

# **2000 ANNUAL REPORT**

**Salmonid Screening, Habitat Enhancement  
and Restoration Section  
(SSHEAR)**

**Environmental Restoration Division  
Habitat Program**

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# **FISH PASSAGE UNIT**

## **INTRODUCTION**

Resident and anadromous salmonids are a vital component of the culture and economy of the Pacific Northwest. Each year, millions of dollars in revenues are generated in Washington, Oregon, and California by sport and commercial fisheries targeting salmon and trout. In addition, the presence and abundance of salmonids indicates the health of Pacific northwest stream ecosystems. Without question, protection and enhancement of salmonids and the habitats that supports them directly enhances the distribution and abundance of many other wildlife species as well.

Correction of human-made fish passage barriers such as impassable culverts, dams, floodgates, or degraded fishways is one of the most cost effective methods of salmonid enhancement and restoration. In many cases, several miles of quality salmon and trout habitat can be retrieved and brought into production by eliminating a single point source fish barrier. To address these problems, the Fish Passage Unit performs several major functions: fishway inspections, fishway operation and maintenance, culvert inventory work, fishway major project development, database management, and training/consultation on fish passage related issues. The unit is composed of specialized fish biologists, engineers, technicians, and equipment operators. Following is a summary of work completed.

## **FISHWAYS**

The Fish Passage Unit is responsible for the inspection and evaluation of 482 fishways statewide. The majority of the fishways are associated with road culverts and small low head dams. Inspections are conducted in the spring, after the threat of major flooding and damage, so that the condition of the fishways can be adequately evaluated. For those fishways requiring maintenance, fishway notification letters are sent out with follow-up calls made to the owners. Where necessary, staff schedule on site consultation with the fishway owner to resolve problems.

Compliance inspections are conducted in the late summer/early fall to ensure that the maintenance work has been completed. During 2000, 363 fishways received scheduled inspections. Of this number, 114 (31%) required maintenance or reconstruction. Compliance inspections conducted later in the year indicated that the owners of 50 (44%) fishways had completed the work requested. Most of the fishways not in compliance were those requiring major reconstruction. The unit is continually working with those owners to ensure that a time line for reconstruction is developed and implemented. The compliance rate of 44% for 2000 was up from the last ten-year average of 38%. The improvement in compliance reflects SSHEAR's efforts to work with fishway owners to resolve fish passage problems.

## **FISHWAYS OPERATION AND MAINTENANCE**

Currently, the Environmental Restoration Division is responsible for the operations, maintenance and the eventual major repairs and modifications of 76 fishways statewide including 24 formal Mitchell Act fishways.

SSHEAR is responsible for maintaining and operating two of the largest fishways in the state. The Granite Falls fishway on the South Fork Stillaquamish River required about 1.2 man months per year for weekly maintenance during the salmon run. The Sunset Falls fishway on the South Fork Skykomish River also requires maintenance and daily operations in the handling and hauling of fish from July through December. Operation of the trap and haul facility at Sunset Falls required 10.8 staff months annually.

Built in 1958, the Sunset Falls fishway consists of a series of 33 vertical slots which leads into a trap and haul facility at River Mile 51.5. The facility provides salmon, steelhead, trout and native char access to over 92 miles of spawning and rearing habitat in the upper South Fork Skykomish watershed. Table 1., lists the number of each species which were passed upstream at the Sunset Falls fishway during the 2000 season.

**Table 1. Fish trapped and transported upstream at Sunset Falls during 2000.**

<b>Species</b>	<b>Total No. Adults</b>	<b>Total No. Jacks</b>
Coho Salmon	23,726	117
Chum Salmon	52	
Summer Chinook Salmon	144	41
Fall Chinook Salmon	568	37
Pink Salmon	1	
Sockeye Salmon	9	
Steelhead Trout	2,052	
Sea Run Cutthroat Trout	0	
Native Char	51	

During the 2000 construction season, maintenance, major repairs, and modifications were performed on the following fishways:

### **Granite Falls Fishway Modifications**

Built in 1956, the Granite Falls fishway consists of a series of 51 vertical slots which lead into a 300 foot long tunnel. The fishway provides pink, coho, chinook, steelhead and native char access to 57 miles of spawning and rearing habitat in the upper South Fork Stillaguamish River. During the summer of 2000 a new exit sill and trash rack were installed at Granite Falls. The new components to the fishway will minimize the amount of debris entering the fishway tunnel and reduce the cost of tunnel maintenance. Additional modifications and repairs will be completed in 2001 with the addition of a new entrance gate and complete concrete repairs to the floor and sills of the fishway. The addition of a new entrance gate will improve the fish passage effectiveness of the fishway.

### **Little Kalama River Fishway Repair**

The Little Kalama River Fishway is one of 24 formal Mitchell Act fishways and provides steelhead and trout access to over four miles of spawning and rearing habitat. In recent years, floods resulted in damage to stop logs in the fishway. In 2000, damaged stop logs were replaced, concrete repairs and general clean out work was completed.

### **Wind River Fishway @ Shipperd Falls Modifications and Repairs**

The Wind River Fishway at Shipperd Falls has been in service for 45 years. The facility provides spring chinook and summer steelhead access to 38 miles of spawning and rearing habitat. In 2001, work continued on the fishway at Shipperd Falls to repair major damage incurred by the flood event of 1996. In 2000, the auxiliary water system (AWS) was cleaned out and a new trash rack system was fabricated and installed. The AWS provides additional water to the fishway entrance and improves fish access. Additional work in 2000 included the fabrication and installation of a new mid-way port gate. This structure provides access for fish that move beyond the primary fishway entrance. Additional modifications and repairs to the fishway in 2001 will include the clean out of the entrance pool, the fabrication and installation of a new entrance gate and the replacement of a maintenance building.

### **Mitchell Act Stream Clearance and Fishway Operation and Maintenance**

This project provides stream clearance and maintenance of fishways constructed under the Mitchell Act in the lower Columbia River drainage. Between January 1 and December 31 , 2000, a total of 10.4 staff months were spent for fishway maintenance and inspections, barrier reconnaissance, design work and development of recommendations for future work.

### **Salt Creek Fishway Repair**

Built in 1951 by the State of Washington Department of Fisheries, the fishway consists of a series of weirs that afford coho, steelhead and cutthroat trout access over an eight foot high falls to 8.4 miles of habitat. 2000 repairs involved the reforming and pouring of six concrete weirs previously damaged by years of wear. The purpose of the project was to maintain the health of wildstock fish species in the Salt Creek watershed.

### **East Fork Humtulips Fishway Repair**

Similar in nature to the Salt Creek fishway, this facility provides access for coho, steelhead and cutthroat trout to 16 miles of habitat. In 2000, a previously damaged fishway wall was rebuilt to maintain the function of the fishway. The age of this fishway and others like Salt Creek will

require additional work in the future to maintain the current state of efficiently.

## **DEPARTMENT OF TRANSPORTATION CULVERT INVENTORY**

In 1991, the Washington State Legislature, working with the Washington State Department of Transportation (WSDOT) and the Washington State Department of Fish and Wildlife (WDFW), organized and implemented a fish passage inventory on Washington State Highways. The purpose of the ongoing inventory is to document fish passage problems at State Route stream crossings and to correct passage problems located by order of highest priority.

During the ongoing WSDOT inventory 3,415 culverts in natural drainages have been inspected; 1963 have been identified as fish bearing, including 784 fish barriers. The second phase of the ongoing project involves conducting habitat surveys, both up and downstream of identified barriers, to establish priorities for correction and quantify the habitat gain. Based on results of surveys completed to date, sufficient habitat gains to justify correction have been identified at 520 barrier culverts. A total of 126 additional culverts are scheduled for further evaluation to determine the need for fish passage repair. The culverts designated for further evaluation are classified as such in part because the recently merged agency, Department of Fish and Wildlife, has recognized the need for maintaining diverse and healthy stocks of resident salmonids through the correction of barrier culverts. Some of the resident species occupy steeper gradient stream sections which may be unsuitable for salmon. Hence, further assessment is underway to determine potential additional corrections based on consideration for resident fish. An estimated 456 barriers remain to be corrected to address all salmonids (520 barriers to fix minus 64 already fixed barriers equals 456).

Since the inventory began, fish passage has been provided by WSDOT and WDFW's Environmental Restoration Division, using dedicated funding, at 37 priority sites. Twenty two fish passage barriers were reported corrected by WSDOT during safety and mobility projects, one barrier was corrected during WSDOT's routine operational maintenance, and three barriers were corrected using other funding sources.

During the year 2000 construction season WSDOT and WDFW corrected four fish barriers on WSDOT highways.

## **DEPARTMENT OF TRANSPORTATION CULVERT REPAIRS**

### **Unnamed Tributary to Pilchuck Creek (Stilliguamish River) - Inter State 5**

An unnamed tributary of Pilchuck Creek (WRIA # 05.0065) passes under Inter State Highway 5

(I-5) at mile post 211, approximately 4 east of the City of Stanwood in Snohomish County. This stream is known to support naturally reproducing populations of cutthroat and steelhead trout and chum and coho salmon. Coho stocks in the Stillaguamish watershed were listed as depressed in the 1992 edition of the Washington State Salmon and Steelhead Stock Inventory.

The culvert under the north bound lanes of the freeway obstructed fish passage because of its extreme length, water velocity and a 2.5 foot drop at the outfall. Working in cooperation with WSDOT, WDFW installed 17 steel baffles and a concrete sill within the culvert to improve fish passage by increasing water depth and reducing water velocity. Five log weirs were also installed immediately downstream of the culvert outfall to improve fish access into the culvert. Spawning gravel was also placed between the log controls to provide additional spawning habitat. Construction of the project was completed in 5 weeks at a cost of approximately \$41,000. Completion of this project along with two other projects which were completed on private land (see Pilchuck Projects #1 and #3 on page ----) restored fish access to 2.2 linear miles of habitat in this stream.

Extremely low stream flows in the fall of 2000 prevented chum salmon from using the stream and significantly delayed the entry of adult coho salmon. Twenty eight coho were observed during periodic surveys on selected portions of the creek in December and January. Expansion of this data suggests that an estimated 60 to 100 adult coho may have spawned in the stream during the 2000-2001 season.

### **Valley Creek - State Route 101**

Valley Creek is a tributary to Port Angeles Harbor. The 7'x8' concrete box culvert under State Route 101 crossing has a 2.2% slope and an outfall drop of up to 2 feet, making it a complete barrier to the upstream migration of salmonids. To provide fish passage, 26 wood baffles were installed in the culvert to increase water depth and reduce water velocity and a roughened channel was constructed downstream of the outfall to improve fish access to the culvert.

This project was constructed by the SSHEAR construction unit and project funding was provided by (\$92,000) by WSDOT. About 1.3 miles of anadromous salmonid habitat will be restored by this project, once the two downstream barriers owned by the City of Port Angeles are repaired.

## **SAFETY AND MOBILITY WORK**

Given the large number of identified barriers in the Washington Department of Transportation inventory (520), it would take more than a century to provide fish passage at the current rate of correction (average six/biennium). It is also apparent that the benefits to Washington's economy and ecosystems are directly proportional to the number of culverts repaired per year. Because

of this, WSDOT and WDFW have agreed to integrate fish passage concerns into ongoing WSDOT road safety and mobility projects. Culvert repairs associated with road projects on state highways can be done more quickly and at lower cost since equipment is already mobilized or in the vicinity of ongoing road construction. Continued fish passage improvements at road crossings and safety and mobility projects will require a substantial long term commitment by the legislature. By correcting these barriers, the recovery of depressed or critical stocks may be accelerated and avoid the need for further listings under the federal Endangered Species Act. (See Washington Department of Transportation Fish Passage Barrier Removal Program Progress Performance Report for Fish Passage Corrections and WSDOT Safety and Mobility Project Review, December, 2000.)

## **WILDLIFE AREA INVENTORY**

Over the past 59 years, WDFW has purchased approximately 840,000 acres of wildlife area sites, scattered throughout almost every county in the state. Due to previous land utilization practices and the increasing interest of fish passage issues, SSHEAR initiated a statewide inventory of fish passage barriers and water diversions on all state owned or managed lands in October of 1997. The purpose of the inventory is to document and correct all agency owned fish passage problems and water diversions. Washington State laws (RCW 77.16.220, RCW 75.55.040, RCW 75.55.060, and RCW 75.55.070) require all diversions from waters of the state to be screened to protect fish and that all stream obstructions provided for fish passage.

In cooperation with the Lands Division, SSHEAR designed a sampling protocol, database format, and Wildlife Area Priority Index for the study. To create the priority index of Wildlife Areas, a prioritization questionnaire was distributed to Regional Lands Coordinators, Regional Fish Biologists and Wildlife Area Managers. This enabled SSHEAR staff to take advantage of the many years of experience and data accumulated from local Wildlife Area Managers. The questionnaire was designed to prioritize wildlife areas based on four main factors (e.g. number of known fish passage problems, stock status, stock mobility, and high profile fish passage issues of public interest). This prioritized list was then used to guide, along with other management considerations, the sequence that the wildlife areas would be inventoried.

To date, inventories have been completed on the Snoqualmie, Olympic, and Methow Wildlife Areas. In 2000, work was concentrated in the Cowlitz Wildlife Area where 274 culverts, 21 dams, 4 pump diversions, 3 gravity diversions, and 14 "other" features were evaluated on fish bearing waters. Of these, 171 of the culverts, 19 of the dams, and 3 of the "others" were found to be barriers. Two of the gravity diversions were screened and one was unscreened. One pump diversion was screened but not in compliance with WDFW screen criteria. The screening status of the other 3 pump diversions is unknown at present. Of the The final report for the Cowlitz Wildlife Area inventory will be available in the summer of 2001. At present, the plan is to next inventory the Sunnyside Wildlife Area followed by the Skagit Wildlife Area.

## **FISH PASSAGE INVENTORY INFORMATION MANAGEMENT**



## **MAJOR FISH PASSAGE PROJECT DEVELOPMENT**

### **TECHNICAL ASSISTANCE**

SSHEAR staff are available to provide training and technical assistance to grant groups and others interested in conducting fish passage inventories and assessments. Table 1 shows the groups that SSHEAR staff have provided training and technical assistance to in the past and/or will be providing training and technical assistance to in the future. Staff have also been available to give presentations on fish passage at various meetings and workshops around the state.

The *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* has been revised. The original manual only dealt with the assessment of culverts for fish passage. The new version of the manual provides for the assessment of water diversions, dams, and fishways. Work is underway to develop an Environmental Restoration Division website that will provide access to SSHEAR and Environmental Engineering Services (EES) resources over the internet.

Table 1. Groups provided training and technical assistance by SSHEAR staff.

Group	Watershed(s) <sup>1</sup>	Status
Clark Conservation District	Lewis River	Completed
Pacific Conservation District	Willapa River (Pacific County owned barriers)	Completed
Pierce Conservation District	Puyallup River, Nisqually River, Key Peninsula Streams	Ongoing
Adopt-A-Stream Foundation	Swamp, Little Bear, Allen, North, and Quilceda Creeks	Ongoing
Grays Harbor Conservation District	Satsop, Wynoochee, and Humptulips Rivers	Ongoing
Cowlitz Conservation District	Elochoman, Cowlitz, and Kalama Rivers	Ongoing
Lewis County Public Works	Chehalis, Cowlitz, and Nisqually Rivers	Ongoing
Washington Trout	Skykomish, Snohomish, and Snoqualmie Rivers	Ongoing
Skagit System Cooperative	Skagit River	Ongoing
Underwood Conservation District	White Salmon River	Ongoing
Yakama Tribe	Klickitat River	Ongoing
Hood Canal Salmon Enhancement Group	Miscellaneous Hood Canal Tributaries	Ongoing
Squaxin Island Tribe	Oakland Bay Tributaries	Ongoing
Quileute Tribe	Bogachiel River	Ongoing
Thurston Conservation District	McLane Creek, Spurgeon Creek	Ongoing
WA State Parks	Statewide	Beginning 2001
Lower Col. Fish Recovery Board	Washougal River	Beginning 2001
South Puget Sound Salmon Enhancement Group	WRIA 14	Beginning 2001
Okanogan Conservation District	Methow	Beginning 2001
WDFW (SSHIAP)	Lower Columbia small dam inventory and assessment	Beginning 2001
Governor's Council on Environmental Education	Statewide	Future
Fish Passage Grants Program	Statewide	Future

<sup>1</sup>Usually does not include the entire watershed

## **WILD STOCK RESTORATION / ENHANCEMENT**

### **INTRODUCTION**

### **NORTH SOUND**

## **NORTH COAST**

### **ABSTRACT**

During 2000, the off-channel spawning and rearing habitat inventory continued in the Sol Duc River with emphasis on its tributary streams. The North Coast inventory project is about 85 percent complete for the main stems of the Queets/Clearwater, Hoh, Bogachiel, Calawah, Sol Duc, and Dickey Rivers and about 40 percent complete for their major tributaries. In 2000, three major fish habitat enhancement projects were completed including rerouting a stream back into its historic channel on the Sol Duc River, development of a spring-fed channel on the Sol Duc, and culvert removal and preservation of a major wetland on the west fork Dickey River.

Maintenance and repair work was performed on several existing projects using contract labor from the Clearwater Corrections Center.

The habitat inventory team also identified potential habitat enhancement opportunities in the Sol Duc, Hoh, and Bogachiel river systems and these are scheduled for completion during the summer of 2001.

Existing and potential habitat enhancement projects were evaluated by monitoring fish use (including spawning activity) and overall function. In 1999, adult coho salmon escapement to the Hoh River system was 4,594 fish and in 2000 the escapement increased to 6,798 fish. This is the second highest return in 27 years. Currently the escapement goal for the Hoh is between 2,000 and 5,000 fish. Coho escapements have exceeded 4,000 fish for seven out of the past ten years, (Figure 6).

The Environmental Restoration Division has developed 13 projects in the Hoh River system to date. These projects have the potential to produce about 14 percent of the estimated total coho smolt production in the Hoh watershed. In the Quillayute system 27 projects have been completed that have the potential to produce over 10 percent of the total smolt output. In the Bogachiel River nine projects have been built that have the potential to produce about 20 percent of the rivers total coho smolt output.

## **METHODOLOGY**

### **Site Inventory**

Aerial photos and U.S.G.S. maps are used to identify potential off-channel spawning and rearing habitat. Field surveys are then conducted to locate and confirm the existence of specific habitat. The land adjacent to each bank of the river is divided into a series of manageable areas. Each area is separated from the next by a distinct geographic landmark (e.g., high cut bank, tributary, bend in the river, bridge, etc.). Within each area are a number of specific habitat sites (channels, ponds, etc.). The areas within a river system and the sites within each area are identified, using an alphanumeric system, beginning at the mouth of each river. For example, H-L1-1 describes a

site along the (H) Hoh River which is on the (L) left bank as you face downstream. The first (1) identifies the first group of habitat sites moving upstream from the mouth and the second (1) identifies the first site within that area. In most cases, local names are also used to help identify the sites. Any sites found on tributaries to the mainstems have existing WRIA numbers included in the site identification name. If the waters are unnumbered they are given a tentative WRIA number.

Each site which has existing and/or potentially fish habitat is surveyed, and data on characteristics such as flood susceptibility, water source and quantity, water quality, juvenile fish access and current use, channel entrance conditions, machinery accessibility, substrate type are recorded. The evaluations for potential enhancement projects are based, in part, on this information. Since many sites are de-watered, or nearly so, during the summer, follow-up surveys sites are conducted after the onset of the autumn rains to provide additional information on water levels and flow.

### **Project Evaluation**

Coho production from these enhancement projects is evaluated primarily by monitoring juvenile fish movement using two way migrant traps. Traps are made of ½ inch plywood and are 4 feet long by 3 feet wide by 4 feet high with 4-inch diameter circular openings on the upstream and downstream ends. A removable 1/4-inch mesh screen separates the interior of the trap. One half is open to upstream migrating fish and the other half to downstream migrating fish. Each half is lined with a 1/8-inch nylon mesh net to facilitate fish removal and lessen the chance of handling injury. Cones formed from 1/4-inch mesh plastic screening and placed over the entrances to both halves of the trap to keep fish from finding their way back out. These cones taper from 4 inches to 1.5 inches. The fish are funneled into the trap openings by placing 1/4-inch mesh screen wing panels in a "V" formation upstream and downstream from the trap. The screens are made of galvanized, stainless steel, or plastic coated hardware cloth. The galvanized wire tends to corrode in one or two years and have been replaced with more expensive coated and stainless wire which lasts five years or more.

A sample of fish is randomly selected at each trap and anesthetized with tricaine methane sulfonate (MS-222). The fork length of each fish in the sample is recorded and every fish is checked visually for freeze brands or paint marks since some of the coho may be holdovers from the previous year.

At selected trapping sites a sample of the upstream migrants are marked with a freeze brand or fluorescent dye.. The freeze branding tool, made of brass and silver, is inserted into a mixture of dry ice and acetone and then placed on the left side of the fish below the dorsal fin for two to four seconds. This leaves a mark which can be visually identified when the fish are recaptured during the downstream migration in the spring, yet disappears soon after the smolts begin to grow in the ocean environment. The dye mark is injected into the base of the anal fin using a "Syrijet" brand pneumatic medication inoculator which forces the dye into the tissue without breaking the surface of the tissue. At other inventoried sites, fish use information is collected by

using an electro-shocker and/or by setting wire mesh minnow traps baited with salmon roe.

### **Project Design**

Each proposed project is rigorously reviewed by a team consisting of the lead Environmental Engineering Services (EES) engineer, the SSHEAR construction superintendent, and the lead SSHEAR Division Environmental Specialist. Once the projects are approved for development, an engineering survey of the site is conducted and a preliminary design is produced. After final review and approval of the design by the project team, landuse agreements are negotiated and applications are submitted for the necessary environmental permits. A project time line is developed that identifies the date for materials purchasing and construction.

### **Construction**

The SSHEAR Construction Unit prepares for the construction of each project by ordering necessary materials and renting the appropriate equipment. The primary pieces of equipment used to complete construction work on the projects include hydraulic excavators, front-end loaders, dozers, and dump trucks.

## **RESULTS**

### **Habitat Inventory**

During 2000, off-channel rearing habitat inventory work continued on the Sol Duc River tributaries. These data are loaded into a database and are available to various resource managers, including local Habitat Management biologists, to help them when reviewing environmental permit applications. This database has improved WDFW's ability to protect key coho producing habitat. To date, this habitat inventory work has been completed on about 80 percent of the North Coast river systems.

This habitat inventory information has become a key component of the Watershed Analysis process being conducted on these river systems. All new habitat sites are being identified and cataloged with the WDFW water resource inventory area (WRIA) numbering system which is the standard identifier for all waters of the State. The inventory has located many miles of previously undocumented waterways. These streams have been assessed for fish use and then recommended for water type classification and inclusion into the state Department of Natural Resources water type maps. In some cases, fish use can be documented in streams that have been previously classified as non-fish bearing. This information assists habitat managers in their efforts to protect critical stream habitat.

Fish passage at human-made structures such as culverts has become a high priority. Any human-made fish barriers encountered during our surveys are documented and included in the SSHEAR fish passage database.

## **Project Evaluations**

The goal of project evaluation is to collect information that will assist in the refinement of current habitat enhancement techniques. So far the data indicates that coho over-winter survival is higher at projects with large amounts of complex submerged woody debris and certain species of submergent and emergent aquatic vegetation. In recent studies in Oregon, the addition of woody debris to constructed overwintering habitat greatly improved the over-winter survival and size of fish. (Rodgers et al., 1993). Coho and trout juveniles use the wood and vegetation as cover to avoid avian and mammalian predators. This complex cover also encourages aquatic insect production which supplies necessary forage for the juvenile fish. We have found that fast-growing shrubs and trees planted along the pond perimeters soon after construction quickly supply shade, soil stability, and an insect food source.

Evaluation work at selected sites will continue into the year 2001.

## **Hoh River Overview**

The adult coho escapement to the Hoh river in the Fall of 1999 was 4,594 fish and in 2000 was 6,798 fish (Mike Gross, Roger Mosley, WDFW personal communication). This is the seventh time in the past ten years that the escapement has been over 4,000 fish, (Figure 6). The year 2000 escapement was the second highest in 27 years. The escapement goal for the Hoh River is between 2,000 and 5,000 fish. The Summer of 2000 was about average for precipitation and would have created favorable rearing conditions for juvenile fish. We operated a two way juvenile fish trap at one existing project site on the Hoh river during the winter of 1999/2000. Using a measured mean production of 0.22 smolts per square meter, the 13 projects on the Hoh are producing about 14 percent of the total smolt output of the entire watershed..

## **Dismal Pond (Hoh River)**

In the summer of 1989, the former Washington Department of Fisheries (WDF) deepened and expanded an existing gravel removal site to create one acre of shallow pond habitat. The pond was then connected to a nearby wall-base channel which flows into the Hoh River. Water flow was supplemented by diverting nearby spring flow into the pond. Rayonier Timberlands (RTOC) granted land use rights for construction and maintenance to WDF, at no cost. Additional woody debris has been added to the pond several times during the life of the project to keep the cover complexity at a high level.

During the fall of 2000, the average fork lengths of the juvenile immigrant coho entering Dismal Pond followed the trend from the past eleven years and we are seeing a very strong, inverse relationship ( $r^2 = 0.89$ ) between the size of the Hoh river coho escapement for the brood year and mean fork length of their progeny measured in the autumn as they enter over-wintering habitat, (Figure 7). In other words, as adult coho escapement increases, the size of their progeny appears to decrease. This information suggests that the summer growth rate of coho young of the year is density dependent.

In the spring of 2000, 24 percent of the coho that were previously marked as they entered Dismal Pond in the fall of 1999 were recovered in the out-migrant trap. During the winter of 2000/01, another 1 percent of the previous year's marked coho were captured as they moved downstream. This brings the total to about 25 percent (Table 6). There was also one day in mid-December 1999 during the upstream migration when the trap was flooded for a short time by the backwater curve of the Hoh River. Juvenile fish could have left the project at that time but it was such a short period that we feel the marked recovery rate of 25 percent can be considered valid.

In the previous eleven years of evaluation at this site, mark-recapture rates have averaged 31 percent. This is lower than the post enhancement, over-wintering survival rate of 56 percent reported by Cederholm, et al., (1988) on their study of Paradise Pond, a Clearwater River tributary located on Washington's Olympic Peninsula. Visual observations at Dismal Pond suggest that predation by otters and birds may be reducing the coho survival rate. During 1999, we added more woody debris cover to the pond to reduce predation. We are currently looking at different nutrient supplementation methods for this site to bolster the growth rates including the addition of salmon carcasses obtain from the two hatcheries in the Hoh system.

In the fall of 2000, 3,591 juvenile coho migrated into Dismal Pond from the Hoh River (Table 7). This is well above the eleven year average immigration of 2,374 coho.

### **Quillayute System Overview**

The Quillayute watershed consists of the Quillayute mainstem, Dickey, Sol Duc, Calawah, and Bogachiel Rivers. Coho escapement for 1999 was good and resulted in good recruitment of juveniles to off-channel habitat in the autumn of 2000. The number of spawners expected to return in 2000 was predicted to be low because of a small adult return in 1997. However, the run was stronger than predicted due in part to favorable ocean conditions.

A two-way juvenile fish trap was operated at one site on the Bogachiel river. The mean density of coho smolts per square meter measured at selected project sites is about 0.35. Using the 27 project sites within the entire watershed we calculate that they are producing about 10 percent of the total Quillayute smolt output. The nine projects on the Bogachiel are estimated to be producing close to 20 percent of its entire smolt yield.

### **Rayonier Channel (Bogachiel River)**

This project site was identified during habitat inventory work in the Bogachiel river floodplain. In 1998, a 1,200 foot long groundwater-fed channel was excavated to create overwinter rearing habitat for juvenile salmonids. Since its construction, we have observed juvenile salmonids using it for summer rearing also. A two-way migrant trap was installed in the fall of 1999 to monitor the movement of juvenile coho and other salmonids. A sample of these fish was marked and, in the spring of 2000, over 29 percent of the marked fish were recovered as they migrated out as smolts, (Table 6).

No spawning occurs at this site and so there no carcasses to provide nutrient. Based on the prior year's poor overwinter growth rate of 11 millimeters, we deposited spawned out hatchery salmon carcasses in the winter of 1999/2000 to supplement the nutrient load in the channel. Growth rate overwinter jumped up to 32 millimeters. This method of nutrient supplementation was repeated during the winter of 2000/01 and preliminary indications show a similar accelerated growth rate. During the fall of 2000, 1,500 juvenile coho moved in to this site to overwinter, (Table 7).

### **Calawah Springs (Bogachiel River)**

This project was originally completed in 1992 and included backwatering a spring-fed channel using log controls and the creation of a small side channel for spawning. Woody debris was added for cover. In the years since the construction, additional woody debris has been added.

This site was monitored with a two-way juvenile fish trap for several years after project construction. Juvenile coho densities were high, but the fish showed very slow growth over the winter months. From five years of trapping, the fish averaged only 10 millimeters of fork length growth from November through April. With the recent information on nutrient enrichment from salmonid carcasses, we added a large number of carcasses from the hatchery to see if there was a detectable response. Early indications show the fish are growing quite well. Over 1,600 juvenile coho were enumerated moving into the project area in the fall of 2000, (Table 7).

## **2000 CONSTRUCTION PROJECTS**

Project costs and habitat benefitted for the 2000 projects is summarized in Table 8. An entire list of projects that have been constructed since 1988 are shown in Figure 5 with details on each project shown in Table 9.

### **Prairie Falls Creek (Sol Duc River)**

During the 1940's, the US Navy did some work on the Quillayute road where this creek once flowed under an old bridge. The creek was rerouted down a road-side ditch and forced to plunge 25 feet into the Sol Duc river. As a result anadromous salmonids have been unable to access the creek for over 50 years. During the summer of 2000 WDFW- SSHEAR installed a large culvert under the road and returned the creek to it's original channel. This was a cooperative project with the Pacific Coast Salmon Coalition, the Quileute tribe, People for Salmon, Rayonier Timber Company, and Clallam county. This project opened up about 4,700 square meters of spawning and rearing habitat.

### **Labrador Creek (West Fork Dickey River)**

An undersized plugged culvert was replaced with a sloping roughened channel to maintain a large wetland that has been created as a result of the plugged culvert. This was a cooperative



project with Green Crow Timber Company and the Pacific Coast Salmon Coalition. It improved fish access to over 2,000 square meters of rearing habitat.

### **M & R Springs (Sol Duc River)**

A series of cedar plank weirs were installed in an existing spring-fed channel to create more winter and summer rearing habitat for juvenile salmonids. This was a cooperative project with the Merrill and Ring timber company and the Pacific Coast Salmon. A total of 700 square meters of rearing habitat were created as a result of this work..

Other maintenance and repair work was done during the summer at various existing project sites using a contract labor crew from the Clearwater Corrections Center.

## **SCHEDULED PROJECTS FOR 2001**

### **Mosley Springs Extension**

This is an extension of an existing project on the South fork Hoh river. Approximately 500 linear feet will be added to the upper end of the project to provide additional rearing and spawning habitat.

### **Lear Creek Springs II**

A series of cedar plank weirs were installed in a spring-fed channel to backwater the existing shallow habitat and create more winter and summer rearing area for juvenile salmonids.

### **Lake Creek Springs**

This project is similar to Lear Creek Springs. It will result in the creation of additional rearing habitat in a high quality spring-fed channel by using cedar plank weirs to backwater the existing shallow habitat.

### **Goakey's Channel**

A disconnected wetland will be reconnected to provide free access for juvenile fish and prevent stranding during periods of higher flows.

### **Maintenance**

Existing project sites will be inspected for maintenance needs and work will be performed as necessary. Stumps and other woody debris will be added to projects that appear to have inadequate cover.

## **SUMMARY**

During 2000, the North Coast area experienced normal precipitation during the summer which and stream flows were maintained at normal levels. This probably increased access to rearing habitat. This year the major juvenile salmonid upstream migration occurred in a normal pattern during October and November and coincided with the onset of autumn rains. Fortunately,

October was wetter than normal and helped buffer the unusually dry months of November and December.

The high-quality rearing and spawning areas which were either created or enhanced in 2000 should provide excellent overwintering habitat for wild juvenile coho and other salmonids. The evaluation of past projects is providing us with information which is used to develop new techniques to improve the overall quantity and quality of off-channel, over-wintering habitat in the North Coast watersheds. For example, waterfowl, otters, and trout appear to be the major predators of juvenile coho in our enhancement projects. To reduce predation, large amounts of complex woody debris are now being incorporated into all projects.

Because of the good number of coho spawners on the Hoh river in 1999 and the higher water conditions of late summer 2000, we expected to see a corresponding increase in juvenile immigrants into the project areas during the autumn of 2000.

Over the past eleven years at the Dismal Pond project we have seen a close inverse relationship ( $r^2 = 0.89$ ) between the Hoh river coho brood year escapement size and the brood year's progeny mean fork length measured the next Fall (Figure 7). The average size of this year's juvenile coho immigrants into Dismal Pond is about 78 mm. Based on the above relationship, we would have expected an average around 78mm.

Preliminary estimates show the 2000 coho run to the Hoh river to be the second largest in the past 27 years. With the number of Hoh river spawners being fairly closely related to the number of following year fall juvenile coho recruits to the Dismal Pond site, it indicates that a higher spawner escapement is needed to fully seed project areas, (Figure 8). Until this happens, the sites may never cycle up to full production capacity.

Off-channel rearing habitat inventory work continued on the Sol Duc river and its tributaries in 2000. New habitat enhancement projects were completed on the Hoh, Bogachiel, Dickey, Clearwater and Sol Duc rivers this year.

During 2000, the Clearwater Corrections Center labor crews, which are supervised by the Department of Natural Resources (DNR), were contracted to perform various parts of the hand labor construction including much of the re-vegetation.

Local timber companies and the DNR have been very cooperative in allowing us to conduct inventories and habitat enhancement/restoration work on their properties. In some cases the timber companies have provided funding and/or in kind services. WDFW will continue to develop cooperative projects with timber companies and any other landowners who are willing to work with us.

Project evaluation work continues at selected sites. The data collected is providing valuable information on the numbers and the quality of fish being produced, over-winter survival rates, and overall project function. The data indicates a need for more complex submerged woody

debris and specific types of aquatic vegetation to provide better protection from predatory birds and mammals. This type of improvement is being incorporated into existing and future projects.

### FUTURE WORK

The habitat inventory work will continue on the North Coast streams. Supplemental survey work must be continued throughout the year to monitor potential project sites under a wide range of environmental conditions.

Evaluation work has also required more time than anticipated. The additional effort required to identify and type new streams and wetlands, participate in Watershed Analysis and other technical advisory groups, and implement the new culvert inventory process has slowed the pace of the habitat inventory but we feel it is necessary to make sure this valuable information is not bypassed.

Because of concerns for fish life, construction work within the streams' ordinary high water mark is limited to a brief period between June 15 and October 15. This combined with the increasingly lengthy and complex process needed to secure the required environmental permits, pre-project evaluation, planning and engineering effectively limits the number of projects that can be completed. However, potential habitat enhancement projects are continually being identified and four are scheduled for completion in the year 2001.

Table 6. North Coast upstream/downstream migrant trapping summary for Fall 1999 and Spring 2000.

Site	River Basin	Coho In	Coho Out	Marked Group Recovery	Trout In	Trout Out
Dismal Pond	Hoh	6,778	2,108	25%	382	16
Rayonier Channel	Bogachiel	1,702	886	29.2%	11	21
Note: All sites have 0+ coho fry moving into them over the summer when the traps aren't operating and, as a result, the number out does not reflect the Fall immigrant population marking study done at each trap.						

Table 7. North Coast upstream migrant trapping summary for Fall 2000.

Site	River Basin	Location (RM)	Coho In	Trout In
Dismal Pond	Hoh	26.0	3,591	173
Rayonier Channel	Bogachiel	18.3	1,480	6
Calawah Springs	Calawah	3.0	1,659	357

Table 8. North Coast habitat enhancement projects completed in 2000

<b>Project</b>	<b>River Basin</b>	<b>Project Type</b>	<b>Habitat Benefitted</b>	<b>Project Cost</b>	<b>Landowner</b>
Prairie Fall Creek	Sol Duc	Fish Passage	4,700m <sup>2</sup>	\$148,400	County
Labrador Creek	W.Fk.Dickey	Fish Passage	2,000m <sup>2</sup>	\$37,800	Green Crow
M & R Springs	Sol Duc	Rearing habitat enhancement	700m <sup>2</sup>	\$59,900	Merrill & Ring
<b>TOTALS</b>			7,400m <sup>2</sup>	\$246,100	

Table 9. Project sites listed on study area map.

<b>PROJECT SITE</b>	<b>RIVER BASIN</b>	<b>YEAR COMPLETED</b>	<b>HABITAT BENEFITTED</b>	<b>COST</b>	<b>PROPERTY OWNER</b>
Airport Pond	Clearwater	1988/89	30,000 m <sup>2</sup>	\$16,900	Rayonier
Rayonier Pond	Hoh	1988	4,048 m <sup>2</sup>	\$19,000	Rayonier
Barlow Pond	Hoh	1988/89	8,100 m <sup>2</sup>	\$26,600	Private
Anderson Ponds	Hoh	1988/89	10,150 m <sup>2</sup>	\$45,900	Private
Pole Creek	Hoh	1988/90	6,100 m <sup>2</sup>	\$45,300	Forest Service
Peterson Pond	Hoh	1989	2,000 m <sup>2</sup>	\$22,500	Private
Dismal Pond	Hoh	1989	4,048 m <sup>2</sup>	\$25,700	Rayonier
Anderson Cr. Channel	Hoh	1990	3,000 m <sup>2</sup>	\$16,500	Rayonier
Nolan Pond	Hoh	1990	8,000 m <sup>2</sup>	\$ 3,200	State
Wilson Springs	Bogachiel	1990	3,200 m <sup>2</sup>	\$41,600	Private
Tall Timber	Bogachiel	1990	800 m <sup>2</sup>	\$10,000	Rayonier
Smith Road Pond	Bogachiel	1990	2,000 m <sup>2</sup>	\$15,600	Rayonier
Dahlgren Springs	Bogachiel	1990	600 m <sup>2</sup>	\$ 7,300	Private
* Morganroth Springs	Bogachiel	1991	14,100 m <sup>2</sup>	\$13,400	Forest Service
* W.F. Dickey	Dickey	1991	23,000 m <sup>2</sup>	\$28,000	Rayonier
* Mosley Springs	S.F.Hoh	1991	4,048 m <sup>2</sup>	\$21,000	State

PROJECT SITE	RIVER BASIN	YEAR COMPLETED	HABITAT BENEFITTED	COST	PROPERTY OWNER
* Lear Springs	S.F.Hoh	1991	800 m <sup>2</sup>	\$18,100	State
* Upper Mosley	S.F.Hoh	1992	690 m <sup>2</sup>	\$23,000	State
Bogey Pond	Bogachiel	1992	13,640 m <sup>2</sup>	\$24,700	Rayonier
Falcon Walrus	Bogachiel	1992,1995	740 m <sup>2</sup>	\$20,600	Rayonier
Calawah Springs	Calawah	1992	900 m <sup>2</sup>	\$50,300	John Hancock Ins.
Colby Springs	Dickey	1992	9,200 m <sup>2</sup>	\$13,500	Rayonier
Elkhorn Pond	Dickey	1992	5,400 m <sup>2</sup>	\$ 9,100	State
W.F.Marsh Ck.	Dickey	1992	3,000 m <sup>2</sup>	\$ 6,200	Rayonier
* Hoh Springs	Hoh	1993,1995	3,450 m <sup>2</sup>	\$86,000	Rayonier
Soot Cr. Springs	E.Fk.Dickey	1993	2,100 m <sup>2</sup>	\$64,000	Rayonier
T-Bone Springs	Dickey	1993	745 m <sup>2</sup>	\$33,000	Rayonier
* Young Slough	Hoh	1994	3,000 m <sup>2</sup>	\$158,000	John Hancock Ins.
* Lewis Channel	Hoh	1994	2,000 m <sup>2</sup>	\$135,000	State
Tassel Springs	Sol Duc	1994	600 m <sup>2</sup>	\$16,000	Private
Laforrest Pond	Bogachiel	1995/96	2,520 m <sup>2</sup>	\$133,000	Private
*Nolan Channel	Hoh	1996	1,800 m <sup>2</sup>	\$151,000	Rayonier
*Huelsdonk Creek	Hoh	1996	12,000 m <sup>2</sup>	\$18,000	DOT
Manor Springs	Clearwater	1996	960 m <sup>2</sup>	\$21,550	DNR
*Cascade Springs	W.Fk.Dickey	1996	3,000 m <sup>2</sup>	\$42,000	Rayonier
*Powell Springs	Sol Duc	1997	2,000 m <sup>2</sup>	\$76,000	Rayonier
Rootstock Springs (I)	Calawah	1997	200 m <sup>2</sup>	\$12,000	Rayonier
Rayonier Channel	Bogachiel	1998	1,700m <sup>2</sup>	\$135,000	Rayonier
Tyee Pond	Sol Duc	1998	2,800m <sup>2</sup>	\$80,000	Rayonier
Rootstock Springs (II)	Calawah	1998	600m <sup>2</sup>	\$22,000	Rayonier
*Eagle Creek Springs	Sol Duc	1999	2,200m <sup>2</sup>	\$84,000	Private
Thomas Springs	Sol Duc	1999	2,800m <sup>2</sup>	\$20,000	Private
Big Beaver Springs	E.Fk. Dickey	1999	7,400m <sup>2</sup>	\$35,000	Rayonier
*Prairie Fall Creek	Sol Duc	2000	4,700m <sup>2</sup>	\$148,400	Clallam County
*Labrador Creek	W.Fk.Dickey	2000	2,000m <sup>2</sup>	\$37,800	Green Crow Timber
*M & R Springs	Sol Duc	2000	700m <sup>2</sup>	\$59,900	Merril & Ring Timber
* Cost share projects with timber companies, DNR, DOT, Salmon Coalition, Counties and/or Tribes.					

(Insert Figure 5 here)

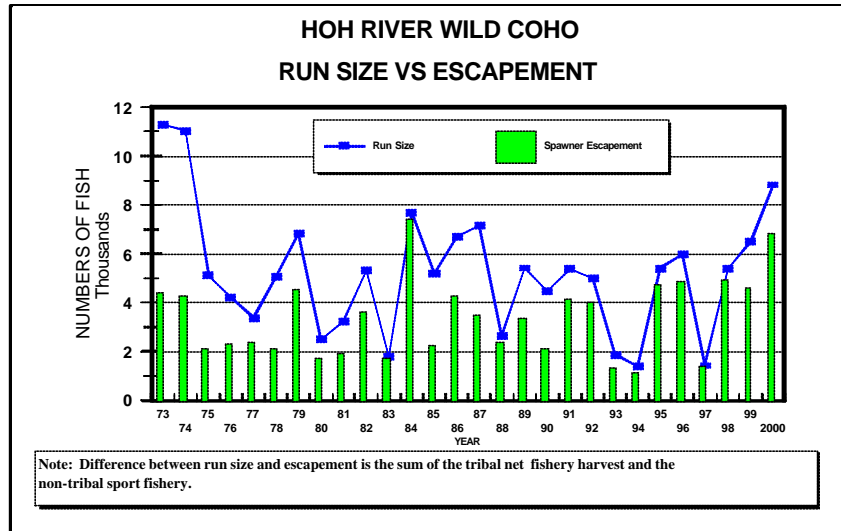


Figure 6. Hoh river wild coho run size and escapement for the years 1973 through 2000.

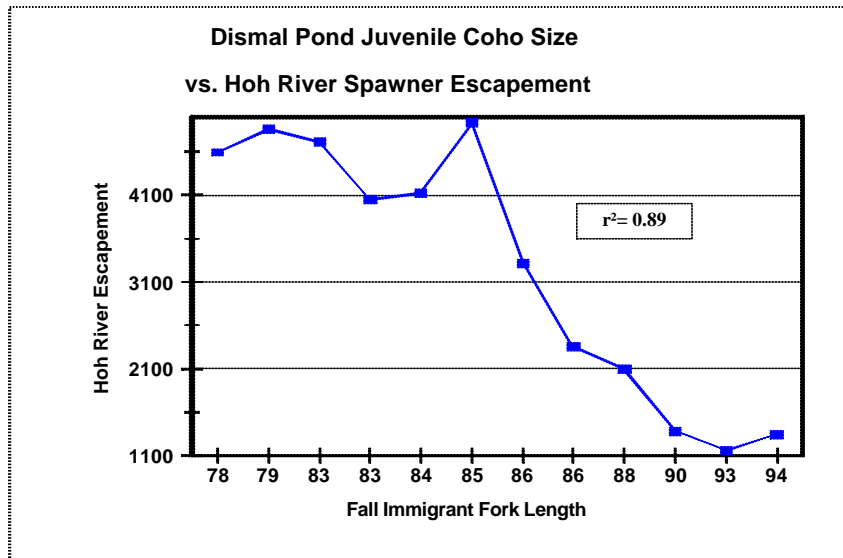


Figure 7. Relationship between the brood year escapement and the size of their progeny measured in the autumn for 12 brood years 1988 to 1999.

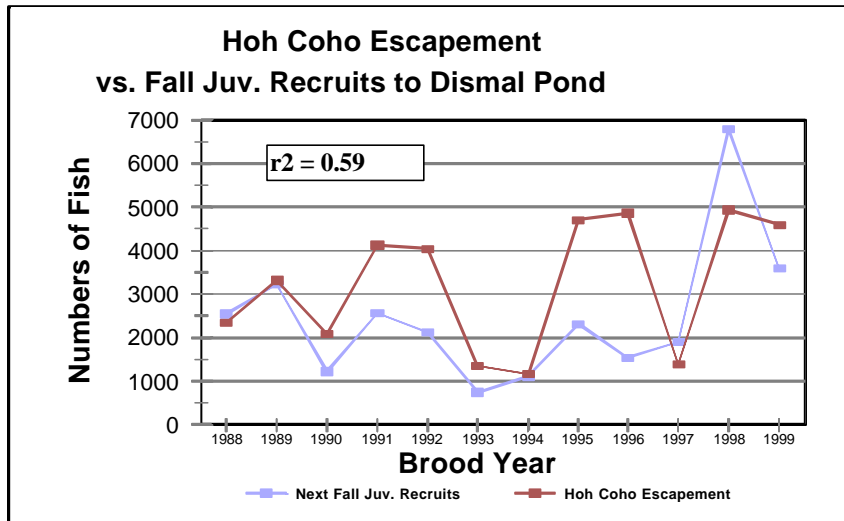


Figure 8. Relationship between Hoh river coho salmon escapement and numbers of brood year offspring immigrating into Dismal Pond the next fall.