WILDLIFE
IN MANAGED FORESTS

Fish Habitat and Passage

Wildlife in Managed Forests – Project Overview

This publication is part of a series from the Oregon Forest Resources Institute that aims to synthesize current research findings and make information available to foresters, wildlife managers and interested parties such as conservation organizations, regulators and policymakers. As part of the Wildlife in Managed Forests Outreach Project, information will be disseminated through publications such as this one, as well as workshops, tours and conferences.

PROJECT PARTNERS:

Confederated Tribes of the Umatilla Indian Reservation
Hancock Forest Management
Luckiamute Watershed Council
National Council for Air and Stream Improvement (NCASI)
Oregon Department of Fish and Wildlife (ODFW)
Oregon Department of Forestry (ODF)
Oregon Forest Industries Council (OFIC)
Oregon Forest Resources Institute (OFRI)
Oregon State University College of Forestry
Oregon State University Department of Fisheries and Wildlife
Oregon Watershed Enhancement Board (OWEB)
Plum Creek Timber Company
Siuslaw Watershed Council
Starker Forests
U.S. Department of Agriculture (USDA) National Wildlife Research Center (NWRC)
US Forest Service Pacific Northwest Research Station (USFS-PNW)
Watersheds Research Cooperative (WRC)
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This publication highlights projects around Oregon that have improved habitat and passage for fish. Large wood in this stream creates complex habitat for fish.

1.0 Introduction

Fish, especially salmon and steelhead, are synonymous with Oregon. Protecting habitat for these iconic species is a fundamental part of forest ownership. Since its inception in 1971, the Oregon Forest Practices Act (FPA) administered by the Oregon Department of Forestry (ODF) has helped forest landowners provide sustainable, healthy forests and habitat. To further this mission specifically for fish species, Oregon developed the Oregon Plan for Salmon and Watersheds (The Oregon Plan) in 1997, with the mission to restore native fish populations and their aquatic ecosystems to productive and sustainable levels. This will provide substantial environmental, cultural and economic benefits for Oregonians.

The Oregon Plan is administered by the Oregon Watershed Enhancement Board (OWEB) with the support of Oregon natural resource agencies and local groups. OWEB provides grants to help Oregonians restore and enhance local streams, rivers, wetlands and natural areas. Specific criteria (outlined in the Oregon Administrative Rules [OARs]) are used to prioritize conservation actions and improve rivers and essential habitat for fish species. In general, keeping forestland in forestry is the number-one thing land managers can do to promote habitat for fish.

For more information on OWEB grants: www.oregon.gov/OWEB

Bull trout like this one are protected by the Oregon Forest Practices Act, the Endangered Species Act, and the Oregon Fish Passage Law.

The forest industry is highly committed to implementing the FPA and The Oregon Plan. The industry has a long history of funding research about forestry and the effects of intensively managed forests on fish and water quality. The Watersheds Research Cooperative (WRC) at Oregon State University's College of Forestry was formed specifically for this purpose. The WRC plays an integral role in providing scientific information about contemporary forest practices.

This publication provides scientific background, identifies challenges, answers questions and offers solutions for land managers who seek to understand the regulations surrounding fish habitat protection and access on their lands.

For more information on the Watersheds Research Cooperative: www.watershedsresearch.org

2.0 Fish in Oregon

Many species of fish live in the streams, lakes and rivers of Oregon's forested landscape. Some are protected by the federal Endangered Species Act (ESA). The Oregon Fish Passage Law requires that native migratory fish be allowed to move freely up and down streams. In addition, there are provisions in the Oregon Forest Practices Act regarding chemical application and providing protections for stream-side vegetation, slopes and roads that in turn influence habitat for fish.

The map across pages 6 and 7 displays the distribution of native migratory fish in Oregon, by watershed. All the species listed below and shown on the map are included under the Oregon Fish Passage Law, and are defined by OAR 635-412-0005(32). However, this publication focuses on fish found in forested habitats.

The map was developed using fish distribution data gathered from the Oregon Department of Fish and Wildlife (ODFW 2003, 2006 & 2013) and from the Western Division of the American Fisheries Society (WDAFS, 2013). Fish distribution data from ODFW were overlaid with Fourth Field Hydrologic Unit Code watershed boundaries using GIS technology to create species distribution layers specific to each watershed. Data from WDAFS was already in this format and required no additional manipulation.

While this map provides an overview of fish distribution for the state of Oregon, it should not take the place of consultations with ODF and ODFW. For specific information on species that may be located within your project area or property, contact your ODF stewardship forester or ODFW district fish biologist.

Coho salmon prefer complex stream habitat.

Native species listed as either threatened or endangered under the federal ESA in Oregon that may be found in forested habitats include:

- Bull trout – Threatened
- Chinook salmon (all) – Threatened (also listed as Threatened under the Oregon ESA)
- Chum salmon – Threatened
- Coho salmon (all) – Threatened (listed as Endangered under the Oregon ESA)
- Green sturgeon – Threatened
- Lahontan cutthroat trout – Threatened
- Lost River sucker – Endangered
- Modoc sucker – Endangered
- Pacific eulachon/smelt – Threatened
- Shortnose sucker – Endangered (also listed as Endangered under the Oregon ESA)
- Sockeye salmon – Endangered
- Steelhead trout (all) – Threatened
- Upper Columbia River spring Chinook salmon – Endangered
- Warner sucker – Threatened (also listed as Endangered under the Oregon ESA)

SOCKEYE SALMON

Understanding if and when fish are or historically were present in streams is critical to planning activities in and around waterways. ODFW has established in-water work windows for streams in Oregon. In-water work activities are defined as any ground-disturbing activities within the beds and banks of waters of the state, also known as the "regulated area." These activities were developed to avoid disturbing fish during their most vulnerable life stages, particularly migration, spawning and rearing.

In-water work windows are different across the state of Oregon and are found on ODFW

COHO SALMON

BULL TROUT

CHINOOK SALMON

Native migratory fish are defined in OAR 635-412-0005(32) for fish passage purposes as species that migrate for their life-cycle needs and include all sub-species and life history patterns of the species shown on the map.

For further information: www.dfw.state.or.us/fish/CRP/migratory.asp

Native Migratory Fish Distribution in Oregon

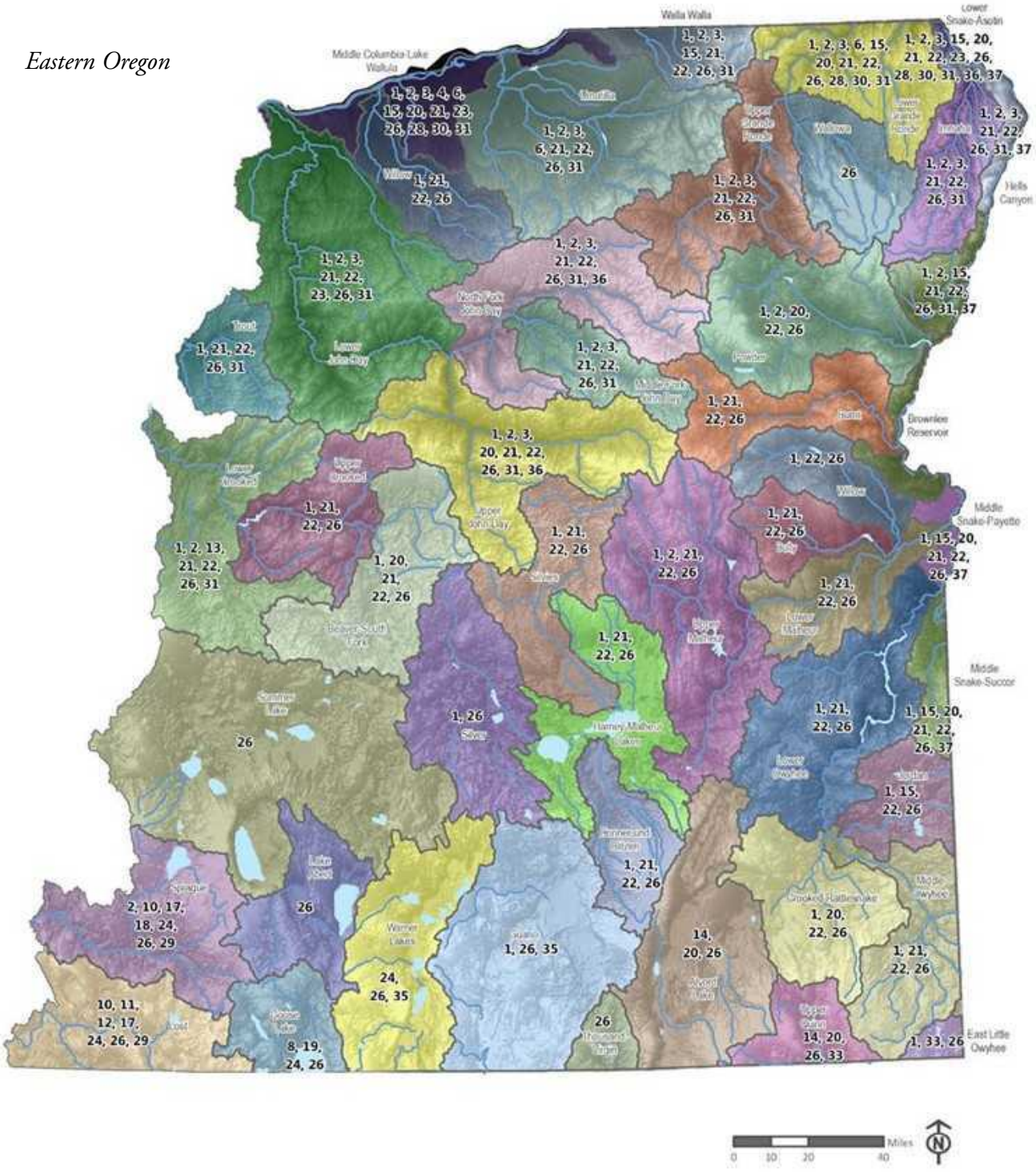
BY WATERSHED (4TH FIELD HYDROLOGIC UNIT CODE)

Species Key

1	Bridgelip sucker
2	Bull trout
3	Chinook salmon
4	Chum salmon
5	Coastal cutthroat trout
6	Coho salmon
7	Eulachon
8	Gooselake sucker
9	Green sturgeon
10	Klamath largescale sucker
11	Klamath River lamprey
12	Klamath smallscale sucker
13	Kokanee salmon
14	Lahontan cutthroat trout
15	Largescale sucker
16	Longfin smelt
17	Lost River sucker
18	Miller Lake lamprey
19	Modoc sucker
20	Mountain sucker
21	Mountain whitefish
22	Northern pikeminnow
23	Pacific lamprey
24	Pit-Klamath lamprey
25	Rainbow trout
26	Redband trout
27	Redtail surfperch
28	River lamprey
29	Shortnose sucker
30	Sockeye salmon
31	Steelhead trout
32	Surf smelt
33	Tahoe sucker
34	Umpqua pikeminnow
35	Warner sucker
36	West slope cutthroat trout
37	White sturgeon

The map on pp. 6-7 was created on January 8, 2014, by Cafferata Consulting, LLC. Data Sources: Fish distribution information derived from Oregon Department of Fish and Wildlife (ODFW 2003, 2006 & 2013) and Western Division of the American Fisheries Society (2013) sources. Rivers and waterbodies from USGS. DEM from Oregon Geospatial Enterprise Office (GEO).

Eastern Oregon



DISCLAIMER: This map displays the distribution of native migratory fish covered under the Oregon Department of Fish and Wildlife's fish passage authority, as defined by OAR 635-412-0005 (32).

This map should be used for information purposes only and is not designed to replace conversations and consultations with district fish biologists. To ascertain the fish distribution in your area, please contact an ODFW fish biologist: http://www.dfw.state.or.us/fish

3.0 Riparian management areas, fish habitat and passage

Most fish found in forested streams prefer complex habitat and cold, clean and connected water. According to the Environmental Protection Agency (EPA), water temperature is critical to fish survival. Not all fish have the same temperature tolerances, and the EPA has established water temperature guidance (EPA, 2003). For example, the optimal range for bull trout juvenile rearing is 46 °F to 53 °F, and 50 °F to 60 °F for juvenile salmon and trout rearing (EPA, 2003).

Clean water means streambeds composed of clean gravels with only small amounts of sand and silts, and low turbidity. Complex habitat has structures such as boulders, pools, large wood and undercut banks. Connected waters allow access to upstream and off-channel habitat. Providing for these habitat elements during day-to-day forest operations leads to high-quality fish habitat.

Watersheds research suggests that the top three things landowners can do to promote healthy habitat for fish are to:

1. Keep watersheds in forested use
2. Follow the Oregon Forest Practices Act rules
3. Participate in voluntary acts that complement the FPA

Examples of voluntary actions that complement the FPA include reducing the number of roads near streams, placing large wood in streams and eliminating human-made barriers to fish passage. For example, if it is not fish-friendly, it may make sense to replace a perched culvert, even if it provides effective drainage.

What do we mean by human-made barrier?

A human-made barrier to fish passage is anything that restricts movement of fish up and down streams. Some structures may be barriers only to juvenile fish. Examples of barriers include hanging or perched culverts, dams and channelized streams with high flows.

QUESTION 1: WHAT IS FISH PASSAGE, AND WHERE DOES IT APPLY?

Throughout Oregon, both anadromous (ocean-going) and native migratory fish species need to be able to move freely up and down streams to find food and shelter and to reproduce. There are many barriers to these basic needs, including road-stream crossings and other human-made obstructions such as dams, dykes, diversions, levees, berms and tide gates. In forested habitats, culverts under forest roads can be a barrier to fish movement if there is a drop on the downstream side large enough that juvenile fish cannot jump into the culvert, or if fish cannot swim upstream when water velocities are too high. Constructing or reconstructing forest roads may trigger the need to address passage for fish species such as the Oregon cutthroat trout or Oregon coastal Coho salmon.

Providing passage for Coho such as those shown here is important so that fish can fulfill their life cycles. Salmon need to be able to reach their native habitat to spawn.

What is an anadromous fish?

Anadromous fish are those that migrate from the ocean into fresh waters to reproduce.

ODFW developed a flowchart for fish passage, available online as a PDF: www.dfw.state.or.us/fish/passage/docs/process_diagram.pdf.

If you're unsure, discuss your project with either your local ODF stewardship forester or an ODFW district fish biologist.

What are the triggers for fish passage requirements?

Fish passage policy requires the owner or operators of the obstruction to address fish passage when certain activities are planned (ORS 509.585). The Oregon Department of Fish and Wildlife administers Oregon's fish passage rules and regulations. However, there is a Memorandum of Understanding between ODFW and ODF that gives ODF jurisdiction over fish passage as part the notification process as long as fish passage meets the requirements of the Oregon Forest Practices Act. It is the responsibility of the owner or operator of an artificial obstruction, such as a culvert or other stream-crossing barrier, to know if fish passage is required. You can find out if your waterway is fish-bearing (native migratory fish) by contacting either your local ODF stewardship forester or an ODFW district fish biologist.

It can be confusing to determine whether fish passage is required for a specific project. Follow these general steps:

- Determine if native migratory fish are present or could be present.
- Determine if your action triggers fish passage requirements.
- If fish are present or could be present, provide fish passage according to local requirements, or seek an exemption or waiver.
- If fish are not present and never were present, proceed with the crossing project without fish passage requirements.

Advice from Stewardship Foresters

OFRI interviewed ODF stewardship foresters around the state and asked them what advice they would give landowners who want to enhance habitat conditions for fish. Here is a compilation of their suggestions:

1. Conduct an assessment of your forest, either on your own or with help from an ODF stewardship forester. Evaluate culverts: Do you need more, fewer or better ones? Where are your roads, and are they contributing sediment to the stream? What's the condition of your riparian area? What kinds of streams do you have?
2. Using the information gathered during your assessment, identify specific actions that could be completed under the Oregon FPA that would benefit fish, such as road improvements or culvert replacements.
3. Be available for and attend forest tours, workshops and meetings that provide information and project ideas that you could implement in your forest.
4. Connect with your neighbors and groups such as local watershed councils that could provide ideas or assistance. Consider joining your local watershed council.
5. Share your ideas with others.
6. Consider temporary road crossings in lieu of permanent road crossings, where practicable.
7. Evaluate the tree species in your riparian area and decide if you're eligible for the basal area or negotiated basal area credit for small, medium or large fish-bearing streams.

Stewardship foresters are ready and willing to help walk you through the fish passage process.

Approval from ODF is required for all work involving fish passage. Note that ODFW fish passage rules apply, but the action is regulated through the ODF notification and written plan process. ODF may involve ODFW on more complicated projects requiring fish passage.

Triggers for fish passage requirements involving culverts and roads include:

- Creating a new, or abandoning an existing, road or stream-crossing structure that crosses a stream channel
- Widening a road footprint within a stream channel
- Filling or removing 50 percent of the material directly above a culvert, such as road material, unless this volume is exclusively composed of the top one foot of material (i.e., there is only one foot of material above the culvert)
- Construction of a new culvert or overflow pipe within a stream channel
- Widening or extending a culvert
- Cumulatively, through time, making repairs or patches to more than 50 percent of the culvert's linear length
- Replacing to its original configuration any part of a culvert except for culvert ends that have become misaligned or eroded
- Making any replacements, modifications, patches or repairs to the existing culvert that are different from the original configuration and that reduce fish passage

Often culverts are installed for fish passage, but bridges such as this one designed by Stuntzner Engineering and Forestry provides fish passage and can sometimes be the right solution for a road crossing.

Are there exceptions to providing fish passage?

ODFW occasionally grants an exemption from providing fish passage, for one of three reasons:

- A lack of fish passage has already been mitigated.
- A legal waiver has already been granted.
- There is no appreciable benefit to native migratory fish.

Fish passage waivers allow an artificial obstruction to not provide fish passage if an "alternative to fish passage" is provided. Waivers are typically sought if providing fish passage "on location" is impractical due to design or cost restraints. However, mitigation must be provided in the case of a waiver and must provide a net benefit to native migratory fish. Passage waivers must go through ODFW for review and approval. In some cases, waiver approval may be granted through the Oregon Fish and Wildlife Commission. Contact ODFW in advance if you choose to seek a passage waiver or exemption.

ODFW maintains a list of priority fish-passage barriers. These opportunities are located throughout the state. www.dfw.state.or.us/fish/passage/docs/2013_Statewide_Prioritization_List.pdf

For more information on fish passage design, visit: www.oregon.gov/odf/privateforests/docs/fishpassguidelines.pdf

QUESTION 2: WHAT ARE SOME PRACTICAL WAYS TO IMPROVE FISH HABITAT AND PASSAGE?

It is important for fish to not only have unimpeded access upstream and downstream of crossings, but also to have high-quality habitat. There are many ways land managers can improve habitat for fish. Protecting or maintaining riparian areas improves habitat for fish, and also helps many other terrestrial species that use these biologically diverse areas. Research has shown that by following FPA rules, landowners have made great strides toward improving fish habitat in Oregon (WRC, 2013).

Most fish found in forested habitats need complex habitat and cold, clean and connected water. In general, many species of fish live or spawn in clear, cold headwaters that are well connected and also contain structural components such as boulders and large wood that help create pools and good hiding cover. Habitat elements and specific management considerations that influence cold, clean, complex and connected waters are described below.

Riparian areas are important for fish habitat for many reasons, including shade, filtration and large wood.

Conifer trees are important for fish habitat because they provide for long-term recruitment of large wood in streams.

Riparian areas:

Well-vegetated riparian areas affect streams in many ways, including providing shade and leaf litter, decreasing flooding by absorbing precipitation, reducing bank erosion, and maintaining appropriate water-quality conditions for fish. Riparian areas trap and filter sediment contained in surface runoff, which reduces siltation of spawning substrates. This same process also helps protect water quality by filtering out contaminants.

Riparian areas are one source of large wood for streams, which creates complex habitat and many nutrient sources for fish. Management actions could include:

- Planting diverse tree species in riparian areas
- Maintaining conifer and hardwood trees in riparian areas for large-wood recruitment, nutrient recruitment, shade and sediment retention

Conifer trees:

Conifers are good for long-term recruitment of large wood in streams. Conifers such as spruce, hemlock, fir and cedar have the potential to last in streams seven times longer than hardwoods such as alder, cottonwood and ash (ODFW, 2010).

Large wood in streams helps create the complex habitat fish need. In addition, eliminating noxious weeds from riparian areas and replanting with native vegetation is great for restoring fish habitat and has the added benefit of helping many wildlife species that live in riparian areas, such as songbirds, mammals, reptiles and amphibians. Management actions could include:

- Planting a diverse mix of conifer trees in riparian areas for future large-wood recruitment

(Note: Not all conifer trees are suitable for riparian plantings; western hemlock and western redcedar are more tolerant of shady riparian conditions than species such as the shade-intolerant Douglas-fir.)

CASE STUDY:
Seeley Creek Culvert Replacement

In the summer of 2013, Weyerhaeuser Company worked with ODF and ODFW to replace an undersized culvert on Seeley Creek near Alsea. Road improvements along a Weyerhaeuser haul route triggered the requirement for a culvert replacement under Oregon's Forest Practices Act. Weyerhaeuser investigated Seeley Creek and learned that it is used by Coho salmon, Chinook salmon, cutthroat trout, steelhead trout and lamprey during the spawning and rearing life cycles of these species.

Culvert replacements need to provide fish passage. Passage is typically achieved by placing culverts at a slope less than the natural stream channel and sinking the culvert 40 percent into the streambed. These techniques allow the culvert to fill with natural stream material so that stream conditions inside the culvert mimic the natural channel conditions. This is known as a streambed simulation design. Designers also attempt to have the culvert width be 1.0 to 1.5 times the stream's normal width, to encourage material to deposit inside the pipe.

It is important to understand water velocity and ensure that water won't flow through the culvert too fast. If the water flows too fast, fish can't swim upstream through the culvert. To ensure that the new culvert would not increase velocities too much for fish, a Weyerhaeuser hydrologist measured nearby natural channel velocities and then used channel and pipe measurements to model potential changes in flow within the proposed culvert. Weyerhaeuser selected a culvert with a bottom width of 14 feet, after determining that the proposed culvert would not increase velocities above natural levels. Following installation, Weyerhaeuser monitored the location and determined that the culvert functioned as designed.

Removing the undersized culvert in Seeley Creek.

Finished culvert in Seeley Creek.

What do we mean by headwaters?

Headwaters are the upslope seeps, springs and streams that feed into larger stream systems.

CASE STUDY:
Upper Luckiamute Floodplain and Side-Channel Reconnection Project.

The Luckiamute Watershed Council, in partnership with Hancock Forest Management and OWEB, removed approximately 6,500 cubic yards of an abandoned railroad berm along the main stem of the Upper Luckiamute River near Kings Valley during the summer of 2013. The project is located on Hancock-managed industrial timberland.

The Valley-Siletz railroad was constructed around 1917, and through the construction process the Luckiamute River channel was straightened, disconnected and made impassable to juvenile salmonids. By removing a portion of the berm, the historic meander is now reconnected to the river. Side-channel habitat has been created, and an additional four miles of upstream habitat is available for juvenile fish. In addition, large wood from the berm and Douglas-fir trees from a nearby U.S. Fish and Wildlife Service oak release project were added to a side channel, creating habitat complexity. Fish were observed using the new side channel almost immediately after construction.

Above: Removing the railroad berm along the mainstream of the Upper Luckiamute River in the summer of 2013.

Below: Approximately eight months after completion. Notice how much the channel has developed.

This project benefits steelhead trout, cutthroat trout, Coho salmon and Pacific lamprey. The project required permits from the U.S. Army Corps of Engineers, Oregon Department of State Lands, NOAA Fisheries, Oregon Department of Fish and Wildlife, and Polk County. In addition, the project required completion of all work during the in-water work window with appropriate fish salvage efforts. As such, alternate fish passage was provided throughout the project, and fish were moved out of the project area before the start of construction.

In-stream habitat:

Large wood such as fallen trees is important to fish for both cover and channel complexity. This wood helps form pools and creates areas for sediment deposition. Large wood also provides physical structures where fish can hide from predators. Restoration efforts for in-stream habitat refer to activities that create habitat by directly altering the bed and banks of streams.

Consideration should be given in these types of projects to ensure that the natural processes of streams are not inhibited by the project. The size of the stream, the stream slope and large-wood diameter are all important considerations for in-stream habitat projects. The minimum diameter required for a key piece of wood depends on the bankfull width of a stream (ODFW, 2010). The minimum diameters are:

Bankfull Width, in Feet	Minimum Diameter Log, in Inches
0 – 10	10
10 – 20	16
20 – 32	18
Over 32	22

ODFW 2010

For guidance on in-stream enhancement projects, refer to this manual (please note that permits are likely required for in-stream work): http://library.state.or.us/repository/2009/200911251437253/index.pdf.

Large wood such as fallen trees is important to fish for both cover and channel complexity. Large wood helps form pools and creates areas for sediment deposition.

Types of actions that create fish habitat include adding logs, root wads and boulders (either anchored or not), constructing pools, evacuating side channels; and installing debris jams. Management actions could include:

- Evaluating water resources on your property: Are there fish? If so, are you providing cold, clean, complex habitat and connected water?
- Partnering with watershed councils or others for in-stream restoration projects
- Strategically placing permitted large wood in streams to create complex habitat for fish

Roads:

Unless properly constructed and maintained, forest roads can be a source of sedimentation to streams through runoff. Road location, design and maintenance are critical to minimize or eliminate sediment in runoff. This can be accomplished in several ways:

- New road plans should minimize the miles near streams and minimize the number of stream crossings.
- Current and new roads that cross or are located near streams should be evaluated for fish presence and passage (which could require fish-passable culverts or bridges), and adequate road runoff treatment.
- Road runoff can be treated by providing drainage so runoff is diverted onto the forest floor away from the stream. This concept or goal aims to disconnect roads from streams.
- Rock and grade dirt roads where practicable, as it can reduce erosion.

Above: Road location, design and maintenance are critical to minimize or eliminate sediment in runoff.

For more information on forest road design:

Oregon Forest Protection Laws: An Illustrated Manual: http://oregonforests.org/sites/default/files/publications/pdf/OR_For_Protect_Laws_2011.pdf.

Managing woodland roads – a field guide. PNW 641, OSU extension. Here's the web link to where the publication can be ordered. http://extension.oregonstate.edu/catalog/abstract.php?seriesno=PNW+641

CASE STUDY:
Swamp Creek Project

The Siuslaw Watershed Council, in partnership with ODF, ODFW, Bureau of Land Management (BLM), Weyerhaeuser and other private landowners, opened up three miles of habitat along Swamp Creek with a multi-year project funded through BLM Secure Rural Schools funds. The project was completed in 2012. Swamp Creek is located outside Veneta, west of Eugene.

Project components included the following:

- Two loads of logs were placed at three locations in Swamp Creek, on Weyerhaeuser lands. The logs were donated by ODF. Access to the three locations was granted by ODF, BLM and Weyerhaeuser.
- Six culverts were removed. Five of them were removed to decommission a road, thus removing it from the stream network. The remaining culvert was replaced with a bridge and is no longer a barrier to fish passage.
- Trees were planted in 2012 in project disturbance areas to enhance the riparian area of Swamp Creek.

Removal and replacement of the culverts, combined with decommissioning a road along Swamp Creek, opened fish access to an additional three miles of habitat. Placing large wood in the stream increased the complexity of the habitat and encouraged pool development in the creek. The combination of all these project elements enhanced Swamp Creek and will allow normal stream processes to occur.

Above: The cooperative effort led by the Siuslaw Watershed Council for Swamp Creek opened up an additional three miles of habitat.

Left: As part of the Swamp Creek Project, two loads of logs were placed at three locations in Swamp Creek, on Weyerhaeuser lands.

CASE STUDY:
Assessing Passage Performance of Coastal Cutthroat Trout through Corrugated Metal Culverts

Replacing culverts is expensive, so understanding what fish are capable of could help landowners determine whether culverts need to be replaced for the benefit of fish passage.

In a study conducted through funding from the National Council for Air and Stream Improvement (NCASI), the Oregon Forest Industries Council (OFIC) and the Association of Oregon Counties, fish biologists from Plum Creek Timber Company, TerraStat Consulting Group and West Fork Environmental Consultants studied how water velocity, culvert steepness and outlet perch height affected the ability of juvenile coastal cutthroat trout to successfully enter and ascend bare metal culverts.

During the study (Peterson et al. 2013), wild-caught cutthroat trout were put through trials in a 40-foot-long, 6-foot-wide culvert over a range of flows. The study determined that wild cutthroat were successful in average passage conditions well beyond those predicted by most passage criteria. A second study showed that juvenile wild-caught cutthroat trout had an easier time entering culverts when there was either no or a minimal jump height to the culvert inlet.

Further testing began in fall 2013 to explore passage success over the course of a year in a range of field settings. These results should help refine passage-barrier identification and broaden landowner options for improving passage. More information on this study may be found here: http://dx.doi.org/10.1080/02755947.2012.750633.

Top: Biologists put tracking devices in fish in order to track their movements. These are called PIT tags.

Left: View of the test culvert where wild cutthroat trout were tested for their ability to swim through at various velocities.

CASE STUDY:
Rock Creek Fish Habitat Restoration and Enhancement Project

The owner of 516 Ranch, in cooperation with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), is addressing the poor fish habitat conditions on multiple streams on the 516 Ranch near La Grande.

Other partners on this multi-phase project include the Natural Resource Conservation Service and Oregon Department of Forestry. The restoration project is also supported by the Bonneville Power Administration-sponsored fish habitat program, the Conservation Reserve Enhancement Program, ODF programs and the Environmental Quality Incentives Program.

Fifteen miles of stream is located on the 516 Ranch within the Rock Creek drainage. The project is addressing many aspects of fish habitat restoration and improving conditions for ESA-listed Snake River Basin spring Chinook salmon, summer steelhead and resident fish. In 2013, 3.8 miles of Graves Creek and 1.4 miles of Little Graves Creek were restored. Project components included:

Forming partnerships such as the one developed for the 516 Ranch is a great way to accomplish stream habitat improvement projects.

- Installing 180 large-wood complexes (collections of large wood at strategic locations) that will facilitate bank stabilization, provide overhead cover for fish, create low-velocity flows and diversify stream-flow conditions to support in-stream habitat
- Constructing 25 riffles at strategic locations (shallow lengths of stream where flows are faster and more turbulent)

Future phases of the project will include:

2014 - 2016

- Abandon 0.2 miles of channelized reach and redirect the stream back into 0.5 miles of historic alignment in Graves Creek.
- Create three floodplain ponds from the channelized reach in Graves Creek.
- Install 124 large-wood complexes and 14 boulder clusters along four miles of Rock Creek, 1 mile of Sheep Creek and 0.4 miles of Little Rock Creek; remove 0.5 miles of floodplain levees.
- Construct 0.62 miles of meandering channel and 0.33 miles of side channels in Rock Creek.
- Install 87 large-wood complexes and 10 boulder clusters in Rock Creek.
- Abandon 0.4 miles of channelized reach at lower Rock Creek and redirect to the historic channel.
- Obliterate 1 mile of floodplain road within the Rock Creek floodplain.
- Construct approximately 0.25 miles of riparian fence.
- Plant the riparian corridor with a mixture of containerized plants and live whips.
- Develop off-channel water sources for livestock.
- Enroll the riparian corridor in the Farm Service Agency Conservation Reserve Enhancement Program (FSA CREP). Areas not eligible for the CREP program will remain in a 15-year Bonneville Power Administration/Confederated Tribes of the Umatilla Indian Reservation conservation easement.

What's been happening around Oregon for fish habitat and passage?

The case studies highlighted in this publication are but a few examples of the types of restoration projects that have been completed in Oregon. Since 1997 private-forest landowners have contributed nearly **$100 million** toward restoration activities that benefit fish passage and habitat (Bobbi Riggers, Oregon Watershed Restoration Inventory coordinator). The following table summarizes fish habitat and passage accomplishments on private forestlands that were completed and reported to OWEB from 1997 to 2011.

Side-channel restoration projects such as the newly constructed one pictured here are one of the ways private landowners in Oregon have helped improve fish habitat.

Statewide Summary of Forestry Accomplishments on Private Forestlands (1997-2011)

Oregon Plan Actions Reported from 1997 to 2011 by Private Forest Landowners	Total
Road Miles Surveyed	16,458
Road Miles Improved	3,289
Road Miles Vacated, Closed or Relocated	550
Number of Peak Flow Improvements (increase culvert or bridge size to pass high stream flows)	7,981
Number of Surface Drainage Improvements	18,505
Number of Stream Crossings Improved for Fish Passage	1,749
Number of Large-wood Placement Projects	569
Number of Other In-stream Projects (boulder placement, side channels and alcoves)	168
Number of Conifer Restoration Projects	65
Number of Riparian Management Projects (voluntary tree retention)	2,651

Based on projects completed and reported to the Oregon Watershed Restoration Inventory. Table prepared by Bobbi Riggers, OWRI coordinator, July 2013.

CASE STUDY:

Wonser Woods Fish Passage Culvert Replacements and Clear Creek In-stream Habitat Enhancement Project

The Wonser Woods Tree Farm is located in Estacada and comprises 622 acres. In partnership with Aquatic Contracting, the Clackamas River Basin Council and the tree farm owner, 0.25 miles of in-stream habitat along Clear Creek was enhanced. Additionally, fish passage and habitat were improved at five locations on a tributary to Clear Creek on the Wonser Woods Tree Farm.

Aquatic Contracting salvaged more than 30 live, standing 18- to 24-inch-diameter Douglas-fir trees for use in the project. The tipped trees with intact root wads were then transported on-site from the source area to enhancement locations along Clear Creek. Working closely with ODFW staff, the contractor placed the logs to create in-stream structures. The log structures provide additional in-stream habitat, as well as helping recruit and retain gravels in this largely bedrock-based, gravel-deficient reach of Clear Creek.

As part of this project, three aging culverts were replaced with much larger fish passable culverts, allowing for increased fish access to upstream habitats. The overall project resulted in fish-passage and habitat improvements for anadromous Coho and steelhead, as well as resident fish species.

Since 1997, private-forest landowners have contributed nearly $100 million toward restoration activities that benefit fish passage and habitat.

QUESTION 3: WHAT RESOURCES ARE AVAILABLE FOR FISH HABITAT AND PASSAGE PROJECTS?

Check out the following links for more information.

There are many resources available to help answer questions about providing fish habitat and passage. Contact your ODF stewardship foresters for assistance.

Fish Species in Oregon:
www.dfw.state.or.us/fish/species/index.asp

Environmental Quality Incentives Program:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip

Know Your Forest (this is an educational website for Oregon forest landowners where you can also find a link to ODF stewardship foresters and other professional resources):
www.knowyourforest.org

Natural Resources Conservation Service Conservation Reserve Program:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs

ODF Forest Practices:
www.oregon.gov/ODF/Pages/lawsrules.aspx

ODFW Fish Passage Policy and Rules:
www.dfw.state.or.us/OARs/412.pdf

ODFW Fish Passage Program Contact List (including field biologists and program managers):
www.dfw.state.or.us/fish/screening/contacts.asp

Oregon Department of Fish and Wildlife Fish Passage Program:
www.dfw.state.or.us/fish/passage

Oregon Explorer (learn more about your watershed):
www.oregonexplorer.info

Oregon Forest Resources Institute – Wildlife in Managed Forests Program:
http://oregonforests.org/content/natural-resources

OWEB Grant Programs:
www.oregon.gov/OWEB/Pages/resources.aspx

Watershed Enhancement Opportunities and Incentives:
www.oregon.gov/odf/privateforests/pages/incentivesoweb.aspx

4.0 Summary

It is encouraging to see how much progress has been made in Oregon forests over the past few decades toward improving fish habitat and passage. Partnerships of private landowners, local watershed councils, state agencies and federal agencies have helped make these improvements possible. The Oregon Plan for Salmon and Watersheds has helped create a community of forest landowners who are committed to providing healthy forests and clean water not only for fish, but also for current and future generations of Oregonians.

Here are some of the top actions landowners can implement to promote fish habitat and passage:

- Manage your forestland to keep it as a working forest in perpetuity.
- Reduce the number of roads near streams.
- Design stream crossings perpendicular to stream flow.
- Manage roads to minimize any fine sediment that is generated or delivered to natural waterways.
- Remove artificial obstructions that preclude fish passage.
- Construct new and existing stream crossings (such as culverts and bridges) that are passable for fish.
- Contact and partner with others to restore habitat for fish on your land through stream and riparian improvement projects.

It is important to continue to support public and private research efforts to understand how watersheds react to contemporary forest practices. Increasing our understanding of aquatic systems will help inform policy that protects the resource and allows for sustainable forest management. Through the efforts of groups such as the Watersheds Research Council and others such as watershed councils, universities, private citizens and government agencies, we will continue to make strides for healthy forests and abundant, high-quality fish habitat.

Coho salmon such as this returning adult have benefited greatly due to the efforts of forest landowners in Oregon.

5.0 Resources

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