Exxon Valdez Oil Spill
Restoration Project Annual Report

Montague Island Riparian Rehabilitation

Restoration Project 96139C1
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.

Ken Hodges

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P.O. Box 280
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April 1997

Montague Island Riparian Rehabilitation

Restoration Project 96139C1
Annual Report

Study History: This project was initiated under Restoration Project 94139. An annual report was issued in 1994 by David E. Schmid et al., under the title *Montague Island Chum Salmon Restoration.* The project was continued under Restoration Project 95139C1, the purpose of which was to monitor the riparian rehabilitation work completed in 1994. An annual report was issued in 1995 by Ken Hodges under the title *Montague Island Riparian Rehabilitation.* Some additional rehabilitation work was done in 1995 and 1996. Monitoring will continue in 1997. A final report will be issued after the monitoring is completed in 1997.

Abstract: From 1994 to 1996, riparian restoration work was undertaken in four watersheds on Montague Island where logging had occurred in the 1960's and 70's. Although this work would not deal directly with the habitat oiled by the Exxon Valdez oil spill, it was felt that the restoration of these watersheds would improve conditions throughout the stream systems and contribute to the overall restoration of chum and pink salmon in Prince William Sound. The work involved two major parts: building instream structures to reduce erosion, moderate flows, and improve fish habitat; and thinning crowded riparian vegetation to stimulate the growth of Sitka spruce, which was the dominant species before the logging. A total of 32 instream structures were built and 17 acres were thinned. Most of the structures were successful, but some of those in the main branch of the largest stream failed. Variable flows in the smaller tributaries may reduce the benefits of habitat enhancement. Mainstem and whorl growth of Sitka spruce in areas where both Sitka spruce and Sitka alder were removed was significantly greater than growth in areas where only the alder was removed or in untreated areas.

Key Words: *Exxon Valdez*, instream structures, thinning, riparian vegetation, Montague Island.

Project Data: Data have been collected on the substrate, fish habitat, and channel geometry around each of the structures and the mainstem and whorl growth of Sitka spruce in thinned and unthinned areas. The structure data are recorded graphically in Corel software. The growth data are on Lotus 1-2-3 spreadsheets. All data will be available when the project is completed in 1997. *Custodian:* Ken Hodges USDA Forest Service, Cordova Ranger District. P.O. Box 280 Cordova, AK 99574. (907) 424-7661.

Citation: Hodges, K. 1996. Montague Island riparian rehabilitation. *Exxon Valdez* Oil Spill Restoration Project 1996 Annual Report (Restoration Project 96139C1), U.S. Department of Agriculture Forest Service, Cordova, Alaska.

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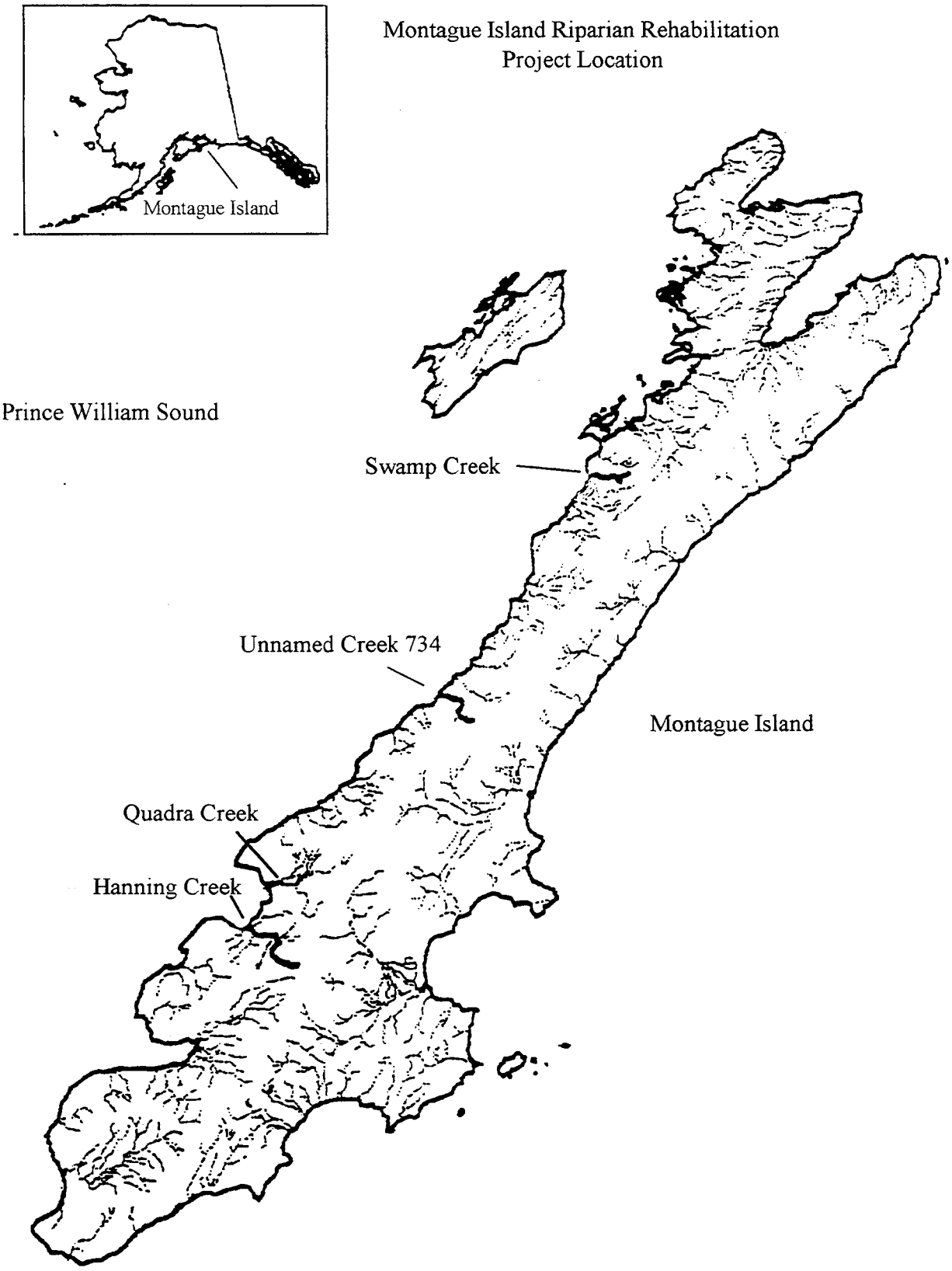

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Executive Summary

After the *Exxon Valdez* oil spill it became apparent that not all of the direct effects of the oil spill or the injuries to various species could be undone. There was an opportunity, however, to help restore a number of watersheds on Montague Island where logging had occurred in the 1960's and 70's. Although this work would not deal directly with the habitat oiled by the spill, it was felt that the restoration of these watersheds would improve conditions throughout the stream systems and contribute to the overall restoration of chum salmon (*Oncorhynchus keta*) and pink salmon (*Oncorhynchus gorbuscha*) in Prince William Sound.

These watersheds had been logged without leaving buffer strips along the streams, and woody material was removed from the streams in the belief that it would improve salmon passage and spawning. As a consequence, water velocities, erosion, and bedload movement have increased. There has also been a loss of pools, reduced fish habitat, and stream widening. Pink and chum salmon redds in downstream spawning areas are subjected to siltation and displacement by higher erratic flows.

In 1994, 32 instream structures were built to reduce water velocities, reduce erosion, lower bedload movement, create pools, or restore fish habitat. Basically the structures perform the same functions that large woody material would perform in a natural system where the streamside vegetation and instream material have not been removed. Although all of the structures survived two bankfull high water events during the summer and fall of 1994, floods associated with the spring runoff destroyed 10 of the 32 structures in 1995. Four structures were rebuilt in 1996 using better anchoring methods.

Most of the structures that failed were designed to reduce velocities and erosion in the main channel of Hanning Creek. The remaining structures and those that were rebuilt appear to be functioning as intended, but will be more fully evaluated in 1997. The structures designed to create pools and fish habitat have been more successful, although low flow levels in some of the smaller tributaries during August reduced the amount of available habitat considerably.

In addition to the structures, 17 acres of riparian vegetation were thinned to accelerate the growth of Sitka spruce. By thinning these areas, the conditions of the old-growth forest that existed previously could be restored in a shorter amount of time. The effects of thinning were evaluated at two sites in 1996. At the first site, only the competing alder and willow had been removed. At the second site, the competing species were removed and the Sitka spruce were thinned. Untreated areas were left at both sites. Although significant differences in mainstem growth and whorl growth had been found between treated and untreated areas at the first site in 1995, no significant differences were found in 1996. At the second site, mainstem and whorl

growth were significantly greater in the treated area than in the untreated area or the treated area at the first site. Comparisons of the two untreated areas are not possible because of the differences in the alder canopy.

Apparently, reduction of interspecies competition at the first site stimulated Sitka spruce growth for one year, but intraspecies competition may be restricting growth now. Growth at the second site has only been monitored for one year, but it appears that the additional thinning is more effective. Additional thinning can be conducted at the first site in 1997.

This project will be completed in 1997. Any additional thinning or structure repair will take place and the final monitoring and evaluation will be made.

Introduction

This project, EVOS 96139C, is the monitoring and evaluation phase of a watershed restoration project which was implemented in 1994. Although this project was designed to address problems caused by logging activities rather than the *Exxon Valdez* oil spill, it was felt that the restoration of these watersheds would help the overall recovery of chum salmon (*Oncorhynchus keta*) and pink salmon (*Oncorhynchus gorbuscha*) in Prince William Sound. Detailed descriptions of this project and the results are included in the 1994 and 1995 Annual Reports. This report will focus on the activities in 1996 and the plans for the final monitoring and evaluation in 1997.

In 1994, 32 instream structures were built to perform the functions of the large woody material that was removed from the streams. Basically these structures would reduce erosion and store sediment (Smith et al. 1993), reduce velocities, and provide fish habitat (Sedell et al. 1984, Fausch and Northcote 1992). The reductions in erosion, velocities, and bedload movement would protect pink and chum salmon redds downstream from displacement or siltation. The fish habitat created by the structures would benefit juvenile coho salmon (*Oncorhynchus kisutch)* or other salmonids. In the riparian areas, which had been logged without buffer zones, crowded stands of Sitka spruce (*Picea sitchensis*) and competing Sitka alder (*Alnus sinuata*) and willows (*Salix spp.*) were thinned to accelerate growth of the remaining spruce. Eventually the spruce will provide the source of large woody debris for the streams.

Although all of the structures survived two bankfull flows in the summer and fall of 1994, floods during the spring runoff of 1995 destroyed 10 structures. In 1996, four structures were rebuilt using improved anchoring techniques. The final monitoring in 1997 will address how well the structures created habitat, reduced erosion, and altered flows.

In the thinned areas, annual mainstem and whorl growth of Sitka spruce have been monitored. Initially all areas showed significantly greater growth than in untreated areas, however, in 1996, growth in an area where only competing willows and alders were removed showed non-significant differences. These parameters will be monitored again in 1997.

Methods

Instream Structures

All of the structures were monitored to ensure that they were still intact and were functioning properly. Four structures which had failed were rebuilt and anchored with cabled earth anchors. Previously these structures had been cabled to stumps or pinned to the substrate

with reinforcement rod (rebar). Diagrams were drawn at each of the four sites to show the existing habitat, depths, substrate composition, and channel geometry. This had also been done at the other structures when they were built. In 1997, all of the structures will be examined to see how these parameters have changed and how these changes relate to the goals of creating habitat, storing sediment, and reducing velocities.

Downstream from all of the structures a 300-foot section of Hanning Creek was chosen as a control site to see how the structures affected flows, substrate, and channel geometry. It was hypothesized that if the structures helped moderate flows or reduce bedload movement, there may be changes in the substrate and channel form over time. The control site contains two riffles and a pool. Each area was mapped and channel cross sections were measured. To analyze the substrate, Wolman pebble counts were conducted for each habitat type as described by Harrelson et al. (1994). A pebble count involves the random measurement of 50 pieces of substrate and gives a quantitative measure of the substrate composition for an area. In 1997, the process will be repeated to determine whether any changes have occurred.

Riparian vegetation thinning

Two methods of thinning were employed. At the site at Hanning Creek, only competing alders and willows were removed since the Sitka spruce were fairly young. At Swamp Creek, the competing species were removed and other Sitka spruce were thinned to a distance of three feet plus a foot for every inch of tree diameter (of the tree saved). Thus, a six-inch diameter tree would have all of the trees within a nine-foot radius removed.

The effects of the thinning were monitored in June 1996 at Hanning Creek and Swamp Creek. (Monitoring in 1995 is discussed in the 1995 annual report.) Thinned and unthinned sites at both creeks were examined. The general health of the remaining trees has been assessed by looking for windthrow, sunburn, and growth. To determine the effect on growth, the main stem and top whorl growth of 20 trees were measured at each site. Mainstem growth was measured to the nearest 0.01 ft. by measuring the length between the two uppermost whorls. This represents the previous year's (1995) growth. Whorl growth was calculated by measuring the 1995 growth, which was the hardened growth of the whorl second from the top. Two of the whorl stems on opposite sides of the tree were measured to the nearest 0.01 ft. and the two measurements were averaged. Both of these parameters were analyzed using a single classification ANOVA. A log transformation was used for whorl growth data at the sites at Swamp Creek. The mainstem growth data at the thinned Hanning Creek site were also skewed. The Kruskal-Wallis test for ranked data was used for the analysis between sites at Hanning Creek and between the treated sites at Swamp and Hanning creeks. All of the statistical tests were conducted with a computer software package (Statgraphics Plus). Comparisons were not made between untreated sites because of differences in alder competition.

A more intensive study of the effects of thinning was initiated in 1995 along Quadra Creek. Two one-acre plots were thinned using different spacing patterns: 14-ft. spacing and

"diameter plus five," in which the average breast height diameter in feet plus five equals the number of feet between trees. The preliminary report by USFS silviculturist Susan Kesti is included in the 1995 annual report. This area was not monitored in 1996.

Results

Of the 32 initial structures, 10 failed in 1995, and four were rebuilt in 1996. There have been no further structure failures. The effects and final results will be addressed in the final report.

The results of the growth analysis are presented in Table 1. There was significantly greater stem growth between thinned and unthinned sites at Swamp Creek and between the thinned sites at Swamp and Hanning Creek. The same pattern holds for whorl growth. No differences were detected at Hanning Creek.

Table 1. Results of growth comparisons between thinned and unthinned sites at Swamp and Hanning creeks. A single classification ANOVA gives the F value. In one comparison, the data was transformed using a log transformation. The K-W is the statistic from the Kruskal-Wallis test for ranked data. The asterisks indicate significant differences.

Site / Growth	Mean (ft)	n	F value	K-W	p
Hanning Thinned Whorl vs.	0.38	20	0.030	---	0.857
Hanning Unthinned Whorl	0.38	20			
Hanning Thinned Stem vs.	0.70	20	non normal	0.594	0.441
Hanning Unthinned Stem	0.57	20			
Swamp Thinned Whorl vs.	0.65	20	10.86	---	0.002*
Swamp Unthinned Whorl	0.47	20	(log trans)		
Swamp Thinned Stem vs.	1.26	20	6.82	---	0.013*
Swamp Unthinned Stem	0.97	20			
Swamp Thinned Whorl vs.	0.65	20	26.27	---	0.0000*
Hanning Thinned Whorl	0.38	20			
Swamp Thinned Stem vs.	1.26	20	non normal	16.91	0.0004*
Hanning Thinned Stem	0.70	20			

Discussion

Instream Structures

This topic will be addressed in the final report after the final monitoring is completed. It does appear, however, that the structures that were not washed out the first year are likely to remain in place, since no further failures have occurred in two years.

Spruce Regeneration

The most difficult part of this project to assess will be the response of the spruce to thinning, simply because the full benefits may not be seen for many years to come. Thinning and removal of competing vegetation has been shown to accelerate the growth of Sitka spruce (Fowells, 1965) and has been a standard silvicultural practice for many years (Smith, 1962). Montague Island, however, is at the extreme northern limit of the range for Sitka spruce. The colder temperatures and shorter growing season may result in slower growth rates and a longer recovery period than in other areas. Although it has been 18 to 25 years since the logging on Montague Island, most of the spruce in the crowded stands are less than 15 feet tall.

The monitoring in 1996 indicates that the thinning at Swamp Creek was more effective than at Hanning Creek, where only the competing willow and alder were removed. Although there were significant differences in growth between treated and untreated areas at Hanning Creek in 1995, it appears that the benefit was only temporary, and that there might be intraspecific competition there now. In 1996, there were no significant differences between thinned and unthinned sites. Swamp Creek sites, on the other hand, showed significant differences in growth even though the gaps between trees was beginning to close. The effects of the closure will need to be monitored in 1997.

The differences in growth between treated sites at Swamp and Hanning Creek may be exaggerated by differences in topography. The sites at Swamp Creek are on flat open areas, while the sites at Hanning Creek are in a shallow canyon. Thus, the Hanning sites may get less sun and have different growth rates regardless of treatments. The two sites at Hanning Creek are similar to each other, however.

There were some difficulties measuring the whorl growth and stem growth of the taller trees at Swamp Creek. If additional thinning is needed in 1997, we could measure the growth of thinned trees to make the measurements more accurate.

Plans for FY 1997

In 1997 all of the structures will be mapped to determine changes in substrate, habitat,

depths, and channel geometry. The control section below the structures will also be examined as described in the methods section. A final analysis of Sitka spruce in thinned and unthinned areas will also be performed.

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