Exxon Valdez **Oil Spill**
Restoration Project Annual Report

Cutthroat Trout and Dolly Varden Rehabilitation in Western Prince William Sound

Restoration Project 95043B
Annual Report

Dan Gillikin

USDA Forest Service
Glacier Ranger District
POB 129
Girdwood, Alaska 99587

March 1996

Exxon Valdez **Oil Spill**
Restoration Project Annual Report

Cutthroat Trout and Dolly Varden Rehabilitation in Western Prince William Sound

Restoration Project 95043B
Annual Report

Dan Gillikin

USDA Forest Service
Glacier Ranger District
POB 129
Girdwood, Alaska 99587

March 1996

Cutthroat Trout and Dolly Varden
Rehabilitation in Western Prince William Sound

Restoration Project 95043B
Annual Report

Study History: Project 95043B was the first year of a four-year study to evaluate the effects of habitat enhancement structures on fish abundance and species composition in several streams in western Prince William Sound. Long-term monitoring will continue with Project 96043B.

Abstract: Stream reaches in four systems were studied to evaluate the effects of habitat enhancement on cutthroat trout, Dolly Varden, and coho salmon populations. Systems included in the study were Otter Lake, Gunboat Lakes, Red Creek, and Billy's Hole in Prince William Sound. Initial stream surveys were conducted to determine pre-treatment habitat availability and fish abundance. Habitat structures were then installed within the study reaches and the reaches surveyed again. The structure enhancements increased the number of habitat units and pocket pools and the amount of small woody debris. Mark-recapture population estimates were too imprecise to use for comparisons so a catch per unit effort was calculated to detect population trends as the study continues. Pre-treatment surveys of fish abundance were problematic and inconclusive, however, post-treatment abundance data was satisfactory to use for trend analysis in long-term monitoring.

Key Words: *Exxon Valdez,* cutthroat trout, *Oncorhynchus clarki*, Dolly Varden, *Salvelinus malma*, Prince William Sound, oil spill.

Project Data: *Description of data* - There are three primary sets of data developed for this project: (1) mark-recapture, trapping effort, and length frequency information on juvenile cutthroat trout, Dolly Varden char, and coho salmon, (2) stream surveys, and (3) fish distribution by area, habitat type, and structure location. *Format* - Data sets are in Excel spreadsheet format. Custodian - Contact Dan Gillikin at the Glacier Ranger District office, USDA Forest Service, P.O.B. 129, Girdwood, Alaska, 99587, (907) 783-3242. *Availability* - Copies of preliminary data sets are available upon written request.

Citation: Gillikin, D. 1996. Cutthroat Trout and Dolly Varden rehabilitation in Western Prince William Sound, *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 95043B). U.S. Forest Service, Anchorage, Alaska.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Habitat availability, fish abundance, and fish distribution were surveyed in stream reaches in four systems located in Prince William Sound - Otter Lake, Gunboat Lakes, Red Creek, and Billy's Hole. Distribution and abundance of cutthroat trout (*Oncorhynchus clarki*), Dolly Varden (*Salvelinus malma*), and coho salmon (*Oncorhynchus kisutch*) were determined using minnow traps and standard mark-recapture techniques. Sampling in 1994 and 1995 suggests that cutthroat trout densities are greatest in moderate gradient tributaries found in the upper reaches of inlet streams in these systems. Sixty-three total habitat enhancement structures were installed in these upper reaches in an effort to increase cutthroat trout and Dolly Varden rearing habitat.

Construction of frequency-pool and pocket-water habitat structures, such as cross-logs, tree covers, and boulder clusters, increased the number of habitat units as well as important habitat components for juvenile fish. Stream enhancement activities increased the overall number of habitat units by 51% within the study reaches. There was an overall increase of 233% in small pocket pools and a 608% increase in the amount of small woody debris. Mark-recapture estimates proved to be problematic due to low mark and recapture rates and it is suggested that more effort be placed on tagging cutthroat trout. Pre-treatment surveys of fish abundance were inconclusive, however, post-treatment abundance data was satisfactory to use for trend analysis in long-term monitoring.

INTRODUCTION

The oil tanker *Exxon Valdez* ran aground on Bligh Reef in 1989 spilling millions of gallons of crude oil into Prince William Sound (PWS) and causing injury to cutthroat trout (*Onchorhynchus clarki*) and Dolly Varden char (*Salvelinus malma*) populations (Hepler 1993). Cutthroat trout in PWS are at the northern extent of the species' North American range and little is known of their genetic diversity, distribution, or life history. Known stocks of cutthroat trout in the Sound are few in number and appear to be discrete populations with limited interbreeding. It is highly possible that there have been unique genetic adaptations in these populations due to local conditions and relative isolation. The population in a given stream system rarely numbers more than 1,000 individuals. Several stocks of cutthroat trout in PWS appear to be anadromous yet have limited home ranges within streams (Heggenes et al. 1991). Both adults and subadults of anadromous populations migrate to the ocean for summer feeding (Trotter 1989, Hepler et al. 1993). Emigration to saltwater occurs in early May through July (Hepler et al. 1993). They return to freshwater in July through November, with a peak in September and October (Trotter 1989).

In-stream habitat enhancement structures, such as cover trees, boulders, and cross-log structures, were installed in several streams to enhance or increase fish-rearing habitat. Increasing the availability of rearing habitat may increase the survival of juvenile cutthroat trout and Dolly Varden and aid in the restoration of these populations.

OBJECTIVES

The main objective of this project is to monitor and document the responses of cutthroat trout, Dolly Varden, and coho salmon populations to modifications made to their habitat by enhancement activities.

Specific objectives are to:

1. Measure the abundance and distribution of cutthroat trout, Dolly Varden, and juvenile coho in the proposed project locations.

2. Measure and monitor cutthroat trout, Dolly Varden, and juvenile coho utilization of newly-installed habitat structures.

METHODS

The four systems studied were: Otter Lake, Bay of Isles, Knight Island; Gunboat Lakes, Eshamy Bay; Red Creek, Esther Passage; and Billy's Hole, Long Bay (Figure 1). Three of the sites are main inlet streams to lakes. The fourth (Gunboat) is a reach located between two lakes. The work focused on upper stream reaches that are accessible to anadromous fish.

Three structure types were constructed: tree cover, cross-logs, and boulder clusters (Figures 2-4). Each structure was designed to create additional rearing habitat. The spruce and hemlock

trees used were taken from the project areas. A summary of the number of structures installed in each system is included in Table 1.

After the structures were installed, another mark-recapture survey was conducted on the four streams. The second survey documented the initial changes caused by the habitat enhancement structures and quantified the amount and types of changes that occurred. The average volumes of each type of installed structure were added to the first survey observations to reduce error in the estimation of woody debris for the second survey.

A modified Hankin and Reeves (1988) technique was used to survey each of the streams before and after placement of enhancement structures (Table 2). Pools, riffles, runs, and glides were categorized as slow, turbulent, or non-turbulent (Figure 5). In response to concerns related to interspecific competition between coho salmon and cutthroat trout, enhancement sites were selected in areas believed to be upstream of preferred coho habitat. On-site assessments and completed stream surveys were used to estimate where conditions were less suitable for coho spawning. This was largely based on substrate size and pool frequency. Only portions of reaches that were upstream of likely coho spawning habitat were included in the enhancement project area. Within these reaches, enhancement sites were selected primarily in large habitat units that had less variability in cover and diversity than other habitat units.

Baited minnow traps were used to capture juvenile fish. Traps were set for approximately two hours. Fishing times were recorded and all captured fish were identified. Trap placement and number varied at each site since the intent was to maximize the capture effort in each stream. It was assumed that a single minnow trap can effectively trap a 10 m^2 area of slow-water habitat and a linear 3 m segment of fast-water habitat. The difference in trapping effectiveness, due to variation in stream characteristics, resulted in fewer traps used to trap equal-sized habitat units in slow water than in fast water. Since the effectiveness of minnow traps varies with stream characteristics, the difference results in unequal trapping effort for various habitat types. To compensate, trapping effort was conducted proportionally to the availability of slow, turbulent, and non-turbulent habitat types in each system. For example, if slow-water habitats comprised 30 percent of the total available habitat within a reach, 30 percent of the trapping effort was randomly placed in slow-water habitat types.

The exception to this is the work at Billy's Hole where initial sampling indicated cutthroat trout in numbers too low to be sampled in a statistically valid manner using the proposed mark-recapture design. Instead, trapping was conducted in a non-random manner to maximize capture of cutthroat trout throughout the project area prior to structure placement. Nearly 100 traps were set at this location throughout the summer which resulted in the capture of only two juvenile cutthroat trout.

Bailey's modification of the Lincoln-Petersen mark-recapture model (as described in Kohler and Hubert 1993) was used to estimate juvenile populations of coho salmon, cutthroat trout, and Dolly Varden char in the streams. A coefficient of variation (CV) was calculated for each population estimate, and a catch per unit effort (CPUE) was calculated for each species.

RESULTS

Preliminary sampling produced population estimates with CV's greater than 0.20, which is generally inadequate and indicates low precision of estimates (Table 3) . This was due to small sample sizes (mostly of cutthroat trout) and low recaptures. Sampling design for the continued monitoring of the enhancement structures (Project 96043B) has been modified to address this problem. Catch per unit effort (CPUE) was calculated for each species at each site to determine population trends (Table 4).

The type of habitat enhancement structures installed at each site varied due to differences in physical characteristics of the streams. Table 4 lists the habitat structures in the stream pre-treatment and their associated CPUE for each species. Most of the boulder structures were installed at Otter Creek since large rocks and the pocket pools formed by them in low gradient riffles (LGRs) appeared to be a missing habitat component. This was not the case at Red and Gunboat creeks. There was little opportunity to improve on existing habitat using this technique, therefore, only cross-log and tree cover structures were installed at these two sites.

The stream channel at Billy's Hole showed signs of a high degree of scouring and bedload movement, decreasing the likelihood of success with boulder structures and cross-log structures. Therefore, tree cover structures made up the majority of enhancements made at this site. Additionally, there was concern that since the number of cutthroat trout at this location was so low and the distribution of juvenile coho was so widespread throughout the project area only structures that were expected to have equal benefit (tree cover type) for both species were installed.

The overall number of habitat units in all stream reaches combined increased 51%. The fifteen cross-log structures provided an increase in available fish-rearing habitat by altering stream flow conditions at each site. Cross-logs and boulder clusters increased the number of pocket pools by 63% (Table 5). Fifteen boulder clusters were installed, primarily at Otter Creek, in fast water sections of streams in LGRs There was an overall increase of 233% of large rocks and associated pocket pools in the project areas. Thirty-three tree-cover structures were installed, primarily in pool habitat, increasing the amount of small woody debris (SWD) by 608% in study reaches combined.

DISCUSSION and CONCLUSIONS

Mark-recapture estimates proved to be highly variable and unreliable due to the low number of markings and recaptures. We plan to increase the marking effort to eliminate this problem. Pre-treatment surveys of fish abundance were problematic and inconclusive, however, post-treatment abundance data was satisfactory to use for trend analysis in long-term monitoring. Monitoring over the next five years will help determine long-term effects of the enhancement activities (Project 96043B). Physical measurements and an annual photographic record of each structure will be established and maintained over the project duration.

ACKNOWLEDGMENTS

The Chugach National Forest wishes to thank the 1995 Glacier District fisheries crew, Will Frost, Dan Young, Kevin VanHatten, Gretchen Fritzgerald, Jim Lazar, Erica Green, and Brad Sommers. The Glacier District also wishes to thank Karen Murphy from the Supervisors Office for her assistance and guidance during this project.

LITERATURE CITED

Exxon Valdez Oil Spill Trustee Council. November 1994. Exxon Valdez Oil Spill Restoration Plan. Anchorage, Alaska.

Exxon Valdez Oil Spill Trustee Council. September 1994. Final Environmental Impact Statement for the *Exxon Valdez* Oil Spill Restoration Plan. Anchorage, Alaska.

Glova, G.J., and J.C. Mason. 1976. Interactive ecology of juvenile salmon and trout in streams. Fish. Res. Board Can. MS Rep. Ser. No. 1391. 24pp.

Hankin, D. G.; Reeves, G. H. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences, (45: 834-844).

Heggenes, J., TG Northcote, A. Peter, 1991. Seasonal Habitat Selection and Preferences by Cutthroat Trout (*Oncorhynchus clarki*) in a Small Coastal Stream. Canadian Journal of Fisheries and Aquatic Sciences, (48:1364-1370).

Hepler, K., PA Hansen, DR Bernard, 1993. Impact of Oil Spilled from the Exxon Valdez on Survival and Growth of Dolly Varden and Cutthroat Trout in Prince William Sound, Alaska. Alaska Department of Fish and Game, 32pp.

Kohler, C. C., and W. A. Hubert, 1993. Inland fisheries management in North America Fisheries Society. Bethesda, Maryland. (35-43 p.).

Trotter, PC, 1989. Coastal Cutthroat Trout: A Life History Compendium. Transactions of the American Fisheries Society (118:463-473).

Figure 1. Project 95043B Location Map, Prince William Sound.

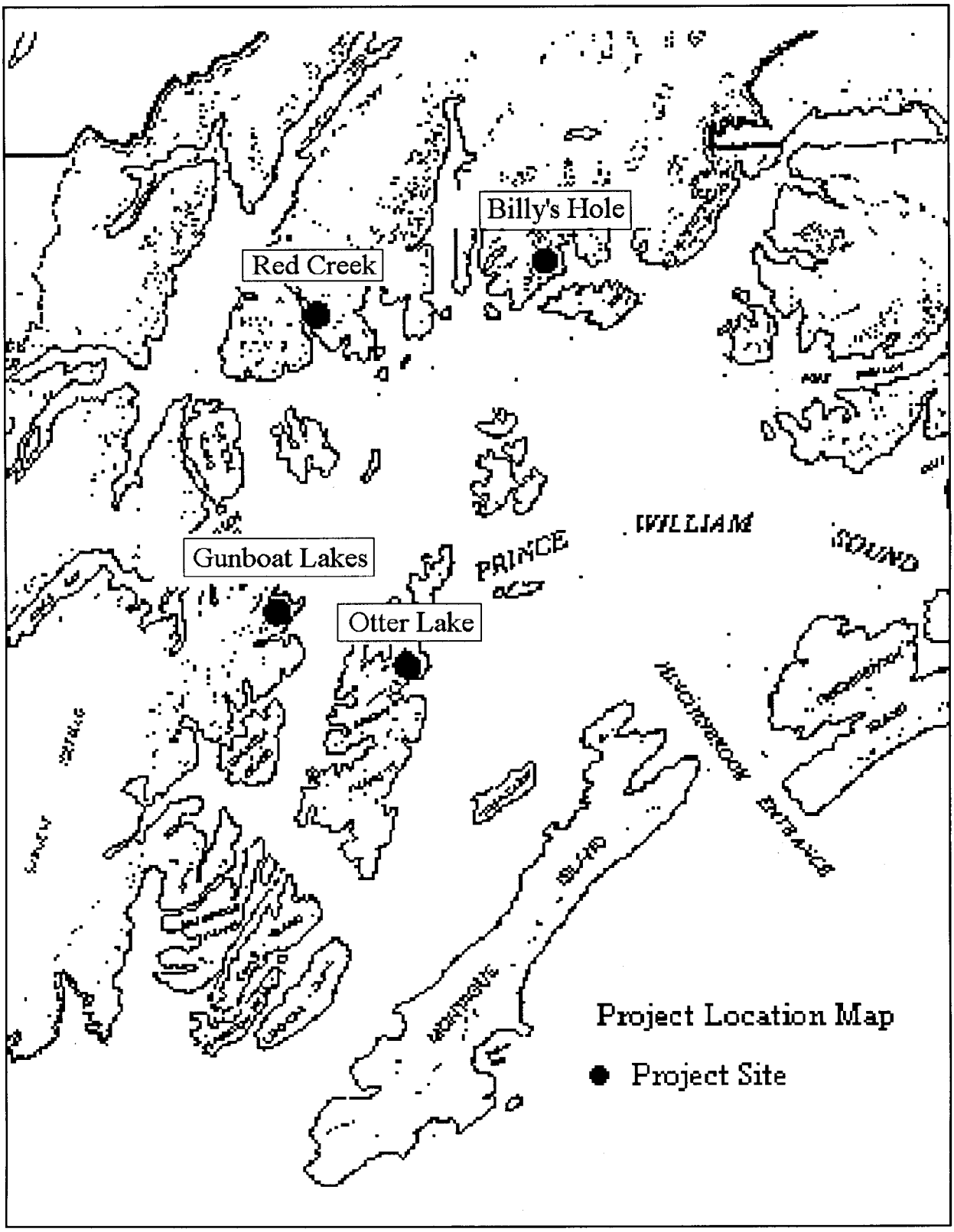

Figure 2. Tree Cover Structure

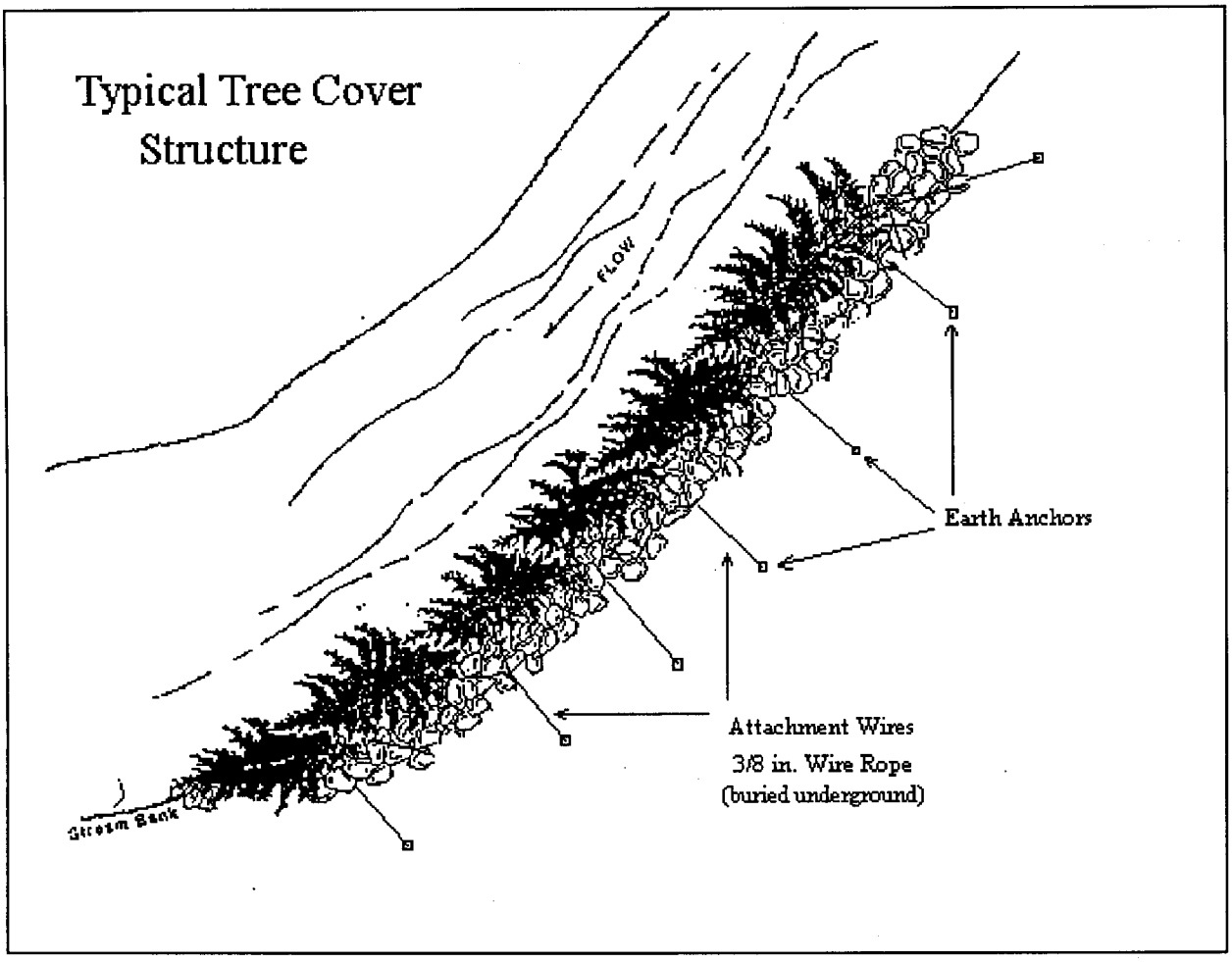

Figure 3. Cross-Log Structure

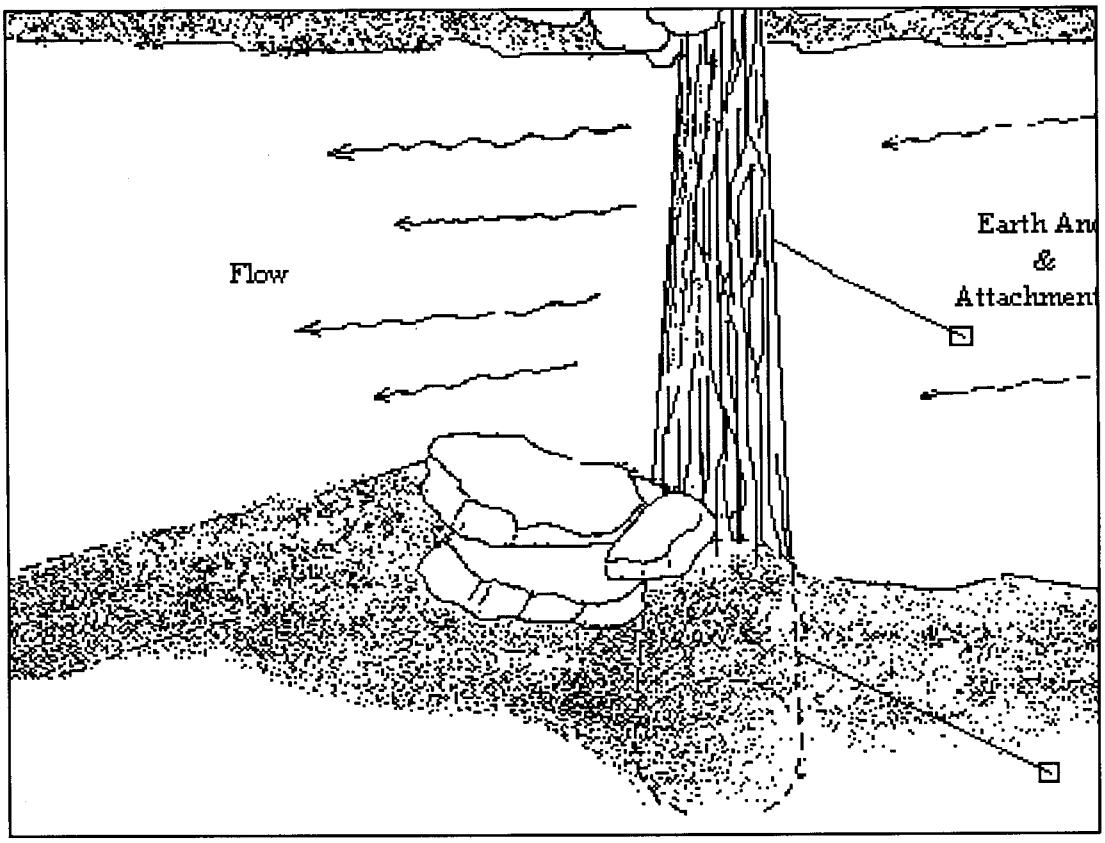

Figure 4. Boulder Cluster Structure

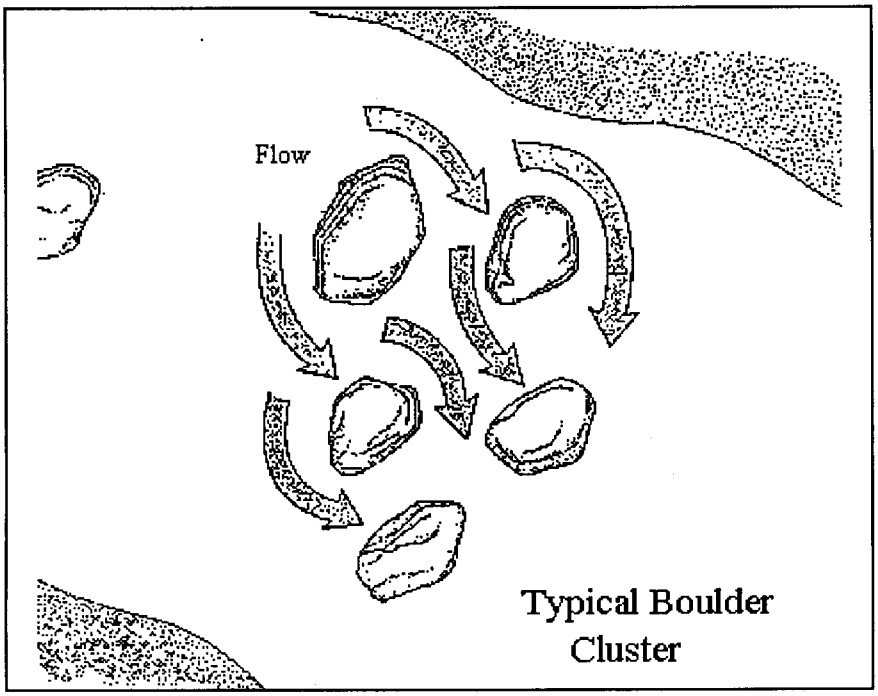

Figure 5. Description of habitat classification technique

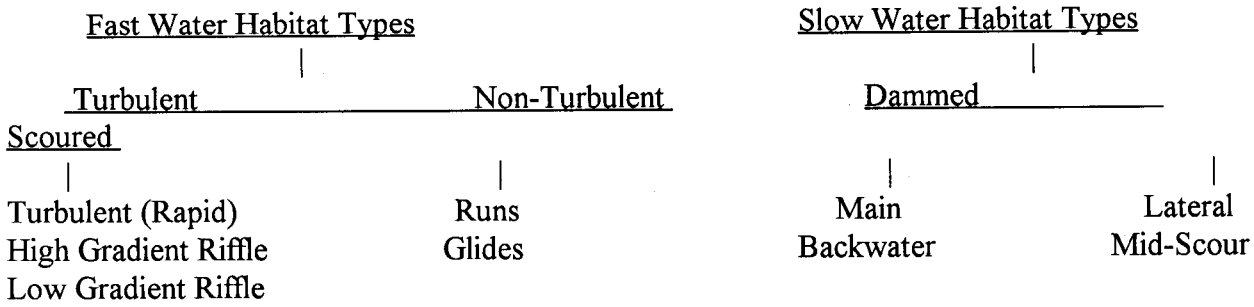

Table 1. Summary of Installed Structures

Location	Cross Logs	Tree Cover	Boulder Clusters	Total
Otter Creek	4	4	13	21
Gunboat Creek	3	6	0	9
Red Creek	5	5	0	10
Billy's Hole	3	18	2	23
Totals	**15**	**33**	**15**	**63**

Table 2. Description of variables measured in habitat surveys

VARIABLE CATEGORY	DESCRIPTION
Fast Water Habitat type: Subdivided into Turbulent and Non-Turbulent Types	Includes Turbulent, High and Low gradient riffles, Runs, Glides, and associated pocket pools.
Slow Water Habitat Types: Subdivided into Dammed and Scoured type pools.	Includes Main and Backwater Dammed pools; Scoured pools of 3 types (lateral, mid and plunge) and the source that caused the pools such as woody debris, boulders, bedrock, tributaries etc...
Length, Width, Depth: Based on actual measurement of the particular habitat unit.	Measured for each habitat unit observed.
The Type and Percent of available cover: Based on an estimation of the percent observed within a particular habitat unit.	Cover types include: Large and Small Woody Debris, root wads, overhanging vegetation, undercut banks, rocks or boulders, beaver dams, aquatic vegetation.
Substrate composition: Based on an estimation of the percent observed within a particular habitat unit.	silt, sand, gravel, small cobble, large cobble
Gradient: Measured with clinometer.	Measured for each habitat unit observed.

Table 3. Summary of mark-recapture and CPUE data for project 95043B.

Project Location	Species	Pop. Est. of sample	Variance of Est.	Coeff. Variation	CPUE	Number of traps set
Otter Ck.	CO	45	324	0.40	.001	66
	CT	6	9	0.50	.0002	66
	DV	128	1536	0.31	.002	66
Gunboat	CO	504	6720	0.16	.003	152
	CT	50	300	0.35	.0004	152
	DV	48	768	0.58	.0002	152
Red Ck.	CO	14	0	0.00	.0002	188
	CT	105	1125	0.32	.0007	188
	DV	427	8169	0.21	.002	188
Billy's	CO	N/A	N/A	N/A	.015	82
	CT	N/A	N/A	N/A	.0007	82
	DV	N/A	N/A	N/A	.035	82

Table 4. Summary CPUE Pre-Project for Selected Sites.

Location	Proposed Site	Structure Type	Effort min.	Coho CPUE.	Cutt CPUE.	Dolly V. CPUE.
Otter Ck.	1	X-Log	500	0	0	0
	2	Boulder	123	0	0	.008
	4	Tree Cover	240	0	0	0
	5	X-Log	325	.003	0	.009
	6	Tree Cover	325	.012	0	.009
	7	X-Log	320	0	0	0
	8	X-Log	300	0	0	0
	TOTAL			**.002**	**0**	**.004**
Gunboat	1	Tree Cover	300	.010	0	0
	2	Tree Cover	375	.003	0	0
	4	Tree Cover	120	0	0	0
	5	Tree Cover	60	0	0	0
	6	Tree Cover	120	0	0	0
	7	X-Log	150	0	0	0
	8	X-Log	75	0	0	0
	9	Tree Cover	510	0	.004	0
	TOTAL			**.002**	**.0005**	**0**
Red Ck.	1	Tree Cover	510	.006	0	.020
	2	X-Log	375	0	.003	.005
	3	Tree Cover	325	.006	.003	.031
	4	X-Log	400	0	0	.003
	5	X-Log	325	0	0	.009
	6	X-Log	450	0	.004	.004
	8	Tree Cover	255	0	.004	.008
	9	Tree Cover	375	0	.003	.005
	10	Tree Cover	300	0	.010	.063
	TOTAL			**.001**	**.003**	**.016**
Billy's	Project	Tree Cover	2800	.015	.001	.035
	TOTAL			**.015**	**.001**	**0.035**

Table 5. Summary of Habitat Surveys

Habitat Units (H.U.); Pocket Pools (P.P.); Turbulent Units (Turb.); Non-Turbulent (Nturb).
Measurements prior to structure installation (Pre).
Measurements after installation of structures (Post).

Loc.		# HU	HU m2	# of PP	# of Turb.	# of Nturb	# of Slow	LWD m2	SWD m2	RS m2
Otter	Pre.	43	1456	24	19	10	14	95	901	7
Creek	Post	53	1675	32	23	13	17	141	1045	22
	Diff.	10	220	8	4	3	3	46	144	15
	% Inc.	23%	15%	33%	21%	30%	21%	49%	16%	230%
Red	Pre.	44	1872	21	17	4	23	65	147	63
Creek	Post	54	2044	26	20	7	27	122	327	63
	Diff.	10	171	5	3	3	4	57	180	0
	% Inc.	23%	9%	24%	18%	75%	17%	87%	123%	0%
Gun	Pre.	38	2825	16	21	5	12	118	77	293
Boat	Post	40	2843	17	20	7	13	152	293	293
	Diff.	2	18	1	-1	2	1	34	216	0
	% Inc.	5%	1%	6%	-5%	40%	8%	28%	281%	0%
Billy's	Pre.	64	8875	41	33	8	23	329	346	58
Hole	Post	64	8875	41	33	8	23	352	994	60
	Diff.	0	0	0	0	0	0	23	648	2
	% Inc.	0%	0%	0%	0%	0%	0%	7%	188%	3%
Total		**51%**	**25%**	**63%**	**34%**	**145%**	**47%**	**171 %**	**608%**	**233 %**