Exxon Valdez Oil Spill
Restoration Project Annual Report

Eastern Prince William Sound Wildstock Salmon Habitat Restoration

Restoration Project 96220
Annual Report

This annual report has been prepared for peer review as part of the *Exxon Valdez* Oil Spill Trustee Council restoration program for the purpose of assessing project progress. Peer review comments have not been addressed in this annual report.

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Study History: This is the first year of the study.

Abstract: We conducted habitat surveys on 11 streams in the Eastern Prince William Sound area to determine the factors limiting production of coho salmon *Oncorhynchus kisutch*. The results were used to determine whether habitat enhancement projects could increase coho salmon production and provide additional subsistence opportunities. The surveys showed that production in most streams is limited by steep gradients, stream length, high flows, or other factors which cannot be changed. In some streams, however, production appears to be limited by the lack of winter habitat, which could be increased with instream habitat structures.

Key Words: *Exxon Valdez*, habitat enhancement, habitat survey, coho salmon, *Oncorhynchus kisutch*, Prince William Sound.

Project Data: Data include different kinds of habitat in each stream, habitat areas, habitat depths, dominant substrate, pieces of large woody debris, amount of spawning area, amount of winter habitat, and stream gradient. Data are used in a simple limiting factors analysis which predicts the number of smolts produced for each life history stage. Raw data are in an Excel spreadsheet. Data will be available after completion of project. *Custodian*: Contact Ken Hodges, USDA Forest Service, Cordova Ranger District. P.O. Box 280 Cordova, AK 99574. (907) 424-7661.

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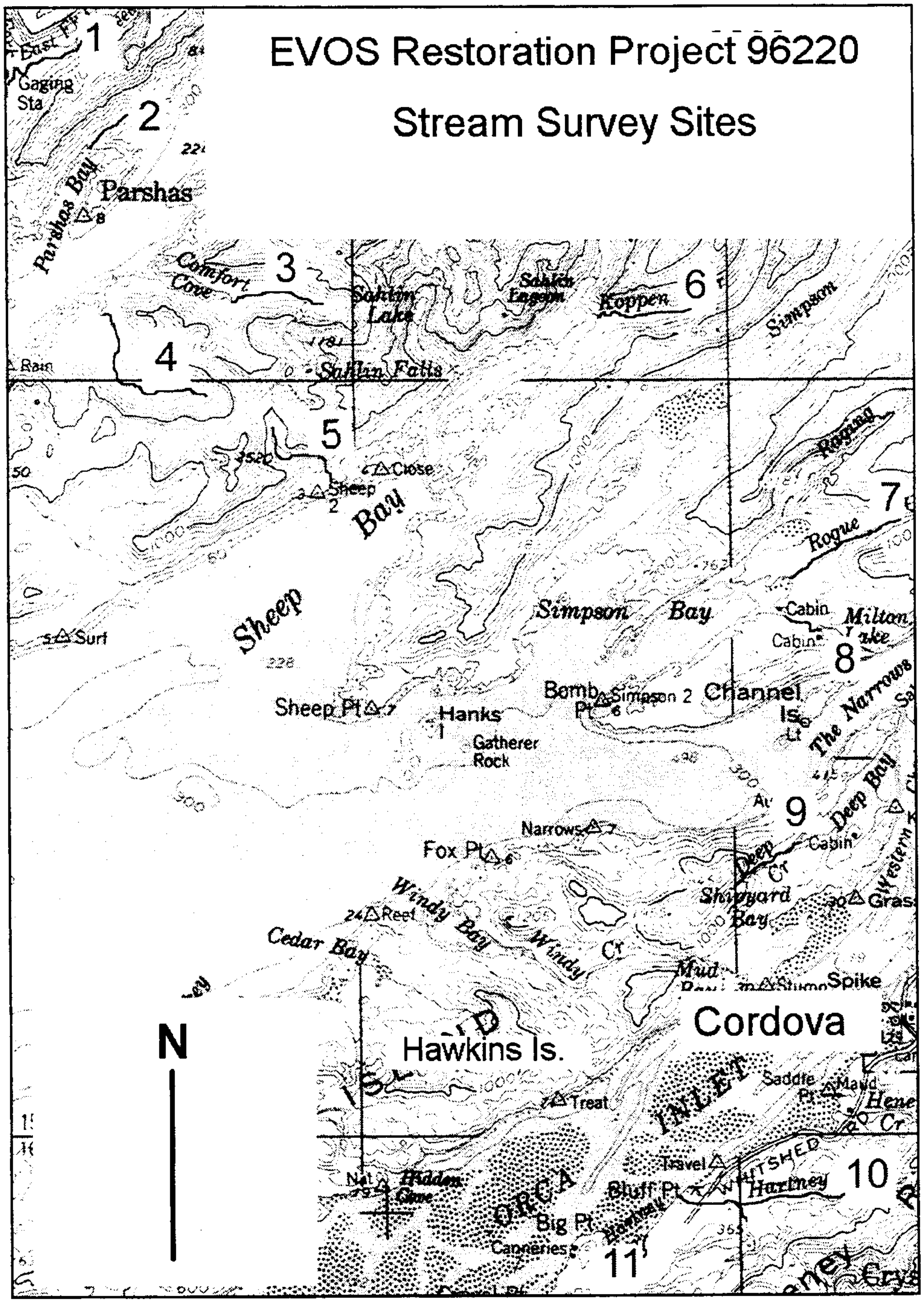

Figure 1. Location map of streams surveyed. 1. East Fork Olsen 2. Parshus 3. Comfort 4. Plateau 5. Allen 6. Koppen 7. Rogue 8. Milton Lake 9. Deep 10. Hartney 11. Duck

Executive Summary

Following the *Exxon Valdez* oil spill, there was a substantial decrease in subsistence harvests in the Prince William Sound area. Although harvest levels have increased, there is concern that the disruption of subsistence activities may have affected traditional lifestyles and the opportunity for young people to learn and practice subsistence culture. The Village of Eyak, working with the USDA Forest Service, proposed a wildstock salmon habitat restoration or enhancement project in the streams of eastern Prince William Sound. By improving habitat to restore or enhance salmon populations, additional subsistence opportunities would be provided. The project would also provide local youth with an opportunity to learn habitat enhancement techniques and use their knowledge of the streams and fish for the management of their lands.

We decided to concentrate our efforts on coho salmon *Oncorhynchus kisutch* since this species is more highly valued than the other species of salmon present in the project area (pink salmon *O. gorbuscha* and chum salmon *O. keta*). Habitat surveys were conducted in 11 streams. The survey crews proceeded upstream classifying and measuring each habitat component until there was a physical barrier preventing anadromous fish passage or it was determined that there was no additional coho salmon habitat. The data collected included the areas of different habitat types (riffles, glides, various types of pools), substrate composition, large woody debris (LWD), and gradient. The dominant substrate size class and its percentage in each habitat area were determined visually. LWD was defined as a piece of wood with a minimum 10cm mean diameter, at least 1 m long, and within the wetted channel. The number of pieces within each habitat type were tallied.

The five streams that appeared to be the most suitable for enhancement were resurveyed during low flow periods in late October and November to determine the amount of spawning area and winter rearing habitat. Spawning area was defined as having substrate predominately 6 - 75 mm and having less than 20% fine material smaller than 3 mm. Areas were measured with a stadia rod or tape measure, and substrate size was determined visually. Winter rearing area was defined as low flow areas with woody debris, boulders, undercut banks, or other cover areas where juveniles can escape high flows and predators. The habitat type, spawning area, and winter habitat data were then used in a limiting factors analysis to determine what habitat components were limiting production.

Coho salmon production was found to be limited by high gradients in five of the 11 streams. Allen, Deep, Duck, and Parshas creeks all had less than 400 meters of stream channel with less than a 3% gradient. Rogue Creek had somewhat more, but almost all of the channel was 2%, which is somewhat marginal for coho salmon production. The high gradients limit the amount of pools and other low velocity areas necessary for juvenile rearing. The percentage of pool habitat ranged from 3.2% in Allen Creek to 30.6% in Rogue Creek. Because of the limited habitat in these streams, spawning area and winter rearing area surveys were not conducted. Enhancement of these streams would require considerable alteration of the channels or other

habitat manipulation, and so these streams were not considered further.

Milton Lake Creek could not be fully analyzed because of the difficulty of determining spawning area and habitat in the lake. Coho salmon sometimes spawn along the lake shores where creeks or seeps enter the lakes and juveniles utilize shallower nearshore areas. Methods for quantifying lake spawning and rearing habitat area are not well defined. Since the creek itself was steep and unsuitable for enhancement work, it was excluded from further consideration for project work.

The results of the surveys and limiting factors analyses show that the scarcity of summer rearing habitat limits production in three stream systems. This is reflected by the low percentage of pool habitat in Koppen Creek (9.4%) and East Fork Olsen Creek (11.5%). Hartney Creek has a higher percentage of pools (40.5%), but much of this area consists of beaver ponds which are highly productive winter habitat. Thus, summer habitat is the limiting factor in Hartney Creek mostly because the winter habitat is more productive than is usual. Pool formation may be low because of the relatively low amounts of LWD in Koppen Creek (12 pieces/100m) and East Fork Olsen Creek (16/100m). Hartney Creek had higher levels of LWD (20/100m).

Winter habitat appears to be the limiting factor in Plateau Creek and Comfort Creek. Plateau Creek had moderate amounts of pool area (23.6%) and LWD (23/100m), but none of the pools were beaver ponds and there were only limited amounts of backwater pools, which are also favored for winter habitat. Comfort Creek had a high percentage of pool area (45.8%), most of which was beaver pond. The usable amount of winter habitat in the ponds was limited, however, because much of the area was shallow and had no cover. There were also a number of shallow backwater channels extending from the ponds which were beginning to freeze up when the area was surveyed in November. These areas were not counted as winter habitat.

The surveys indicate that Plateau Creek offers the best opportunity for habitat enhancement, and we have proposed an enhancement project there for 1997. Additional winter habitat can be created with simple log and boulder structures, which have proven effective in other areas. Plateau Creek is also a relatively small stream, which makes it easier to work in and lowers the chance of structure failure. Hartney, Koppen, and East Fork Olsen creeks are subject to high flows in the spring and fall. Comfort Creek could provide enhancement opportunities if additional cover is added to the beaver ponds for winter habitat. However, we may have underestimated winter habitat in the backwater areas, in which case, the available habitat may be better balanced than the analysis indicates.

Introduction

Following the *Exxon Valdez* oil spill, there was a substantial decrease in subsistence harvests in the Prince William Sound area. Although harvest levels have increased, there is concern that the disruption of subsistence activities may have affected traditional lifestyles and the opportunity for young people to learn and practice subsistence culture (*Exxon Valdez* Oil Spill Trustee Council 1996). The Village of Eyak, working with the USDA Forest Service, proposed a wildstock salmon habitat restoration or enhancement project in the streams of eastern Prince William Sound. By improving habitat to restore or enhance salmon populations, additional subsistence opportunities would be provided. The project would also provide local youth with an opportunity to learn habitat enhancement techniques and use their knowledge of the streams and fish for the management of their lands.

We decided to concentrate our efforts on coho salmon *Oncorhynchus kisutch* habitat enhancement, since this species is more highly valued than the other species of salmon present in the project area (pink salmon *O. gorbuscha* and chum salmon *O. keta*). A number of successful coho salmon habitat improvement projects have been implemented with simple instream habitat structures (House and Boehne 1985, Nickelson et al. 1992, Crispin et al. 1993, House 1996). Another consideration was that the habitat requirements of coho salmon have been studied extensively (Bustard and Narver 1975, Crone and Bond 1976, Dolloff 1987, Swales et al. 1988, Nickelson et al. 1992), and factors such as good spawning gravels and winter habitat areas are well defined. A coho salmon production model is also available for conducting a habitat-based limiting factors analysis (Reeves et al. 1989) and determining the types and amount of habitat that may be needed to increase production.

In 1996, habitat surveys were conducted on 11 streams in eastern Prince William Sound near the city of Cordova. The initial surveys were conducted in the summer, with additional surveys of spawning area and winter habitat during low flow periods in late October and November. As recommended in the limiting factors analysis by Reeves et al. (1989), the surveys followed the methods of Hankin and Reeves (1988) with some additional methods from Dolloff et al. (1993) and U.S. Forest Service Region 10 protocols (unpublished). The surveys and analyses indicate that enhancement in most of the streams is not feasible due to factors which cannot be altered, such as stream gradients. However, it appears that coho salmon production in Plateau Creek could be increased by enhancing winter habitat for juvenile fish. We have proposed an enhancement project there for 1997.

Objectives

1. Use habitat survey data to determine factors limiting coho salmon production.

2. Increase coho salmon production for additional subsistence opportunities.

3. Provide local youth with the opportunity to learn about habitat enhancement techniques and to

use their knowledge of local conditions to help manage the resources.

4. Document habitat conditions in unaltered streams for use in future restoration work or comparisons with other watersheds.

Methods

The initial habitat surveys basically consist of identifying and calculating the areas of different habitat types (riffles, glides, and various kinds of pools) as defined by Bisson et al. (1982). The surveys were conducted in June and July and followed the methods described in Hankin and Reeves (1988) except that habitat lengths were measured rather than visually estimated (Dolloff et al. 1993, U.S. Forest Service Region 10 protocols unpublished). Habitat widths were visually estimated with every tenth pool or riffle width being measured so that the estimates could be corrected (Hankin and Reeves 1988, Dolloff et al. 1993).

The estimated habitat widths were correlated with the measured widths to determine the consistency of the estimates. Since the estimated and measured widths were highly correlated, a proportional correction factor could be used to adjust the estimated widths (Hankin and Reeves 1988, Dolloff et al. 1993). The uncertainty of the total adjusted widths was determined by calculating the variance and the 95% confidence intervals. Since the confidence bounds were relatively low, the adjusted widths and the measured lengths were then used to calculate the area for each habitat unit. The units of each habitat type were summed to determine the total amounts of various habitat types within the stream system. In some short streams there were too few habitat units, so no widths were measured and the estimates were not adjusted.

Residual pool depths were measured, dominant substrate size and percentage of fine sediment (<3mm) were visually estimated, and stream channel gradients were measured with a clinometer. Pool depth and substrate data were collected for qualitative information, but were not statistically analyzed. The length of stream channel with a gradient less than 3% was calculated to determine the total length of potential coho salmon habitat. Pieces of large woody debris were counted, and the number of pieces per 100 meters was calculated. Large woody debris was defined as pieces with a minimum average diameter of 4 cm and at least 1 m long. The streams were surveyed until an impassable barrier to coho salmon migration was encountered or until the gradients were consistently greater than 3-4%, which generally marks the end of usable habitat.

The five streams which appeared to have the best potential for habitat enhancement were resurveyed at low flow periods in late October and November to determine the amount of winter habitat and spawning area. Winter habitat was defined as areas with reduced flows, (such as backwater pools, secondary channels, or beaver ponds) with large woody debris, undercut banks, or boulders for cover (Bustard and Narver 1975, Brown and Hartman 1988, Nickelson et al. 1992). Definitions of spawning substrate for coho salmon vary. The maximum substrate size has been described as being anywhere from 100 - 200 mm, and the maximum percentage of fine materials being from 15 - 30% (Reeves et al 1989, Groot and Margolis 1991, Bjornn and Reiser

1991).In order to be more conservative and exclude marginally productive areas, we defined spawning substrate as being from 6 - 75 mm and containing less than 20% fine material smaller than 3 mm. Winter habitat and spawning areas were measured with a stadia rod or tape measure. Substrate size and composition were determined visually. Adult coho salmon were counted, but except at Hartney Creek the surveys were too late in the season for a meaningful count.

The totals for habitat types, spawning area, and winter habitat were used in a habitat-based limiting factors analysis (Reeves et al. 1989). The habitat type data is used to determine the amount of spring rearing area (for newly hatched fish) and summer habitat. The analysis then determines how many smolts could be produced by the available spring, summer, winter, or spawning area if production is not constrained by other factors. The area producing the fewest number of smolts is the limiting factor. The analysis includes the amount of additional area needed to fully seed or accommodate the maximum summer population.

Results

The results of the habitat surveys are summarized in table 1. The percentage of total pool area, an important habitat component for juvenile coho salmon, ranges from 3.2% - 45.8%. Beaver ponds, which provide important winter habitat, are present in only three of the stream systems. Cascades are common in all of the streams except Hartney Creek.

Table 1. Habitat type area totals for 11 surveyed streams. CS = cascade, GL = glide, BP = beaver pond, LS = lateral scour pool, MS = midchannel scour pool, DP = dam pool, PP = plunge pool, TP = trench pool, RF = riffle, SR = secondary channel riffle, SP = secondary channel pool, %P = total pool area/total area. Area is in square meters.

Creek	CS	GL	BP	LS	MS	DP	PP	TP	RF	SR	SP	% P
Allen	2710	0	0	0	96	0	0	0	0	210	0	3.2
Comfort	3306	442	3899	1419	1437	0	175	0	3698	1165	343	45.8
Deep	899	55	0	0	58	0	150	0	690	0	0	11.2
Duck	198	285	0	0	793	0	0	0	1528	25	0	28.0
EF Olsen	250	660	0	0	2056	0	318	0	13134	887	283	11.5
Hartney	0	2544	8940	3534	6381	107	1329	0	26962	1513	840	40.5
Koppen	3638	0	0	0	1563	0	0	0	10736	762	0	9.4
Milton	461	225	1356	0	0	305	42	0	1393	10	13	45.1
Parshus	1995	25	0	0	516	0	151	0	760	107	0	22.5
Plateau	1814	1494	0	1365	940	101	681	163	7552	690	420	23.6
Rogue	717	240	0	100	1144	0	230	0	2341	345	189	30.6

The correlation between the estimated channel widths and the measured widths was relatively high, with a correlation coefficient of 0.92 ($n = 41$). The regression equation, $y = 0.1745 + 0.9998 x$, shows that the regression line passes close to the origin and the slope is close to 1.00. The correction factor was 1.028, indicating that the overall estimates were slightly low. The sum of the corrected widths was 1821 meters +/- 118 meters at the 95% confidence level. This is 6.5% of the total.

The amounts of LWD per 100 meters of channel ranged from 12 - 63 pieces and are listed in table 2. The high value is from Rogue Creek where a section of buffer strip along the creek was blown down. For comparison, some values from other studies have been presented. These include a range of values for six different channel types in seven streams in southeast Alaska (Murphy and Koski 1989), a range of values for Sheehan Creek, southeast Alaska (Sedell et al. 1984), and a mean value for four sections of Musqueam Creek, British Columbia (Fausch and Northcote 1992). All of the areas except Rogue and Hartney creeks are undisturbed.

Table 2. Pieces of large woody debris (LWD) per 100 meters of stream channel. *Rogue Creek has a section of timber blowdown. ** The values are the range of six different channel types from seven streams in Southeast Alaska (Murphy and Koski 1989). Values for Sheehan Creek, Southeast Alaska are from Sedell et al. (1984). The value for Musqueam Creek, British Columbia is from Fausch and Northcote (1992). All of the streams except Rogue and Hartney are in unlogged areas.

Pieces of Large Woody Debris per 100 Meters				
Allen	Comfort	Deep	Duck	Hartney
13	23	24	21	20
Koppen	Milton	E F Olsen	Parshas	Plateau
12	28	16	34	23
Rogue*		7 SE AK**	Sheehan , SE AK	Musqueam, B.C.
63		15 - 46	33 - 45	42

The results of the spawning area and winter habitat surveys are listed in table 3 along with the estimated smolt production derived from the limiting factor analyses. The habitat area producing the fewest smolts is the limiting factor for that stream system. Summer habitat was indicated as the limiting factor in Hartney, Koppen, and East Fork Olsen creeks. Winter habitat is the limiting factor in Comfort and Plateau creeks. All of the five streams appeared to have more spawning area than required. The amounts of spring rearing area also appear to be sufficient.

Table 3. Habitat availability and potential smolt production in the five streams with the best potential for enhancement. Areas are in square meters. Area needed is the amount of each habitat area required to produce or accommodate the potential summer population. The smolt factor is the number of smolts that can be produced for each square meter of habitat if there are no other constraints in later seasonal habitats. The habitat that has the lowest potential smolt production is the limiting factor for that stream system (in bold).

Stream Name Potential Summer Pop. Seasonal Habitat	Area Needed	Area Available	Smolt Factor	Potential Smolt Production
Comfort Creek 15244 summer population				
Spawning Area	91	468	45	21060
Spring Rearing Habitat	4573	5708	0.8	4566
Summer Rearing Habitat	9146	9146	0.4	3658
Winter Rearing Habitat	3048	850	1.6	**1360**
Hartney Creek 18210 summer population				
Spawning Area	109	551	45	24795
Spring Rearing Habitat	5463	14504	0.8	11603
Summer Rearing Habitat	10926	10926	0.4	**4490**
Winter Rearing Habitat	3642	4978	1.6	8028
Koppen Creek 3085 summer population				
Spawning Area	19	3726	45	167602
Spring Rearing Habitat	925	2959	0.8	1967
Summer Rearing Habitat	1851	1851	0.4	**740**
Winter Rearing Habitat	617	1182	1.6	1891
E F Olsen Creek 6396 summer population				
Spawning Area	38	321	45	14485
Spring Rearing Habitat	1918	4821	0.8	3856
Summer Rearing Habitat	3877	3877	0.4	**1535**
Winter Rearing Habitat	1279	1996	1.6	2046
Plateau Creek 4798 summer population				
Spawning Area	29	128	45	5760
Spring Rearing Habitat	1439	3917	0.8	3133
Summer Rearing Habitat	2878	2878	0.4	1151
Winter Rearing Habitat	960	226	1.6	**362**

While winter habitat and spawning area surveys were being conducted, 103 adult coho salmon were seen in Hartney Creek on October 23, 1996. One coho salmon and several redds were observed in Plateau Creek on November 6. No coho salmon or redds were seen in the other creeks. Comfort Creek was surveyed November 6, East Fork Olsen Creek November 15, and Koppen Creek November 25.

In many streams there were limited amounts of stream channel with less than a 3% gradient. A gradient of 3% is usually the upper limit for coho salmon habitat (Reeves et al. 1989). Five streams had less than 400 meters of low gradient stream channel: Allen (226), Deep (184), Duck (269), Milton Lake (187), and Parshus (359). In Koppen (924) and Rogue (790) there were moderate amounts of low gradient channel, while Comfort (1818), East Fork Olsen (2395), and Plateau (2172) had the most.

Discussion

Habitat Area Determination

One of the important components of the habitat surveys is the estimation of the widths, and in turn, the calculation of the habitat area. Given the relatively high correlation between the estimated and measured widths, the intercept and slope of the regression line, and the relatively small size of the confidence boundaries, the estimations appear to be consistent and accurate. If widths were inconsistently estimated, with large overestimations and underestimations, the variance of the total corrected widths and the confidence limits would have been much greater (Dolloff et al. 1993).

We cannot directly compare the correlation coefficient of our width estimates (0.92) with the values in the studies by Hankin and Reeves (1988) and Dolloff et al. (1993). These studies estimated both lengths and widths and correlated estimated areas versus measured areas. However, since our correlation value is similar to the values they reported, the accuracy of our estimates appears to be reasonably good. Hankin and Reeves (1988) reported a correlation of 0.93 for all habitat units, while Dolloff et al. (1993) reported correlations of 0.97 for pools and 0.99 for riffles. Although their correlations are somewhat higher, we only estimated one dimension (all lengths were measured), and so an additional source of error was eliminated.

The magnitude of the uncertainty of our width estimates (+/- 6.5%) is similar or somewhat less than the percentages reported for habitat areas in the other studies. Hankin and Reeves (1988) reported that confidence limits were +/- 13% of their total estimated pool area and 16% of the estimated riffle area. Dolloff et al. (1993) had limits of +/- 8.2% for pool area and 5.4% for riffle area. Since our surveys contained glides, cascades, and other habitat types not used in the other studies, we did not try to determine differences between pool and riffle estimates.

The other major component of the habitat surveys was the assessment of spawning area and winter habitat. Although we surveyed the streams at low flow conditions in late fall, we had to assume that water levels would continue to drop during the course of the winter as the streams froze over and precipitation turned to snow. Thus, for each site there is always some professional judgment as to how depths, water velocities, and anticipated water levels will affect the freezing of the spawning gravels or winter habitat. For Comfort Creek, the degree of potential freeze-out was difficult to assess. We were conservative in our evaluations and may have underestimated the amount of winter habitat. In Plateau Creek, however, the habitat is less complex, the channel is more confined, and the average depths were greater. In this case it was easier to identify the areas that would still be available even if flows were lower.

Adult Escapement

Hartney Creek is the only stream where substantial numbers of adult coho salmon were seen. Hartney Creek was first surveyed on October 23, when 103 fish were observed. The only other creek where coho salmon were seen is Plateau Creek (one adult and numerous juveniles in the summer). The other creeks were surveyed on November 6, 15, and 25, which appears to have been too late in the year. When Hartney Creek was resurveyed November 7, only 10 fish remained, and there was no evidence of carcasses. If the other creeks had small runs, the fish might have already spawned and died. Rains might have washed away the carcasses and evidence of redds, and animals may have eaten the carcasses. It is also possible that there are very few or no coho in these other creeks.

Limiting Factors Analysis

Our ability to accurately identify the habitat factors limiting coho salmon production is also dependent on the validity of the limiting factors analysis we used (Reeves et al. 1989). Gordon Reeves (personal communication) said that the model has worked well for most of the studies that have used it. Reeves et al. (1989) recognize, however, that factors other than habitat could limit production. The U.S. Forest Service, Cordova Ranger District (unpublished data) has used this model to estimate smolt production in a stream system near Cordova. Based on habitat surveys in 1993, estimated smolt production in the system would be 25,689. In 1993 and 1996, actual production was 22,782 and 21,253 respectively, which is reasonably close. However, production in 1994 and 1995 was only 6,123 and 8,031. It is thought that severe winters may have drastically reduced the spawning area, which had been identified as the limiting factor (author's personal observation). Obviously, the smolt production estimates cannot always be accurate in highly dynamic systems, but the model does appear to provide a reasonable basis for identifying limiting factors or at least determining gross habitat imbalances.

We must emphasize that we have only attempted to determine the physical habitat factor that limits production, not the biological factors such as food availability. The information in the literature as to what controls production is mixed. Nickelson et al. (1992) state that winter habitat is probably the limiting factor in coastal streams of Oregon, while Koski and Kirchhofer (1984) generally see food availability as the factor limiting salmonid densities. Reeves et al. (1989) are more pragmatic and state that features such as nutrients or food availability may limit production, but " ... neither the procedures for identifying such limitations nor the techniques for eliminating them are well developed and therefore they are not yet useful to fishery managers." We elected to use the model by Reeves et al. (1989) because it could reveal significant habitat deficiencies which we have the ability to alleviate.

Proposed Actions

Given the results of the limiting factors analysis and other more qualitative observations, it appears that Plateau Creek would be the best site for coho salmon habitat enhancement. The analysis indicates that winter habitat is by far the most restrictive habitat factor, which appears reasonable given the lack of pools and the general lack of channel complexity. Simple log and boulder structures can be built to create backwaters, pools, and cover areas for winter habitat (Crispin 1988, Crispin et al. 1993). Since these areas are used to varying degrees for spring and summer habitat, production would also be increased at all seasonal life stages.

We are currently proposing to build these structures in the summer of 1997. Plateau Creek is somewhat smaller than the other streams, so construction should be easier and the structures should be less prone to failure. The survey crew also qualitatively noted that there were high numbers of aquatic insects. While they did not systematically sample Plateau or other creeks, this observation is encouraging and food availability may not be an additional limiting factor.

Some of the other streams may be suitable for enhancement work, but additional information is needed. As stated earlier, we may have underestimated the amount of winter habitat in Comfort Creek since we were uncertain about the amount of freezing in the backwater areas. If a mid-winter survey is conducted, we could determine whether these areas are available as winter habitat and proceed accordingly. East Fork Olsen and Koppen creeks have low amounts of large woody debris and low percentages of pool area, which limit their summer and winter habitat. These streams could use habitat enhancement, but they appear to be subject to high flows. We were not able to observe these streams during the spring runoff periods. The intensity of the flows may affect spawning area and spring habitat, which may alter the results of the limiting factor analysis. The habitat in Hartney Creek is more balanced than the other system, but it appears to have even higher flows than the other streams. Instream habitat structures would probably not be successful in this stream.

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Cave, Keith Davis, Laurie Lamm, and Mike Ezukameow assisted her with the data collection and entry. David Saiget and Merlyn Schelske collected data on spawning area and winter habitat.

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