not just science. Another reason is that science isn't tidy. Scientists often disagree with one another.

"But we know a lot—enough to give informed advice and help the people of Oregon help the fish," says Jim Martin, an assistant director of the Oregon Department of Fish and Wildlife and a developer of the Oregon Plan for Salmon and Watersheds (see related article about the Oregon Plan, page 20).

"Years ago," recalls Logan Norris, the head of Oregon State University's Department of Forest Science, "we [scientists] didn't fully understand the system salmon are a part of and told people to take the woody debris out of streams. It turns out we were wrong. Large woody debris like logs provides important habitat for salmon.

"People who expect perfection in human decision making are certain to be disappointed," Norris continues. "Almost certainly some things we conclude now will prove to be wrong years from now when more information is available. But in science the only way to avoid being wrong is to do nothing, and that's certainly wrong."

Martin uses a medical analogy. "We all know medical knowledge is imperfect," he says, 'but we usually take the doctor's advice."

Exactly how could scientists, with all their degrees and expertise, reach different conclusions?

In part, it's the process they use: observing, hypothesizing, testing, debating and validating. To fully understand something, they study it from different angles, or disciplines. And they're human. They look at the world through their life experiences.

"It is in the limelight of disagreement that new knowledge is developed," says Robert Beschta, a hydrology professor in the OSU College of Forestry who does salmon-related research.

The field of salmon science is broad. Let's look at some scientists' thoughts in a few areas. First of all, on what they call habitat:

Many biologists agree that a large amount of the salmon's inland home—forested and grass-covered uplands, and stream and streamside areas from headwaters to estuaries—has been degraded. Some a little, some a lot.

"This is a huge area of scientific consensus and we need to make decisions flowing out of that," asserts Bill Liss, a fisheries biologist at Oregon State University.

What caused the habitat problem, and how bad is it? In Oregon, the list of contributors to habitat degradation that scientists and others have identified leads to just about every resident of the state, as well as to natural processes.

The list of human-related factors includes: dams, many parts of urban and suburban life, fishing, forestry, farming, ranching, mining, manufacturing and many other kinds of industry. There's still some disagreement and uncertainty among scientists over the amount, and causes, of habitat problems in particular areas. The greatest debate is over the relative importance of each factor.

Another area where scientists' opinions vary is on how to fix salmon habitat problems.

"In my opinion, the first and most critical step is to halt or

(continued on page 7)

TOM GENTLE, OSU EXTENSION AND STATION COMMUNICATIONS

A stream ecologist photographs salmon on Knowles Creek in the Oregon Coast range. The stream feeds into the Siuslaw River.

Salmon carcasses (continued from page 5)

offers better food conditions for salmon. These weather patterns affect populations of ocean creatures that eat salmon, and creatures that compete with salmon for food. Also, scientists believe there are longer-range climatic shifts in the ocean that affect salmon. These shifts play out over decades.

Salmon have other functions in this ecological system: The huge salmon runs of the past in the Northwest played an important role in transporting nutrients from the ocean to the inland environment, biologists say. When salmon die after they spawn (deposit eggs that will become the next generation), their carcasses carry important nutrients from rich ocean environments inland to the relatively nutrient-poor freshwater environment. One study determined that 22 species of forest-dwelling birds and mammals fed directly on the carcasses of spawned-out salmon.

Ecological systems are not continually stable, notes Bill Krueger, head of OSU's rangeland resources department.

"There is always change and compensation for that change," says Krueger. "You'll never have the same ecosystem tomorrow that you have today."

"In my opinion, it's very important to take the ecosystem perspective in dealing with the problems of salmon," says Bill Liss, a fisheries biologist at Oregon State University. "These days I hear people say our salmon problems are simply a result of poor ocean conditions. But what happens in the ocean and in fresh water are connected. Things that happen in fresh water can affect salmon's ability to cope with the ocean, and vice versa. It's all connected.

"An example is that, within limits, larger smolts [young salmon that migrate to the ocean] tend to have higher survival rates in the ocean," Liss continues. "High water temperatures, poor food supplies and that sort of thing in fresh water make the smolts smaller and thus poorer survivors in the ocean—probably less able to cope with ocean cycles that don't favor salmon."

Not everyone supports the systems view. But Dan Bottom, a research biologist with the Oregon Department of Fish and Wildlife, does.

"One thing that's unique about a systems view is that it requires an historic, evolutionary view that wild salmon populations have adapted to very specific conditions of a watershed in terms of rainfall, stream flow, water temperature at certain times of the year, the timing of their runs and so on," says Bottom. Also, each population may be adapted to certain ocean conditions.

"That's why when we try to put those systems back together," he asserts, "we have to consider a process that happened over millennia. We need to consider what the system was like so we know what to try and emulate."

Scientists' views (continued from page 6)

modify activities causing degradation or preventing recovery," says Beschta, the OSU hydrology researcher. "This is sometimes called passive restoration. It allows nature to do the job.

"Where such efforts are still insufficient for recovery to occur," he continues, "intervention by humans, sometimes called active restoration, may be needed to make streams better places for salmon to live."

A carefully timed combination approach may be best sometimes, and a long-term focus is always important, he adds.

Derek Godwin, a bioresources engineer, is a watershed extension specialist in Coos and Curry counties with the OSU Sea Grant, agriculture and forestry programs. Godwin works on restoration projects involving streams used by endangered coho and other salmon.

"I'm for active restoration," he says. "You should be encouraging Mother Nature along to where she would go anyway. With passive restoration, it will get there, but it may mean waiting 20 years or more. The landowners I work with often are willing to protect salmon habitat by keeping livestock out of the riparian [streamside] zone, or changing other ways they use the land. But they definitely like to be active in restoring the habitat, too."

"From my perspective, the active versus passive restoration debate depends a lot on what we think we know," says Dan Bottom, a research biologist with the Oregon Department of Fish and Wildlife. "We now know wood is important because we have a lot of data to show this. But we still do not have a lot of experience 'fixing' things in complex systems.

"We can put wood back in some locations and hope it recreates the functions we lost. We have some data to suggest this is possible, but nothing long term," adds Bottom. "While I agree we need to try some things, we also need to be cautious and not make a lot of local decisions that add up to large-scale mistakes. Passive restoration is a low-risk policy that requires time. Active restoration is much more costly, will be difficult to afford on large scales, but may be useful where passive processes will take too long by themselves."

Whether the restoration is passive or active, Bill Krueger, the head of Oregon State University's Department of Rangeland Resources, says he thinks organizations like watershed councils and Watershed Ecosystem Management (WEST), a program the Oregon Cattlemen's Association developed to help residents learn more about how to protect and improve their watersheds, "are on the right track. They get people thinking of salmon when they make decisions, and the decisions are site specific."

An area where quite a few fish biologists, and some other scientists, have similar views is on hatcheries. They say salmon produced as a "commodity" in many hatcheries in the past hurt wild salmon, competing with them for habitat and food and allowing salmon harvests that chipped away at shrinking populations of wild salmon.

"We swamped the wild fish with these hatchery fish for decades with the best intentions, thinking that was the right thing to do," says Jim Martin. "But rather than hand-wringing and blame-slinging, I think we should celebrate that we're finally smart enough to know that hatcheries, the way we ran them, hurt wild fish."

Not every scientist has a negative view of hatcheries. "The hatchery fish came from native fish. They have the genetic traits to be very adaptive. There are successful examples of restoration using hatchery-reared fish," says Henry Yuen, a fisheries biologist for the Columbia River Inter-Tribal Fish Commission, based in Portland. He notes that the hatchery fish used in restoration should be descendents of salmon that evolved in the area.

However, some people contend that restoration successes with hatchery-reared salmon have not been tested over an extended period of time (over decades, for example).

There's a major research need, according to Don Chapman, a fish biologist with a private consulting firm in Idaho.

"The elephant sitting in the front room," says Chapman, "is ocean ecology. There's a lack of understanding of that, even though many of these salmon species spend more than half their lives at sea. There's an awful lot about salmon in the ocean we don't know." That also makes it hard to calculate the impacts of inland problems more precisely, he says.

Like a lot of other scientists, Chapman believes a wide range of human activities and natural processes are responsible for the salmon decline.

"Dams are a problem on the Columbia River," he says, "but what about livestock grazing, agricultural water withdrawals and logging? And salmon are in trouble in coastal streams where there are no dams. The problem in part is that a lot of people don't agree there are multiple causes. There are still a lot of single-factor folks."

Draw your watershed, professor suggests

Ray William, an Oregon State University horticulture professor, specializes in taking discussion of ecological systems down to a community level. In recent years, William has facilitated meetings of people who live in watersheds.

"I use a four-step process to encourage people to look at the system as a whole," he says. "It's amazing how constructive this process is, compared to having people just come in and express their particular points of view.

"One benefit always seems to be simply having folks at one end of a watershed meet those from the other end and start to understand how what they do is related and can affect the system," he adds.

William suggests Oregonians experiment with the "systems approach."

"Do what I ask groups to do," he says. "Draw the watershed you live in. Find relationships among the components. Look for areas where significant impact could occur—for leverage. It's the beginning of systems thinking. Then you can move toward assessing what's happening in your watershed and talking with others about what you want to happen in the future."

—Andy Duncan

These seven make up Oregon's science team

Seven Northwest scientists have a tough assignment from the state of Oregon.

The seven scientists are the state of Oregon's official "Independent, Multidisciplinary Science Team." The Legislature and Gov. John Kitzhaber authorized the team, which was appointed through a nomination process, to obtain advice on matters of science related to the Oregon Plan for Salmon and Watersheds, a public/private attempt at salmon restoration (see related article, page 20).

"Our challenge is to synthesize research findings and other kinds of information—to tell Oregonians what the science says. We don't do policy," says Logan Norris, the head of Oregon State University's Department of Forest Science.

The scientists are working on more than a dozen projects. They will issue reports to the Legislature and the Governor over the next year or so.

Besides Norris, members of the science team are: John Buckhouse, OSU Department of Rangeland Resouces; Wayne Elmore, U.S. Bureau of Land Management; Stan Gregory, OSU Department of Fisheries and Wildlife; Kathleen Kavanagh, OSU Extension Service and Department of Forest Resources; James Lichatowich, Alder Fork Consulting; William Pearcy, OSU College of Oceanic and Atmospheric Sciences.

—Andy Duncan

TOM GENTLE, OSU EXTENSION AND STATION COMMUNICATIONS

Researchers from Oregon State University's Department of Fisheries and Wildlife track chinook salmon in the Willamette River to learn more about migration patterns. The fish are fitted with tiny radio transmitters.

NOW

let's examine some human and natural influences on Oregon's salmon

OREGON SEA GRANT

An adult, male chinook salmon that is "ripe," or ready to spawn.

Up to here, we've offered you stories that provide general background information on salmon and surrounding issues. Now we're going to shift gears.

Recently a group of individuals from a number of fields gathered on the Oregon State University campus. The group came up with a list of human activities and natural phenomena that have been identified widely as influences on salmon. These influences range from the fresh waters where salmon hatch, down the streams they travel to the ocean, and back to the home streams where they spawn and create the next generation.

On the next few pages, each story will examine one or more of these influences. Most of the stories will offer a variety of human perspectives. This isn't about blame. It's to give you a better understanding of the range of viewpoints that make the salmon crisis a public issue not easily "solved."

We probably omitted worthy topics, unintentionally. And the logic of how we picked some may not be obvious. For example, the topic of predators could fit in several areas. We singled it out because often this seems to be a "flash point" in discussions of the salmon issue.

We hope this information will help you fulfill your role as a citizen, including the very important activity of discussing the salmon issue with other Oregonians.

Can you hear the water gurgling, high in a mountain stream? Off we go.

—The Public Issues Education Group, OSU Extension Service

Mining

By Bob Rost

Mining and salmon have had to share the same turf in the Pacific Northwest. Mining, whether for gold or gravel, usually takes place in or near streams and creeks, and salmon use the same waterways for spawning and rearing.

Although not currently a major industry in Oregon, mining for precious metals has continued here from the early days of settlement up to the present. Finding gold and silver mattered most to the first miners in the 1800s and early 1900s. Today, sand and gravel mining account for most of the mining activity in the state.

Mineral mining in Oregon began in the 1800s when gold strikes were made in Baker and Grant counties in eastern Oregon and in Jackson County in southern Oregon. The mining practices of those days (some underground mining, but mostly placer, or dredge, mining) caused tremendous destruction of salmon habitat in streams and creeks. Placer or dredge mining took place within the stream. Miners removed large amounts of the stream bed, then washed and screened the material to find precious metals, and finally discarded the processed material along stream banks. Even in the case of underground, or hard rock, mining, water from streams was needed to wash the mined material. Early miners left huge piles of discarded rock, called tailings, near streams, and these deposits are still there today.

(continued on page 9)

TOM GENTLE, OSU EXTENSION AND STATION COMMUNICATIONS

Dredging for gravel, shown here on the Umpqua River, can reduce or eliminate salmon spawning habitat. The industry is funding research to reduce habitat impact.

Mining (continued from page 8)

These operations disrupted salmon activity in the affected streams and created permanent changes in stream structure. For example, scooping out the stream bed deepens the channel of the stream. This may increase the speed of the water flow in the stream while disturbing or destroying salmon spawning grounds and removing streamside vegetation. Also, erosion from the tailings of hard rock mining carried trace amounts of toxic chemicals, such as mercury, into stream flows.

Fortunately for salmon, the destructive placer mining and dredging practices of the old gold rush days are no longer a threat to Oregon streams, although Oregon State University fisheries biologist Judy Li emphasizes that the effects of early mining practices are still with us.

"The old mine tailings taken out of streams and placed along the banks, particularly in Sumpter Valley east of John Day and on the John Day River, are still there and still preventing the affected streams from operating as they did before they were dredged," said Li. "That early stream dredging created a long-term problem that won't just go away."

Li added that agencies such as the U.S. Forest Service are exploring ways to restore streams that were dredged by early miners.

Today, mining streams for precious metals is pretty much limited to what state officials call recreational and part-time mining, which is done by citizens who prospect for gold in their spare time.

"In many streams and creeks around the state, such as Quartzville Creek which empties into the North Santiam River, recreational miners use small suction dredges to search for gold or silver," said Li.

According to Jenifer Robison of the Oregon Division of State Lands, part-time miners are generally careful to observe the rules placed on small-scale stream dredging.

"For example, dredging is allowed only in certain parts of streams at certain times of the year," Robison said. "Also, no dredging is allowed beyond the water's edge on either side of a stream, miners cannot move large trees and boulders or rocks in the stream, and miners cannot leave holes in the stream bed that may trap fish when water levels drop in the stream."

State law has also designated some parts of streams and rivers to be "essential salmon habitat," and dredging is closely regulated in those areas.

Gravel extraction from Oregon rivers is also regulated by law, but the stakes are higher because urban development activity is brisk in Oregon these days. That means high demand for concrete and asphalt, building products that require liberal amounts of gravel as a basic component.

Most gravel extraction in the state takes place along rivers in western Oregon. The mining areas are often located near large cities and towns, where most of the urban build-up in the state is taking place. For example, four gravel mining operations are located at the confluence of the McKenzie and Willamette rivers near the Eugene-Springfield area.

Gravel mining activities in Oregon can be divided into three categories. Deep water dredging for sand and gravel takes place in the Columbia, Willamette and Umpqua Rivers. This type of dredging takes place in fairly deep water near the main channels of the rivers.

In several Oregon rivers, mostly on the west side of the state, sand and gravel companies conduct gravel bar scalping operations, which involves removing material that builds up on sand bars in the river.

There are also gravel pits excavated by sand and gravel companies in floodplain areas near rivers. The four gravel mining operations mentioned above fall into this category. Gravel pits are located in areas where flood activity of nearby rivers has caused huge amounts of sand and gravel to accumulate over time.

State laws regulate gravel mining on floodplains. The Department of Environmental Quality plays a part in this regulation because of its role in managing water quality. The Division of State Lands also is directly involved in regulating gravel mining due to its authority to require a permit for the fill or removal of material in all waters of Oregon. For example, the DSL regulates gravel bar scalping operations by limiting the amount of gravel that can be removed and requiring the operators to survey the removal site before and after the extraction. Also, operators working on gravel bars cannot remove any material below the surface of the water and usually they cannot move any equipment into the water.

These rules help protect salmon that spawn in the shallow gravel of shaded, calm portions of streams and rivers. The removal of sand and gravel below the water surface deepens streams, disturbing spawning grounds, and possibly causing the rate of water flow in the stream to speed up. This is detrimental to juvenile salmon that need calm, slow-flowing water to live in as they develop.

OREGON HISTORICAL SOCIETY

Hydraulic mining like this disappeared in Oregon long ago, but some of the damage to salmon habitat remains.

Further, removal of gravel from the floodplains that line the Willamette Basin and other Oregon river systems also has historically meant the loss of spawning habitat.

It is a situation that the Oregon Concrete and Aggregate Producers Association is working now to help remedy, according to their spokesman, Rich Angstrom.

Recently, they entered into an agreement with the Oregon Department of Fish and Wildlife, Oregon State University and Morse Bros., a sand and gravel extraction company. With money from the Oregon Aggregate Removal tax, the three are seeking ways to improve channels for salmon during aggregate removal. Started in March, the plan has just begun, said Jeff Steyaert, the environmental engineer for Morse Bros.

"We're hoping this benefits not just salmon, but all salmonids [salmon-type fish]," he said.

Forestry

By Carol Savonen

To early settlers and loggers, Oregon's forests seemed endless and inexhaustible. But in less time than it took to grow them, most of the original forests were harvested. Forestry was Oregon's leading industry for many decades.

More than 40 percent of Oregon was once covered by native forests. These forests were important to salmon, for a supply of cool, clean water and rearing and spawning habitats. Since the mid-1800s, intensive timber harvest has affected salmon populations in coastal, interior and mountain forestlands.

Aquatic scientists have studied the effects of timber harvest on fish habitat for many decades. They have learned that through the past century and a half, logging and road building and related activities altered salmon freshwater habitat in many ways.

For example:

• In the 1800s, trees were frequently removed from wooded riversides and coastlines and floated away to mill sites. When the timber within easy access of a navigable stream or river was exhausted, logging operations moved on.

Heavily logged river valleys resulted in unstable soils, higher water temperatures and increased sediment deposits in spawning gravel. Food for fish declined and rearing habitat disappeared with the trees. The supply of large, woody debris that naturally formed the structure for fish habitat disappeared.

• Early logging operations built temporary structures called "splash dams" across small streams in more than 160 locations on Oregon's coastal streams and Columbia River tributaries. First, a dam was built and filled with water. When it was blown up, mammoth logs roared downstream in a huge torrent. These torrents of water and logs would scour stream bottoms as logs pushed gravel off stream bottoms, leaving bare bedrock. Salmon, their habitat and their offspring were often destroyed.

• After World War II, heavy equipment was used to harvest trees. Yarders, loaders, bulldozers and trucks came down extensive networks of newly built roads into areas formerly inaccessible to timber harvest. On federal lands, there is now an average of between 3 and 4 miles of road per square mile of watershed area, according to a 1993 Federal Ecosystem Management Assessment Team Report. Forest Service studies showed that where roads were built on steep terrain in the 1940s through the 1960s, the frequency of landslides increased dramatically compared to steep roadless terrain.

Mechanized timber harvest and associated road construction increased sediment into streams and raised stream temperatures. Inadequately designed road culverts blocked salmon migration to spawning areas. Until the 1980s, large woody debris was often removed from salmon streams because biologists thought it helped fish migrate upstream to spawn.

Gordon Reeves, a fish biologist with the U.S. Forest Service Pacific Northwest

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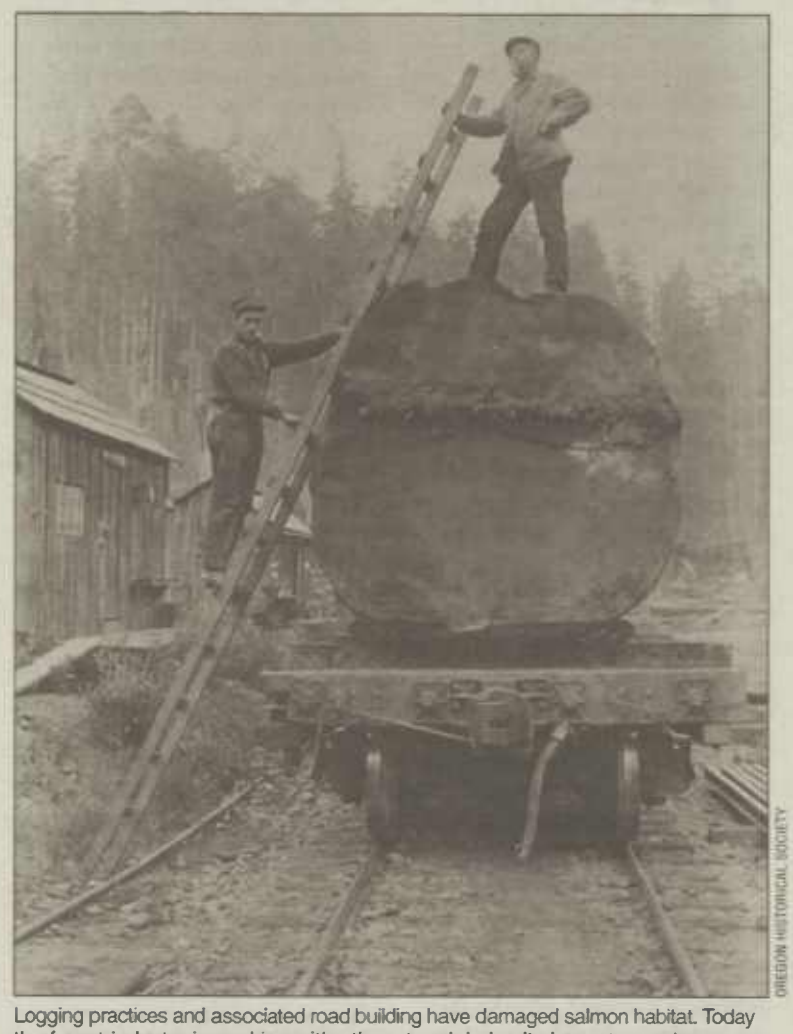


OREGON HISTORICAL SOCIETY

Logging practices and associated road building have damaged salmon habitat. Today the forest industry is working with others to minimize its impact on salmon.

Forestry
(continued from page 9)

Research Station in Corvallis, has investigated the impact of forestry throughout the Pacific Northwest, from Alaska to Oregon. He says we have changed our forest ecosystems in profound ways in terms of salmon habitat.

"We have altered the natural processes that originally created our forested and aquatic ecosystems," said Reeves. "You have all the immediate effects, like increased sediment into streams and increased water temperatures. But you also have to look at the big picture—we have harvested the timber to such a sheer magnitude, over such a wide area of land, so much more frequently than natural disturbances like wildfire occur—that the entire ecosystem is different.

"We no longer have significant large woody debris in the streams and rivers. Wood was the basis for stream structure, fish habitat. Wood, creating backwaters and pools, trapped spawning gravel, provided detritus [loose material] for the energy base of the stream. Wood was the glue that held together the whole stream and river systems. And wood is woefully inadequate now.

"If we want to restore habitat for salmon we are going to have to do more than pat ourselves on the back for putting in a few logs here and there in a stream," continued Reeves. "We aren't acknowledging the causes of watershed habitat degradation—we are merely treating the symptoms. To have adequate habitat for wild salmon, we will need to manage whole watersheds, whole ecosystems differently. We aren't doing this yet."

However, Bill Arsenault, who operates a small woodland farm near Elkton and is a vice president of the Oregon Small Woodlands Association, has a different perspective. Arsenault says a study conducted by the Oregon Forest Resources Institute, a state-chartered organization, showed that about 90 percent of the forest land base in Oregon in 1600 exists today.

"What I'm doing on my place primarily is putting wood back in the streams," said Arsenault. "This is very important as an interim step [in improving salmon habitat]. Current forest practices are designed to allow the natural system to put wood back in the streams. But that's a long-term process."

Although timber practices are now changing for the better and public land managers are now protecting more areas for natural, non-consumptive uses including wilderness, wildlife, fisheries and water quality, the salmon will be affected by past forest practices for many decades, said Reeves.

But notwithstanding past problems, the healthiest remaining habitat for salmon is in some forested areas, said Jim Martin, an assistant director of the Oregon Department of Fish and Wildlife.

The forest industry, from large corporations to small-woodlot owners, has faced many changes because of regulations established to protect natural resources. Environmental laws, such as the Oregon Forest Practices Act on state and private lands and the Northwest Forest Plan on westside federal timber lands, are changing forestry practices. Buffer strips of trees must be left along most year-round streams to provide shade and a source of wood. Reforestation is required. Culverts are better designed to allow fish to pass, and road construction standards are much stricter. Fish and wildlife habitat must be protected in certain areas. On federal lands, watershed reserves have been set aside to help threatened species such as spotted owls and marbled murrelets, and these areas also help salmon.

"The Oregon Forest Practices Act is a dynamic statute—it is ever changing," said Ray Wilkeson, legislative director for the Oregon Forest Industry Council. "We have supported significant increases in the level of regulation over time. And we have complied, as long as the regulations are based upon science and newly learned information. For example, we are inventorying old logging roads because they have been a problem for water quality and fish in the past, and either rehabilitating or repairing them or putting culverts in them to provide safe passage for fish."

Today, the forest industry, university researchers, citizens in watershed councils and the government are working together more than ever to try to minimize forestry's impact on salmon habitat, especially in the Oregon Plan, to promote recovery of Oregon's native salmon stocks.

"We all want pretty much the same thing—to manage the forest so it doesn't degrade fish habitat," said Wilkeson. "But we don't want to be put out of business."

Ranching

By Andy Duncan

There is ranching through much of Oregon. This includes the beef cattle and dairy industries. But it's different in the higher, drier country east of the Cascades than on the rain-soaked lands of western Oregon. The reason isn't simply precipitation.

In western Oregon, most of the livestock graze on private land. In eastern Oregon, many ranchers in the beef cattle industry lease federal property managed by the Bureau of Land Management and the Forest Service to augment their own land.

When it comes to ranching and salmon, there are plenty of perspectives. They range as wide as the western landscape:

"East of the Cascades, livestock grazing has had the greatest impact on salmon outside of the dams," says Bill Marlett, executive director of the Bend-based Oregon Natural Desert Association.

"I think we have grossly underestimated the impact on watersheds and water quality caused by livestock," he adds. "To restore habitat and water quality, we must phase out livestock grazing on our public lands. Because taxpayers subsidize livestock grazing on our public lands, this would have the added benefit of saving taxpayers millions of dollars. As it stands now, the public ends up 'paying' ranchers to maintain a lifestyle that destroys salmon habitat. On private land, ranchers must keep their cows out of the streams. That's just common sense and should be a basic cost of doing business."

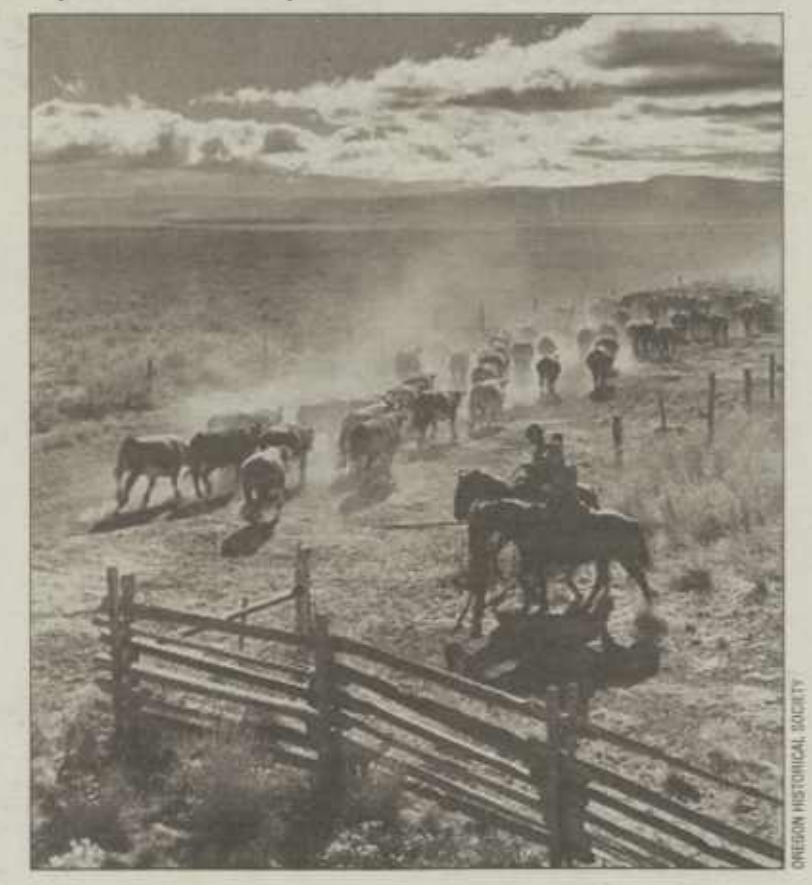
Sharon Beck, president of the Oregon Cattlemen's Association, looks at salmon and livestock very differently.

"We spend a lot of time trying to negate the misinformation people put out," says Beck, who ranches with her husband in Union County along the Grande Ronde River. "A lot of them don't have a clue about the land, the watersheds. They're never out there.

"What I'd like people to know about the ranchers of Oregon is that we're in this—clean water, good habitat for salmon—up to our eyebrows. It's our land these people are talking about. Many of us have been here for generations. The Oregon Cattlemen's Association is going to continue its programs like the WESt [Watershed Ecosystems Management] program that help people do a better job of promoting properly functioning natural systems. We're open to change, and we have our own kind of internal regulation. We don't support ranchers if they are abusing the land."

Boone Kauffman, a professor in Oregon State University's Department of Fisheries and Wildlife, says "ranching doesn't impact salmon. Cows impact salmon." According to Kauffman, cattle and other livestock can:

- Graze vegetation and trample stream banks, which can change the shape of the stream's channel, making it less suitable for salmon survival.
- Alter a stream's water quality through fecal inputs and sediment caused by trampling.
- Make water warmer by eating or trampling plants that provide shade and by altering plant life on uplands (land above a stream).
- Remove streamside vegetation that is an important source of nutrients for aquatic insects salmon feed on.



OREGON HISTORICAL SOCIETY

Right: Livestock can damage salmon habitat in several ways. Now ranchers have a program to promote properly functioning watershed ecosystems.

"The bottom line," he says, "is that in a good ecological system you can probably have some grazing. But in degraded systems it's tougher, especially where the salmon are just hanging on. If you ask the question, what's the most rapid way to recover an ecosystem, it's complete rest."

Bill Krueger, head of OSU's Department of Rangeland Resources, works with a lot of ranchers.

"People abusing their resources are probably detrimental to salmon," he says. "People trying to do a good job managing resources are probably neutral. People setting out to enhance salmon probably are.

"My attitude toward the whole salmon and grazing thing is that it's as much a discussion over paradigms as of science," says Krueger. "I think there is a group of people who say, 'what can we do to protect the earth from the evils of man,' instead of saying, 'what can we do to sustain our natural resources

(continued on page 11)

Ranching (continued from page 10)

and at the same time help people make a living so they can pay taxes and support their families.'"

Generally, Oregon rangelands are improving, although "it's still bad" in some areas, asserts Ray Jaindl, who's in charge of the Oregon Department of Agriculture's natural resources division.

"Until about the 1940s, livestock numbers were very high, and a lot of the most severe damage was done between the 1890s and the 1930s," Jaindl says. "Ranchers are living with the legacy of the past. From what I've seen, many of today's ranchers are trying to do something positive.

"But it's difficult," he adds. "They can be doing all the right things and not meet the expectations of a lot of groups in, say, a five-year period. Many places in eastern Oregon are dry, and it may take 50 or 100 years."

Jim Myron, the conservation director of Oregon Trout, a native fish conservation group, says livestock still are causing some damage. Streamside areas, where livestock tend to congregate, are not recovering as quickly as upland areas, he asserts.

With dairy cattle, one of the major challenges is managing waste. Cows are brought into a confined space for milking. Many of their owners are installing special tanks to store manure until it can be used in an environmentally "friendly" manner.

With beef cattle, the challenge can be keeping them from congregating on their own in the wrong place. In eastern Oregon, many roam free in the spring, summer and fall. Bob Morse, who ranches near Troy in northeastern Oregon, says he's made changes on land he owns and land he leases from the government.

"The streams are not fish-bearing, but the water in them gets into streams with salmon," Morse says. "We've made a lot of changes—dozens of ponds, troughs and salt blocks that distribute cattle up away from the streams. It really works. We've done other things like putting in culverts so water doesn't run over roads and cause erosion."

"Ranching has been harmful," says Bill Bakke, head of the Oregon Native Fish Society. "But I think some ranchers have shown it doesn't have to be. Overall, I'm optimistic. Once people recognize their individual practices are harmful, they'll want to make changes."

Farming

By Bob Rost

Because farmed crops need water and fertile soil, a lot of Pacific Northwest farming takes place very near to the waterways that salmon need to complete their life cycle. Typical farming methods, such as irrigation, tilling and fertilizing the soil, can bring about a variety of changes in streams and creeks running near cropland.

Agriculture has had a huge impact on salmon spawning grounds in low elevation areas, according to Geoff Pampush, executive director of Oregon Trout. The best farmland is located in valley floor areas with ample supplies of water from rivers and streams, he said. Those same streams were also once prime salmon spawning and rearing habitat, but continuous agricultural activity on adjacent lands eventually altered the streams, causing the fish to seek spawning grounds up higher where streams flow through forestland, he added.

For example, streams on farmland may be straightened, or "channelized," to increase the rate of water drainage during winter or to improve their efficiency in providing irrigation water. This is often achieved by taking all vegetation, such as fallen trees, out of the stream, and clearing stream banks of vegetation. The stream banks may be "rip-rapped," or armored with the addition of large chunks of rock to stabilize them. This prevents the stream from meandering, or changing its course gradually over time.

Salmon and other wildlife benefit from vegetation in and along the banks of streams. Fallen trees in streams create pools where salmon can spawn, and vegetation on stream banks shades the water, keeping it cool while creating a rich environment for large and small insects and aquatic organisms that salmon feed on. Meandering streams form pools near bends in the stream that serve as holding areas for adult salmon and rearing areas for juvenile salmon.

Plowing cropland contributes to soil erosion and buildup of sedimentation in streams, which tends to cover salmon spawning grounds. Application of fertilizers and other chemicals leads to the release of trace amounts of nitrates and pesticides into stream flows that may affect organisms that salmon feed on and the oxygen content in the water.

Mike Wolf, water quality specialist with the Oregon Department of Agriculture, believes that improved crop management practices, such as the use of cover crops between plant rows to soak up fertilizer not used by the primary crop, will help keep nitrates from fertilizers out of streams. He agrees that soil erosion from farm fields into streams is harmful to salmon spawning habitat.

"I'm not sure that we've pinned down exactly how much agriculture, forestry or urban development contributes to it, but soil erosion into streams that leads to buildup of sediment in gravel beds that salmon use for spawning is something that must be looked at," said Wolf. "Erosion control is an issue that agriculture is looking to improve in."

Farmers control erosion by using cover crops to stabilize the soil during winter rains. They use reduced tillage methods to protect bare soil with a layer of crop plant residue.

Taking water out of the stream for irrigation can also affect salmon. If so much water is removed from a stream that it becomes very shallow, the water temperature may increase, which is detrimental to juvenile salmon. Or, in extreme cases, if several irrigation demands are made on a stream at the same time, it may almost dry up completely. This can be very harmful to salmon if it happens while eggs or juveniles are in the stream.

OREGON STATE UNIVERSITY ARCHIVES

Farming, including irrigation, has changed the landscape in and around many Oregon streams. Today farmers, with others, are developing more "fish friendly" practices.

Other problems include irrigation intakes that lead fish into ditches and fields that will dry out when the intake is closed, and push-up dams used to divert irrigation water from the stream channel to nearby fields. Push-up dams are banks of gravel and soil pushed up in the middle of a stream with a tractor or other piece of heavy farm equipment. Their construction obliterates spawning grounds near the dam while reducing the stream flow below the dam to a trickle.

According to Bianca Streif, state biologist with the Natural Resources Conservation Service, push-up dams are being replaced by other methods of diverting irrigation water such as gravel intake infiltration galleries. These are subsurface water intakes consisting of a system of tubes under a grate covered with gravel. Water sinks through the gravel into the gallery and is pumped out of the stream. This allows removal of water without disturbing the stream, said Streif. And it enables farmers to accurately measure the amount of water they take, she added.

Farmers keep fish out of diversion ditches and irrigated fields by putting screens on irrigation intakes.

Streif noted that many farmers around the state are trying to avoid over-taxing water resources in streams by working together in watershed groups to coordinate the timing of their irrigation demands on a particular stream or creek.

Dave Buchanan, an Oregon Department of Fish and Wildlife biologist who also farms near Corvallis, sees watershed working groups as one of the best things farmers are doing to help salmon.

"Watershed groups include farmers and other landowners in a particular watershed," said Buchanan. "These groups provide opportunities for people concerned about the watershed they live in to talk to each other. As a wildlife biologist and a farmer I believe it's important for landowners and biologists to listen to each other. Watershed working groups provide a forum where this can happen."

Many watershed groups such as the Trout Creek group in eastern Oregon, and the Mary's River, Tillamook, Coquille River and Illinois Valley groups in western Oregon, are well-established. Others are forming around the state.

Kent Madison, a farmer near Hermiston in eastern Oregon, said the most important thing farmers could do for salmon is to fence off streams on farm property. That's what he has done along streams on his 15,000-acre farm.

"There's no question that historically, some farming practices have caused problems in streams," said Madison. "However, streams can recover if they are protected. If the public can come up with a way to compensate farmers for the taxes they have to pay on land set aside to create buffer zones along streams, before long we would have more fish than we know what to do with."

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Farming
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Streif agrees with Madison that protecting streams is a high priority for helping salmon.

"The primary way that farming affects fisheries is either farming all the way through the riparian zone, or farming too close to the edge of the stream," Streif said.

When left to develop naturally, a stream becomes a complex system of different characteristics, Streif explained. It will tend to meander and have rapidly flowing shallow stretches in combination with deep, cool pools where flow rates are slow, and the vegetation in the stream and along its banks will vary quite a bit, she added.

"Salmon have a complex life cycle and they need diversity in the habitat structure of the stream in order to survive," Streif said.

People in farming have learned from past mistakes and they've made changes in their soil and water management practices, according to Madison. But the public needs to remember that farming is a business and farmers are influenced by economic factors, he added.

Dams

By Tom Gentle

Dams pose stark and difficult choices in the debate about the future of salmon. There is little good that can be said about the effects dams have on salmon populations. On the other hand, few would deny that dams have made our lives better.

It's important to note that any discussion of dams involves two distinct sets of dams.

1) The federal dams in the Columbia-Snake River system, which includes 14 dams on the Columbia and 13 on the Snake. These dams constitute a sophisticated, interlinked system that generates electricity and provides benefits to navigation, flood control and irrigation to the entire region and beyond.

2) The dams that are not part of the Federal Columbia River Power System. Within the Columbia Basin—including, in Oregon, the Willamette and Deschutes rivers—there are 136 dams that provide hydropower and other benefits. In addition, there are as many as 3,600 smaller dams in Oregon that provide water for municipal, industrial, irrigation, livestock and rural uses.

There are two major issues with dams.

• Dams block fish passage upstream to areas where salmon once reproduced and spent their early lives. Grand Coulee on the Columbia River and Hells Canyon on the Snake permanently block 1,200 miles of those mainstem rivers once used by salmon. Similarly, dams block rivers and streams in the Willamette Valley, central Oregon, Klamath County and southeastern Oregon.

• Dams reduce the number of juvenile salmon that migrate downstream to the ocean. On the Columbia-Snake system, juvenile salmon that remain in the river on their downstream migration must pass eight dams. An estimated 10 to 15 percent die passing through the turbines at each dam—which means 60 to 70 percent of those fish will never reach the ocean. The dams also create a series of lakes, slowing the current and delaying downstream migration. The delay interferes with internal biological changes that enable the young salmon to survive in saltwater. In addition, the slack water exposes them to northern pikeminnows, also known as squawfish, and other predators, including several introduced species, walleye and bass.

LYNN KETCHUM, OSU EXTENSION AND STATION COMMUNICATIONS

Matt Adams, a technician with the Oregon Department of Fish and Wildlife, holds a chinook salmon just downstream from Bonneville Dam on the Columbia River. Adams works at his agency's nearby Bonnevile fish hatchery.

LYNN KETCHUM, OSU EXTENSION AND STATION COMMUNICATIONS

Dams restrict fish passage to the ocean and back to spawning grounds.

A number of solutions have been proposed to reduce the harm caused by dams:

• Spill water over the dams at critical times to speed downstream migration.

• Install screens and bypass systems to divert fish away from turbines.

• Continue transporting juvenile salmon downstream in barges to avoid killing fish at each dam and to speed their trip downstream.

• Lower the water level behind some dams to the top of the spillway.

• Remove or breach some dams.

Each of these solutions is surrounded by controversy and scientific uncertainty. For example, spilling water over the dams is costly in terms of lost electric power generation. The National Research Council endorsed barging as an effective approach for moving juvenile salmon downstream, though noted that more information is needed about how many of the young salmon return as adults and successfully spawn.

"Some of these solutions, like barging, attempt to get around natural processes rather than create conditions that salmon are adapted to. Instead, we should be looking for solutions that take into account the biological and physical conditions that salmon need to survive," said Bill Liss, an OSU fisheries biologist.

As an example, he pointed to the massive release of water on the Colorado River that created new gravel bars, pools and other conditions needed by native fish. He also noted that new surface bypass systems to get smolts past the turbines take into account the surface-oriented nature of migrating juvenile salmon. "This approach has promise, and it doesn't mean we have to return the river to its pre-European condition."

Removal or breaching of dams is being seriously considered for some non-Columbia-Snake system dams. "Many of these dams are licensed by the Federal Energy Regulatory Commission. When their licenses expire, they may have to install fish passage facilities to get renewed if required by the appropriate federal agency to protect salmon. It's too costly for some of the dam operators and it's possible the dams will be removed." said Peter Paquet of the Northwest Power Planning Council.

Jackson Street Dam in Medford is being replaced by a smaller structure that will allow fish passage, and Savage Rapids Dam on the Rogue near Grants Pass is under consideration for removal.

Breaching dams in the Columbia-Snake system is also being considered, an action that would have more far-reaching consequences as well as opposition. The U.S. Army Corps of Engineers is conducting a feasibility study to remove the earthen portion of four lower Snake River dams. It is felt that breaching would reduce the number of salmon that die passing each dam, increase the flow of water and speed migrating salmon downriver, and create spawning habitat. The Corps of Engineers is also studying a proposal to lower the 76-mile-long reservoir behind John Day Dam to expose what scientists say is about 40 miles of ideal fall chinook spawning ground.

These studies are to be completed in 1999. Among the issues raised by critics of these proposals are:

• Loss of electrical power generating capacity of five dams and the revenues from selling the electricity. An increase in reliance on natural gas, a fossil fuel, for electricity.

• Loss of the shipping corridor from Lewiston, Idaho, to Portland. An estimated $440 million worth of commodities move on the lower Snake River every year.

• Loss of irrigation for 36,000 irrigated acres that are used to grow grapes, apples and potatoes.

The debate will begin in earnest when the Corps of Engineers' report and recommendations are made public. At the center of the debate will be an issue raised by Bruce Lovelin, executive director of the Columbia River Alliance for Fish, Commerce, and Communities.

"We know the economic consequences of the proposed permanent drawdowns are great. However, the biological merits of dam removal have not been made clear," he said.

Urban life

By Carol Savonen

People have always traveled along, and settled near, water. Early Oregon settlers followed major river drainages, down the Columbia or across the Cascade Mountains, then passed down river corridors to the west. These same routes became the major transportation corridors in the state. Like beads on a necklace, the urban centers of Eugene, Corvallis, Albany, Salem and Portland are strung together by the Willamette River. East of the Cascades, major population centers like The Dalles, Bend and Pendleton are also on rivers.

About 70 percent of the people in our region live on about 2 percent of the total land mass of the Pacific Northwest. With that concentration of humans, many square miles of what was once premier salmon habitat—low-elevation wetlands, salt marshes, estuaries, streams and backwaters—are now covered with parking lots, factories, lawns, airports, shopping centers, subdivisions and roads.

"Aquatic habitats in urban areas are more highly altered than in any other land-use type in the Pacific Northwest," explained Stan Gregory, river ecologist in Oregon State University's Department of Fisheries and Wildlife. "The proportion of the streams within the urban areas that are degraded is greater than the proportion of highly altered streams on agricultural, range or forested lands. Though the total urban area may be small, cities and towns are located at biologically critical positions on major rivers, tributary junctions and estuaries."

"Our urban areas contained low-elevation wetlands and estuaries that were some of the most productive salmon habitat on earth," said Geoff Pampush, executive director of Oregon Trout, a conservation group. "People think that forest land is the best habitat for salmon. That may be true today, but in the past, low-elevation areas where our cities lie were some of the best spawning habitat."

What changes have occurred in our urban areas over time, from a salmon's point of view? Mary Abrams, soil scientist and natural resource manager for the City of Portland describes some of the ways urban life impacts salmon:

- While salmon have declined, people have become ever more plentiful. Human populations have skyrocketed in the Pacific Northwest in the past two centuries, from 100,000 in about 1800, to 1 million in 1900, to almost 10 million as we approach the year 2000. According to the National Research Council's calculation, if the population growth continues at the rate it has in the past half century, the population in 2100 will be more than 65 million people.
- We have eliminated or degraded most of the wetlands in our urban areas. These streams and rivers were once important spawning and rearing habitats. They have been dammed for early hydropower, polluted, channelized, stabilized, culverted and dewatered. Estuaries, wetlands where fresh water meets saltwater and crucial rearing areas for several species of salmon, are places where people built towns and dredged waterways. The Columbia River estuary, now a center for industry and shipping, has lost almost two-thirds of its tidal swamps and marshes because of diking and filling.
- We have altered the natural way water travels in our urban regions. Hundreds of square miles of pavement prevents natural rainwater from cycling back into the groundwater or entering streams and wetlands. Natural seeps and springs have dried up. Rain hits roofs, rain gutters and parking lots, then flows into storm sewers and is channeled out into the sewage system, then into the rivers. Flood control structures such as dikes and berms prevent water from following its natural course on river floodplains.
- Urban runoff is not just rain—it is pollution. Petroleum products, air pollution byproducts, lawn and garden chemicals, sewage and other urban dirt gets picked up by rainwater and flushed into our rivers. People illegally dispose of household chemicals down storm drains. Construction sites send large amounts of sediment into the waterways in the rainy season.
- When we cut trees for views and development, we remove the cooling shade along urban waterways.
- With increasing needs for urban drinking water, we take water out of salmon habitat for human needs. The more water we take for urban use, the less is left for salmon.

BOB ROST, OSU EXTENSION AND STATION COMMUNICATIONS

In some areas in Oregon, what was premier salmon habitat—low-elevation wetlands, salt marshes, estuaries, streams and backwaters—is now covered with parking lots, factories, lawns, airports, shopping centers, subdivisions and roads. This is Portland.

LYNN KETCHUM, OSU EXTENSION AND STATION COMMUNICATIONS

Orgeonians in cities and small towns around the state will need to make changes in how they live to make salmon recovery successful in their areas, many observers say.

With the listing of the steelhead as threatened on the lower Columbia River—including the Portland Metro area—the Endangered Species Act (ESA) has come "downtown" to urban Oregonians.

"The listing of the steelhead was a major wakeup call to us," said Eric Sten, Portland city councilor, who is coordinating Portland's response to the National Marine Fisheries Service steelhead listing. "We have no quarrel with it. They are going extinct. The big question is, can the listing become a key force in restoring salmon in our area?

"Portlanders generally really want to see rivers and streams cleaned up," continued Sten. "They want to get waste out of the Willamette and restore fish habitat. We are trying to respond with a proactive plan. And we are going to need a lot of help."

According to city councilor Sten and natural resource manager Abrams, major Portland-area efforts to help the steelhead recover will include:

- Getting rid of raw sewage in the Willamette River. By separating the storm water system from the sewer system, there will be less overflow of raw sewage into the river during periods of heavy rain.
- Establishing stricter rules for floodplain and stream corridor development, including better erosion control in and along waterways with construction practices and timing.
- Increasing public awareness about how daily activities such as the consumption of water and the use of pesticides and lawn chemicals affect local streams and rivers.
- Reducing use of chemicals in city parks and other public lands.
- Restoring habitat for salmon on the Willamette River and tributary streams.

"All these things we propose are in and of themselves good, regardless of the steelhead listing," added Sten. "If we clean up our rivers, I really think the fish will come back. They are tough creatures."

But urban areas are more difficult to restore than agricultural or forested areas.

"You can't just go in and tear everything out in the city and bring it back to its original state," said Abrams. "But you can be sensitive to the needs of the aquatic ecosystem when you redevelop or build a new area.

"Basically what we are doing now is assessing what our impacts as a city are," she said. "Then we will learn how to change."

Groups such as the Portland Home Builders Association have serious concerns about the consequences of increased regulations that may come with saving the salmon.

"We are very concerned with what might happen with measures to restore salmon runs in Portland and other cities on the Willamette," said Kelly Ross, director of government affairs of the Portland Home Builders Association.

"We've already gotten a taste of restrictions through Title III [a requirement Metro, a Portland-area regional government agency, is implementing along with local governments]. With

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that, we've had to adhere to increased setbacks from all waterways with our equipment and buildings. We have to have a 50-foot corridor on all sides from a stream, river or wetland. And that requirement might even get bigger. We already use silt fences, which are really expensive. Now there's talk of shortening the construction season, to keep it out of the rainy season."

Ross said he is not against saving salmon. But he thinks for urban interests to truly work successfully to improve odds for the salmon, there needs to be a broad-based effort by all parties involved—from citizens, to urban industries, to farming, fishing, ranching and forestry.

"All various interests need to take a cooperative approach, and be sensitive and aware of what other groups are giving up," Ross continued. "You have to be careful that no one group is feeling singled out. No one should be forced to correct a situation if others don't have to. Everybody has to give something up. Otherwise salmon recovery will never work."

Hatcheries

By Theresa Novak

Young salmon are deceptively easy to produce artificially.

Cannery operators built the first hatcheries in Oregon in the late 1870s, on the Clackamas and Rogue rivers. Their goal was to increase salmon runs by artificially combining salmon genetic material to create baby salmon fry, and then releasing the juvenile smolts to join wild young salmon swimming seaward from their upstream spawning grounds.

Today, more than 70 percent of Oregon's salmon start life not in streams but in a fish hatchery.

The role of salmon hatcheries has shifted several times over the years between a remedy for lost fish habitat to a method of helping boost wild salmon stock restoration.

But the evidence is mounting that the economic value from using hatchery salmon to supplement wild runs has come at a high cost to the health of the wild salmon.

Large-scale construction of salmon hatcheries didn't begin until after massive dams rose in the Columbia River Basin.

In 1938, Congress passed the Mitchell Act to provide federal money for aggressive construction of hatcheries as a way of replacing the thousands of acres of salmon spawning grounds that were blocked or flooded behind dams. Subsequently, more than 80 were built in the Columbia River Basin.

Along the Oregon coast, hatcheries were used to increase the numbers of salmon for sport fishing. The Oregon Department of Fish and Wildlife operates 34 salmon hatcheries. There are 10 additional ones through ODFW's volunteer-operated Salmon Trout Enhancement Program, known as STEP.

Fish from these hatchery programs sometimes are used to stock so-called artificially created water systems that are not connected to wild streams.

Such hatchery enhancements were favored by people who thought that if it looks like a salmon, catches like a salmon and tastes like a salmon, who cares where its parents were, or where and how it was hatched?

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A hatchery worker in the early 1980s. Many biologists say salmon produced in hatcheries have contributed to the loss of wild salmon. Others argue that hatcheries, managed differently, can play a role in the recovery of wild salmon.

But between the mid-50s and early 1970s, scientists increasingly found there was plenty to be concerned about. They were saying that the mass production of hatchery salmon was harming the remaining wild salmon runs and endangering the future welfare of salmon populations.

"They were like a large, unregulated experiment," said Jim Lichatowich, a fisheries biologist and salmon consultant in the Seattle area.

Early hatchery management often involved little more than transporting the biggest, most desirable species of salmon from one river to another. Little was understood then about the unique genetic makeup of each salmon run, and the "homing" device built into these fish to allow them to find their way back to their native streams.

This was clearly evident on the lower Columbia River. By 1991, the National Marine Fisheries Service could find no significant remnants of native coho salmon in the river.

Hatchery fish were less able to survive in the ocean than wild fish, although as smolts the larger, artificially reared hatchery fish sometimes outcompeted the smaller native fish.

If some salmon streams contain 70 percent or more of hatchery fish, how do you tell a hatchery salmon from a wild salmon?

Other than DNA testing, many hatchery salmon can be identified because they are missing a tiny, unused fin near the tail, called an adipose fin, that is clipped before the smolts leave the hatchery.

Onno Husing, executive director of the Oregon Coastal Zone Management Association, said some people are convinced that 50 years of aggressive hatchery propagation has destroyed all of the wild fish.

"It's a viewpoint at one end of the spectrum, but it's out there," he said.

But other groups, including Oregon Trout, a native fish conservation group, and the National Marine Fisheries Service, the federal agency in charge of protecting wild salmon, believe wild fish runs and genetically wild fish still exist.

They believe that wild salmon runs can be built back up if salmon streams are returned to their natural conditions and enough wild fish come back to reproduce there.

Underlying all of this is Oregon's Wild Fish Management Policy, which was formally adopted by the Oregon Department of Fish and Wildlife in 1992. It declares that it is the goal "of the people of the state of Oregon to restore native stocks of salmon and trout to their historic levels of abundance."

The goal of the wild fish policy is to reduce the negative effect that the hatcheries have had on the wild fish, while still maintaining the economic value of the fisheries and the communities that rely on them.

Many involved in salmon restoration groups and projects say it is easy to see now where the major mistakes were made in early hatchery management programs.

Diseases and parasites spread easily in hatchery fish, and the long-term effects of early cures sometimes were worse than the disease.

Little study was given to the long-term effects that mass releases of hatchery salmon would have on the health of streams and the other life forms in them.

Because hatchery salmon do not return to spawning grounds, fewer salmon are laying eggs and dying in woodland streams.

This means the loss of an important source of food for bears, foxes, eagles and raccoons, as well as in-stream animals.

"We're just beginning to understand how important those carcasses are to the whole ecosystem of that habitat," said Jim Martin, a chief developer of the Oregon Plan for Salmon and Watersheds.

Salmon also are important to the culture and economy of Pacific Northwest native American tribes.

For centuries, salmon served both as an important food source and cultural icon for the native people of the Northwest. But without consulting them, federal and state governments blocked salmon streams with dams and then built hatcheries downstream rather than in the upstream fishing grounds of the tribes.

Yet some see modern hatcheries that manage for genetic diversity as an important component in salmon recovery.

Henry Yuen, a fisheries biologist for the Columbia River Inter-Tribal Fish Commission in Portland, said hatcheries may become intensive care centers in the salmon recovery process, incubating dwindling stocks of wild salmon for re-release into restored habitats.

"Not every scientist has a negative view of hatcheries, and some offer solutions on how to use them properly," Yuen said.

For example, hatchery fish have been used to repopulate and re-establish extinct wild runs, such as the ones in the Umatilla River. Considered a conspicuous success, the massive project cost more than $50 million to bring hatchery-reared salmon back to a river where runs of coho and chinook had been extinct for more than 70 years.

Those hatchery fish appear to be surviving and behaving as if they were born to be wild, Yuen said.

Commercial fishing

By Tom Gentle

The decline of salmon has had a decidedly negative effect on the commercial salmon fishing industry in Oregon. To make matters worse, the industry and fish managers must bear much of the blame. Overfishing in the past, based on unrealistic harvest levels and reliance on hatchery salmon, contributed to the present situation.

What is overfishing? In the case of salmon, it means fishermen caught too many fish and didn't let enough return to their native streams to spawn. "Escapement" is the term given to the number of adult fish that return to spawn because they escaped being caught.

In order to increase the escapement of certain species and runs of salmon, fishing regulations have placed ever tighter controls on commercial and sport fishermen. Fishing seasons for various salmon species have been closed. For others there are shorter seasons, quotas on the number of fish that can be caught, or gear restrictions such as mesh size in nets that allow fish to avoid being caught.

"There's probably no natural resource in the United States managed as intensively as the salmon in Oregon. We [managers and fishermen] have made some mistakes, but the fishery is watched closely," said Jeff Feldner, a Newport salmon fisherman.

Even though season closures and strict regulations have reduced fishing efforts and numbers of participants, commercial salmon fishing continues in Oregon. This often comes as a mystery to people like the visitor from the Midwest who recently asked the clerk in a Eugene seafood store, "If salmon are endangered, why do they let anyone catch them?"

The answer to that question lies in the unique life histories of different species of salmon that come from different river systems. Not all species of salmon that return to Oregon's rivers are endangered. Some can be caught in the ocean because they are not mixed together with other species that are protected.

Today, there are three distinct commercial salmon fisheries in Oregon.

- An ocean troll chinook fishery along the Oregon coast. Trollers catch fish by slowly trailing baited lines through the water.
- A non-Indian gillnet fishery on the lower Columbia River. About 100 fishermen participate in a special fishery for aquaculture-raised salmon in Youngs Bay. Gillnetters, who use a net that entangles fish by the gills, can also catch hatchery runs if there is a surplus. In addition, sturgeon gillnetters are allowed to keep 100 spring chinook caught accidentally while fishing for sturgeon.
- A treaty Indian gillnet fishery on the Columbia River between Bonneville and McNary dams. This year, four Indian tribes are entitled to catch 40,000 fall chinook and a specified number of steelhead under treaties with the U.S. government specifying that the tribes reserved the right to fish "at all usual and accustomed fishing sites in common with citizens of the United States." The fall chinook run is in the best condition of all the salmon on the Columbia River. In 1998, a total fall chinook run of 232,000 fish is expected, including both hatchery and wild fish.

In addition, commercial fishermen from British Columbia and southeast Alaska catch chinook that originate in the Columbia River system and the coasts of Oregon and Washington. The Pacific Northwest fish are mixed with salmon from Canadian and Alaskan rivers.

In the past 3 years, Canadian salmon trollers have cut back fishing off Vancouver Island by 70 to 80 percent, which has reduced the harvest of Columbia River and Oregon coast chinook, according to Paul Heikkila, OSU Extension Sea Grant agent. Similarly, the Alaskan salmon troll harvest has been cut in half from the effort 10 years ago, primarily to avoid catching Snake River chinook.

The restrictions on commercial fishing have taken a toll on individual fishermen and the Oregon economy.

Commercial salmon trolling licenses in Oregon rose to more than 8,000 in 1980. By 1993, there were fewer than 2,000 licenses. That figure is now estimated to have dropped to 1,200 licenses, according to Heikkila. But only about 300 of those license holders reported making any landings this year.

Astoria was the site of a huge salmon gillnet fishery early in the 20th century. Most of the remaining gillnetters now fish in Alaska and rarely set their nets on the Columbia River.

According to a report on the economic impact of fishing restrictions on Oregon's salmon trolling fleet prepared for the Oregon Coastal Zone Management Association, commercial salmon fishing is expected to generate $4 million in personal income in 1998. This compares to a yearly average of $41 million in 1976–80; an average of $14 million in 1981–85, a period that includes a severe El Niño; and a yearly average of $25 million in 1986–90.

The situation of the treaty Indians is more complicated. Before court decisions that recognized their rights to salmon, landings of fall chinook varied from 40,000 to 57,000 fish each year. In 1975, the catch peaked at 140,000 fish. In 1997, that number dropped to 39,400 fish.

"The size of the tribal catch depends on the size of the returning salmon run, so it fluctuates from year to year," said Rick Taylor, public information officer for the Columbia River Inter-Tribal Fish Commission. "But it's fair to say that few if any tribal fishers can make a moderate living by fishing."

To add to these economic woes, the ready availability of salmon from aquaculture operations around the world has depressed the prices commercial salmon fishermen receive for their catch. Some salmon trollers can supplement their income by fishing for other species such as albacore, crab and bottomfish. But the days when a troller could earn a decent living from salmon alone appear to be over.

"Salmon trolling was the traditional entry point into the fishing industry for young people. They learned how to fish and moved to bigger boats in other fisheries," said Ginny Goblirsch, OSU Extension Sea Grant agent. "Not only are a lot of people losing a livelihood, for many families a way of life is coming to an end."

Most observers see a limited future for commercial salmon fishing on the Oregon coast. Restrictions being considered for various chinook populations could squeeze the trollers even more.

Jeff Feldner is an optimist about the future. "The best thing we can do is bring habitat back in line with what we know to be suitable for spawning and rearing. And we need to continue to hold catch rates down. If we get the cold water conditions [ocean upwelling] we had in the 1960s and 70s, fish will come back if we have the habitat," he said.

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Commercial fishing harvest levels contributed to the salmon decline. New regulations are intended to help the fish recover.

Recreational fishing

By Tom Gentle

Last August, a special sportfishing season to catch hatchery coho opened off the mouth of the Columbia River. The season was to remain open for eight weeks or until 7,000 fish had been caught. It took only six days for salmon anglers to reach the 7,000 fish limit.

There are two lessons to this story. First, salmon fishing is a big deal in Oregon, a fact confirmed by Liz Hamilton, executive director of the Northwest Sportfishing Industry Association. Her organization represents businesses that cater to recreational anglers, from makers of boats and fishing reels to sporting goods stores, marinas and guides.

"Salmon are the heart and soul of sportfishing in Oregon. Not only do large numbers of people fish for salmon and steelhead, but they do so with passion and commitment," Hamilton said.

The second lesson of the shortened fishing season is that salmon anglers catch a lot of fish and have been one of the contributors to the salmon decline.

How big is salmon angling in Oregon? Of the 800,000 anglers who purchased fishing licenses in 1996, roughly one-third, or 265,000, also received a salmon and steelhead tag that allowed the holder to fish for salmon.

Sportfishing is a big business in the state. In 1996, anglers spent almost $623 million in

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Oregon and generated $1.2 billion in economic activity, according to statistics compiled by the American Sportfishing Association. That total applies to all kinds of recreational fishing, including trout, sturgeon, bass, walleye, halibut and ocean bottomfish. Salmon angling accounts for one-third of that total or more.

Unlike other sport fish, salmon are caught in both saltwater and fresh water, from the ocean to coastal bays to coastal rivers and tributaries of the Columbia River. Such wide geographic distribution as well as the varying life cycles of different species helps explain why recreational fishing for salmon can continue even as some populations of salmon are declining. In some rivers, a fall run may be in trouble, but a spring run may be healthy. The runs on other rivers may be consistently healthy.

But anglers have encountered more restrictive regulations to protect salmon populations in recent years. Restrictions include closure of streams, shortened seasons, bag limits, catch-and-release rules, prohibitions on bait and certain types of fish hooks. These restrictions have applied to various runs of chinook, coho and steelhead on streams such as the Willamette, Deschutes, Rogue, lower Columbia and many smaller streams on the southern Oregon coast.

TOM GENTLE, OSU EXTENSION AND STATION COMMUNICATIONS

An angler hauls in a Columbia River fall chinook near Portland. Sportfishing restrictions are intended to cut pressure on salmon.

Perhaps the most notable effect of the salmon decline on recreational fishing in Oregon has been the closure since 1994 of most recreational ocean coho fishing. Hamilton called it "a most painful closure. It was a tremendous loss."

Coho, which are caught near the surface in water close to the coastline, bite with abandon and are prized for their fighting qualities. The number of salmon and steelhead tags issued in 1994 gives an indication of the effect of the coho season closure. The number of tags dropped from a high of 312,300 in 1989 to 176,000 in 1994, or 136,000 fewer potential salmon anglers.

With coho out of the picture, many anglers have shifted to fishing for other species of fish, thus putting more fishing pressure on other species. "And those who can afford it now head to Alaska or Canada. So instead of taking several salmon fishing trips a year in Oregon, we're seeing people make one trip up north," Hamilton said.

"The sportfishing closure really hit the charterboats in the small ports like Winchester Bay and Gold Beach," said Ginny Goblirsch, OSU Extension Sea Grant agent.

Coho fishing was the backbone of the charterboat industry, according to Frank Warren, a Portlander who operates a charterboat out of Hammond at the mouth of the Columbia River. "Now we're about as low as we can get without shutting down," Warren said. "This five-day hatchery coho season doesn't really help charterboat operators. You can't even pay your insurance in a five-day season."

Unlike commercial salmon trollers who switched to chinook when coho fishing was banned, charterboat operators do not have the proper gear to catch chinook, which are caught at greater depths farther offshore than coho. With ocean chinook unavailable, charterboats have turned to halibut and bottomfish in the ocean and sturgeon in the Columbia River as alternatives.

Ironically, the switch to other ocean species has put more strain on these stocks, most notably lingcod and other bottomfish.

Thanks to the variety of different fish in Oregon, sportfishing remains one of the state's great attractions. And because of the huge numbers of anglers, the sportfishing industry represents one of the best hopes for the future of salmon in Oregon, according to Hamilton. She pointed out that salmon anglers are the one group that interacts with salmon at every place they are found, from the ocean to the distant inland tributaries.

Recreational anglers have been a significant force in salmon recovery efforts as far back as the 1960s. When the Oregon legislature passed a law establishing the Salmon and Trout Enhancement Program, or STEP, in the early 1980s, anglers were major participants in voluntary STEP activities to improve and restore populations of salmon and trout.

"There isn't a group more dedicated to the future health of our streams than sportfishermen," said Hamilton, who counts herself among those early STEP volunteers who planted trees on streambanks and placed logs and rocks in streams to create better habitat for salmon.

The Native American fishery

By Theresa Novak

For many centuries, the native people of the Pacific Northwest based their economy, culture and religion on salmon fishing.

In the last century, the tribes saw both their management of salmon and the salmon runs themselves diminish despite treaties that assured their basic cultural rights to salmon.

But in the past 30 years, Native Americans have become key participants in front-line salmon management and restoration.

Twelve of the 13 federally recognized tribes in Oregon now are actively involved in seeing that salmon runs are restored or preserved for future generations, reversing a trend that began when European fur trappers arrived in the Columbia Basin in 1770.

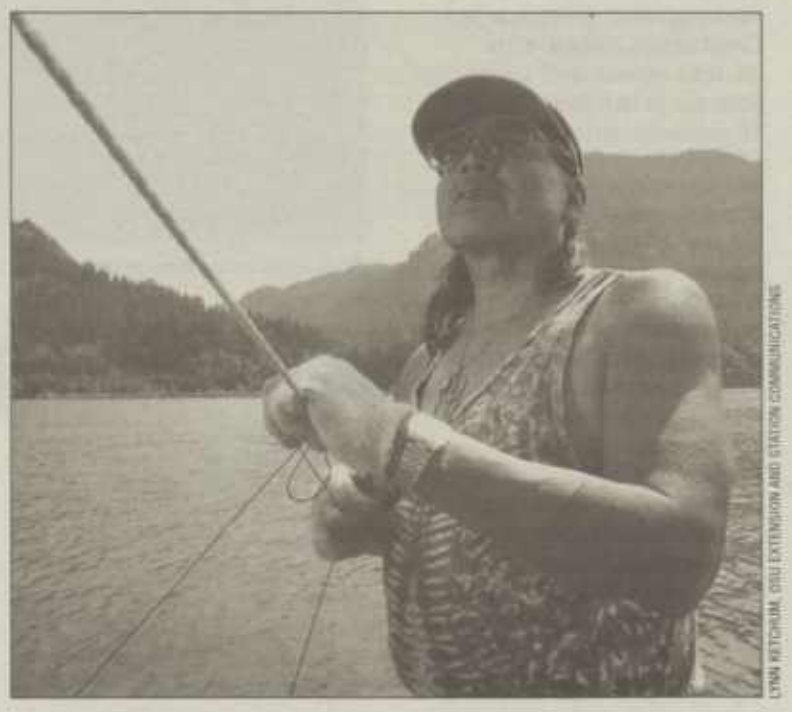
Those early explorers found a thriving population of about 100,000 Native Americans. Salmon runs of up to 16 million fish sustained them.

By 1870, the population of Native Americans was less than 10,000, mostly as a result of the diseases brought along with the westward migration. The non-native population grew to 100,000.

In 1855, the territorial government in the Pacific Northwest negotiated treaties with the Columbia River tribes. Along with assurance against attack and some health care provisions, the main provision of the 1885 treaty assured the native tribes the right to fish within reservations and "all usual and accustomed fishing places...in common with citizens."

For this they signed over to the government control of the 40 million acres that is now Oregon, Washington and Idaho.

But the tribes did not have any power to object when a growing Northwest harnessed the powerful waters of the Columbia River behind a network of dams that drowned about 2,800 miles of fish habitat in the mainstem Columbia and along its tributaries.



LYNN KITCHIN, OSU EXTENSION AND STATION COMMUNICATIONS

Jesse Sampson checks a gillnet just above Bonneville Dam for steelhead. A member of the Yakama Tribe, Sampson has fished on the Columbia River all his life. As a boy he fished at Celilo Falls, now covered with water backed up from a dam.

Tribal elders such as Delbert Frank, Sr. of the Warm Springs tribe reflected on the change in historic documents of the Columbia River Inter-Tribal Fish Commission:

"I remember the times when the Columbia River was wild and free-flowing. I have seen the massive destruction caused by the dams. The lakes created by the dams have covered many of the places I knew as a boy and a young man.

"The fishing sites, the places I camped with my family, and even the places where some of my children were born are all under water."

(continued on page 17)

Native fishery (continued from page 16)

To make up for the loss of the salmon habitat, Congress allocated money to build hatcheries. But only two of the hatcheries built were in the traditional fishing grounds of the tribes above The Dalles Dam. The remainder were below the dams.

And some tribes not a part of the Columbia River Tribes and not covered by treaty lost their salmon runs without compensation.

In 1968, fourteen members of the Yakama tribe filed suit against Oregon. They said that Oregon's state fishing regulations of native off-reservation fishing violated the 1855 treaty.

The other Columbia River tribes—the Warm Springs, Umatilla and Nez Perce—joined in the suit and won the landmark case in federal court the following year. Judge Robert J. Belloni ruled the tribes were entitled to a "fair share" of the salmon runs and the state had limited powers to regulate them.

A similar court case in Washington state resulted in a ruling that defined "fair share" as half of the harvestable fish destined to pass by the tribes' usual and accustomed fishing places.

Some fisheries organizations reacted by saying that these court rulings amounted to giving native people "supercitizen" status when it came to catching salmon. But Judge Belloni defended his decision this way:

"I did not grant the Indians anything. They possessed the right to fish for thousands of years. The treaties of 1855 simply reserved to the Indians the right which they already possessed. They traded title to most of the land in the Northwest in return for the right not to be dispossessed of their fishing rights.... No one can claim the Indians got the best of the bargain."

These days, salmon fishing experts such as Scott Boley of Gold Beach, the former president of the Oregon Salmon Commission, say the current system of harvest allocation has created a rigid, quirky system that can be unfair to tribal and non-tribal fishers.

While Boley has no argument with native tribes receiving a fish harvest allotment, he said that the tight regulatory system under which that catch is divided sometimes makes equitable solutions impossible.

With their rights to actively govern the management of salmon restored, the Columbia Tribes assumed a greater role in determining the future of salmon after formation of The Columbia River Inter-Tribal Fish Commission.

The agency is involved in the Pacific Fishery Management Council and the Pacific Salmon Treaty process and plays a key role in salmon recovery efforts.

The tribes have their own biologists and fisheries experts to assure a steady supply of salmon for economic and ceremonial uses.

The Columbia River tribes have their own salmon restoration plan, called "Wy-Kan-Ush-Mi-Wa-Kish-Wit" or "The Spirit of the Salmon."

The tribal approach to salmon restoration differs both from non-tribal managers and from the recovery plans of other tribes, said Patty O'Toole, the primary fisheries biologist for the Warm Springs tribes.

"We still are fortunate enough to have populations of wild fish to protect, whereas some of the others focus more on hatchery production," she said.

Rather than bolting together logs in streams to give salmon a shaded area for spawning, O'Toole said the focus is less on engineering a solution and more on allowing natural habitat recovery to work.

"We practice some passive restoration techniques and not a lot of bio-engineering," she said. "We'll build a fence, keep the cows out and let (the stream) stabilize on its own."

Tribal members are active in on-the-ground work such as building fences and installing solar-powered water pumps to bring water to the cattle in the fields. They build concrete irrigation dams for landowners, complete with fish passages to discourage construction of temporary earthen water storage dams that block fish migration.

Louie Pitt, the director of government affairs and planning for the Confederated Tribes of Warm Springs, said the emphasis on direct action and direct benefits to fish reflects the philosophy of the tribe:

"We are here for the long run," Pitt said. "We want to see the salmon here for our generations to come."

Alanna Farrow of the Umatilla tribe said many Columbia River tribes see themselves as "salmon people."

"For most tribal people, the salmon is an indicator species not only of the animal world but of the Indian people.... Once the salmon are gone, soon the Indian people also will be extinct."

Estuaries

By Theresa Novak

TOM GENTLE, OSU EXTENSION COMMUNICATIONS

South Slough estuary at Coos Bay. Estuaries are where rivers and streams meet the ocean. Salmon migrating to the ocean spend time in estuaries. Human activities can make estuaries less hospitable. Several restoration programs are underway in the state.

To those of us who enjoy the ocean, an estuary is simply a place where the incoming ocean meets out-flowing rivers and streams, forming mudflats and marshes.

To salmon, it is a sort of incubation area. Young smolts headed out to sea adjust to the saltwater that will be their home until they are mature enough to return to their inland spawning grounds to launch a new generation of salmon.

Estuaries are where young salmon smolts spend the winter, gaining strength and size before heading into the ocean.

Oregon's estuaries are better off than those of many coastal states.

Nationally, the chief administrator for the National Oceanic and Atmospheric Administration announced in February 1998 that 20 federal agencies have launched a "State of the Coast" report to detail the threats to the nation's estuaries and coastlines from booming population growth and increasing pollution.

But Oregon's 21 distinct coastal estuaries, ranging from 25 acres to 3,000 acres, are protected under Goal 16 of Oregon's land-use planning laws. Goal 16 specifies that all estuaries in the state be classified as either development, conservation or natural.

While that now assures that estuaries have certain protection, laws passed long ago damaged estuaries and tidelands.

The Federal Swamplands Acts of 1849, 1859 and 1860 encouraged coastal settlers to drain and dike tidelands.

Between 1885 and 1983, development, draining and dredging along the lower Columbia River converted about 7,000 acres of marshland into farmland through dike-building that was pursued until the 1930s.

After the 1930s, most of the development of estuaries and wetlands involved dredging and filling to deepen channels for ports, piers, boardwalks and buildings.

By the 1970s, between 50 and 70 percent of Pacific Northwest estuary wetlands had been reduced through diking and dredging

These projects eliminated some of the wetlands where smolts linger, grow and acclimate before heading out to the ocean. Salmon species such as chum, coastal coho and chinook seem particularly dependent on estuaries to accustom them to saltwater and prepare them for their lives at sea.

But increasing information about the role of coastal wetlands and estuaries led to increased federal and state rules about building new dikes or dredging and filling activities.

Oregon has required permits for filling or removing land in waterways of all kinds—including estuaries—since 1971.

Pollution also poses a threat to estuaries. Storm water washes off everything from parking lots in Portland to farm fields in Silverton and eventually washes into estuaries as well.

Jane Lubchenco, a marine ecologist at Oregon State University, said the excess of nitrogen and phosphorus from fertilizer runoff, waste from people and animals and the burning of petroleum products appears linked to large, oxygen-robbing blooms of algae.

These blooms can sicken humans and kill fish, she said.

Yet the dangers to estuaries are balanced by efforts on their behalf.

Some of the most aggressive efforts on behalf of habitat restoration are taking place along coastal estuaries.

In the Salmon River Estuary, Coos Bay and the Youngs Bay system, estuary wetlands are being returned to their natural function through the removal of dikes. Culverts also are being removed or modified to restore the tidal exchange and improve the health of estuaries.

Three such programs are:

- The Tillamook Bay National Estuary Project. Over four years, studies of the condition of the bay have helped develop a plan to improve salmon stocks and solve problems of bacterial pollution and the silting-in of the bay.
- The Lower Columbia National Estuary Program. This involves Oregon and Washington. The goal is to improve this estuary, which extends from Bonneville Dam to the mouth of the river near Astoria.
- The long-running South Slough National Estuarine Research Reserve, five miles southwest of Coos Bay. This has been an education and research site for estuary management since 1974.

Predators

By Theresa Novak

Salmon once were so abundant, they were a main food source for animals of the land, air and water.

But as the number of salmon have decreased, concerns have increased that not enough is being done to control the number of natural predators that feed on them.

Seals and sea lions are two examples of salmon predators that now seem out of balance with their prey.

The population of these fur-bearing, ocean-going mammals dropped very low in the early part of the century due to demand for their pelts. Fishermen sometimes shot them on sight because they competed for fish and raided fishing nets.

While seal and sea lion numbers rebounded after the Marine Mammals Protection Act in 1978 prohibited harming them, the numbers of salmon have fallen to historic lows.

Some people thought the two trends were related, a view that gained popular attention by the well-publicized salmon-gobbling antics of Hershel, the determined sea lion.

In the 1980s, the big sea lion had a big appetite for mature steelhead salmon. His habit of gobbling them as they swam into the locks in the Ballard district of Seattle earned him the reputation for almost single-handedly wiping out a steelhead run.

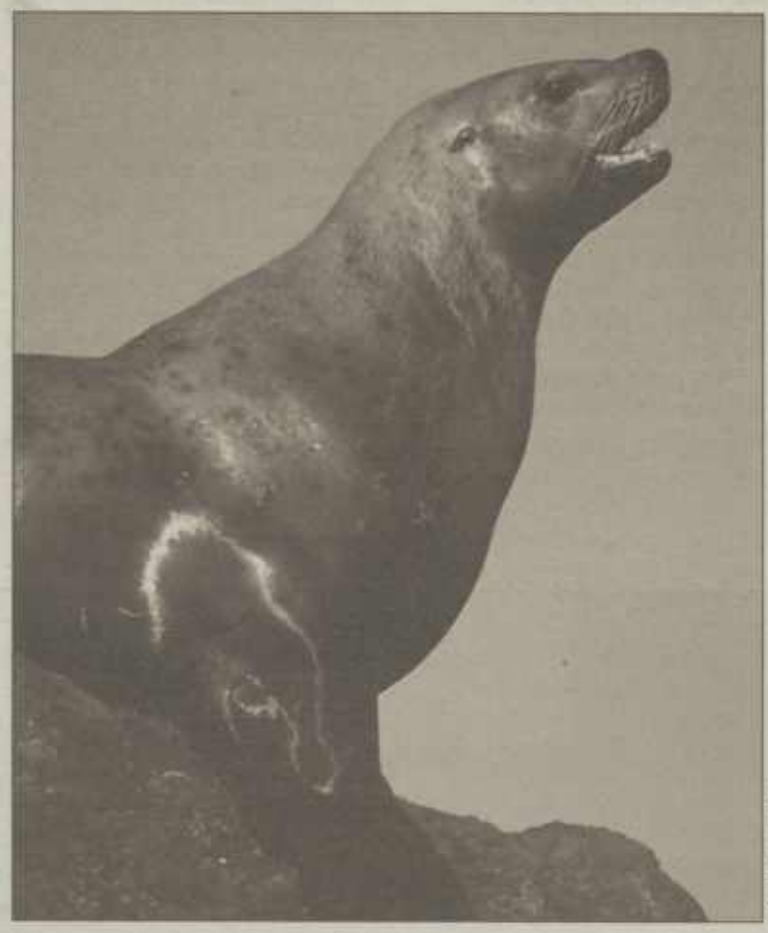
Hershel also proved to be determined. Despite being moved many miles from the locks at Seattle, he found his way back.

Nowadays, Hershel is an attraction at Sea World.

But nuisance animals such as Hershel, who go into a feeding frenzy over migrating salmon, prompted an amendment to the Marine Mammals Protection Act allowing federal marine fisheries officials to remove—even kill—particular individuals that are devastating a salmon run.

"When you have 600–700 adult sea lions (in a given area) and you only have an expected return of 2,500 wild coho, you have to ask yourself whether that is an acceptable loss," said Robin Brown, a marine mammals specialist with the Oregon Department of Fish and Wildlife.

And as wildlife officials struggle to control one predator whose numbers are on the rise, the impacts of other predators are being better understood.



TOM AND PAT LEESON

Many researchers see increased predation by creatures such as sea lions, triggered by human-related changes in the ecosystem, as one of numerous factors contributing to the decline of salmon.

A three-year research project by wildlife biologist Daniel Roby of Oregon State University and OSU researchers Larry Davies and Carl Schreck indicates that sea birds known as Caspian terns are gobbling millions of salmon smolts as they swim down the Columbia River estuary and head toward the Pacific.

The terns have established what may be the largest breeding colony in the world. More than 8,000 nesting pairs live on a man-made sandbar called Rice Island, produced during dredging of the Columbia River. The seven-mile finger of sand has formed the perfect place for the terns, but its effect on salmon appears devastating.

According to research by the Roby-Schreck team, between 5 million and 20 million salmon smolts headed for the estuary in 1997 fell victim to terns nesting on Rice Island. That amounted to up to 30 percent of the smolts that were headed for the estuary.

The numbers vary so greatly because it isn't known how much of the loss of the smolts was due to terns and how much of it was due to gulls and cormorants, which also feed on smolts.

Yet as sea birds, the terns are federally protected, once again posing the question: How do you prevent one protected species from pushing another closer to extinction?

However, neither Brown nor the history of salmon predator control supports a full-scale attack on salmon predators such as the terns, mostly because such efforts in the past have produced unwanted side effects.

For example, after a 1991 study showed that northern pike, once known as squawfish, were eating up to 61 percent of the salmon smolts entering the pool of the John Day Dam, an aggressive program was started to reduce the number of these native fish.

The plan had some unexpected consequences. Predators that normally ate the northern pike began eating salmon instead. The same thing happened after populations of northern lampreys, once an abundant eel-like fish that was the preferred food of seals and sea lions, began declining because of changes in the lamprey habitat.

Non-native predators such as walleye, shad and small-mouthed and large-mouthed bass also prey upon salmon smolts. Largely unknown is what sorts of ocean-going predators may be seeking out salmon as food because their usual supply of prey is not available.

Those concerned with salmon restoration are taking action and gathering more information and authority so that natural predators don't wipe out salmon while humans continue efforts to restore salmon habitat.

Now the Oregon Department of Fish and Wildlife is seeking authority to remove or occasionally destroy nuisance seals and sea lions without having to go through federal channels.

The ODFW also is seeking ways to reduce the number of exotic fish that out-compete or eat salmon.

The way that salmon are released from hatcheries and barged around dams also is being changed to make it tougher for predators to catch the salmon when they are most vulnerable.

More will need to be done in the way of research and compromise so that the struggle for survival between salmon and their predators will again be a fair fight.

Natural fluctuations

By Theresa Novak

Salmon are one of Nature's toughest species. Their habitat ranges between inland streams and ocean depths. They have evolved over the ages to survive many natural changes in their environment.

Fossil records indicate times when salmon were plentiful and when they were scarce. Those may have been times when salmon populations were recovering from shifts in climate that brought about Ice Ages.

Devastating earthquakes, volcanic eruptions, massive floods, landslides and brush fires also represented the fluctuating conditions on the landscape of salmon.

Given enough time, salmon have proven that they can weather such fluctuations. A recent example is that salmon are starting to return to streams through the blast zone on Mount St. Helens less than two decades after the 1980 eruption.

Salmon similarly can adapt—and sometimes even benefit—from large floods that send woody debris into streams and open up new channels that may be blocked by landslides.

But humans may be having an influence on the rate of natural fluctuations, said Dan Bottom, the monitoring coordinator of the Oregon Department of Fish and Wildlife for Oregon's salmon recovery plan.

Pollution, long-range changes in climate, shifting ocean currents that run hot and cold and pollution are suspected of having an influence on salmon.

The upsurge of cold, nutrient-rich water from the ocean depths is one natural phenomenon that benefits salmon smolts as they enter the ocean. What prompts this seasonal cold-water upwelling is not well understood. Yet when the upsurge is delayed, as it sometimes is, young salmon smolts don't get enough to eat, so more of them die.

Warmer temperatures seem to trigger another natural control on salmon, diseases.

John Fryer, a microbiologist and retired department head of Oregon State University's microbiology program, said about 40 types of disease-causing bacteria multiply more quickly in warmer water in both streams and oceans.

While easier to document in hatcheries, the effects of warmer ocean and fresh-water temperatures are more difficult to examine, since the fish are dispersed.

One trend that appears consistent is that salmon prefer cold, wet weather rather than warm and dry, said George Taylor, Oregon's state climatologist.

A study of the weather in the Pacific Northwest and Alaska between 1896 and 1994 revealed four separate long-range climate trends. Two of them were cold and wet in the Pacific Northwest and two of these eras were mostly warm and dry.

When it was wet and cold in Alaska, it tended to be dry and warm in the Pacific Northwest, and vice versa.

Salmon populations clearly fluctuated based on the trend.

(continued on page 19)

Natural fluctuations (continued from page 18)

Alaskan salmon reached record numbers of survival during times when it was wet and cold.

When it was comparatively warm and dry in Alaska, salmon runs in the Pacific Northwest were greatly increased.

Taylor said the past 20 years, when it was warm and dry in the Northwest, have coincided with the decline of the salmon. But he said the next 20 years appear to be starting into a wet, colder time. That could mean the natural fluctuations pendulum is swinging back in favor of the fish.

Bob Wissmar of the fisheries research department at the University of Washington in Seattle said that pendulum may be moving faster than it used to because of some human-caused factors such as pollution, possible changes to the earth's atmosphere and the increased rate of changes to the inland landscape of the salmon.

For example, some biologists observe that landslides and fires, two naturally occurring phenomena, have been increasing because of human development activities in salmon habitat.

That could be speeding up changes faster than salmon can adjust.

"We human beings think in the short term," Wissmar said. "We don't realize that the rest of the Earth operates on different time scales: decades, centuries, eons."

Where possible, he suggests that humans alter the rate of fluctuations that affect salmon to slow down changes and give salmon a chance to adapt.

ANDY DUNCAN, OSU EXTENSION AND STATION COMMUNICATIONS

Right: Mount St. Helens. Salmon have always had to contend with such natural changes in their world.

The ocean

By Theresa Novak

The time that salmon spend in the ocean provides the most questions and the fewest answers as to why they are in decline.

Salmon spend 40 to 75 percent of their lives at sea, so ocean conditions play a vital role in whether these salmon will reach maturity and reproduce.

Yet increasing ocean and salmon research information indicates that ocean-going salmon smolts head into hostile waters when they head out to sea these days.

Monitoring studies of the El Niño ocean warming phenomenon, the deterioration of the ozone layer and shifts in ocean currents seem to coincide with many of the salmons' ocean-going woes: Pollution, predation, lack of food, more diseases and parasites all point to increasing water temperatures and lower survival.

Water temperature is important to salmon, which remain healthier in colder, nutrient-rich water. This kind of water historically wells up from the ocean depths to the surface waters in early spring, just in time for the arrival of the salmon smolts.

The little smolts can feed on the small creatures that eat microscopic plankton—the tiny ocean life forms that are the building blocks of the ocean food chain.

But in the past two years, said John McGowan of San Diego's Scripps Institute of Oceanography, warmer ocean temperatures attributed to the El Niño phenomenon have meant a delayed upwelling of the cold, food-rich water.

Although the colder water finally did arrive a little later in the spring, it may have been too late to save smolts from dying of starvation or being eaten by other creatures whose normal prey species already had died.

Dan Bottom, the Oregon Department of Fish and Wildlife's monitoring coordinator for the Oregon Plan for Salmon and Watersheds, said these large-scale weather changes are further stressing a species already struggling with poor habitat conditions in their freshwater environment.

"We've known for a long time about freshwater conditions important to salmon," Bottom said. "We are only now learning how those are important in the ocean."

Bill Peterson, a biologist with the National Marine Fisheries Service in Newport, has been surveying how much plankton has been available in the ocean during the past few years.

His findings support the idea that delayed arrival of colder ocean waters due to the El Niño phenomenon may be responsible for the poor survival of smolts.

Equally disturbing is the changing chemistry of an ocean that is growing algae in places where the waters had been too cold and clean before—the middle of the Pacific and Atlantic oceans now have been the site of large-scale algae blooms, indicating places where the water temperature is high and oxygen is relatively low.

George Taylor, Oregon's state climatologist, said it appears clear that survival of returning salmon from the ocean is poor during warm, dry long-range weather trends and it improves when the overall long-range weather trend is cold and wet.

Taylor said that scientists will have the opportunity to test that theory again soon, if weather predictions are correct. According to analysis of the ocean area off South America where the El Niño phenomenon begins, the coming winter should be colder and wetter than normal, as all predictions point to La Niña, or colder-than-normal ocean conditions, which could mean more smolts make it home to spawn next spring.

There is no universal agreement that warming of the oceans is a trend that will continue indefinitely, Taylor said.

"There are many variations in global and regional climate we don't fully understand. At this point, to attribute changes in these weather phenomena to human conditions is really stretching the science, in my view," said Taylor.

A remedy for ocean warming conditions will not be easy to find, but Bottom said some action taken on land can help salmon at sea. Among his suggestions:

Hatcheries could release smolts later during El Niño years, so that the arrival of the smolts coincides with the upwelling of the food-rich cold water.

A longer-term solution will require international treaties that seek agreements to limit pollution of the oceans and atmosphere.

ALASKA STOCK

Many salmon, such as this chinook, spend much of their lives at sea, but surprisingly little is known about the interplay of natural processes and human-related activities that affect ocean conditions. Learning more is a research priority.

Cumulative effects

By Andy Duncan

If Jay Nicholas wanted to point fingers in the salmon crisis, he'd need millions.

"The way I look at it, it's not anybody's fault, it's everybody's. We all get the benefits of our society. Every one of us," says Nicholas, a technical advisor to Gov. John Kitzhaber for the Oregon Plan for Salmon and Watersheds.

"But this is America. We have an incredible diversity of opinions and objectives," adds Nicholas. We want food (including salmon) and wood and electricity and shopping centers and good roads.

"We want wild salmon. We even want wildness in our neighborhoods—until the coyotes start having our pets for dinner. It's a dilemma. Our society wants everything, and finding reasonable compromises is a tremendous challenge."

Where Nicholas is headed with these observations is a discussion of cumulative effects, a theory that's a relatively young area of scientific study.

"One way to think of cumulative effects is to think of all the little actions that happen in a watershed that can have an impact," says Keith Kirkendall, a Portland-based fisheries biologist with the National Marine Fisheries Service.

"In a watershed there may be a gold mining operation. You may have gravel extraction, timber cuts and road construction to get to the timber cuts, a campground for the public, and so on," says Kirkendall. "By themselves none of these may be all that big of a deal, but when you start adding them up you say, hey, where'd all this sediment come from? Why is the water temperature rising?"

There are a couple of ways to look at cumulative effects, adds Spencer Hovekamp, another National Marine Fisheries Service fisheries biologist.

One way is "additive," he says. This is when you simply sum up the effects of all the individual human activities in a watershed. The more accurate way to look at the concept is "interactive," he says. This is when the effect of one activity interacts with the effect of another activity, or several activities, in a way that makes the impact more than just the sum.

For example, the forest canopy catches rain. Part of the water drips slowly to the ground. Some sinks in, reaching the stream gradually. This reduces the chances of erosion and helps keep the stream cool. When you remove timber, more of the water runs into the stream right away. Additional sun also heats the stream. If there's a campground, the earth probably is compacted from people walking and driving. With compaction, even more water will run into the stream immediately. Irrigation downstream, if done in certain ways, may warm the stream more. And so on.

"All the little interactions combine," says Kirkendall. "In an urban area, it's things like the black, hardened surfaces in parking lots that absorb sunlight and heat rainwater and promote runoff. It's cars in the parking lots leaking oil and antifreeze that run into streams. It's sewer outfalls and storm drain runoff into streams. It's de-icing chemicals from the airport, fertilizers from people's lawns, and so on.

"And streams in urban areas usually have been cut off from floodplains and stripped of the shallow edgewaters and wetlands that provide habitat for young salmon and filter out pollutants that enter the stream," he adds.

Estuaries, where fresh and ocean water meet, and where many young migrating salmon pause to get their bodies used to the saltwater, are "great places to build up cumulative effects," adds Hovekamp. Also, little is know about cumulative effects in the ocean.

"There's no cookbook on the shelf on how to get a handle on cumulative effects," he says. However, Kirkendall notes that "science in this area has progressed more in the last 10 years than it did during the previous 50 years."

"The state is developing an assessment manual that watershed councils around the state will be able to use to evaluate the order of magnitude of cumulative effects in their watershed," says Ken Bierly, program manager of the Governor's Watershed Enhancement Board.

Bill Krueger, the head of Oregon State University's Department of Rangeland Resources, says there is a danger that the theory of cumulative effects could confuse nonscientists.

"Everything does not add up to a cumulative effect," he says. "Thresholds and compensation [in natural systems] are well-accepted scientific principles. So some impacts are site and situation specific."

Compensation, he goes on to explain, refers to the ability of natural systems (a stream, for example) to cope with a certain level of disruption. If the threshold level is not exceeded, the system can compensate.

"I see broad recognition that cumulative effects are a matter of concern we need to look at," says Jay Nicholas. "But how we do that is not at all clear. We're trying to find a way to co-exist with nature, but we don't know how, precisely enough.

"Society wants a prosperous economy—jobs in fishing, agriculture and forestry, cheap electricity, new housing and so on. On the other hand, individual scientists might tell us we have too many roads, and parking lots and sources of effluents. Too many clearcuts and acres of pasture land and dams. But there's no formula that shows decision makers exactly how everything is connected. How much asphalt is too much? Cumulative effects is more of an art than a science at this time, in my opinion."

He reemphasizes the importance of learning more:

"Allowing the demise of salmon would be like throwing part of our historical identity in the trash can. But this is about more than salmon. We don't know how it all fits together. If watersheds are not healthy enough to support salmon, they're probably not healthy enough to support people in the long term."

NASA

Many scientists believe multiple factors caused the salmon decline. Some are studying how to more precisely understand the cumulative effect of human and natural factors.

Oregon recovery plan tries to give everyone a role

By Tom Gentle

In simple terms, the Oregon Plan for Salmon and Watersheds is an organized approach to improving watershed health and reversing the decline of native salmon in Oregon's rivers, lakes and coastal waters. It's also a proactive attempt to meet the requirements of the Endangered Species Act and other federal and state laws.

In 1995, Gov. Kitzhaber asked various state agencies to develop a salmon recovery plan for coastal coho salmon. This plan, completed in 1996, was called the Oregon Coastal Salmon Restoration Initiative. The 1997 Oregon legislature supported the plan with legislation and funding. Since then, a plan for steelhead in the lower Columbia River and along the coast has been added and a plan for the Willamette Valley is now underway. This entire planning effort is now referred to as the Oregon Plan.

So you can say the Oregon Plan is an umbrella for a number of recovery efforts involving different species of salmon—coho, steelhead, chinook—and different rivers and geographic locations of each species. Sometimes these recovery efforts are referred to as the Oregon Plan and sometimes by their more specific titles.

This is not the first attempt to save the salmon. Salmon recovery efforts in Oregon go back more than 125 years. What makes the Oregon Plan different? Earlier recovery plans tended to focus on individual parts of the problem, according to Jay Nicholas, technical advisor to

(continued on page 21)

COURTESY: CAPITAL-PRESS

Oregon legislators Lynn Lundquist, left, and Brady Adams, center, and Gov. John Kitzhaber publicly celebrate agreement on a salmon and watershed recovery plan.

Oregon plan (continued from page 20)

Gov. Kitzhaber and principal writer of the Oregon Plan.

For example, hatcheries were intended to increase the number of salmon. Fishing regulations were aimed at limiting the harvest so more salmon could return to spawn. Or a particular industry, such as logging, was singled out and asked to make changes to help restore fish habitat. But generally these efforts were carried out as if they had no connection to one another even though their goals were similar.

"In the Oregon Plan, we acknowledge that single track approaches will not get the job done. Everyone who has a role—government agencies, city dwellers, farmers, foresters, fishermen, environmental interests—needs to contribute to a solution," Nicholas said.

The Oregon Plan is also unique in its use of both regulatory and voluntary approaches, or what Nicholas calls "top down and bottom up." Fishing regulations, for instance, come from the top down to everyone who catches fish. You disobey them at your peril. On the other hand, decisions to conduct stream improvement projects on streams passing through private land are purely voluntary. You do them because you want to.

The voluntary element of the Oregon Plan is carried out through watershed councils—soil and water conservation districts and groups of local citizens who develop plans and carry out improvement projects. The voluntary element is considered crucial because a high percentage of salmon habitat occurs on private land and successful recovery efforts will require cooperation with private landowners.

Under the Endangered Species Act, the National Marine Fisheries Service (NMFS), a federal agency, is authorized to determine if Oregon's coastal coho are endangered or threatened. Once such a determination is made—called a "listing"—legal steps are set in motion that will affect the manner in which restoration occurs.

In 1997, NMFS signed a Memorandum of Agreement with the State of Oregon that said, in effect, if the state carried out the Oregon Plan, NMFS would not invoke the Endangered Species Act by listing coastal coho as threatened. "The acceptance of the Oregon Plan by NMFS reflects a whole new approach by the federal government," said Brian Gorman, NMFS spokesman in Seattle. "It's a recognition that the federal government can't recover salmon alone. It has to be done with broad support from state, county and local governments and local property owners. Recovery won't be successful without strong local support."

Environmental groups challenged the agreement in court. Chief among their complaints: the Oregon Plan places too much emphasis on voluntary efforts that could start out well but not be carried through if not compelled to do so by law.

In June 1998, a federal magistrate ruled that the law did not allow the fisheries service to avoid listing the coho as threatened in order to give the Oregon Plan a chance to work. In August, NMFS announced it would issue such a listing.

Supporters of the listing say it will create greater support for recovery efforts because it shows the importance of taking immediate action. Those opposed to the listing, including Gov. Kitzhaber, say the Endangered Species Act focuses on preventing further harm to coastal coho rather than on improving coho habitat.

Thus, the federal law can prevent private landowners from doing anything that harms the coho, but it cannot require them, for example, to carry out restoration projects such as streamside fencing.

"We at NMFS know we can't force people to do things. That's why we support the Oregon Plan. It encourages people to do positive things rather than the Endangered Species Act approach that tells people what they can't do," Gorman said.

Moreover, landowners may be reluctant to make improvements for fear of unintentionally harming the fish, which violates the Endangered Species Act and can result in a $25,000 fine and a year in jail. However, an earlier listing for coho on the southern Oregon coast did not slow restoration efforts there, according to Paul Heikkila, OSU Extension Sea Grant agent.

"People involved in stream restoration activities hoped there wouldn't be a listing. But once it happened, the attitude was to keep working at making streams better for salmon," Heikkila said.

Also on the down side, the listing will put an end to a special timber tax aimed at helping finance salmon recovery activities.

In spite of the disagreement on the merits of applying the Endangered Species Act to coastal coho, almost everyone appears to agree that the Oregon Plan holds the key to salmon restoration efforts. Spokesmen for timber, agriculture and environmental groups voiced continued support for it following the listing.

The Oregon Plan will continue to be in the news as both the state and the federal government have appealed the federal court ruling. Whatever the outcome, the Oregon Plan will still be the basic building block of salmon recovery.

There is an increasing recognition that salmon recovery is a regional problem. The federal response is already regional as evidenced in the Northwest Forest Plan and the Interior Columbia Basin Salmon Plan. In addition, salmon recovery plans with elements similar to those found in Oregon's plan are underway in California and Washington.

Restoration projects popping up around Oregon

TOM GENTLE, OSU EXTENSION AND STATION COMMUNICATIONS

Oregon State University marine extension agent Paul Heikkila plants willow trees to stabilize the bank of the Coquille River, a prime salmon stream on Oregon's South Coast. Many landowners in the area are working to improve salmon habitat, says Heikkila.

By Theresa Novak

A big part of the future of Oregon's coastal coho and other salmon species depends on the success of salmon restoration projects by private landowners such as Mike Knapp.

Since more than half of the salmon habitat in Oregon is in private ownership, private landowners have a more direct link to the health of salmon habitat.

Knapp figures that makes salmon recovery a more personal issue for him. Langlois and North Langlois creeks, both good coho streams, flow through Knapp's seaside cattle ranch near Port Orford.

"We always thought of the salmon as neighbors," said Knapp, whose family has seen the salmon runs dwindle in the past 50 years.

Knapp supports direct landowner action on behalf of fish to help restore the habitat. So in the past four years, Knapp has launched his own restoration project. So far, he has:

- Placed hatchery boxes for salmon fry at the edge of the Langlois and North Langlois creeks.
- Built a shallow lake to serve as a rearing ground for the fry until they can head out to the ocean.
- Built 7.25 miles of fences to keep cattle from entering the salmon streams.
- Installed three large cattle-watering systems that pipe fresh water to large vats in the grazing fields, encouraging cattle to avoid the fenced stream bank.
- Planted 1,680 willows along the creek edge for shade and filtration. He also planted 4,572 cedars for shade and future sources of woody debris.

In the past two seasons, Knapp has seen the number of returning coho increase from 15 to more than 120.

While that sort of observation seems promising, the success of such restoration projects will require more time and independent study, according to the Governor's Watershed Enhancement Board, which is helping to evaluate the success of Oregon's salmon and watershed recovery plan.

In the past two years, 1,234 restoration projects have been reported to the Watershed Enhancement Board, known as GWEB for short.

More than 84 percent of those projects were on private forest lands. Knapp's efforts are among the 16 percent in agricultural and ranch ownership.

So far, about 30 percent of those restoration projects have

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Restoration projects (continued from page 21)

been evaluated for their effectiveness, according to the GWEB report, which states that state, federal and private spending for these projects amounts to about $20 million a year in public and private monies.

Most of these projects involved removing culverts that divert salmon streams; stabilizing eroding streambanks and adding shade by planting native streamside vegetation; adding woody debris to streams for salmon spawning and leaving shade trees along creeks during logging operations to keep streams cool and provide future downed logs for spawning habitat.

Knapp said that he started the restoration projects in hopes that the National Marine Fisheries Service, which administers the Endangered Species Act for fish species, would not list coastal coho without giving Oregon's recovery plan a chance to work first.

However, Knapp said he expected the Aug. 3, 1998, announcement from the National Marine Fisheries Service that it would list coastal coho as a threatened species, triggering the protections of the Endangered Species Act.

LYNN KETCHUM, OSU EXTENSION AND STATION COMMUNICATIONS

Left: An active restoration project.The idea here is to add big logs to the stream, Beaver Creek on the South Coast, during a dry period. When the water rises, the logs will provide places for salmon to hide, rest, feed and rear.

Knapp said he will continue with his restoration efforts despite the listing announcement. But he said it may discourage others who may not be willing to undertake both voluntary and federally required projects and changes.

"We had people in this area who were warming up (to the idea of salmon restoration) and are now drawing their heads in a bit," Knapp said.

Other landowners say they don't agree with the effectiveness of some of the provisions of the restoration plan.

Ron Puhl lives near Port Orford on the Elk River, still a prime stream for coho and chinook salmon. He produces livestock, timber and cranberries on his land. He thinks that human interaction with nature can have a powerful healing effect.

"I have a hard time believing in completely inactive restoration," said Puhl. "We have stream bank areas that are completely unstable...I'm not willing to just stand by and let nature take more of my land when we can stabilize it. We do things like adding whole trees and root wads to streams to provide places for juvenile salmon to hide from predators. Without coming here and seeing, it's hard to understand what we accomplish."

The Oregon Natural Resources Council, which led the court challenge to the Oregon Plan to gain the coho listing, thinks that voluntary efforts are great, but they don't do enough to stop future watershed damage.

"The whole focus is on taking places that are already damaged and trying to repair them," said Diane Valantine of the ONRC. "That is good. But we need to stop new and additional damage, too, and voluntary efforts don't accomplish that."

Ideally, she said, both the Oregon Plan and the federal requirements will work together to accomplish what neither could do alone.

What can you and I do to help salmon?

By Tom Gentle

Oregonians whose lives and livelihoods are directly affected by the salmon decline know the commitments they are being asked to make. But what about the rest of us? What can we do as individuals to stem the decline and start salmon back on the road to recovery?

"That's a question that recognizes this is not an issue that affects one or two sectors of our state, such as agriculture or timber. It affects people in downtown Portland, the suburbs, the cities of the Willamette Valley. And it reflects the challenge of how we live in the 21st century and whether or not there is room for wild salmon in our civilization," said Ken Bierly, program manager of the Governor's Watershed Enhancement Board.

It's also a question that Jim Martin, an assistant director of the Oregon Department of Fish and Wildlife and a developer of the Oregon Plan, has wrestled with for a long time. When pressed for an answer, he points to the bottle bill and the state's public beaches and how they have become ingrained in our daily lives. He would like people to think about salmon in the same way. "We want to make salmon recovery a permanent part of the public consciousness so it will not disappear—just like we can't get rid of the bottle bill or public beaches," he said.

A big part of that "public consciousness" involves educating the public about ways to behave that will help rather than harm salmon. "All of us make hundreds of choices in our daily lives. Taken separately, they don't mean much. But all those little decisions have a cumulative effect. That is, they add up, especially in the Willamette Valley where three-fourths of Oregon's population lives," said Louise Solliday, of the Governor's Office for Natural Resources. "We want people to make choices that will benefit fish and water quality."

The Governor's Office for Natural Resources is publishing a series of "Ten ways people can help restore clean water and salmon." There are lists for homeowners, gardeners, boaters, hikers and bikers as well as more specific ones for home builders, landscapers, owners of forest land and so on.

Urban landowners are urged to think about ways to reduce contamination of storm water with oil and household chemicals, and to conserve water. In semi-rural and rural areas, the emphasis is on activities that affect potential sediment runoff as well as chemical contamination and water conservation.

At first glance, many of the suggestions appear to be simple common sense. "Don't dump oil or chemicals down storm drains." "Avoid overuse of fertilizers, herbicides and pesticides." "When planting a garden, seek landscaping advice to help prevent erosion."

These are voluntary things that people can do. They are some of the ways we can change how we live in the modern world and still maintain habitat for anadromous [ocean going] fish, according to Bierly.

A number of natural resource protection laws also guide human activities in the urban and suburban areas. The federal Clean Water Act requires the Oregon Department of Environmental Quality to develop water quality standards to protect drinking water, cold water fisheries, industrial water supply, recreation and agricultural uses. The state must monitor water quality and ensure the standards are being met.

Section 303(d) of the Clean Water Act requires each state to develop a list of water bodies that do not meet standards and to submit an updated list to the Environmental Protection Agency every two years.

The Oregon Healthy Streams Partnership, approved and funded by the 1997 Oregon legislature, uses existing regulations under the Oregon Agriculture, Forestry and Environmental Quality departments to address water bodies that currently do not meet water quality standards.

In addition to laws, state officials are searching for ways to provide incentives to farmers and forest landowners to carry out projects for the benefit of salmon. "While we want landowners to do things that will help salmon, we don't want them to be hurt financially," Bierly said.

The Conservation Reserve Enhancement Program is one example of a program that provides an incentive to farmers. An offshoot of the federal Conservation Reserve Program, it will pay farmers to establish buffers along streams rather than planting crops to the water's edge. For forest landowners, the Stewardship Incentive Program provides up to 75 percent reimbursement for instream and riparian improvement projects.

But the cost of many changes to benefit salmon will have to be borne by all Oregonians. Here are some of the commitments we will be asked to make in order to restore salmon:

- Pay more for treatment of stormwater and waste water.
- Pay more for water (for example, pumping, water treatment, alternative sources).
- Pay more for electricity as we change the flow of water downriver to take fish into account.
- Restrict growth.
- Restrict development during certain times of year and in certain places.
- Redirect growth by requiring setbacks from floodplains; in some areas put development in foothills rather than flatlands to improve flood management by creating fewer hard surfaces for runoff.

There's another commitment that people will be asked to make: a commitment of time to become involved in local government issues relating to

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What can you and I do? (continued from page 22)

salmon. Perhaps the greatest long term challenge to salmon is the constantly growing human population in Oregon and the development it brings. Because local governments have a primary responsibility in determining where and how growth is accommodated, they will play a crucial role in salmon recovery.

Wide public participation is the key to successful management of growth, according to Helen Berg, mayor of Corvallis. "A lot of people complain that local governments spend too much time debating before they take action. But from my point of view, having a large segment of the public involved in public issues leads to broad-based decisions that don't tend to change much over the years. Public involvement gets us away from short-term thinking and short-term decisions," Berg said.

While people are being asked to make some major commitments for the sake of salmon, the fish are not the only ones to benefit. People benefit, too, by taking actions that will ensure an adequate supply of clean water at a time when many areas of the country face growing uncertainties about water.

When it comes to dealing with society at large, officials involved in salmon recovery efforts are using a carrot and stick approach. But in interviews, it was obvious they prefer to emphasize the carrot rather than the stick.

People in the Willamette Valley were quick to pick up on household recycling, these officials say. Now the question is whether or not people will embrace a salmon ethic with the same willing commitment.

Want more information?

If you want to learn more about the salmon issue, here are some books, publications and web sites where you'll find information:

• *Upstream: Salmon and Society in the Pacific Northwest.* A national team of scientists assembled by the National Research Council compiled this report. The National Academy Press, Washington, D.C., published the book in 1996. An executive summary is available on the web. Address: www.nap.edu (then click on salmon).

• The Oregon Plan for Salmon and Watersheds web site. Includes the entire Oregon Plan, executive summaries of various documents, an illustrated, on-line book for children, and links to many other sites, including state agencies such as the Oregon Department of Fish and Wildlife. Address: http://www.oregon-plan.org

• *A Directory of Groups Involved in Salmon and Watershed Education in Oregon.* This publication tells you how to contact groups throughout Oregon, from local, state and federal agencies and private organizations to elementary schools. It lists materials available from the groups. A limited number of copies are available from the Governor's Watershed Enhancement Board, 255 Capitol Street, N.E., 3rd Floor, Salem, OR 97310. The directory soon will be accessible through the Oregon Plan web site described above.

• The Oregon Sea Grant web site. Includes information on salmon and watersheds and tells you how to get educational materials such as publications, videos and a restoration newsletter. Address: seagrant.orst.edu

• The Oregon Extension Service salmon tabloid web page. Includes an on-line copy of this tabloid, plus links to publications, videos and other materials. Address: eesc.orst.edu/salmon/

• The Columbia River Inter-Tribal Fish Commission web site. Includes information on the importance of salmon to the Tribes, and press releases. Address: www.critfc.org

• The Northwest Power Planning Council web site. Includes descriptions of a variety of publications on salmon and watershed topics. Address: www.nwppc.org

• For the Sake of the Salmon web site. Includes sections on the Endangered Species Act, salmon biology and how to help salmon. Address: www.4sos.org

TOM AND PAT LEESON

A chinook salmon fights its way toward ancestral spawning grounds, where its life will end and new lives will begin.

A Snapshot of Salmon in Oregon

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WHAT'S INSIDE

Front cover: Salmon migration (Alaska Stock). Back cover: Salmon eggs hatching .