THE WEST FORK OF THE HOOD RIVER HABITAT RESTORATION PROJECT

ANNUAL REPORT FY92

BY

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Agreement Number DE-AI79-84BP16726
Project Number 84-l 1

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ABSTRACT

The West Fork of The Hood River Basin has historically had large woody debris (LWD) which affected the stream morphology of the West Fork and its tributaries. Large wood provides large roughness elements creating varied water velocities. Consequently, LWD creates secondary pools and retains spawning gravel within stream systems. Past logging practices and the policy of large wood removal in streams has created channel bedforms in cascade streams which did not exist before. These bedforms have fewer spawning gravels and fewer secondary cover pools for both juvenile and adult salmonids. The Hood River District has accomplished several projects in the Hood River Basin. In 1992 The West Fork project used more woody debris and created more complex structares than in the past. Success using complex structures simulating natural LWD loading has been documented in the 1990 and 1991 projects on Lake Branch of the West Fork Hood River. This type of treatment was used in the 1992 West Fork project. The limiting factors in the West Fork were pools, cover, complexity associated with rearing habitat and usable spawning gravel. The limiting factors were caused by historical railroad logging and removal of all large trees within and adjacent to the entire stream. The desired futrue condition of the West Fork riparian corridor and adjacent upland, is an old growth forested ecosystem composed of large conifers in excess of 36 inches dbh, which in time will naturally fall into the West Fork channel and create habitat. In the interim, the current work will provide habitat for adult and juvenile anadeomous salmonids Imported logs and boulders were cabled together to accomplish the project objectives, in attempts to modify the identified limiting factors. Structure designs were created to perform at all flow levels and local channel conditions.

INTRODUCTION

The West Fork of the Hood River is a producer of summer steelhead, winter steelhead, spring chinook and fall chinook. Current limiting factors in the West Fork have been reductions in spawning gravel and rearing habitat. These reductions result from the removal of instream LWD which provides stream structure, spawning gravel, and rearing habitat in the West Fork. Logging of adjacent old growth trees has removed future long term wood inputs and resulting stream structure.

West Fork steelhead and chinook runs all have hatchery supplementation. Wild summer and winter steelbead still spawn in the system. The extent of wild steelhead production is unknown. However, all fish entering the Hood River system were trapped and recorded in 1992 (Table 1). To improve the information on the states of anadromous stocks within the Hood River, the Hood River Ranger District has received a challenge cost-share grant to begin a telemetry program in the Hood River system. The goal of this study will identify areas where fish are presently spawning within the Hood River basin and identify the use of habitat structures by adult fish within the East, Middle, and West Fork sub-basins of the Hood River. Locations of holding areas, the speed at which the fish move. through each system, and species preference in each system will be better understood following this project. The Hood River/Barlow fisheries program considers itself a partner in the commitment to improve the anadromous fishery in the Colombia River Basin with Oregon Department of Fish and Wildlife (ODFW), Bonneville Power Administration (BPA), Confederated Tribes of the Warm Spring Indian Reservation, and other public and private agencies and groups. The telemetry project will be a cooperative effort between the United States Forest Service (USFS) and ODFW to provide needed information to increase remaining salmon and wild steelhead populations in the Columbia River Basin. Consultation on this project will take place between the USFS, ODFW, the Confederated Tribes of the Warm Springs Reservation and National Marine Fisheries Service (NMFS). It is the goal of the Hood River/Barlow fisheries program to obtain more and better information on the biology of the hatchery and wild stocks of anadromous salmonids within the Hood River Basin. This information will improve. the ability to prioritize habitat deficiencies which can then be improved to benefit present fish stocks. The information will also provide ODFW with more data to manage current populations of anafromus fish.

Tbis report will discuss past habitat work accomplished by the Hood River District, limiting factors of current habitat, causes of habitat degradation, and will explain the improvement methods and materials used to address the identified limiting factors and restore the degradation which has taken place on streams within the Hood River District.

1		POWERDALE DAM UPSTREAM MIGRANT TRAP DATA 1992									
2											
3		JAN	FE8	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT
4											
5	SST-W	2	1	16	24	39	103	109	60	93	55
6	SST-H	6	6	29	135	326	418	465	164	81	34
7	WST-W	32	67	186	328	119	2				
8	WST-H	125	109	42	12						
9	SPCH				12	244	155	27	5	1	
10	FCH.W								7	14	3
11	FCH-H									2	2
12	COHO								1	56	35
13	BULLS					5	2				
14	SRCUT				2					1	
15	BROWNS						2	3			

Table 1. Preliminary data from the upstream migrant trap on the Hood River at Powerdale Dam. Species as follows: line 5 wild summer steelhead, line 6 hatchery summer steelhead, line 7 wild winter steelhead, line 8 hatchery winter steelhead, line 9 hatchery spring chinook, line 10 wild fall chinook, line 11 hatchery fall chinook, line 12 coho, line 13 bull trout, line 14 sea run cutthroat, line 15 brown trout. Data provided by ODFW.

EXTENT OF HABITAT WORK IN THE WEST FORK BASIN

The majority of past habitat improvement projects within the West Fork basin have been in Lake Branch of the West Fork Hood River. Improvements from 1983 through 1987 were all BPA funded projects. In 1983, boulder clusters, gabions, and boulder berms were. installed to improve pool habitat and off-channel rearing habitat in Lake Branch near Raker Pit.

Improvements completed in Lake Branch during 1984 were installed immediately above River Mile (RM) 8.3. These structures consisted of large logs and boulders which concentrated flows creating scour areas and pools. A side channel was excavated to provide spawning and rearing habitat.

In 1985, improvements at Lake Branch were undertaken in two reaches. In reach A, near Raker Pit, boulder groupings were. placed to increase cover and depth. A high water side channel was opened and deepened to provide a year round rearing channel. In roach B, below Raker Pit, 12 boulder structures were built to increase pool habitat.

In 1986, no work was done on Lake Branch. However, improvements were implemented on McGee Creek, a tributary to the West Fork of the Hood River. Log structures were constructed at 19 sites. Six large trees were also felled into the stream channel for structure cover.

During 1987, within Lake Branch, a total of 42 structures were installed in two reaches. Fourteen log structures were constructed near RM 8.5 to improve channel characteristics for spawning and rearing. Near RM 9.0, 28 log structures were installed to increase channel stability, increase channel roughness, provide pool habitat, and collect spawning gravels.

In 1988 a Knutson-Vandenberg (KV) funded project was completed in lower Lake Branch at RM 5.3 to RM 5.5 and RM 7.2 to 7.4. Thirty three log structues and 3 boulder structures were completed. Fourteen boulder placements were also Fished. The purpose of this project was to increase pools and glides. Increased spawning gravels and biding cover were also expected following project completion.

In 1990, a BPA funded project had objectives to increase pools, gravel and habitat diversity. From Lake Branch RM 5.4 to 7.2, trees were felled into the channel. Access limited machine use to the section from RM 4.5 to 5.3. Here, a spider backhoe used felled trees and blowdown to build structures. These structures were cabled to existing boulders within the stream. A total of 57 trees were felled in the upper 1.8 miles of the project reach. The trees were in excess of 36 inches dbh. Considering the size and peak discharges of the treatment reach, it was determined that large trees should be used to accomplish project objectives. It was concluded that smaller trees would be flushed out of the system since there were no large trees in the system to stop them and accumulate complex habitat. A total of 18 trees and 12 structures using blowdown material were constructed in the lower 0.8 miles of stream. These structures were constructed using a spider backhoe. Structure work involved the use of more logs per structure site than past projects. This increased complexity and better simulated natural habitat. In stream systems such as Lake Branch natural habitat often takes the form of concentrated accumulations of inter-locking woody material or log jams.

In 1991 two BPA funded projects were. completed. These projects were part of the 84-11 project agreement modification A012. The first project was in Lake Branch (RM 7.8 to RM 8.2). The second project was in McGee Creek, a tributary to the West Fork. The McGee Creek project was located between RM 1.3 to RM 2.4. A total of 55 structures were built using 162 logs along the ***5600*** feet of stream treated. Of the ***162*** logs, 99 were imported. The remaining logs were taken from felled trees which were bucked to size. Trees were taken from the upland and yarded down to structure sites. No boulders were imported to the project. Only in-stream boulders were used to ballast the structure logs.

The Lake Branch project imported all logs and boulders along a single access point. A total of 75 boulders and 85 logs were used to build 24 structures within 3200 feet of stream. Following monitoring of multi-log structures, it was found that the best cover, habitat complexity, and spawning gravel accumulation existed within the area of influence of these structures. The success of complex structures in west side cascade stream environments can be attributed to the same elements that act and create habitats which are formed and maintained naturally.

Bankfull stream discharges are. the primary channel forming feature in most streams. Therefore, bankfull flows are important in defining channel shape and bedform (Wolmao and Miller ***1960; Yu*** and Wolmao, 1987). Roughness elements can stratify water velocity and provide the hydraulics which allow smaller sized substrate to be retained in stream channels. Roughness elements can take the form of brush, root wads, grass, boulders and other organic or inorganic material which finds its way in or near the stream channel.

In old growth forested streams, blowdown and undercut trees provide large volumes of roughness elements. They provide the tools to create habitat where it would not exist otherwise. Complex structures imitate the type of habitat created when old growth trees fall into streams and floodplains.

In west side cascade streams, natural large woody debris can have a profound affect on channel morphology. Fragmentation of the stream channel by large woody debris, create areas of high and low velocity. Low velocity areas allow the retainment of smaller sized substrate moving as bedload, high velocity areas scour out pools. Spawning gravel and rearing pools are basic habitat requirements for salmonids LWD plays a significant role in providing the roughness elements which break up riffle sequences and provide channel variations (Robison and Beschta, 1989).

Streams which have had large trees in them, and have been cleaned, become more. monotypic in velocity and substrate. With no large roughness elements, pools and riffles tend to occur at consistent intervals (Leopold et al., 1964). Following LWD removal, low and high velocity variation is diminished. Velocities become less stratified and more monotypic throughout the channel. Smaller sized gravels become easily transported as bedload throughout the system. Reduction in high velocity areas reduce secondary scour and pool development. As a result, secondary pool areas fill in, and substrate variations are reduced as smaller sized gravel is transported downstream. Total physical habitat for adult and juveniles becomes reduced in quantity and quality.

Large trees historically created the stratified water velocities which create ideal anadromous habitat. where, for how long, and to what extent trees actively produce habitat depends on the geographical location of a stream, ecosystem surrounding the stream, and size of watershed within a given stream reach (Keller et al., 1983). As one moves downstream, discharges greater than bakfull rearrange and move LWD. As one moves down watersheds, LWD becomes more peripheral and less a factor in main channel hydraulics. LWD as salmonid habitat, does not play a major role in all stream environments. The level of significance that LWD plays, varies between ecosystems, and stream geomorphology. Over time, storm occurrence, sedimentation, vegetation succession, and land use can change channel characteristics (Stack and Beschta, 1989). Existing channel morphology following removal of in-stream wood can be drastically different than the same channel with wood. Examining stream characteristics and present channel form, while determinin g the historical significance of LWD in stream channels, is a critical aspect of habitat enhancement and restoration on the Hood River Ranger District.

Baokfull discharges sort and transport woody material as well as bedload material. When large trees fall in a stream and can't be moved by high flows, they naturally collect smaller trees and other material which can be moved by high flows (Bilby, 1981). The material, once collected, create much of the complexity required by salmonids while adding to the hydraulics which sort and deposit spawning gravel nearby. This process is continual. However, this dynamic degradation and addition of trees and organic material in stream systems has been interrupted by forest management (Bryant, 1983). This has impacted anadrolnous salmonids by eliminating habitat accumulated naturally and removing future sources of habitat in the form of LWD.

On the west side of the Hood River Ranger District old growth trees have historically provided salmonid habitat and shaped channel morphology. Smaller material is incorporated into complex inter-woven habitat anchored and established by whole old growth trees. The complex structures built in Lake Branch during the 1990 and 1991 BPA funded projects were designed to behave. the same way.

DESCRIPTION OF 1992 PROJECT AREA

HYDROLOGY

The West Fork of the Hood River is a major fifth-order tributary to the Hood River. The West Fork is formed by the confluence of McGee and Elk Creeks. McGee Creek originates on the northwest slopes of Mount Hood. Elk Creek originates east of Lolo Pass. The West Fork flows northeast 13.9 miles where it joins the Hood River, 12 miles upstream from the Columbia River (Figure 1).

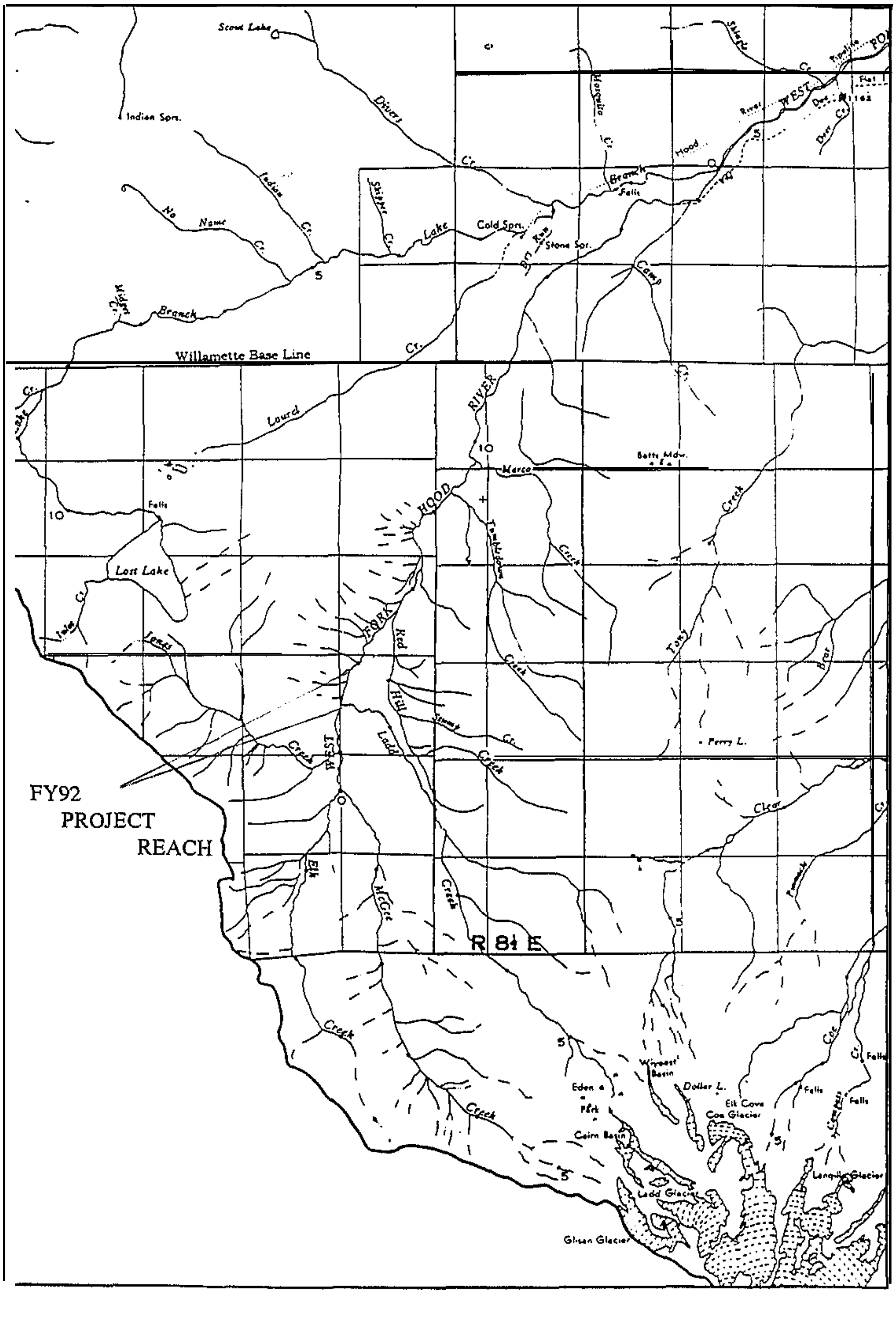

Figure 1. A map showing the project reach location within the West Fork of the Hood River Basin (adapted from State Water Resources Board, Hood River Drainage Map 4.8, 1964).

The 1992 project work was 2000 feet below and 200 feet above Ladd Creek. Project elevation is between 2200 and 2300 feet. Below Ladd Creek gradient approaches 4%. The channel is entrenched and confined by the glacial alluvial fan emanating from the Ladd Creek drainage. Beyond the lower end of the project the West Fork enters a bedrock canyon.

Ladd Creek originates on Ladd glacier. As a result, the suspended sediment load increases in the West Fork below the Ladd Creek confluence during the summer months. Due to the elevation, rain on snow events are common. These events can produce high, flashy flows which carry a great deal of energy in a short period of time. West Fork flows can range from summer lows around 20 cfs to as much as 7000 during rain on snow events.

HISTORICAL LAND USE

The watershed was extensively logged at the turn of the century. Railroad logging by Oregon Lumber Co. cleared the old growth timber and left no in-stream woody debris. The slash was burned. Today the majority of the trees adjacent to the stream are alder and second growth Douglas fir and Cedar. It is estimated that it will be another 200 years before the standing second growth can provide LWD sufficiently large to naturally create the habitat that existed prior to logging activity.

FISHERIES

The West Fork of the Hood River is the primary fish producing drainage in the Hood River system. Currently there are spring and fall Chinook (Oncorhynchus tshawytscha), winter and summer steelhead and rainbow trout (Oncorhynchus mykiss), and cutthroat trout (Oncorhynchus clarkii). The Oregon Department of Fish and Wildlife stocks the West Fork with spring chinook and summer steelhead smolts at Dry Run Bridge along the FS 1810 road.

A survey by Mount Hood National Forest biologists in the fall of 1984 indicated that the West Fork was riffle dominated (60% riffle) with predominantly cobble substrate. Steelbead sized gravel was limiting the amount of spawning area available. Nearly 60% of the gravels were of the larger size preferred by Chinook (size range 3-6 inches) (Cain and Kinzey, 1984). Large woody debris was lacking in the stream and within the floodplain. The majority of the fish habitat below Ladd Creek, and within the FY92 project reach, was associated with the few pools created by undercut banks, and rootwad stumps left over following railroad logging. The FY92 project reach was over 90% riffle with a boulder cobble substrate.

1992 PURPOSE OF HABITAT WORK

Further monitoring of 1990 and 1991 complex log and rock structures continued to show the advantages of building more. complex multi-log structures in streams such as Lake Branch and the West Fork. What was learned in 1990 and 1991 was applied to the 1992 project design and size of materials used. Spawning gravel and rearing habitat were deemed major limiting factors within the project reach. There is no continuous supply of large woody debris in a large percentage of the West Fork basin. The removal of in-stream wood and potential wood as standing trees has decreased variations in water velocities within the stream. Timber harvest throughout the West Fork basin has increased storm discharges. It is deduced that the combination of decreased variation or stratification in water velocities and increased peak discharges, have allowed the West Fork to strip the main channel of remaining wood and associated habitat. Stream channel degradation and simplification is a common result of woody debris removal. This has occurred in many reaches within the West Fork. Within these reaches, stabilization under current conditions, have left a bed-form composed primarily of cobble and larger substrate. The present substrate is stable under the current channel configuration and discharge conditions. Unfortunately, little of it can be moved by spawning adults. Salmonids require natural substrate size distributions for spawning, food, and cover. A complex mixture of sediment sizes, in combination with certain hydraulic conditions are needed to obtain quality salmonid habitat (Beschta and Platts, 1986). This situation does not exist in the West Fork project reach.

Minshall et al. (1985) stated “stream ecosystem dynamics are also coupled closely to fluvial geomorphic conditions.” LWD was a critical component of the ecology of the upper West Fork of the Hood River. It historically affected the stream morphology. Anadromous salmonids have life cycles which have evolved and are adapted to the habitat created by woody debris components and the geomorphic influence they have on ecosystems such as the West Fork of the Hood River. The West Fork restoration project is basing the structure design, location, concentration, and materials used on this premise. The project goals are to m-link the West Fork with riparian interactions which historically occurred in the form of LWD inputs. As the LWD strucutres decay over time the natural regeneration of large conifers will close this link broken by historical logging in the area. In the interim, the structures will create desired salmon and steelhead habitat in the form of cover from predation, velocity refuge at high flow, and maintenance of varied substrates and usable spawning gravel.

To accomplish this, logs and boulders were used to emulate the habitat that is created. naturally when large old growth trees fall into west side cascade stream environments. The majority of the structure work consisted of large multi-log complex structures. The structures fully spanned the channel. Small openings were left open to allow migration for adults and juveniles at all flow conditions. The structures created a variety of hydraulic velocities which resulted in sorted substrate ranging in size from sand to boulder. Pre project substrates were boulder cobble. The structures were designed to supply habitat and velocity refuge at all flow levels. This was accomplished by layering or vertically influencing the channel with the complex structures. Location of low velocity areas change through the water column vertically and horizontally as the water rises and falls. Complex log structures on the West Fork have a 4 to 5 foot vertical influence. As water levels rise salmonids will still have low velocity refuge, but at different locations around the complex structure and in the water column. As the water recedes these locations will change back to original locations of refuge seen at low flows. The stratified velocities at high flow levels create naturally scoured pools for low flow rearing and cover from predation. It was the goal of this project to design structures which create habitat anadromous salmonids need during all stages of their life cycle within the West Fork of the Hood River.

The interagency BPA ,USFS agreement DE-AI79-84BP16726 stated “the goal of the West Fork Hood River Basin Habitat Improvement Project is to improve low flow rearing habitat for summer steelhead and spring chinook on approximately 30 % of the stream miles currently available to anadromous fish in the basin. This will primarily be accomplished through the introduction of large wood and boulder structure to increase pool, glide, and deep riffle habitats associated with good cover. ” In addition the agreement stated to “increase habitat diversity by creating low flow pools, highflow refuge areas, adult holding water, cover, and increase the amount and distribution of spawning gravel.”

METHODS AND MATERIALS

To accomplish the above stated objectives large boulders and logs were used to build complex structures in this years project. A total of 383, 40 foot logs and 376 boulders were delivered to the access site for the FY 92 and FY93 projects on the West Fork. Logs were between 20 and 60 inches dbh. Boulders were. from 2 to 4 cubic yards in size. The logs came from a variety of sources throughout the Mount Hood National Forest. On the Hood River District, twenty-five logs were obtained from hazard trees which were cut down around the Coe Branch irrigation station. The Lost Lake campground project provided 220 logs. Clackamas Ranger district provided a total of 108 logs. These logs were taken from trees cut down for the hydro power project on the Oak Grove Fork of the Clackamas River. Several of the logs taken form these trees exceeded 40 inches dbh. Three were 60 inches dbh. Large diameter logs were important for restoring habitat in the West Fork due to the high energy flows and quality of habitat produced using large wood material in a larger stream such as the West Fork. Boulders were needed to ballast the log structures in place.

The boulders and cable are an attempt to replicate the effect of long tree lengths and attached root wads in natural environments to keep the woody debris, in this case planned structures, in place. Boulders are currently the best way to keep the imported logs in place during bankfull and higher flow discharge events. One of the main objectives of this and any other habitat work on the Hood River District is to place habitat structures which will self-maintain long enough to allow second growth conifers to mature and naturally fall into the channel.

The boulders used were mined approximately 1.5 miles from the access site. The boulders were taken from Forest Service land and Longview Fibre land and trucked to the access site on Longview Fibre land. A memorandum of understanding was signed by the Mount Hood National Forest and Longview fibre to mine boulders from Longview land, use Longview land to access the West Fork, and restore habitat in the West Fork were it travelled through Longview land.

Once all of the materials were in place at the access site, an excavator and crawler loader were used to move the logs and boulders downstream to the structure locations. Due to the size of the boulders and logs, a 155 horsepower excavator was used. Logs and boulders were moved downstream using both machines. The actual structures were built using the. excavator. A large percentage of the logs required the use of 112 to 1 inch cat chokers to manipulate the logs to desired locations at each structure site. Forest Service personnel set and moved the chokers.

Following the completion of heavy equipment work, the project was cabled using 112 inch galvanized steel core cable. Cable was anchored to boulders by drilling the rock, placing the cable in the hole and anchoring with an epoxy resin. Holes were drilled using a gas powered hammer drill. Each hole drilled had to be properly cleaned of all rock residue to insure the epoxy resin would hold the cable in place. Bank cabling was accomplished by looping and weaving cable around living alder trees. The alders were not girdled by this action. Cable clamps were used to tie in the woven cable to prevent the cable from unraveling. All log ends which were put up on the bank were either cabled to alders or boulders using the epoxy resin. Over 5500 feet of cable was used to cable down the 176 logs used in the 2600 feet of restoration which took place in the FY92 project. Cable was moved to several locations along the project reach using a 12 man work crew. Actual cabling was completed by Forest Service personal.

Compaction of the stream substrate was a concern. To mitigate this problem, the stream channel was ripped using the excavator bucket. Only the 12 foot wide shuttle path used to shuttle materials needed ripping. The substrate was turned over at a depth of 6 to 12 inches to insure the gravel could be used for spawning. The project finished 200 feet upstream from the confluence of Ladd Creek. The 2200 foot path used upstream of the project reach to shuttle materials from the access site was also ripped. This path was also 12 feet wide and the first 6 to 12 inches of substrate within that path was turned over to insure it could be used for spawning that year. The FY 93 project will continue upstream form Ladd Creek, finishing the remaining 4200 feet of stream that can be restored using a large excavator.

1992 POST PROJECT REACH WEST FORK SPAWNING GROUND SURVEYS

In mid-August spring Chinook spawned in the project area. Redd counts within the upper 1300 feet of ripped stream totalled 16. The 3300 feet above, to the confluence of Elk and McGee Creeks, totalled 11. Of the 16 redds counted in the ripped reach, 100% of the redds were located in gravel that was exposed by ripping the shuttle path formed by the excavator and loader. No redds were found in untouched areas of stream bed withii this reach. The 11 redds above were located in areas where fist size or smaller gravel was located. These areas were associated with pool tailouts, undercut banks associated with old growth stumps, and peripheral areas were water velocities enabled the retainment of smaller sized gravels. Results of this survey can be seen in Table 2.

RESULTS AND DISCUSSIONS

Work on the FY project was completed by mid-August. The reach below Ladd Creek was difficult to work in. The amount of boulders present and size of materials used, taxed the limits of both the crawler loader and excavator. Both machines broke track pins due to the working conditions. Considering the conditions, the excavator and operator performed admirably. Original structures which were planned, were accomplished. The amount of boulders needed from the access site were less than anticipated. Many more boulders of adequate size were found digging in the stream bed. In some cases, smaller on site boulders were used due to the physical stress the excavator was encountering getting larger boulders to more difficult areas. The lack of total ballast was mitigated by using cross structure logs, cabled to key heavily ballasted logs. Bank cabled logs were cabled to alders or boulders on the bank. The most difficult areas for the excavator were the lower most 1000 feet. Above tbis point, the amount of boulders decreased and more imported boulders were utilized. Following the first high flow in November, spawning size. gravel started to reestablish within the project reach. High flow effectiveness for adult and juvenile cover was working as planned. To date, all structures have remained in place and are functioning well.

All tasks and objectives were accomplished. Habitat diversity, holding water, high flow refuge for adults and juveniles, cover, and spawning gravel were increased. Spawning gravel continues to accumulate in the project reach. The structures have trapped more spawning gravel to date than was anticipated following the first winter. Monitoring of FY92 and all structure work on the Hood River Ranger District continues to date.

		WEST FORK HOOD RIVER SPAWNING SURVEY 1992					
	* = CWT FISH						
	NUMBERS ARE DART TAGGED FISH						
DATE		CARCASSES					
		FEMALE		MALE			
8/19/92		1		1	5682		
8/27/92		5	6460	2			
			1 lost				
8/28/92		13	5247*	6	(3 cwt with no dart tags)		
			5920				
			5412*				
			5744				
			5500				
			5406				
			5192*				
			5555				
		(+ 2 cwt w/o dart tags)					
		(3 had no cwt or dart tags)					
8/31/92		2	(sex not positive ID)				
TOTALS		21		9			
	REDD COUNT						
Elk Cr (W Fork confluence to 200 yds up)						0	
McGee Cr (W Fork confluence up 0.5 mile)						11	
West Fork (confluence Elk/McGee to Road Access) -3300'-						11	
West Fork (Road Access to Ladd Creek) -1350'-						16	
					TOTAL	38	
NOTE:	ALL CARCASSES MARKED BY CUTTING OFF TAIL AT PEDUNCLE						
	COUNTS ON 8/19 AND 8/28 ARE ON VIDEOTAPE						

Table 2. West Fork Hood River Spawning Survey 1992. Surveys were performed by Chuti Ridgley and Tom Macy.

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