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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Title: Deposit Sand to Promote Clam Recruitment - Feasibility Study

Project Number: 94068

Lead Agency: ADF&G

Cooperating Agency: None

Cost of Project, FY94: $36.4K  Cost of Project, FY95: $36.4K

Project Startup Date: May 1994  Duration: 2-3 years

Geographic Area: Prince William Sound

INTRODUCTION

The purpose of the proposed work is to test a practical method for restoring clam populations to the intertidal habitats injured during the Exxon Valdez oil spill and clean-up operations. High pressure hot water (HPHW) was a treatment extensively used in 1989 for cleaning heavily oiled beaches in Prince William Sound (PWS). This treatment is estimated to have killed > 70% of the hardshell clams remaining on the beaches several months after the spill. In addition, HPHW stripped the treated beaches of fine sediments, washing them from the upper and mid-intertidal zones to the lower intertidal and subtidal, and leaving a rubble of coarse sediments and cobble in its wake. Loss of these fine sediments has been identified as the proximate cause for the documented recruitment failure of intertidal clams at cleaned beaches. Recovery of this species is important for subsistence and recreational users and for a variety of birds and mammals that use the intertidal region to obtain prey, particularly juvenile sea otters. Recovery is not expected until a suitable sediment regime is re-established on beaches which were treated with HPHW.

The purpose of the proposed work will be to answer the question: Can intertidal clam recruitment success and population recovery be enhanced by replacing fine sediments on HPHW treated beaches? This project has significant implications for the sea otters of PWS which rely almost exclusively on clams and mussels for prey. Juvenile otters and mothers with pups forage extensively in the intertidal zone for Protothaca (littleneck clams), Saxidomus (butter clams) and Mya (soft-shell clams). Recent studies show that juvenile otters continued to have a lower than normal survival rate since the spill. This project may be combined with Project 94081.
PROJECT DESCRIPTION

The recruitment of intertidal clams on cleaned beaches will remain low until a substrate of appropriate grain size is re-established, either naturally or via restoration efforts. This project will test that hypothesis using a rigorous experimental design. The approach will be to add fine sediments to plots on washed beaches, and then compare recruitment success and recovery between these and control plots. Control plots will consist of: HPHW plots without sediment addition, oiled plots not treated with HPHW, and plots not oiled and not cleaned with HPHW. Parameters to be measured at all plots will include clam size and species distribution, and sediment grain size. This approach will provide answers to the following specific questions within 2-3 years:

1. Can infaunal recruitment be enhanced by adding fine sediments to beaches stripped by HPHW cleaning?
2. What is the natural clam population recovery rate on cleaned beaches?
3. What is the natural sediment recovery rate on cleaned beaches?
4. Is sediment addition an effective means of clam habitat restoration that could and should be applied on a wide scale in PWS?

This proposal represents one of the few active restoration alternatives available to address the damage caused by the spill. Recovery of intertidal infauna will not only be of benefit to sea otters, but also to the numerous birds, fish and mammals that are known to forage in this formerly rich habitat. If this pilot study is successful, the restoration concept could then be considered for wider application.

A. Resources and/or Associated Services

Large numbers of intertidal clams and their habitat were destroyed during the HPHW clean-up operations following the oil spill. These clams (particularly littlenecks) and other intertidal infaunal invertebrates (e.g., echiuroid worms) are important prey items for several species of marine mammals and birds that were severely injured during the spill, especially juvenile sea otters, river otters, and harlequin ducks. Replacement of the fine-grained sediment structure to formerly rich and productive beaches will greatly accelerate the recovery of these key prey species populations and restore the forage value of these habitats for other wildlife.

B. Objectives

The primary objective of the project will be to accelerate the already demonstrated slow recovery of intertidal clams to beaches treated with HPHW. The hypothesis is that the slow recovery is due to larval recruitment failure as a result of the loss of fine-grained sediments washed from the beaches during cleanup. If this is true, then depositing finer sand on the beaches should result in greatly enhanced larval recruitment and population recovery within one or two years. The proposed project is a small-scale feasibility study to test the beach restoration concept. If successful, the approach can then be expanded over a much broader geographic range.
Project Description

C. Methods

It is known from other studies that littleneck clams have been recruiting to unoiled and untreated beaches as well as oiled beaches not treated with HPHW. These same studies have documented recruitment failure only at beaches treated with HPHW (Category 3) where only coarse sediments remain. This study will focus only on Category 3 beaches to assess the value of restoring fine sediment to the intertidal zone.

The approach will be to select two of the Category 3 beaches already identified in Houghton et al.'s 1993 study for sediment addition. At each of these sites several, 10 m² plots will be established as control and treatment plots. Three of the treatment plots will receive sediment pumped up from the subtidal using a gasoline powered, diver-operated gold dredge. Three additional treatment plots will receive sediment from adjacent terrestrial sources. No sediment will be added to the 3 control plots.

The sediment grain size and littleneck clam population (size distribution and abundance) will be sampled within each plot prior to the addition of the sediment. Plots will be resampled at one year intervals for two years. At these times recruitment success of littleneck clams and other invertebrate species will be monitored, as well as the persistence of the added sediments in the treatment plots and the natural recovery of fine sediment to the control plots. The project will require a time commitment of two weeks in the field per year for 2-3 years. The month of June is ideal to maximize the good weather window and to implement the study prior to the major spawning time of littleneck clams.

D. Location

Various locations in PWS.

E. Technical Support

A minimum of one, preferably two small boats (13 to 25 ft.), SCUBA compressor, sediment dredge and field camp support for 2 weeks are required. The U.S. Fish and Wildlife Service may be able to provide this equipment.

F. Contracts

A contract will be made with Moss Landing Marine Labs and awarded through the San Jose State University Foundation. The Moss Landing Marine Laboratory will supply all personnel and diving and sampling equipment for the project.
SCHEDULES

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EXISTING AGENCY PROGRAM

None

ENVIRONMENTAL COMPLIANCE/PERMIT/COORDINATION STATUS

The National Oceanic and Atmospheric Administration (NOAA) is the lead federal agency for National Environmental Policy Act (NEPA) compliance for this project. This project will require an Environmental Assessment.

PERFORMANCE MONITORING

Annual reports describing the work completed to date and clam recruitment success will be provided each December following commencement of the project. A draft final report will be submitted during December of the final year of the project. The final report will be completed within one month following the return of the draft report.
**FY94 BUDGET (S$K)**

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Title: Restoration of High Intertidal *Fucus*

Project Number: 94070

Lead Agency: ADF&G

Cooperating Agency: None

Cost of Project, FY94: $285.8K  
Cost of Project, FY95: $172.5K

Project Startup Date: October 1993  
Duration: 5 years

Geographic Area: Knight Island, Prince William Sound.

INTRODUCTION

Marine intertidal communities were the largest single category of habitat affected by the *Exxon Valdez* oil spill. Experiments conducted at Herring Bay, Knight Island, and throughout the spill impact area since 1990 clearly indicate that one of the consequences of the oil spill and resultant clean-up activities was serious injury to intertidal algal populations, especially in the mid- to upper-intertidal zones. The dominant member in this community is the rockweed, *Fucus gardneri*, which provides habitat and food for a variety of invertebrates. These invertebrates in turn serve as an important food source for marine mammals, birds, and fishes.

Surveys made during 1992 and 1993 show that the *Fucus* populations in the high intertidal (top one meter of the intertidal zone) in many areas of Prince William Sound (PWS) still have not recovered. These habitats remain as bare rock with sparse barnacle and littorine populations. The barren areas are predominately on south-facing rocky slopes in sheltered habitats. One area at the north end of Herring Bay has been extensively studied since 1991. Quadrat counts of individual *Fucus* plants at this site show that there has been virtually no recruitment into the top 0.5 m of the intertidal through the spring of 1993. In the zone from the 0.5 meter vertical drop (MVD) to the 1.0 MVD, *Fucus* densities are very low and did not increase between 1992 and 1993. The plants counted in these quadrats were generally newly recruited plants and did not produce any significant percent cover. This site is a region subject to the greatest solar insolation during the summer months. In addition, it is in a location protected from heavy wave action so there is no wave spray to moisten and cool the rock surface.

Other habitats of this type were identified using the Geographic Information System (GIS) database established by the Alaska Department of Natural Resources (ADNR). The GIS system was used to integrate information on the geographical distributions of factors important in defining these habitats such as oiling category, shoreline aspect, shoreline slope,
and exposure regime. At least 12 miles of shoreline that fall into this habitat category have been identified.

This project will better define the amount of shoreline where \textit{Fucus} has re-established itself, and expand, based on 1993 results, tests of a method of restoring \textit{Fucus} populations to these areas using biodegradable erosion-control fabric. Tests are still underway as this proposal is being written; however, a request for proposals (RFP) will be issued to begin small scale restoration actions based on 1993 results.

\textit{Fucus} is a relatively slow-growing plant. One growing season is needed for newly settled embryos to grow to a size that can be seen in the field (1 to 2 mm in length). Another season is needed for the plants to recruit into the juvenile population and be expected to produce an adult plant. Because of this slow growth, final results on the experimental plots set out in 1993 will be unknown until late in 1994. However, at this time a small-scale pilot project based on the current preliminary results is worth the effort and expense for implementation in 1994.

**PROJECT DESCRIPTION**

A. Resources and/or Associated Services

Resources to be restored are the biota in the upper intertidal in sheltered rocky areas that were affected by the oil spill and clean-up activities. The focus will be on restoring \textit{Fucus} populations and subsequent monitoring of dependent biota. Restoration of \textit{Fucus} will allow reestablishment of the upper intertidal community and use of this area by invertebrates, birds and mammals.

B. Objectives

1. To create a model of affected shorelines that will predict which high intertidal areas will have depressed \textit{Fucus} populations due to the oil spill and subsequent cleanup.

2. To determine the rates of recovery, if any of \textit{Fucus} populations in those affected upper intertidal zones selected in objective "1." above.

3. To initiate small scale restoration actions to accelerate the recovery of \textit{Fucus} in selected intertidal zones.
C. Methods

1. Model of affected shorelines/rates of recovery. Using information from the Alaska Department of Natural Resources, at least 5 impacted sites plus two sets of controls will be identified in order to quantify the density of *Fucus* in the upper intertidal. The sites will be randomly chosen from the list of sites available in each category. The position of the sites will be located with large scale site maps produced from the GIS database and GPS positioning. At each site *Fucus* density and percent cover in the upper 1 meter of the intertidal will be quantified and a map of the upper boundary of the "*Fucus* zone" will be drawn. This zone will be defined by a continuous cover of adult *Fucus* plants. These sites will be monitored annually to ascertain rates of natural recovery.

2. Restoration experiments. During the past two summers hundreds of artificial substrates seeded with *Fucus* embryos were transplanted. These substrates consisted of unglazed tiles, epoxy plates, and plastic dishes. They were placed in a variety of sites in both the upper and lower intertidal. Very few of these substrates, however, successfully produced juvenile plants. The primary reason for embryo mortality on these plates appears to be desiccation and the effects of high substrate temperature. The unglazed tiles and plastic dishes were flat in texture and would dry out during tidal exposures. The epoxy plates had shallow grooves which retained some moisture, but the grooves were too wide in relation to their depth to retain sufficient water to keep the embryos moist for a high tide cycle on a sunny day. Similar results showing microhabitat temperature as the primary factor controlling embryo survival have been shown for *Pelvetia* populations.

Transplants of fertile adult *Fucus* plants into the upper intertidal to serve as sources of eggs to establish new populations have been only partially successful. The transplanted *Fucus* quickly became desiccated and died, but there is some evidence that eggs released from these plants were able to germinate and grow.

The recovery of *Fucus* at sites with a south aspect can be enhanced by providing microhabitats with conditions more suitable for embryo survival and growth, i.e., higher moisture and lower substrate temperatures. Those conditions will be provided using biodegradable erosion-control fabric. There are many versions of this product developed for a variety of terrestrial applications. Preliminary studies have shown that jute fibers do not persist more than a few months in the marine environment, and a fabric composed of coconut fiber may be the best material for the restoration.

A preliminary study conducted in Herring Bay during June of 1993 showed that temperatures on the rock below a coconut fiber mat during low tide were significantly lower than on an adjacent bare rock. This site was in the upper intertidal at the north end of Herring Bay which suffered a complete loss of *Fucus*.
The highest temperature observed on the bare rock during a sunny day was 35 degrees C.

The experiment itself will consist of the deployment of erosion control fabric in one meter wide swaths in an affected area of the upper intertidal zone. The studies on Fucus egg dispersal in Herring Bay have shown that there are relatively few eggs reaching upper intertidal substrates in oiled areas. This potential egg dispersal problem will be avoided by seeding the erosion-control fabric with Fucus embryos. Unseeded strips of fabric will be used to test whether embryo seeding is necessary to produce new populations of plants in these environments. Control plots will consist of areas without attached fabric. An initial trial experiment was deployed in Herring Bay in 1993 and will be expanded and monitored in subsequent seasons. Fucus densities in each experimental site will be monitored at the beginning and the end of each summer season using 9, 100 sq cm quadrats placed randomly in each 1 meter-wide test strip. Because results from related experiments performed in Herring Bay indicate it will take three years before Fucus plants will mature, these sites will be monitored for three summer seasons after deployment.

The most time consuming and expensive part of a major restoration project with erosion-control fabric will be attaching the fabric to the substrate. Screws and small patches of epoxy putty will be used to secure the fabric to the rock substrate. The cost effectiveness of this procedure for large scale restoration will be assessed.

3. Pilot Scale Project. An impacted beach near Knight Island will be selected from existing GIS and DNR data bases for the sites of a pilot scale restoration project. Transplants of fertile Fucus will be made to this beach at regular intervals in areas with and without strips of biodegradable fabric attached. The exact configuration for the locations and attachment of the fabric and for the location and attachment of the plants will be determined based on the results of current, on-going experiments. The methodology will entail drilling holes in the substrata for attachment of the fabric between the +7 and +10 foot tidelines. Transplanting will be performed early in the summer, and augmented as necessary throughout the season. Monitoring of the recruitment and growth of juvenile Fucus will be performed using randomly placed 100 sq cm quadrats. The site will be monitored for three summer seasons after deployment.

D. Location

The project will be undertaken at intertidal sites around Knight Island (especially Herring Bay) and nearby islands in PWS. The project's benefits will be realized at all upper intertidal sites in which Fucus populations are depressed. The associated animal and plant communities in the sub-, inter- and supra-tidal will benefit by this restoration project.
Project Description

E. Technical Support

GIS services from ADNR will be necessary to predict and locate potential sites for population surveys and restoration activities.

F. Contracts

The University of Alaska-Fairbanks (UAF) will determine the shorelines with high intertidal areas with depressed *Fucus* populations due to the oil spill or cleanup activities, determine the rates of *Fucus* recovery, and select locations for restoration actions. The UAF will continue tests of recovery methods if warranted following the 1993 field season (the UAF has been the cooperating agency in this and closely related studies since 1990). A request for proposals (RFP) will be issued and a contract awarded to perform the pilot restoration portion of this project. The contractor will work under the guidance of the UAF researchers to apply appropriate restoration methods in the locations identified by UAF.

SCHEDULES

FY94

Oct. 93 - Jan. 94: Complete analysis and report from 1993 field season

Nov. 93 - Mar. 94: Begin *Fucus* seeding experiments
Refine GIS model and select potential field sites
Set up logistics for 94 field season

Mar. 94 - May 94: Ship supplies to staging area at Seward
Preliminary outplant experiments at Juneau
Ship seeded fabric

June 94: Field work - experimental setups, preliminary population assessment, fabric deployment

July 94: Assessment of June field work

Aug. 94: Field work - population monitoring

Sep. 94: Begin data compilation and analysis
FY95

Oct. 94 - Jan. 95: Complete analysis and report from 1994 field season
Prepare for phased expansion of pilot project or initiation of full scale
restoration effort as warranted by results to date.

Summer 95: Phased expansion of pilot project or initiation of full scale restoration
effort as warranted.
Continued monitoring of experiments and sites. Two data acquisition
trips.

FY96 Implement full scale restoration project if not begun in 1995.
Continued monitoring of test and implementation activities + annual
report

FY97 Continued monitoring of implementation activities + annual report

FY98 Final project report

EXISTING AGENCY PROGRAM

The UAF conducts the Herring Bay Experimental and Monitoring Studies (Project 94086) in
PWS from which this project has evolved. The ADF&G has no other similar normal agency
projects.

ENVIRONMENTAL COMPLIANCE/PERMIT/COORDINATION STATUS

The National Oceanic and Atmospheric Administration (NOAA) is lead federal agency for
National Environmental Policy Act (NEPA) compliance for this project. This project will
require an Environmental Assessment.

PERFORMANCE MONITORING

Annual final reports on each season’s field work will be prepared by March 1, following the
field season. A final project report will be completed by May 1, 1998.
## FY94 Budget ($K)

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Title: Recruitment Monitoring of Littleneck Clams

Project Number: 94081

Lead Agency: ADF&G

Cooperating Agency: None

Cost of Project, FY94: $206.7K        Cost of Project, FY95: $206.7K

Project Startup Date: October 1993        Duration: 3-4 years

Geographic Area: Prince William Sound

INTRODUCTION

The Exxon Valdez oil spill and clean-up effort in Prince William Sound (PWS) injured existing stocks of littleneck clams. Since then, there has been a failure of recruitment to this once subsistence-harvested population. The high-pressure, hot water flushing action used during cleanup activities removed the fine-grained substrate used as habitat by these clams.

In addition to restoring the subsistence harvest of littleneck clams, this project has implications for the PWS sea otter. These bivalves are an important item in the diet of female otters with juveniles that forage in the intertidal areas.

The natural replenishment of beach sediments, which appears to be very slow, needs to be augmented. This project will test a restoration plan that will do that. Juvenile clam recruitment will be determined by in-situ sampling intertidally as well as subtidally using SCUBA. Recruitment at different sites will be determined and compared on: (1) oiled sites that were cleaned, (2) oiled sites not actively cleaned, and (3) control sites unaffected by the spill.

Clam spawning in PWS takes place from June to September followed by a three week planktonic larval stage before settlement to the benthos. Low temperatures limit clam recruitment and growth in PWS, as this is the extreme limit of the littleneck clam range. The 1993 water temperatures in PWS appear to be rather warm, thus we expect that spawning, subsequent growth as plankton, and recruitment to the benthos to have had optimal conditions. Poor survival during the first winter has been identified as a limiting factor for PWS littlenecks. This project may be combined with Project 94068.
PROJECT DESCRIPTION

A. Resources and/or Associated Services

The clam stocks were decimated by the clean-up effort following the spill. Littleneck clams are a heavily-used subsistence resource and an important prey for mammals and birds that were affected by the spill. Restoration action via substrate relocation presumably will enhance recruitment of affected clam populations.

B. Objectives

The recruitment process will be assessed to determine the need to facilitate recovery of littlenecks.

C. Methods

Assessment of the recruitment from the 1993 spawning will be made during the Spring 1994 phase of the project. Sites selected for monitoring will be prepared at this time as well, in anticipation of 1994 recruitment. Young-of-the-year clams will be measured during a late survey of the sites. Survival of the 1994 year class will be measured August 1995. Recruitment and survival of the 1995 year class will be measured in a similar fashion in 1996.

1. Natural recruitment and survival to the subsequent year from spawnings taking place in 1993, 1994, and 1995 will be assessed (except for the 1993 spawning where only survival into 1994 will be measured). Intertidal and shallow subtidal sampling at 0.0 to 0.5 mean low low water (MLLW). This is the peak level of juvenile littleneck clam distribution as determined by Paul and Feder, using standard techniques (randomly placed 0.25 m$^2$ quadrats followed by laboratory analysis of sieved samples) during late summer surveys following, settlement of young of the year.

2. Recruitment data will be compared in: (a) oiled sites that were not subject to spill cleanup activities, (b) oiled sites where the substrate was denuded by cleaning, and (c) unoiled control sites.

3. Recruitment will be compared in the 3-way experiment described above to ascertain the best course of action for further enhancement of the stocks.

4. The natural replenishment of substrate will be assessed by collecting and comparing sediment samples in treatments (a) to (c) listed above using standard marine geological techniques (Van Veen grab samples and laboratory analysis).
Project Description

D. Location

Sites will be selected to match the sampling design described in above.

E. Technical Support

A chartered vessel capable of deploying a Van Veen grab sampler will serve as a floating laboratory during field sampling. Small boats will be used to access the sites. Equipment needed includes pumps, screens, tidal height equipment and quadrats.

F. Contracts

Contractors to perform this project will be solicited by the state Request For Proposals process.

SCHEDULES

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EXISTING AGENCY PROGRAM

None.

ENVIRONMENTAL COMPLIANCE/PERMIT/COORDINATION STATUS

The National Oceanic and Atmospheric Administration (NOAA) is lead federal agency for National Environmental Policy Act (NEPA) compliance for this project. This project meets NOAA agency requirements for Categorical Exclusion from the NEPA process.

The appropriate scientific sampling permit will be obtained from the Alaska Department of Fish & Game before sampling. All operations aboard the research vessel will conform to U.S. Coast Guard safety standards.
PERFORMANCE MONITORING

A rigorous quality assurance/quality control (QA/QC) program will ensure the reliability and validity of field and laboratory data. All sample collection, labeling, preservation and storage in the field will be carried out by a team of three. Chain-of-Custody forms that accommodate the standard signatory policy will always accompany the benthic samples and sediment hydrocarbon samples until processing has been completed. A procedure of double checking all labeling and entry of data in field notebooks and data forms will be performed by a member of the team that did not complete the original field notebook.

Draft final reports describing the work completed to date and littleneck clam recruitment success will be provided each April. The final report will be completed 60 days after receiving peer review comments.

FY94 BUDGET ($K)

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Title: Monitoring of Oiled and Treated Shorelines

Project Number: 94083

Lead Agency: NOAA

Cooperating Agency: None

Cost of Project, FY94: $616.6K

Cost of Project, FY95: $286.6K

Project Startup Date: March 1994

Duration: 3 years with possibility of follow up in 1999

Geographic Area: Prince William Sound

INTRODUCTION

This project is documenting the natural recovery of shoreline ecosystems in Prince William Sound (PWS), especially those shorelines impacted by oil cleanup activities. Specifically, this project entails tracking the return of marine life and the loss of oil, at cleaned and uncleaned shorelines. The project has been formally underway since the spring of 1990. The year 1994 marks the fifth summer of continuous monitoring and the sixth summer since the spill. Recovery is occurring, but has been slower at treated than at untreated sites.

PROJECT DESCRIPTION

A. Resources and/or Associated Services

The targeted resources are the intertidal biotic communities and the associated physical environment at selected beaches in PWS.

B. Objectives

The objectives of this monitoring and assessment project are as follows:

1. determine whether or not initial treatment enhanced or delayed recovery of shoreline ecosystems;

2. evaluate temporal changes in physical characteristics of selected shorelines that were oiled;