

96021

SEASONAL MOVEMENTS AND PELAGIC HABITAT USE BY COMMON MURRES AND TUFTED PUFFINS

Project Number: 96021

Restoration Category: Research

Proposer: Alaska Science Center, National Biological Service

Lead Trustee Agency: DOI-NBS

Cooperating Agencies: N/A

Duration: 3 years

Cost FY 96: \$166,337

Cost FY 97: \$166,337

Cost FY 98: \$20,000

Geographic Area: Barren Islands

Injured Resource/Service: Common murre

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EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

Common murres were the bird species most heavily impacted by the *Exxon Valdez* oil spill. The failure to recover documented in this species 5 years after the oil spill may be related to a long-term decline in the availability of suitable forage. Elsewhere in the restoration program, tufted puffins are being used as samplers of the forage fish community and as indicators of changes that may be affecting murres and other injured resources. Tests of hypotheses concerning food limitation on murre population recovery and the application of puffins as fish samplers require information on the foraging ranges and feeding areas of birds from specific colonies. This project will employ state-of-the-art satellite telemetry to supply that information for murres and puffins breeding on the Barren Islands.

INTRODUCTION

The recovery of common murres and other piscivorous bird species after the *Exxon Valdez* oil spill may be limited by food resources, specifically a change in the abundance, availability, or species composition of forage fish. Restoration efforts are underway or proposed to establish the relations between murre productivity and trends and the distribution, abundance, and quality of their prey in summer. Related to that objective is the proposed use of tufted puffins as surrogate samplers of the forage fish community in the same locations where murres and other injured bird species are investigated. This study will complement the work on murre and puffin foraging by providing crucial information on the spatial distribution of foraging effort in these two species. Besides answering

questions about foraging ranges and pelagic habitat use in summer, the application of satellite transmitters offers the potential to identify the wintering areas of birds from specific colonies. This is important, because it is unwise to assume that food limitation in summer is the only or even the key factor affecting these populations--winter limitation is the obvious alternative.

Work proposed here for Fiscal Years 1996 through 1998 is a continuation and enhancement of restoration project 95021, "Seasonal movements and pelagic habitat use by common murres from the Barren Islands." No results are available as yet from the 1995 effort, but a pilot study to determine the feasibility of satellite telemetry in murres was conducted independently during 1994 by the National Biological Service (NBS). The results of that effort are described in Attachment 1. Proposed enhancements to the project after 1995 include the deployment of transmitters in tufted puffins as well as murres and the use of time-at-depth recorders to determine the vertical distribution of foraging effort in both species. During 1995, the NBS will conduct (and independently fund) a pilot study on the application of satellite telemetry in puffins.

NEED FOR THE PROJECT

A. Statement of Problem

About 75% of the 35,000 bird carcasses recovered during and shortly after the Exxon Valdez oil spill were murres (mostly common murres), and estimates of murre losses were in excess of 100,000 individuals. After the spill, fewer breeding murres were found at the Barren Islands compared to historical data, and annual censuses have not detected any recovery in numbers. Based on data from Nord Island, production of chicks was almost zero in both 1989 and 1990, and still low in 1991 and 1992 compared to colonies outside the spill zone.

B. Rationale

One hypothesis to explain the failure of recovery in common murres is that food availability is limiting the ability of birds to breed successfully or to survive in sufficient numbers during the nonbreeding season. An evaluation of that hypothesis requires that we identify the principal feeding areas of murres in both seasons and design appropriate oceanographic studies to assess the factors affecting food availability. To the extent that prey species composition and quality may prove to be important factors, tufted puffins can be invaluable as relatively inexpensive but effective samplers of the forage fish community near mixed-species colonies of seabirds that include puffins. It is important, however, to determine at what distances from the colony and from what depth strata murres and puffins obtain their prey. This information is vital to the interpretation of fish surveys (using hydroacoustics and nets) as proposed for APEX research (Apex Predator Ecosystem Experiment, project 95163).

Small (30 g) satellite transmitters have recently become available for use in wildlife telemetry. These implantable devices are proven effective when deployed on birds in the size range of common murres, i.e., about 1 kg (Petersen et al. 1995). The pilot study in 1995 should establish whether tufted puffins are also an amenable study species. Telemetry offers a more cost-effective approach for determining foraging patterns and habitat use by birds than is possible using traditional survey methods.

In this project, satellite transmitters will be surgically implanted in samples of murres and puffins from the Barren Islands to determine both the summer feeding areas and wintering areas of birds from this heavily impacted colony. This information will be vital for designing and optimizing an investigation of food

availability to murres and for testing the hypothesis that food limitation is constraining the recovery of the Barren Islands population following the *Exxon Valdez* oil spill.

As diving birds, murres and puffins do not access the entire water column uniformly, but concentrate their foraging activity in depth ranges dictated by the distribution of their preferred foods and limitations imposed by their own diving physiology. This additional information is needed to address the question of food limitation on murre productivity and recovery and for the interpretation of puffin diet information. Externally mounted depth recorders will be used to determine the average time-at-depth for murres and puffins foraging in the vicinity of the Barren Islands.

In many populations of seabirds, the majority of natural mortality occurs during the winter months (Hatch 1987, Hatch et al. 1993). Problems with the food supply on the wintering grounds may constrain the recovery of Barren Islands murres even if productivity improves. Probably there is another critical period in fall, when recently fledged young make the transition to self-feeding (Burger 1980). However, the existence or location of possible "nursery areas" is all but unknown for this and other populations of seabirds.

Through the combined use of satellite transmitters and time-depth recorders, this project will provide a three-dimensional view of foraging patterns in murres and puffins around the Barren Islands in summer. Additionally, transmitters tracked through the winter months should reveal the primary wintering areas of both populations. It may also be possible to locate key foraging areas of juvenile murres by deploying transmitters on breeding males late in the season. Flightless murre chicks are led to sea by their male parents, who continue to provide parental care for several weeks as the young learn gradually to feed themselves.

C. Summary of Major Hypotheses and Objectives

The project's primary objective is to determine the foraging ranges and primary feeding areas of common murres and tufted puffins from the Barren Islands, including individual and temporal variation. The major hypothesis to be tested is whether food is limiting the recovery of common murres. While information from this project alone is insufficient to test the food limitation hypothesis, other restoration research designed to address this question (APEX project) is likewise dependent on definitive data regarding seabird foraging ranges, habitats, and behavior.

D. Completion Date

Interannual variation in the foraging behavior of murres and puffins is a strong possibility that argues for a multi-year investigation. Therefore, data collection is proposed to continue for three years (1995-1997) at the Barren Islands. In addition to annual progress reports, the final report of the project would be available in April, 1998.

COMMUNITY INVOLVEMENT

The idea of using satellite transmitters to identify the foraging areas of common murres was introduced at a meeting of public and government representatives interested in forage fish research (Anchorage, 9 May 1994). Further opportunities for public input will be available at annual winter workshops scheduled by the Exxon Valdez Oil Spill Restoration Office. Because of the remoteness of the field site

and brief nature of the field work, opportunities for hands-on involvement of the public in this research are limited.

FY 96 BUDGET

Personnel	50.2
Travel	2.0
Contractual	10.4
Commodities	41.4
Equipment	54.0
Subtotal	157.8
Gen. Admin.	8.3
Total	166.3

PROJECT DESIGN

A. Objectives

1. Determine the foraging ranges and primary feeding areas of common murres and tufted puffins from the Barren Islands, including assessment of individual and temporal variation.
2. Locate important nursery and/or wintering areas of common murres from the Barren Islands and determine the timing of use of those critical habitats.
3. Obtain average time-at-depth profiles for samples of foraging murres and puffins from the Barren Islands.

B. Methods

In 1995, we plan to refine bird capture techniques and surgical procedures and conduct a limited investigation of murre foraging by deploying 6 satellite transmitters in common murres and 2 or more transmitters in tufted puffins at the Barren Islands. During the period covered by this proposal (1996 and 1997 field seasons) we will expand the use of satellite telemetry (10 transmitters in each species per year) and add the study component involving time-depth recording.

Murres will be captured with poles and nooses during incubation or chick-rearing in the Lighthouse Rock portion of the colony on East Amatuli Island. Puffins are easily taken from their burrows at any time after egg-laying. Transmitters will be surgically implanted by a qualified and experienced veterinarian. Standard procedures for surgical implants are detailed in Attachment 2. The ARGOS Data Collection and Location System will be used to track the movements of instrumented birds. Transmitters will be programmed to emit signals on one of two duty cycles: (1) continuous transmission, providing frequent information on locations over a 3-week period (expected battery life), or (2) low-interval transmissions (e.g., 6 h every 4 days) for less frequent position data over a portion of the nonbreeding period (2-6 months). Position data will be mapped using CAMRIS (Computer Aided Mapping and Resource Information System) or other suitable GIS software. An example of the graphical products expected to result from this study is provided in Attachment 1.

Time-depth recorders are relatively inexpensive devices employing hypodermic syringes and photographic film to record the depth-dependent position of a light-emitting diode (Wilson et al. 1989). The instruments are attached externally to the dorsal feathers and must be retrieved after an appropriate interval to obtain the data on diving depths. Information on the depth and duration of dives is cumulatively recorded on the film, and the exposed film is analyzed using a densitometer. Each unit is calibrated prior to deployment. LED depth recorders have been used successfully with thick-billed murres in the Canadian Arctic (Croll et al. 1992) and on smaller alcid species in the North Pacific (Burger 1991).

C. Contracts and Other Agency Assistance

The manufacture, calibration, and optical density measurements of LED depth recorders will be contracted to a qualified specialist.

D. Location

Field operations will be conducted on East Amatuli Island of the Barren Islands, located at the mouth of Cook Inlet, northern Gulf of Alaska.

SCHEDULE

A. Measureable Project Tasks for FY 96

October - December:	Continue ARGOS data collection (based on July 1995 implants)
December - April:	Prepare 1995 annual report
January:	Issue contract for manufacture, calibration, and optical density measurements of LED depth gauges
April - June:	Procure satellite transmitters and other equipment
June:	Recruit field assistants; conduct safety training
July:	Initiate field work (surgical implants); begin ARGOS data collection
July - August:	Conduct labor-intensive field work associated with depth gauge deployment and retrieval
September:	Continue ARGOS data collection; deliver spent LED recorders to contractor for analysis

B. Project Milestones and Endpoints

July - August 1995:	First-year assessment of murre foraging patterns around the Barren Islands (Objective 1 partially met; reduced sample, no assessment of interannual variation). Undertake feasibility study of tufted puffins.
August - December 1995:	Identify fall movements and wintering areas of instrumented birds (Objective 2 partially met; no interannual data).
July - August 1996:	Second-year assessment of murre foraging patterns around the Barren Islands; first-year assessment of puffin foraging (Objective 1 with some assessment of interannual variation for murres). First deployment of LED depth recorders on murres and puffins.

August -December 1996:	Second-year assessment of murre wintering sites; first-year assessment for puffins. Laboratory analysis and interpretation of LED depth recorders. (Objective 3 partially met; no measurement of interannual variation).
July - August 1997:	Third-year assessment of murre foraging patterns around the Barren Islands; second-year assessment of puffin foraging (Objective 1 fully met). Second deployment of LED depth recorders on murres and puffins.
August - December 1997:	Third-year assessment of murre wintering sites; second-year assessment for puffins (Objective 2 fully met). Laboratory analysis and interpretation of LED depth recordings (Objective 3 fully met).
January - April 1998:	All objectives fully met; preparation of final report.

C. Project Reports

April 1996:	1995 annual report submission. First-year results for murres (assessment of individual variation); feasibility analysis for puffins.
April 1997:	1996 annual report submission. Interannual comparison for murres; first-year analysis for puffins. First-year results from LED dive-depth recorders.
April 1998:	Final report submission. Individual, interannual, and species comparisons of foraging places and dive depths in murres and puffins; summary of information gained on wintering areas.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Results of this study will be shared in the most timely manner possible with the project leader and principal investigators of the APEX project (95163). This research is intended specifically to support the APEX project by providing information on the foraging ranges and behavior of murres and puffins that is essential for interpreting data on the distribution and abundance of seabird prey from shipboard surveys and diet analyses. Logistics costs for field work on the Barren Islands will be shared with ongoing projects at that site including APEX studies of murres, kittiwakes, and puffins, and/or murre population monitoring (project 97039-A).

The Minerals Management Service is supporting seabird studies in Lower Cook Inlet, including the Barren Islands, during 1995 and 1996 (the funds are managed by the National Biological Service). That agency may be interested in sharing the costs of an expanded telemetry project for murres and puffins on the Barren Islands in 1996 (as described in this proposal), and this possibility will be fully explored before the Trustee Council makes any final decision on funding of this project in August 1995.

ENVIRONMENTAL COMPLIANCE

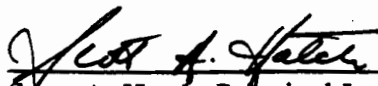
Study plans for this project are subject to approval by the Animal Care and Use Committee (ACUC) of the Alaska Science Center, National Biological Survey, which is responsible for ensuring compliance with the provisions of the Animal Welfare Act. Surgical implants for satellite transmitters follow a standard protocol approved by the ACUC (Attachment 2). This project meets DOI requirements for Categorical Exclusion under the NEPA process.

PERSONNEL

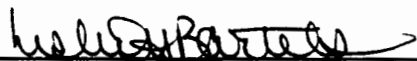
Key project personnel include the Principal Investigator, responsible for planning, overall scientific direction in the field and office, and preparation of the annual report; a collaborator for dive physiology, who will manufacture, calibrate, and perform the optical density analysis of LED depth gauges; a veterinarian, licensed in Alaska and trained in the surgical procedures required to do the transmitter implants; and a data management specialist experienced in the procedures for ARGOS data acquisition and GIS processing of animal location data. Qualifications of project personnel are described in Attachment 3.

LITERATURE CITED

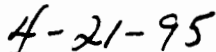
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Date prepared

ATTACHMENT 1

SEASONAL MOVEMENTS AND PELAGIC HABITAT USE BY COMMON MURRES DETERMINED BY SATELLITE TELEMETRY

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Introduction

Common murres were the bird species most seriously injured by the *Exxon Valdez* oil spill. About 75% of the 35,000 bird carcasses recovered after the spill were murres, and estimates of murre losses were in excess of 100,000 individuals. After the oil spill, fewer breeding murres were found at the Barren Islands compared to historical data, and annual censuses have not detected any recovery in numbers. Also, based on data from Nord Island, production of chicks was almost zero in both 1989 and 1990, and still low in 1991 and 1992 compared to colonies outside the spill zone.

One hypothesis to explain the failure of recovery in common murres is that food availability is limiting the ability of birds to breed successfully or to survive in sufficient numbers during the nonbreeding season. An evaluation of that hypothesis requires that we identify the principal feeding areas of murres in both seasons and design appropriate oceanographic studies to assess factors affecting food availability.

Small (<35 g) satellite transmitters have recently become available for use in wildlife telemetry. These implantable devices are proven effective when deployed on birds in the size range of common murres, i.e., about 1 kg. This development offers a more efficient approach for determining the at-sea movements and habitat requirements of murres than is possible using traditional survey methods. We conducted a pilot study during 1994 to assess the feasibility of using implantable satellite transmitters to determine the foraging patterns and seasonal movements of common murres.

Procedures

Two PTT (Platform Transmitting Terminal) transmitters were delivered by Microwave Telemetry Inc., Columbia, Maryland, on 14 July and flown immediately to Middleton Island (59° 25' N, 146° 20' W) for deployment in common murres. Surgical implants were performed on 16 July in birds weighing 1135 g and 1060 g. At 34.5 g and 33.5 g, the transmitters constituted about 3% of the birds' body mass. A 20-cm long multistrand stainless steel antenna exited percutaneously near the tail. Both birds were released to the water in apparently healthy condition within 2 hours after surgery and began transmitting location data immediately. One PTT (#7877, carried by bird number CM01) was programmed to transmit on a cycle of 8 hours on-8 hours off for 50 cycles (about 33 days), then switch to a cycle of 6 hours on every 4.67 days. PTT #5891 (carried by CM02) was programmed initially to be alternately on for 6 hours and off 12 hours for 5 cycles (90 hours total), then switch to a long-term pattern of 6 hours on every 4.67 days (similar to 7877). Transmitters were also equipped with sensors to provide information on body temperature and battery voltage with each transmission. Transmitted data were received by NOAA satellites 11 and 12 and processed by the ARGOS Data Collection and Location System.

Results

Visual observation of the birds immediately after release indicated that one murre (CM02) carried its antenna upright and well exposed to the air while swimming. The other installation (CM01) appeared unsatisfactory because the antenna was submerged much of the time as the bird swam. Subsequent performance of the two transmitters confirmed this assessment. Few usable data were obtained from CM01, and the transmitter was not heard from after 22 July (6 days post-surgery).

PTT #5891 (CM02) provided location data from soon after release through much of August. Between 18 July and 24 July, CM02 foraged to the north of Middleton Island, especially in the vicinity of a shoal area known as Wessels Reef (Fig. 1). One location on 18 July near the east side of Montegue Island may be spurious, but the relatively tight grouping of other locations obtained on that date and during subsequent transmission periods clearly indicate repeated foraging activity by this individual at locations 10-30 km from its nest site. After 24 July, CM02 migrated from its breeding place on Middleton Island to waters around the Barren Islands and north end of Afognak Island. Later transmissions indicated declining battery voltage, and ARGOS was unable to compute locations after 19 August. Temperature data received as late as 20 September indicated the instrumented bird was alive on that date.

Evaluation and Prognosis

This pilot study was intended to answer questions about the ability of common murres to undergo surgery and carry implanted transmitters, as well as questions about the adequacy of ARGOS data to determine the movements and habitat use of murres during summer and winter. We are encouraged by our results on both counts. Murres appear to tolerate well the necessary anesthesia and surgical procedures, and the package size (3% of body weight, minimal drag) is well within accepted guidelines for telemetric studies of birds. The accuracy of our location data is comparable to previous animal tracking studies employing satellite transmitters and ARGOS data processing, i.e., errors are generally <1000 m, but unknown for individual locations. Because of redundancy in the locations obtained (i.e., during a 6-hour transmission interval), it is possible to determine with acceptable precision the foraging areas of breeding murres in relation to their nest sites. Seasonal movements and wintering areas are also clearly established by this method.

We encountered two significant problems. One of our implants had an unsatisfactory orientation of the antenna in the free-ranging bird. We believe this outcome can be avoided in the future by: (1) reconfiguring the transmitter package to provide a more upright angle between the antenna and transmitter (easily done according to the manufacturer), and (2) applying what we learned about the surgical techniques required to obtain a good installation in common murres. The second problem was unexpectedly short transmitter life (about 1 month in PTT #5891 instead of the expected 8 months based on calculations of load and capacity). From the results of this study, other applications in 1993-94, and bench tests, Microwave Telemetry has determined that the lithium batteries they are using are prone to self-discharging at three times the expected rate when kept at the constant high internal temperature of a bird (40° C). The company is working with its battery supplier to correct the problem and expects to provide a transmitter with much improved performance for use in 1995.

In summary, this pilot study has verified that the objectives identified for EVOS study 95021 ("Seasonal Movements and Pelagic Habitat Use by Common Murres from the Barren Islands") are attainable using

the methods proposed. The full-scale study will increase the number of transmitters deployed and will use appropriate statistical algorithms to identify important habitat areas in both summer and winter.

One additional and unanticipated result of our pilot study is noteworthy. The instrumented bird that departed Middleton Island in late July moved to the vicinity of the Barren Islands, possibly to spend the winter. Substantial numbers of murres regularly winter in the bays along the Kenai Peninsula and in the Kodiak archipelago, but previously we had no idea from what colonies these birds originate. This is the area in which large numbers of murres contacted oil and died in April 1989. As murres did not return to their breeding sites on Middleton Island until 17 April 1989, it is possible that birds from this colony were included in the mortality associated with the *Exxon Valdez* spill. (A few oiled murres--dead and dying--were in fact recovered on the beaches of Middleton Island in late April 1989). Thus, our preliminary results suggest that wide application of satellite telemetry could be useful in assessing the geographic extent of likely impacts of the oil spill on murres.

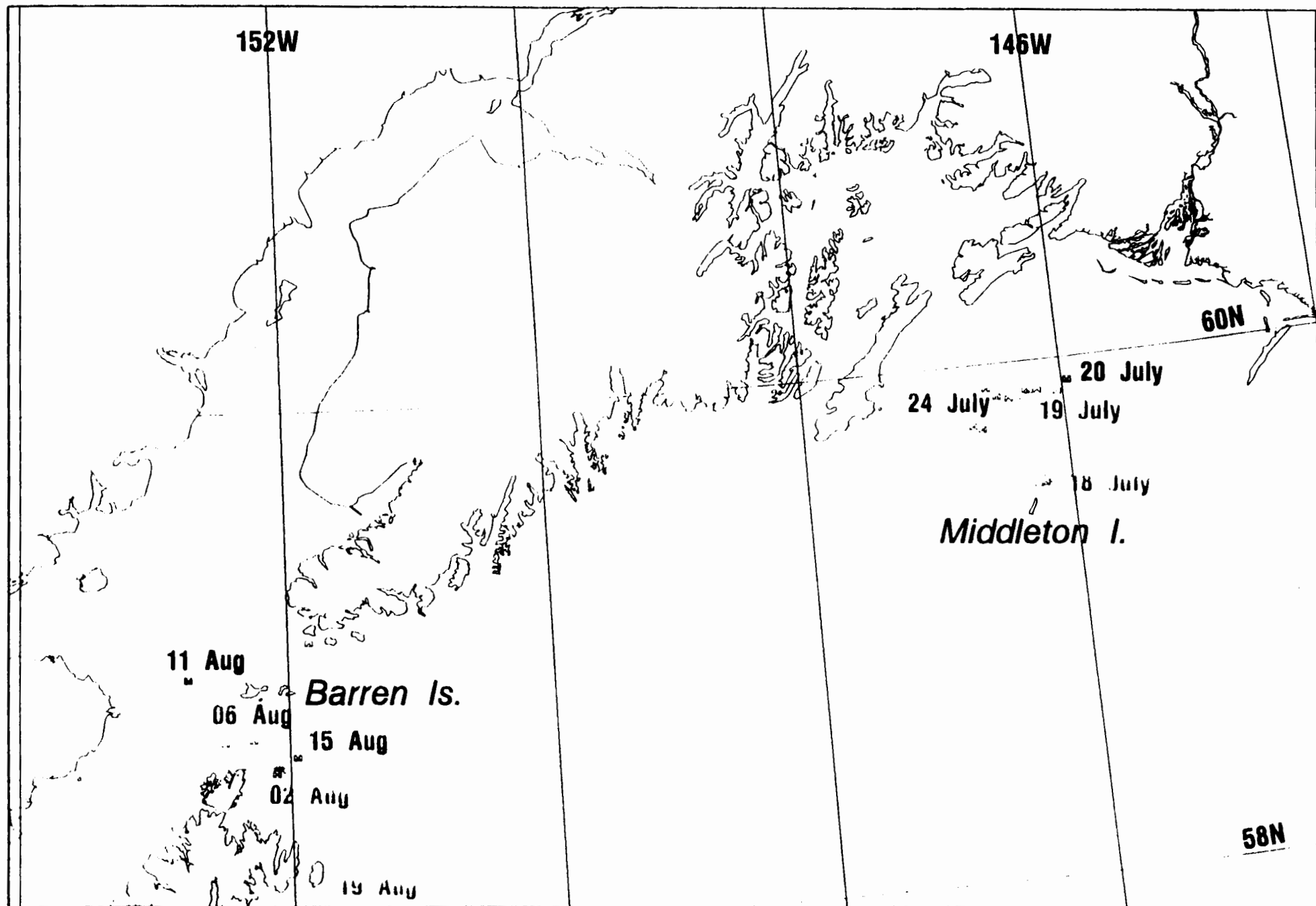


Figure 1. Satellite relocations of one common murre (CM02) captured at Middleton Island and Implanted with a transmitter on 16 July 1994. Repeated locations obtained during a 6-hour transmission interval are color-coded.

ATTACHMENT 2

NATIONAL BIOLOGICAL SERVICE
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DATE: 25 JANUARY 1995
APPROVED:
PAGE 1 OF 4

STANDARD PROCEDURE

PROCEDURE TITLE: Surgical implantation of transmitters in the abdomens of birds.

SCOPE: This protocol applies to the intra-abdominal surgical implantation of both satellite and conventional radio transmitters in both waterfowl and sea birds.

PRINCIPLE: Diving ducks have been a notoriously difficult group of birds to which to attach instrumentation, especially transmitters. Harness and nasal-mounted transmitters have caused alterations in behavior, weight loss, and feather destruction (c.i.f.: USFWS Canvasback Telemetry Workshop, held at Patuxent WRC on 24-25 February, 1987; unpubl.). The surgical procedure is adapted from that described by Korschgen et al. 1984.

PROCEDURES:

1. A minimum of three people are required for the procedure: a surgeon, an anesthetist and a person who positions the bird and assists with the passage of the percutaneous antenna.
2. Standard aseptic surgical technique shall be practiced, including the surgeon wearing sterile gloves and a surgical mask. The surgical site will be prepared as for any surgical procedure, including plucking feathers, skin disinfection and the use of a sterile drape.
3. When possible, the transmitters should be gas-sterilized in suitable packaging permeable to gas but not to bacteria. Gas sterilized transmitters should be allowed to outgas for a period of 24 hours before their use. When gas sterilization is not possible, transmitters may be cold-sterilized in a solution of 0.13% (Zephiran[®]) or chlorhexidine (Nolvasan[®]) in water for 12 hours.
4. Surgical instruments should be sterilized in an autoclave in suitable packaging. When necessary, instruments may be cold sterilized in the same manner described for the transmitters, above.
5. Position the bird on the surgical table in dorsal recumbancy with the legs extended and the wings folded. A warm water bottle and an insulated (bubble-wrap or equivalent) cover for the surgical table should be used to retard heat loss.
6. Isoflurane gas anesthetic is administered to the bird by face mask. Induction is at 3-4% isoflurane; maintenance is at 1-2% isoflurane in oxygen. Maintenance concentrations may vary depending on the individual bird and environmental variables. Once the abdominal air sacs of a bird are opened.

respiration may occur partially through the surgical incision, which may require a higher setting on the vaporizer to compensate.

7. **Anesthesia is monitored by use of a respiratory or cardiac monitor, or both. A pulse oximeter or Doppler ultrasound are the preferred monitors. Manual palpation of a tibial or brachial arterial pulse can also be used, but is less preferred to an attached continuous mechanical monitor.**
8. **The surgical site is between the distal end of the keel and the conjuncture of the distal ends of the pubic bones, palpated through the abdominal wall. The feathers are plucked from the site. An area 1 cm on either side of the incision site should be plucked free of feathers. The feathers around the site are taped back with pieces of microporous tape. A site for the exit of the percutaneous antennae is located by palpating with finger the intersection of the right pubis bone with the synsacrum. A small (1 cm²) area is plucked free of feathers and the feathers adjacent to the site are taped back using microporous tape. Both sites are swabbed with povidone-iodine or benzalkonium chloride solution. A sterile fenestrated drape is placed over the surgical site.**
9. **The skin is incised along the ventral midline with a no. 11 sterile blade. The subcutaneous layer and fat are sharp dissected. Once the muscular abdominal wall is reached, the linea alba is identified. The linea alba is seized with a forceps and lifted to permit penetration of the abdominal wall with a blade. The linea alba is then sharp dissected with blade or scissors, avoiding the viscera, to a length of about 4 cm, or a distance sufficient to pass the transmitter body.**
10. **Using fingers, clear a space on the right side of the abdomen, as dorsally (lateral to the ventriculus) as possible.**
11. **Maintaining a sterile surgical site, the surgeon lifts the drape, folding it over the abdominal incision. The assistant positions the legs of the bird to permit access to the antenna exit site. The surgeon palpates the site with the right hand and nicks the skin with a blade at the most dorsal position nearest to the intersection of the pubis and synsacrum. Then the surgeon uses a blunt stainless steel trochar to penetrate the abdominal wall, protecting the viscera with his left index finger placed inside the bird. The trochar is drawn inside the bird full length and the assistant holds the exterior end of the trochar in order to maintain its position and to keep the pointed end of the trochar visible through the incision.**
12. **The surgeon changes gloves and returns the drape to its proper position. The surgeon removes the transmitter from the sterilizing solution or the envelope. While the surgeon holds the transmitter away from the incision, an assistant rinses the sterilizing solution from the transmitter using at least 10 cc of sterile saline.**
13. **The surgeon then seizes the end of the trochar and places then end of the antenna into one of the holes in the trochar. Then, as the surgeon guides the antenna into the incision, the assistant slowly withdraws the trochar until the end of the antenna can be seen or felt. Frequently there is a detente as the antenna meets and penetrates the body wall.**
14. **As the assistant continues to withdraw the antenna, the surgeon guides the transmitter through the incision, which may need to be slightly stretched to pass the transmitter. The antenna is withdrawn until the collar meets the body wall. The transmitter must be positioned on its narrowest edge and fits snugly along the dorsal wall, in a "notch" that can be palpated by the surgeon.**

15. The assistant maintains the position of the transmitter for the remainder of the surgery by keeping a firm grip on the antenna adjacent to the body wall, to prevent rotation of the transmitter if the bird moves.
16. The surgical incision is closed in two layers using 3-0 braided absorbable suture on a cutting needle. The linea alba is closed using a simple continuous pattern and the skin is closed using either a simple continuous or simple interrupted pattern.
17. A single simple interrupted suture is used to hold the antenna collar to the body wall. When placing the suture, the needle must penetrate the dacron or plastic of the collar to assure stability. To determine that the collar has been penetrated, the antenna can be moved in and out to see if the suture moves with it, before the knot is tied.
18. The drape is removed and the vaporizer is turned to zero. Oxygen supplementation should continue until the bird recovers. Additional procedures such as obtaining a blood sample or banding may be done during this period.
19. Following recovery, the bird should be placed in a cage or kennel for at least one hour prior to release. Placing the cage partially into a pool of water may permit the bird to rehydrate and begin preening.

EQUIPMENT AND SUPPLIES:

Benzalkonium chloride or chlorhexidine diacetate solution
 Sterilizing basin (about 6" x 12" x 2")
 Sterile saline
 10 or 12 cc syringes and needles
 Anesthesia machine with isoflurane vaporizer
 Isoflurane
 Bain, Ayers T or similar non-rebreathing system
 Cat or small dog-sized anesthetic cone
 Respiratory monitor
 Pulse oximeter or doppler ultrasound cardiac monitor
 Surgical masks
 Sterile gloves (2 pair per bird)
 No. 11 blades
 Stainless steel blunt trochars
 3-0 braided, absorbable suture (1 pack per bird)
 Four-inch fenestrated disposable drapes
 Surgical pack for each bird:
 Mayo-Hagar needle holder
 4 inch mosquito forceps
 Brown-Adson tissue forceps
 Scalpel handle
 Scissors
 2-4 2 x2 sponges
 Sharps disposal container
 Iodophor solution-soaked swabs

Microporous tape

REFERENCES:

Korschgen, C.E., S.J. Maxson, and V.B. Kuechle. 1984. Evaluation of implanted radio transmitters in ducks. *J. Wildl. Manage.* 48:982-987.

APPROVALS:

Chairman, Animal Care and Use Committee

Date

ATTACHMENT 3

PERSONNEL QUALIFICATIONS

1. Scott A. Hatch, Principal Investigator

Scott Hatch is employed as a Research Wildlife Biologist in the Alaska Science Center, National Biological Survey. He has conducted research on the population dynamics and feeding ecology of seabirds in Alaska since 1975. Dr. Hatch has authored more than 30 published papers on those topics and has managed interagency programs for seabird research and monitoring since 1987. Curriculum vitae are filed and available on request from the Restoration Office, *Exxon Valdez* Oil Spill Trustee Council.

Education:

Ph.D., University of California, Berkeley, 1985, Zoology

M.S., University of Alaska, Fairbanks, 1979, Wildlife Management

B.S., University of Washington, 1975, Wildlife Science

Selected Publications:

Hatch, S.A. 1983. The fledging of common and thick-billed murres on Middleton Island, Alaska. *J. Field Ornithol.* 54: 266-274.

Hatch, S.A. 1984. Nestling diet and feeding rates of rhinoceros auklets in Alaska. Pages 106-115 in D.N. Nettleship, G.A. Sanger, and P.F. Springer, eds. *Marine birds: their feeding ecology and commercial fisheries relationships*. Can. Wildl. Serv. Spec. Pub., Ottawa.

Hatch, S.A. 1987. Did the 1982-1983 El Nino-Southern Oscillation affect seabirds in Alaska? *Wilson Bull.* 99: 468-474.

Hatch, S.A. 1987. Adult survival and productivity of northern fulmars in Alaska. *Condor* 89: 685-696

Hatch, S.A. and M.A. Hatch. 1989. Attendance of murres at breeding sites: implications for monitoring. *J. Wildl. Manage.* 53: 483-493.

Hatch, S.A. and M.A. Hatch. 1990. Breeding seasons of oceanic birds in a subarctic colony. *Can. J. Zool.* 68: 1664-1679.

Hatch, S.A. and M.A. Hatch. 1990. Components of breeding productivity in a marine bird community: key factors and concordance. *Can. J. Zool.* 68: 1680-1690.

Hatch, S.A. 1990. Time allocation by northern fulmars during the breeding season. *Ornis Scand.* 21: 89-98.

Hatch, S.A. and G.A. Sanger. 1992. Puffins as samplers of juvenile pollock and other forage fish in the Gulf of Alaska. Mar. Ecol. Prog. Ser. 80: 1-14.

Hatch, S.A., B.D. Roberts, and B.S. Fadely. 1993. Adult survival of black-legged kittiwakes *Rissa tridactyla* in a Pacific colony. Ibis 135: 247-254.

Hatch, S.A., G.W. Kaiser, A. Ya. Kondratyev, and G.V. Byrd. 1994. A seabird monitoring program for the North Pacific. Trans. 59th No. Am. Wildl. & Natur. Resour. Conf.: 121-131.

2. Daniel M. Mulcahy, DVM

Dr. Mulcahy is presently the wildlife veterinarian for the Alaska Science Center, National Biological Survey. For two years he was an independent contractor supplying veterinary services to practices and government agencies in Alaska. For 13 years he was an employee of the U.S. Fish and Wildlife Service, including 10 years as a research scientist investigating diseases of free-ranging and hatchery salmonid fishes, and three years as head of research at the National Wildlife Health Research Center in Madison, Wisconsin. Dr. Mulcahy has experience with fish, marine mammals and birds. In addition to his work at ASC, he practices small animal medicine and is a volunteer veterinarian at the Bird Treatment and Learning Center in Anchorage.

Dr. Mulcahy is the only veterinarian in Alaska experienced with the current technique of satellite transmitter implantations. He has performed nearly 40 of the surgeries to date.

Education:

D.V.M. 1992. University of Wisconsin, Madison.

Ph.D. 1977. Oregon State University, Corvallis. Microbiology.

B.S. 1970. California State University, Long Beach. Zoology.

Professional Memberships:

American Veterinary Medical Association
Southcentral Alaska Veterinary Medical Association (President-elect)
Wildlife Disease Association
Association of Zoo Veterinarians
American Association of Avian Veterinarians
International Sled Dog Veterinary Medical Association
American Animal Hospital Association
American Fisheries Society
Fish Health Section, AFS

Publications:

Dr. Mulcahy has published about 50 scientific publications in refereed journals or as monographs and special publications. A list of publications is available on request.

3. David C. Douglas, ARGOS System Specialist

David C. Douglas, Research Wildlife Biologist, Alaska Science Center, National Biological Survey, Anchorage, Alaska

Mr. Douglas received an MS Degree in Wildlife Biology at Washington State University in 1986. Since that time, he has worked in Anchorage for the USFWS/NBS where he currently serves as Leader of the High Technology Project. Since 1986, Mr. Douglas has processed and disseminated ARGOS satellite telemetry data (over 800 animal deployments) to a diverse community of scientists studying the movements and behaviors of mammals and birds. He has consulted with manufacturers to improve transmitter performance as well as with Service ARGOS to improve the applicability of the ARGOS system for wildlife research. His expertise also includes digital processing of satellite imagery to document and monitor environmental conditions applicable to subsequent GIS analyses with wildlife distribution data.

Relevant publications:

- Petersen, M. R., D. C. Douglas, and D. M. Mulcahy. 1995. Use of implanted satellite transmitters to locate spectacled eiders at-sea. *Condor*. (in press).
- Douglas, D. C., M. S. Udevitz, and J. Takekawa. 1992. Successful performance of satellite transmitters attached to migrating lesser snow geese. USFWS RIB #92-30.
- Harris, R. B., S. G. Fancy, D. C. Douglas, G. W. Garner, S. C. Amstrup, T. R. McCabe, and L. F. Pank. 1990. Tracking wildlife by satellite: current systems and performance. U.S. Fish and Wildl. Serv., Tech. Report No. 30. 53 pp.
- Douglas, D. C., J. C. Greslin, and L. F. Pank. 1989. Satellite telemetry and geographic information systems: powerful tools for wildlife research and management. Pages 83-93 in J. G. Buhyoff, ed., *Proc. Resour. Technology 88*. First. Symp. on Advanced Technology in Nat. Resour. Manage. Am. Soc. Photogram. and Remote Sensing, Falls Church, VA. 277 pp.
- Garner, G. W., S. C. Amstrup, D. C. Douglas, and C. L. Gardner. 1989. Performance and utility of satellite telemetry during field studies of free-ranging polar bears in Alaska. Pages 67-76 in C. J. Amlander, Jr., ed. *Biotelem. Proc. of the 10th Int. Symp. on Biotelemetry*. Univ. of Arkansas Press, Fayetteville.
- Garner, G. W., S. T. Knick, and D. C. Douglas. 1989. Seasonal movements of adult polar bears in the Bering and Chukchi seas. *Int. Conf. Bear Res. and Manage.* 8:219-226.
- Fancy, S. G., L. F. Pank, D. C. Douglas, C. H. Curby, G. W. Garner, S. C. Amstrup, and W. L. Reglin. 1988. Satellite telemetry: a new tool for wildlife research and management. U.S. Fish and Wildl. Serv., Resour. Publ. No. 172. 55 pp.

4. Alan E. Burger, Diving Physiologist

Dr. Burger, collaborator for the study of diving behavior, is an Assistant Professor of Biology at the University of Victoria in British Columbia. His research specialty is the foraging patterns and diving physiology of penguins and alcids, on which he has published widely in the ornithological literature. Dr. Burger was involved in the original development of LED depth recorders and has used the devices extensively in recent research on the diving characteristics of alcids.

1996 EXXON VALDEZ TRUST JUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$18.4	\$50.2						
Travel	\$3.0	\$2.0						
Contractual	\$0.0	\$10.4						
Commodities	\$7.4	\$41.4						
Equipment	\$22.2	\$54.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$51.0	\$158.0	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration	\$2.8	\$8.3						
Project Total	\$53.8	\$166.3	\$166.3	\$20.0				
Full-time Equivalents (FTE)	0.7	1.4						
Dollar amounts are shown in thousands of dollars.								
Other Resources	\$28.1	\$44.1	\$36.1	\$36.1				
Comments:								
Other resources: PI salary (6 mo.) paid by DOI-NBS (18.1 in FFY 1995, 36.1 in FFY 1996-98); computers and software (value 10.0) supplied by NBS in FFY 1995; field equipment (inflatable boat, motors, safety and camp gear) supplied by NBS in FFY 1996 (value 8.0).								

1996

Prepared:

1 of 4

Project Number: 96021
 Project Title: Seasonal Movements and Pelagic Habitat use by
 Common Murres and Tufted Puffins
 Agency: Dept. of the Interior, National Biological Service

FORM 3A
 AGENCY
 PROJECT
 DETAIL

4/12/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996	
PM	Name	Position Description						
	Vacant	Project Assistant (Wildl. Biol.)	GS/9/1	12.0	3,333		40.0	
	C. Robbins	Computer Technician	GS/9/3	0.5	3,600		1.8	
	Vacant	Biological Technician	GS/5/1	2.0	2,100		4.2	
	Vacant	Biological Technician	GS/5/1	2.0	2,100		4.2	
Subtotal				16.5	11,133	0		
Those costs associated with program management should be indicated by placement of an *.							Personnel Total	\$50.2
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996	
PM	Description							
	Anchorage - Homer; 5 persons; transit to field site		180	5	5	131	1.6	
	Barren Island; work in field camp; 144 person-days				144	3	0.4	
Those costs associated with program management should be indicated by placement of an *.							Travel Total	\$2.0

1996

Project Number: 96021
 Project Title: Seasonal Movements and Pelagic Habitat use by
 Common Murres and Tufted Puffins
 Agency: Dept. of the Interior, National Biological Service

FORM 3B
 Personnel
 & Travel
 DETAIL

1996 EXXON VALDEZ TRUSTI ... JUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Manufacture, calibration, optical density analysis of LED dive depth gauge		5.0
Veterinary services, 8 days @ \$300		2.4
Boat charter, Homer-Barren Island, 1 round-trip		2.0
Helicopter charter, Homer-Barren Island, 1 round-trip		1.0
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$10.4
Commodities Costs:		Proposed
Description		FFY 1996
Field camp food, 144 person-days @ \$10		1.4
Data processing costs:		
Data tapes, 10 mo. @ \$150		1.5
Tymnet log-on, 10 mo. @ \$90		0.9
ARGOS standard processing, 20 PTT's @ \$1070 (10 mo.)		21.4
Class-o processing, 20 PTT's @ \$510 (10 mo.)		10.2
Multi-satellite service, 20 PTT's @ \$300 (10 mo.)		6.0
Commodities Total		\$41.4

1996

Project Number: 96021
Project Title: Seasonal Movements and Pelagic Habitat use by
Common Murres and Tufted Puffins
Agency: Dept. of the Interior, National Biological Service

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
	Satellite transmitters (PTT's)	20	2,700	54.0
Those purchases associated with replacement equipment should be indicated by placement of an R.				New Equipment Total
				\$54.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				
	Inflatable boat	1	NBS	
	Outboard motors	2	NBS	
	Float suits	4	NBS	
	Pentium computers	2	NBS	
(Note: all above equipment items purchased with NBS funds; i.e., non-EVOS equipment contributed to project.)				

1996

Project Number: 96021
 Project Title: Seasonal Movements and Pelagic Habitat use by
 Common Murres and Tufted Puffins
 Agency: Dept. of the Interior, National Biological Service

FORM 3B
 Equipment
 DETAIL

Project Title: Mechanisms of Impact and Potential Recovery of Nearshore Vertebrate Predators

Project Number:	96025
Restoration Category:	Research
Proposer:	National Biological Service
Lead Trustee Agency:	National Biological Service
Cooperating Agencies:	ADFG, NOAA, USFWS
Project Duration:	4 years
Cost FY 96: c49	1 ,68 ,500
Cost FY97:	1 ,68 ,500
Cost FY98:	1 ,68 ,500
Cost FY99:	1 450,000
Geographic Area:	Western Prince William Sound
Injured Resource/Service:	Sea otter, River otter, Harlequin duck, Pigeon guillemot, intertidal organisms, subtidal organisms

ABSTRACT

The Nearshore Vertebrate Predator Project (NVP) makes an integrated assessment of trophic, health, and demographic factors across a suite of apex predators injured by the spill to determine mechanisms constraining recovery and to improve our knowledge of the status of recovery. Primary hypotheses are: 1) Recovery of nearshore resources injured by EVOS is limited by recruitment processes; 2) Initial and/or residual oil in benthic habitats and in or on benthic prey organisms has had a limiting effect on the recovery of benthic foraging predators; and 3) EVOS induced changes in populations of benthic prey species have influenced the recovery of benthic foraging predators.

INTRODUCTION

Because of shorelines and coastal physiography, the nearshore ecosystem served as a repository for much of the oil spilled by the T/V *Exxon Valdez* (EVOS). Mortalities occurred across a suite of apex predators, as well as in benthic invertebrate populations, including mussels, clams, and crabs. The initial changes in composition and abundance of species which resulted from these acute mortalities and habitat disturbances likely continue to modify important structuring processes in the nearshore populations (i.e., competition, predation, and recruitment), thus constraining recovery. This is a 5-year project that received approval from the Trustees in

March, 1995 and will begin data collection in late summer, 1995. The project examines the status of recovery of four selected top vertebrate predators (sea otter, river otter, pigeon guillemot, and harlequin duck) in the nearshore environment of Prince William Sound and is designed to assess mechanisms constraining their recovery. Work to be undertaken in FY 95 includes primarily pilot efforts. These efforts will be used to establish final sample size and experimental design requirements for prey sampling (invertebrates), validate a number of techniques and establish up-to-date sea otter population data prior to full study implementation of the study in spring FY96. However, the sea duck component of the study will be initiated in full because of its fall/winter data collection needs. There will be three full field seasons (FY96, 97, 98) in the NVP Study with study closeout in FY99.

NEED FOR THE PROJECT

A. Statement of Problem

The nearshore marine ecosystem of Prince William Sound (PWS) plays a critical role in the commercial, subsistence, and recreation economy of southcentral Alaska. Because of shorelines and coastal physiography, the nearshore ecosystem served as a repository for much of the oil spilled by the T/V *Exxon Valdez* (EVOS). As a result, many of the injured resources under study by the *Exxon Valdez* Trustees Council are components of the nearshore system. Thus, we propose the Nearshore Vertebrate Predator (NVP) study, which describes a research approach for assessing the biological and ecological significance of trophic issues and contaminants present in the environment. We focus on the status of system recovery and a suite of injured apex predators as indicators of environmental stress--the invertebrate feeding sea otter and harlequin duck, and fish feeding pigeon guillemot and river otter. The first three of these species have not recovered from EVOS, and the recovery of the fourth is unknown. NVP takes a multispecies, integrated approach to assess several potential key mechanisms constraining recovery of the nearshore system.

B. Rationale

Effective implementation of the EVOS Trustees Council's policy that "Restoration should contribute to a healthy, productive and biologically diverse ecosystem...", is complicated by the diversity and trophic interdependence of the numerous injured resources within the nearshore system. Beyond these ecological constraints, we are practically constrained in judging restoration by a lack of accurate and precise pre-spill population demographic data for many injured resources upon which to judge the progress of restoration. However, sufficient evidence exists to suggest that a wide variety of nearshore vertebrate predators and crucial subtidal and intertidal invertebrate prey are not recovered. The three factors most likely to be limiting recovery are intrinsic demographic constraints, continued hydrocarbon exposure, and food limitation. Concurrently, these data will provide information regarding the status of recovery.

Demography--Demography will be examined by comparing population densities and parameters affecting population growth rates between oiled and unoled sites. The rate of recovery of

nearshore vertebrate predators may be constrained by oil-related factors (continued toxicity of oil and food availability) as well as non-oil related processes. The latter include death and birth processes as affected by factors such as intrinsic reproductive capacity and mortality due to adverse weather conditions. It may be, for example, that death and birth rates do not differ among injured and non-injured subpopulations of nearshore vertebrate predators, but that the rate of population increase is too slow to have allowed for complete recovery of the injured nearshore vertebrate predator populations., in the absence of continued effects of oil. In other words, the nearshore vertebrate predator populations may not be fully recovered, but may be recovering as quickly as possible under naturally-occurring conditions

Continued Hydrocarbon Exposure--The question of continued exposure to oil will be assessed by comparing indicators of exposure to oil and individual health between oiled and unoiled sites. Today, hydrocarbon impacts may still exist. Between 8- 6% of the 0.8 million gallons of crude oil spilled by the *Exxon Valdez* remains buried in marine sediments. Such oil is not subject to degradation by marine organisms and remains in a form that is toxic to many vertebrates. Moreover, microbial analyses suggest that oil in sediments along oiled shorelines is still several orders of magnitude more common than in unoiled sites, suggesting oil may still be available for biological transport from benthic invertebrates through the food chain. In fact, various bioindicator and health measures suggest that continued injury may be occurring among vertebrate predators.

Food Availability--Food limitation will be considered by examining population densities and size class structures of dominant prey species. Considerable dietary overlap and potential competition for food exists among the apex predators of the nearshore system. There is also strong evidence to suggest that population densities of many nearshore vertebrate predators are limited by food. For example, after initial immigration of sea otters into eastern PWS in 1979, the population increased rapidly over the next several years. Concurrent with this increase in otters was a rapid decline in many preferred prey items, including Dungeness crabs. Following prey reduction, sea otter populations declined and became relatively stable. Similar patterns have been observed at Amchitka and the Commander Islands. Evaluation of abundance and size distribution data for prey items may also be useful for providing additional indirect evidence for estimating recovery of some predator species. For example, it is well documented that sea otters prefer sea urchins as prey and that in the presence of strong predation by sea otters, both the abundance and average size of sea urchins is reduced. Other suggestions of food limitation exist for sea ducks.

C. Summary of Major Hypotheses and Objectives

For our test species, the document "Proceedings of the Workshop: Science for the Restoration Process" suggested that three factors had high potential as factors constraining recovery:

- 1) recovery of nearshore resources injured by EVOS is limited by recruitment processes;
- 2) Initial and/or residual oil in benthic habitats and in or on benthic prey organisms has had a limiting effect on the recovery of benthic foraging predators; and
- 3) EVOS induced changes in populations of benthic prey species have influenced the recovery of benthic foraging predators.

Based on that consensus, we will ask "are vertebrate populations recovering, and if so, are they recovering as quickly as possible given potential rates of population increase?" by measuring population density and demographic factors (e.g., size and age distributions, birth rates, survival rates) at both oiled and unoiled sites to examine possible reasons for lack of recovery, and assess progress toward recovery given demographic restraints. In conjunction with this "recovery monitoring" approach, we will also ask the question "is it oil?" or "is it food?" that limits recovery. This will be addressed through evaluation of demographic measures, health assessments, biomarkers of oil exposure, and availability of prey for the four nearshore vertebrate predators in oiled and unoiled areas of Prince William Sound.

D. Completion Date

The NVP Project objectives will be completed in FY99.

COMMUNITY INVOLVEMENT

The project concept was developed as a result of the April 1994 "Science for the Restoration Process" workshop, a public forum. Continued discussion of the project occurred through the 1995 Work Plan and the initial project underwent public review through the Trustees Council process. Planning funds were approved by the Trustees in November 1994 at public meeting. Subsequently, a working meeting was held in November to discuss the framework for the project, also an open meeting. The Nearshore Vertebrate Predator Project was presented at January 1995 Trustees sponsored Restoration Workshop in Anchorage. Further opportunities for public input will be available at annual workshops and the Trustee meetings. In addition, volunteer opportunities will exist to assist project biologists in data collection.

FY 96 BUDGET

Personnel	33 .4
Travel	40.5
Contractual	, 24.9
Commodities	42.5
Equipment	38.0
Subtotal	,577.5
Gen. Administration	04.0 (NBS will not charge overhead on Research Work Orders)
Total	,68 .5

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New version - FAX'd to EA office 7-5-95

Budget Category:	Authorized FFY 1995	Proposed FFY 1996	PROPOSED FFY 1996 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
				\$521.6			1048.20	\$153.1
Personnel	\$0.0	\$331.3						
Travel	\$0.0	\$43.3						
Contractual	\$0.0	\$1,136.0						
Commodities	\$0.0	\$43.5						
Equipment	\$0.0	\$61.4	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$1,615.5	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration	\$0.0	\$104.0						
Project Total	\$0.0	\$1,707.4	\$1,669.4	\$1,669.4	\$450.0	0.0	0.00	\$0.0
Full-time Equivalents (FTE)	0.0	6.7						
Dollar amounts are shown in thousands of dollars.								
Other Resources	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	0.0	0.00	\$0.0

Comments:

See individual 3A forms for personnel details.

The estimated FFY 1999 budget reflects estimated costs for all three trustee agencies combined. As the project progresses, the roles of the three trustee agencies in FFY 1999 can be clearly defined.

This amended budget reflects increased costs to the:

- 1) Sea Duck component to cover those costs to be incurred by following the recommendations of the Trustee Council in order for the subcomponent to proceed with collections outside of the Sound.
- 2) Subtidal Clam/Invertebrate Predator components for purchase of equipment that was requested from the pool of equipment purchased by other Trustee Agencies with Trustee Council Funds.

1996

Project Number: ~~95025~~
 Project Title: Mechanisms of Impact & Potential Recovery of
 Nearshore Vertebrate Predators
 Lead Agency: National Biological Service

FORM 2A
PROJECT
DETAIL

Prepared:

1 of 26

6/30/95

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1996 EXXON VALDEZ STEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$233.5						
Travel		\$32.7						
Contractual		\$622.4						
Commodities		\$29.4						
Equipment		\$61.4	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$979.4	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$53.3						
Project Total	\$0.0	\$1,032.7	\$994.7	\$994.7				
Full-time Equivalents (FTE)		4.8						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								
NBS will not charge GA to RWOs for University of Alaska or University of Washington, therefore GA figures have been modified to include only NBS direct salaries and contract figures in calculation. SO = Sea Otters HD = Harlequin Ducks CS = Chief Scientist Oversight RO/PG = River Otters/Pigeon Guillemots SC = Subtidal Clams IP = Invertebrate Predators								

1996

Prepared:

2 of 26

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
 Nearshore Vertebrate Predators

Note: sea otter, har. duck,
 proj. man., RWO-riv. otter, pig. guil., subtidal clams, inv. pred. components of NVP.

Agency: National Biological Service

FORM 3A
 AGENCY
 PROJECT
 DETAIL

6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
		SO: Superv. WB	GS-12	3.0	5000.0	0.00	15.0
		Research WB	GS-9	12.0	3500.0		42.0
		HD: Veterinarian	GS-13	1.0	6000.0		6.0
		Research WB	GS-11	12.0	4833.0		58.0
		Wildlife Biologist	GS-11	4.0	4350.0		17.4
		Bio. Tech.	GS-7	12.0	2400.0		28.8
		CS: Chief Scientist	GS-14	2.5	7000.0		17.5
		Secretarial	GS-5	1.0	2800.0		2.8
		Data Manager	GS-11	9.6	4290.0		41.2
		Modeler	GS-12	1.0	4800.0		4.8
Subtotal				58.1	44973.0	0.00	

Those costs associated with program management should be indicated by placement of an *.

Personnel Total \$233.5

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description					
	SO: ANC/Cordova/ANC	250	16			4.0
	Per diem Cordova			60.0	141.00	8.5
	ARR to Whittier 25' Boat	1000	3			3.0
	HD: ANC/BC/ANC	0	0			0.0
	ANC/Cordova/ANC	250	20			5.0
	Per diem			28.4	141.00	4.0
	Meetings/Workshops	500	5			2.5
	CS: ANC/FAI/ANC	200	2			0.4
	ANC/Cordova/ANC	250	2			0.5
	Per diem			14.0	141.00	2.0
	CAPTURE ADD.: ANC/KOD/ANC plus town per diem	180	6	12.0	139.00	2.7
	field per diem			42.0	3.00	0.1

Those costs associated with program management should be indicated by placement of an *.

Travel Total \$32.7

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators

Note: sea otter, har. duck,

proj. man., RWO-riv. otter, pig. guil., subtidal clams, inv. pred. components of NVP.

Agency: National Biological Service

FORM 3B
Personnel
& Travel
DETAIL

6/30/95

013/022

EVOS

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1996 EXXON VALDEZ T... FEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
RO/PG: Univ. Alaska-Fairbanks Research Work Order Overhead-10% Total Direct Costs		16.4
Salaries		65.9
Travel		8.0
Contractual		38.7
Commodities		45.3
Equipment		5.2
SO: Contractual		105.1
HD: Contractual plus CAPTURE/ADD:(11.1K)		151.7
SC, IP: Univ. Washington Research Work Order Overhead - 20%		21.9
Salaries		31.0
Travel		12.0
Contractual		4.8
Commodities		5.4
Equipment		7.5
IP: Salaries		31.5
Travel		13.1
Contractual		38.4
Commodities		5.5
Equipment		0.0
CS: Statistical Consultation (Lyman McDonald - P.I.)		15.0
When a non-trustee organization is used, the form 4A is required.		Contractual Total \$622.4
Commodities Costs:		Proposed
Description		FFY 1996
SO: Fuel, 500 gal. @ 3/gal.; FY 96 - 2500 gal. @ 3/gal		7.5
Food, 25 days @ \$20/day; FY 96 - 60 days @ \$20/day		1.2
Office/field supplies, miscellaneous		1.5
HD: Fuel, 166 gal. @ 3/gal.; FY 96 - 1000 gal @ 3/gal. (Capture Add: Fuel: .15K)		3.2
Surgical supplies		9.0
Training		2.0
Equipment maintenance (Capture Add: Gear Shipping: .75K)		2.8
CS: Data Management software, access fees, on-line services, shipping, phone, presentation costs (e.g. slides, overhead prep, graphic		2.2
		Commodities Total \$29.4

1996	Project Number: 95025	FORM 3B Contractual & Commodities DETAIL
	Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators	
	Agency: National Biological Service	
4 of 26		6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
SO:	70 HP OB - OMC	1.0	4.00	4.0
	Hand held VHF radios	2.0	0.50	1.0
	Capture gear & supplies			5.0
HD:	Radio transmitters	100.0	0.20	20.0
	Radio receivers			0.0
	TOBEC			0.0
	Miscellaneous			8.0
CS:				0.0
IP/SC:	Binoculars, low light, 3(1.2) = 3600	3.0	1.20	3.6
	Mustang Suits, 6(.6) = 3600	6.0	0.60	3.6
	Survival Suits, 6(.3) = 1800	6.0	0.30	1.8
	Laptop computer-486 minimum, 2(3.0) = 6000	2.0	3.00	6.0
	Desktop computer-486 minumum, 1(3.0) = 3000	1.0	3.00	3.0
	Printers, 2(1.0) = 2000	2.0	1.00	2.0
	25 HP Motors, 2 (1.7) = 3400	2.0	1.70	3.4
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$61.4
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
Nearshore Vertebrate Predators Note: sea otter, har. duck,
proj. man., RWO-riv. otter, pig. guil., subtidal clams, inv. pred. components of NVP.

Agency: National Biological Service

FORM 3B
Equipment
DETAIL

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1996 EXXON VALDEZ STEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$7.0						
Travel		\$0.0						
Contractual		\$491.2						
Commodities		\$0.0						
Equipment		\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$498.2	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$23.4						
Project Total	\$0.0	\$521.6	\$521.6	\$521.6				
Full-time Equivalents (FTE)		0.1						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Prepared:

6 of 26

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
Nearshore Vertebrate Predators

Note: Intertidal clams,
urchins/crabs, fishes, har. duck prey, side-scan sonar components of NVP.

Agency:

Alaska Department of Fish & Game

FORM 3A
AGENCY
PROJECT
DETAIL

6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996	
PM	Name	Position Description						
		Program Management *		1.0	7000.0		7.0	
Subtotal				1.0	7000.0	0.00		
Those costs associated with program management should be indicated by placement of an *.							Personnel Total	\$7.0
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996	
PM	Description							
Those costs associated with program management should be indicated by placement of an *.							Travel Total	\$0.0

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators

Note: intertidal clams, urchins/crabs, fishes, har. duck prey, side-scan sonar components of NVP.

Agency: Alaska Department of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Contract to Jewett & Dean through University of Alaska Fairbanks		
University Overhead		81.9
Salaries		166.6
Travel		11.2
Contractual		226.7
Commodities		4.8
Equipment		0.0
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$491.2
Commodities Costs:		Proposed
Description		FFY 1996
Commodities Total		\$0.0

1996

8 of 26

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
Nearshore Vertebrate Predators

Note: intertidal clams,
urchins/crabs, fishes, har. duck prey, side-scan sonar components of NVP.

Agency: Alaska Department of Fish & Game

FORM 3B
Contractual &
Commodities
DETAIL

6/30/95

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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
Those purchases associated with replacement equipment should be indicated by placement of an R.				New Equipment Total
				\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of

Nearshore Vertebrate Predators

Note: intertidal clams,

urchins/crabs, fishes, har. duck prey, side-scan sonar components of NVP.

Agency:

Alaska Department of Fish & Game

FORM 3B
Equipment
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$90.8						
Travel		\$10.6						
Contractual		\$22.4						
Commodities		\$14.1						
Equipment		\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$137.9	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$15.2						
Project Total	\$0.0	\$153.1	\$153.1	\$153.1				
Full-time Equivalents (FTE)		1.8						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Prepared:

10 of 26

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
Nearshore Vertebrate Predators

Note: mussel component of the NVP.

Agency:

National Oceanic & Atmospheric Administration

FORM 3A
AGENCY
PROJECT
DETAIL

6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/	Months	Monthly		Proposed
PM	Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1996
	Mussels:						
		Fishery Biologist	GS/12	3.0	6670.0		20.0
		Fishery Biologist	GS/9/4	1.0	4100.0		4.1
		Fishery Biologist	GS/9/5	3.0	4630.0		13.9
		Lab Technician	GS/9	12.0	2740.0		32.9
		Chemist	GS/11	1.0	14900.0		14.9
		Project Manager *	GS/12	1.0	5000.0		5.0
Subtotal				21.0	38040.0	0.00	
Those costs associated with program management should be indicated by placement of an *.							Personnel Total \$90.8
Travel Costs:			Ticket	Round	Total	Daily	Proposed
PM	Description		Price	Trips	Days	Per Diem	FFY 1996
	Mussels:						
	JUN/ANC/JUN		600	12		0.00	4.8
	JUN/SEW/JUN		720	12		0.00	5.8
Those costs associated with program management should be indicated by placement of an *.							Travel Total \$10.6

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators

Note: mussel component of the NVP.

Agency: National Oceanic & Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

6/30/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Mussels:		
Vessel Charter (14 days @ 1600)		22.4
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$22.4
Commodities Costs:		Proposed
Description		FFY 1996
Mussels:		
Hydrocarbon chemistry supplies		2.5
Field & lab chemicals		2.3
Field & lab supplies (pumps, sieves, jars)		1.2
Electronic calipers & digital recorders		0.0
Weight/measure supplies		0.6
Publication/presentation costs		0.5
Shipping, freight, containers, equipment maintenance		2.0
Image analysis		5.0
Commodities Total		\$14.1

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of
Nearshore Vertebrate Predators

Note: mussel component of the NVP.

Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual &
Commodities
DETAIL

Description	Quantity	Unit	Price	Total
1. 1000	1000	kg	1000	1000
2. 1000	1000	kg	1000	1000
3. 1000	1000	kg	1000	1000
4. 1000	1000	kg	1000	1000
5. 1000	1000	kg	1000	1000
6. 1000	1000	kg	1000	1000
7. 1000	1000	kg	1000	1000
8. 1000	1000	kg	1000	1000
9. 1000	1000	kg	1000	1000
10. 1000	1000	kg	1000	1000
11. 1000	1000	kg	1000	1000
12. 1000	1000	kg	1000	1000
13. 1000	1000	kg	1000	1000
14. 1000	1000	kg	1000	1000
15. 1000	1000	kg	1000	1000
16. 1000	1000	kg	1000	1000
17. 1000	1000	kg	1000	1000
18. 1000	1000	kg	1000	1000
19. 1000	1000	kg	1000	1000
20. 1000	1000	kg	1000	1000
21. 1000	1000	kg	1000	1000
22. 1000	1000	kg	1000	1000
23. 1000	1000	kg	1000	1000
24. 1000	1000	kg	1000	1000
25. 1000	1000	kg	1000	1000
26. 1000	1000	kg	1000	

Number
of UnitsUnit
Price

Proposed
FFY 1996

Those purchases associated with replacement equipment should be indicated by placement of an R.

New Equipment Total

\$0.0

Existing Equipment Usage:

Description	Quantity	Unit	Amount	Total
1.000	1.000	1.000	1.000	1.000
2.000	2.000	2.000	2.000	2.000
3.000	3.000	3.000	3.000	3.000
4.000	4.000	4.000	4.000	4.000
5.000	5.000	5.000	5.000	5.000
6.000	6.000	6.000	6.000	6.000
7.000	7.000	7.000	7.000	7.000
8.000	8.000	8.000	8.000	8.000
9.000	9.000	9.000	9.000	9.000
10.000	10.000	10.000	10.000	10.000
11.000	11.000	11.000	11.000	11.000
12.000	12.000	12.000	12.000	12.000
13.000	13.000	13.000	13.000	13.000
14.000	14.000	14.000	14.000	14.000
15.000	15.000	15.000	15.000	15.000
16.000	16.000	16.000	16.000	16.000
17.000	17.000	17.000	17.000	17.000
18.000	18.000	18.000	18.000	18.000
19.000	19.000	19.000	19.000	19.000
20.000	20.000	20.000	20.000	20.000
21.000	21.000	21.000	21.000	21.000
22.000	22.000	22.000	22.000	22.000
23.000	23.000	23.000	23.000	23.000
24.000	24.000	24.000	24.000	24.000
25.000	25.000	25.000		

Number
of UnitsInventory
Agency

1996

Project Number: 95025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators

Note: mussel component of the NVP.

Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

6/30/95

96027

Kodiak Archipelago Shoreline Assessment: Monitoring Surface and Subsurface Oil

Project Number: 96027

Restoration Category: Monitoring (continued)

Proposed By: ADEC

Lead Trustee Agency: ADEC

Duration: One year

Cost FY 96: \$35.1

Cost FY 97 and Future Years: None

Geographic Area: Kodiak

Injured Resource/Service: Subsistence, recreation, intertidal and subtidal organisms, all other injured resources and services dependent upon recovery of oiled beaches

ABSTRACT

This project completes work begun in FY 95 to determine the areal extent, toxicity and origin of oil on selected Kodiak Archipelago shorelines. Most of these shorelines were last surveyed in 1990. The information about the remaining oil is necessary to determine whether recovery is proceeding at an acceptable rate; to help local people assess whether the presence of remaining oil is still affecting shoreline activities; to determine the origin and toxicity of any remaining oil; and to determine if any beaches need additional treatment.

INTRODUCTION

This project is closeout only. The draft report will have been written in FY 95. However, an important purpose of this project is to create a common understanding among the Trustees, local residents, subsistence and recreation user groups, scientists, and the general public about the presence or absence of *Exxon Valdez* oil in the Kodiak area. This closeout funding will fund travel and meetings to convey the results of the 1995 field work to Kodiak area residents. It will also fund any response to peer review comments on the draft, and final printing.

Data from previous shoreline assessments indicates that this project may be the last comprehensive shoreline assessment of the Kodiak area, though it may locate additional "hot spots" that need continued monitoring or treatment. If the survey finds more oil than anticipated, additional survey work at additional sites may be necessary in FY 96.

This project is important for subsistence, recreation, sediments, mussels, and intertidal and subtidal organisms. It is also relevant to harlequin ducks, sea otters, and other injured species that feed in the intertidal area. In addition, while oil itself is not an injured resource or service, it is the cause of the injuries. Monitoring the continued presence of oil in the environment including location, extent, origin, and toxicity provides current information about the remaining oil contamination in the ecosystem.

A and B. Statement of the Problem and Rationale

Subsistence. The objective for subsistence restoration adopted by the Trustee Council reads in part, "Subsistence will have recovered when...people are confident that the resources are safe to eat."

Recreation. Recreation, like subsistence, is affected by the visual recognition of oil. The objective for recreation restoration adopted by the Trustee Council reads in part, "Recreation and tourism will have recovered, in large part, when the fish and wildlife resources on which they depend have recovered, [and] *when recreation use of oiled beaches is no longer impaired...*" Monitoring the presence or absence of oil is an important part of monitoring the ability of the Kodiak shorelines to provide for recreational and tourism use.

Sediments, mussels, intertidal and subtidal organisms, and other natural resources. Shorelines treated in 1989 and 1990 and other potentially oiled sites need to be evaluated to determine if the shorelines responded to treatment, or if additional localized treatment is required to restore resources and services. Previous surveys in the spill area have shown that surface oil (usually in the form of tar mats) is quite stable, but responds well to treatment. Surveys in Prince William Sound indicate subsurface oil is disappearing at most sites, but some sites would benefit from additional treatment. We have only limited information on the subsurface oil in the Kodiak area, but it may be persisting in some locations. The oil around Kodiak is present primarily in the form of mousse which has been resistant to degradation in Prince William Sound. The resources most affected are sediments, mussels, and intertidal and subtidal organisms. Monitoring the shorelines provides current information that helps scientists understand the recovery of these and other resources and services in the Kodiak area.

C. Summary of Major Hypothesis and Objectives

The objectives of the total project (FY 95 and 96), as modified during FY 95 DPD review, are below:

- a. Create a common understanding that does not now exist among the Trees, local residents, subsistence and recreational user groups, scientists, and the general public about the presence or absence of *Exxon Valdez* oil in the Kodiak Area. The project should take special concern and focus on areas of community concern with respect to the presence or absence of the oil.
- b. Achieve the above objective in such a way that the project provides current information useful for all injured resource and services; that is, the project will update the 1991 information base necessary for other research and restoration in the Kodiak area.

- c. Where (and if) surface and subsurface oil is found, the project will locate "hot spots: where continued monitoring, and possible treatment, is necessary. Where oil is found, analysis will be done to determine toxicity and origin of the oil. Where oil is not found or found only in trace amounts, the project will end the need for continued shoreline assessments. Thus, this project may be the last comprehensive shoreline assessment for this area.
- d. Maintain (and possible end) the record of the extent, concentration, and degradation of surface and subsurface oil from the 1989 *Exxon Valdez* oil spill in these areas.

Most of these objectives will have been met in FY 95. The only task remaining for FY 96 will be to work with communities to understand the information and determine if anything further needs to be done. That is, only portions of objectives a) and c) remain for FY 96.

D. Completion Date

All objectives will be complete during FY 96.

COMMUNITY INVOLVEMENT

This project has and will continue to involve the communities of Kodiak Archipelago in three ways:

- *Locating Beaches.* The beaches to be surveyed were located by ADEC in consultation with Kodiak residents. That is, ADEC made a first draft of beaches to survey based on past data. That list was significantly altered during community review in two meetings in Kodiak involving residents of the Municipality Kodiak, residents of the six outlying villages, and discussions with the Mayor's office.
- *Involving a Local Representative in the Survey.* At the request of the Kodiak Villages, the survey team involves a Native college intern specializing in a natural resource field chosen by village representatives, and/or landowners or village government representatives. By involving local labor in the survey team, helps integrate the results into the community knowledge base.
- *Communicating the Results.* ADEC representatives will work with villages to understand and digest the results of the survey. This will involve publication appropriate to citizen readers, and meetings with concerned villagers.

FY 96 BUDGET (figures in thousand dollars)

Personnel	\$18.9
Travel	4.5
Contractual	5.5
Commodities	3.0
Equipment	0.0
Subtotal	31.9
General Admin	3.2
Total	35.1

PROJECT DESIGN

The detailed objectives and methodology for FY 95 are not repeated here, because they will have been accomplished before FY 96 begin.

A. Objectives

See discussion under "Need for the Project, Part C. Summary of Major Hypothesis and Objectives."

B. Methods

The FY 96 component of this project has two methods;

1. Publication and distribution of results appropriate for the general public (as opposed to the scientific community).
2. Meetings with communities and interest groups, as appropriate to discuss results. If at all possible, these meetings will occur in conjunction with other Trustee Council activities, rather than as individual meetings. This will better communicate the entire suite of Trustee Council activities as opposed to communicating oiling information only. In addition, it will lower travel and meeting costs, and avoid deluging the communicates with a plethora of scientists and personnel.

C. Contracts and Other Agency Assistance

Not Applicable.

D. Location

Kodiak Archipelago and communities.

SCHEDULE

A. Measurable Project Tasks for FY 96

Draft Report	October 1, 1995
Final Report	45 days after peer review comments received. (Most likely before January 1996).
General Public Report	45 days after peer review comments received. Due to the Christmas holidays, it will most likely be distributed in January 1996.
Community Meetings	Because community meetings will take advantage of other Trustee Council activities in the area, it is not possible to schedule them precisely at this time. However, they will be completed between October 1995 and February 1996.

B. Project Milestones and Endpoints

See above.

C. Project Reports

See above.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Not applicable. Except that community meetings will be coordinated with other Trustee Council meetings in the region.

ENVIRONMENTAL COMPLIANCE

NEPA compliance for this project was completed in FY 95.

PERSONNEL

Ernie Piper, Restoration Chief
Alaska Department of Environmental Conservation
3601 "C" Street; Suite 1334
Anchorage, AK 99503
ph. 563-6529
fax 562-4026

Alaska Department of Environmental Conservation
645 G Street
Anchorage, AK 99501
ph. 278-8012
fax 276-7178

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996							
Personnel	\$133.7	\$4.7							
Travel	\$27.2	\$3.0							
Contractual	\$152.4	\$1.5							
Commodities	\$26.5	\$0.0							
Equipment	\$20.0	\$0.0							
Subtotal	\$359.8	\$9.2	LONG RANGE FUNDING REQUIREMENTS						
General Administration	\$30.7	\$0.8	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Project Total	\$390.5	\$10.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	
Full-time Equivalents (FTE)	1.9	0.1							
Other Resources			Dollar amounts are shown in thousands of dollars.						
Comments: Upon completion of the field work, activities will center around integrating new data into the EVOS database of shoreline oiling conditions, work will continue with the laboratory re the samples submitted for analysis and once this work completed the information placed in the database. Shoreline maps will be updated, a report prepared and submitted for peer review. Program administration costs will include closing out contracts, resolving outstanding invoices, final inventory, printing of final report, etc. This is the closeout of Project number 95027.									

1996

Prepared:4/26/95

1 of 4

Project Number: 96027
 Project Title: Kodiak Shoreline Assessment
 Agency: AK Dept. of Environmental Conservation

**FORM 3A
 AGENCY
 PROJECT
 DETAIL**

7/18/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
	Dianne Munson (18X019)	Restoration Specialist	18A	1.0	4,732		4.7
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Subtotal				1.0	4,732	0	
Those costs associated with program management should be indicated by placement of an *.							Personnel Total \$4.7
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
	Anchorage--Kodiak		386	3	12	150	0.0
							3.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.							Travel Total \$3.0

1996

Project Number: 96027
Project Title: Kodiak Shoreline Assessment
Agency: AK Dept. of Environmental Conservation

FORM 3B
Personnel
& Travel
DETAIL

October 1, 1995 - September 30, 1996

1996

Project Number: 96027 Project Title: Kodiak Shoreline Assessment Agency: AK Dept. of Environmental Conservation

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

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1996

Project Number: 96027
Project Title: Kodiak Shoreline Assessment
Agency: AK Dept. of Environmental Conservation

FORM 3B
Equipment
DETAIL

V

Project Title: Development of a Productivity Index to Monitor the Reproductive Success of Marbled and Kittlitz's Murrelets in Prince William Sound, Alaska

Project Number: 96031
Project Category: Research
Proposer: Katherine J. Kuletz
Lead Trustee Agency: DOI
Duration: 3 years (FY 96 is 2nd year of 3-year project begun in FY 95)
Cost FY 96: \$254,600 (write-up of FY 95 and field season FY 96)
Cost FY 97: \$254,600 (write-up of FY 96 and field season FY 97)
Cost FY 98: \$ 39,900 (write-up of FY 97 work)
Geographic Area: Prince William Sound
Injured Resource/Service: Marbled Murrelet (*Brachyramphus marmoratus*) and Kittlitz's Murrelet (*B. brevirostris*)

RECEIVED
May
EXXON VALDEZ OIL SPILL

ABSTRACT

We propose to develop a means to monitor the productivity of the two *Brachyramphus* murrelets, marbled and Kittlitz's murrelets, in Prince William Sound. The reproductive success of these two non-colonial seabirds can not be monitored using standard techniques. To develop a productivity survey protocol, we will survey murrelets at sea to determine the timing and abundance of juveniles, the ratio of juveniles to adults, and to describe coastal and marine features that best predict juvenile abundance. We will also determine the post-fledging movement of juveniles, to aid the design of a monitoring program. By monitoring murrelet productivity in relation to population trends, this index can eventually be used to determine what factors, including forage fish abundance, influence murrelet recovery.

INTRODUCTION

The marbled murrelet (*Brachyramphus marmoratus*), the most abundant seabird in Prince William Sound in the summer, was a species injured in the *Exxon Valdez* Oil Spill. It's close relative the Kittlitz's murrelet (*B. brevirostris*), is rare, and because a significant portion of their world population breeds in the spill zone, they will probably be added to the list of injured species in 1995. These two species comprise the *Brachyramphus* murrelets, whose numbers declined significantly since the early 1970's (Klosiewski and Laing 1994).

The goal of this 3-year project is to develop a means to measure murrelet productivity that will enable us to determine if low reproductive success is limiting the recovery of marbled and Kittlitz's murrelets in Prince William Sound. Earlier restoration projects identified marbled murrelet nesting habitat in southcentral Alaska to guide land acquisition efforts (Restoration Projects R15 and 93051B). A 1994 project (94102) determined the foraging ranges of marbled murrelets breeding in Prince William Sound, and identified key marine habitats used by adults during the breeding season. In a related pilot study conducted under

project 94102, we investigated the use of at-sea surveys for juveniles at two locations in Prince William Sound (Kuletz et al. 1995). The first year of work to develop a productivity index will begin in 1995.

Although this project was initiated for the marbled murrelet, data for both species can be collected simultaneously if known areas of Kittlitz's concentrations are included in the surveys. With a method of monitoring reproduction of both species, and in conjunction with data from the APEX project (96163), we can eventually examine the hypothesis that food limitation is affecting murrelet productivity. Ultimately we will improve our ability to predict how management options will affect the recovery of these species.

NEED FOR THE PROJECT

A. Statement of problem

The marbled murrelet, as the most abundant apex predator in the Prince William Sound marine ecosystem, could be an important indicator of the health of the marine environment. Because of difficulties distinguishing it from the rare Kittlitz's murrelet, the conspecifics were lumped during surveys of Prince William Sound. Although *Brachyramphus* murrelets suffered high mortality in the *Exxon Valdez* oil spill (Ecological Consulting, Inc. 1991, Piatt et al. 1990, Kuletz 1994), the spill cannot account for the 67% reduction in numbers observed in post-spill years (Klosiewski and Laing 1994). There has been no significant increase in the Prince William Sound murrelet population since 1989 (Agler et al. 1994). Murrelet recovery could be inhibited by low recruitment (juveniles entering the population), but we do not have the data to determine if low breeding success is a problem. Low adult survivorship, due to gillnet mortality or winter mortality outside Prince William Sound, could also be inhibiting murrelet recovery. Without information on productivity, the long-term population trends will not indicate where the problem originates.

Because of their secretive and highly dispersed nesting habits, the reproductive success of these two species can not be followed using standard techniques. By developing a cost-effective index of reproductive success for *Brachyramphus* murrelets, we will be able to examine the physical and biological factors that may influence murrelet productivity. The marbled murrelet, the more abundant of the conspecifics, is a threatened species under the Endangered Species Act in California, Oregon and Washington, and a Category II species of concern in Alaska. The Kittlitz's murrelet, indigenous to Alaska and the Russian Far East and rare, is also a Category II species of concern.

B. Rationale

South of Alaska, marbled murrelet populations have declined primarily due to the loss of old-growth forest nesting habitat (Stein and Miller 1992). However, a comparatively small proportion of potential nesting habitat has been harvested in PWS. The nesting habitat of the Kittlitz's murrelet, which nests exclusively on the ground at high elevations, should not be threatened by current human activities. Concurrent with murrelet population declines, populations of other apex predators that eat small schooling fish have also declined in Prince

William Sound (Frost et al. 1994, Klosiewski and Laing 1994, Oakley and Kuletz 1994). These schooling, or forage fish, on which murrelets depend include sand lance, (*Ammodytes hexapterous*), capelin (*Mallotus villosus*), herring (*Clupeidae spp*) and pollock (*Gadidae spp*) (Oakley and Kuletz 1979, Krasnow and Sanger 1986, Sanger 1987, Kuletz, unpubl. data). The concurrent population declines in Prince William Sound suggest that the murrelet population may be affected during the breeding season, perhaps due to low food availability.

If food is limiting murrelet recovery by affecting their reproductive success, it is possible that recruitment is not replacing adult mortality. Because murrelets are likely long-lived (Beissinger 1995), the effects of low reproduction may not be evident in population surveys for a decade after the perturbation that caused the loss. Thus, the recovery objective for murrelets, to have their populations increasing or stable, may not be measurable in a timely manner with surveys of the adult population alone. Alternatively, trends in the total population estimates might reflect adult survivorship, which might require a different management approach. To effectively monitor murrelet recovery and make appropriate management decisions, requires that we monitor murrelet productivity in addition to population trends.

Despite years of effort throughout their range, few nests of either species have been found to examine reproductive parameters (Nelson and Hamer 1995, Day et al. 1983, Day 1995). Without telemetry, we located 14 nests between 1991 and 1993. In 1993 and 1994 we used telemetry to locate six nests and track the foraging movements of 56 marbled murrelets and 1 Kittlitz's murrelet (Burns et al. 1994, Kuletz et al. 1995). Telemetry provided us with valuable knowledge of murrelet foraging ecology that will be needed to develop a productivity survey protocol. However, locating such low numbers of nests is unlikely to provide a long-term, effective means of monitoring the reproductive health of the population. This project, 95031-97031, will research and develop a protocol to achieve that goal.

C. Summary of Major Hypotheses and Objectives

To meet our objective to develop a murrelet productivity index, we will survey murrelets at sea at 6 locations in Prince William Sound over 3 years, to compare among-site and annual variation of several parameters. These parameters will be the timing and absolute abundance of juveniles, the ratio of juveniles to adults, habitat associations, and juvenile movement during July and August. We will test the hypothesis that temporal and spatial variability in juveniles will be convergent among sites during the 3 years. We will examine the relationship between juvenile abundance and the marine environment / coastal features to determine what combination of features influence juvenile abundance.

D. Completion Date

The third year of field work in FY 97 will complete the research to develop the protocol for a murrelet productivity index. The final report for this project will be completed in FY 98.

COMMUNITY INVOLVEMENT

Murrelets are not used for subsistence by local communities. They are, however, subject to gillnet mortality (Wynne et al. 1992, Carter 1995). Gillnet by-catch, and observations by fishermen, could identify areas with high juvenile murrelet activity or concentrations of post-breeding adult murrelets. Additionally, dead juveniles have been found on land and at sea in late summer by residents. In 1994, we displayed a poster soliciting murrelet carcasses for study skins in Whittier and Cordova, and local residents contributed a few samples. This effort will be continued in 1995 at other communities in Prince William Sound.

FY 96 BUDGET

Personnel	163.1
Travel	11.9
Contractual	19.4
Commodities	34.4
Equipment	0.0
Subtotal	228.8
Gen. Admin.	25.8
Total	254.6

PROJECT DESIGN

A. Objective

1. Develop an index of marbled and Kittlitz's murrelet reproductive success for Prince William Sound by:
 - a. Determining the timing and abundance of juveniles on the water relative to numbers of adults.
 - b. Determining what environmental factors influence the abundance and distribution of juvenile murrelets at sea.
 - c. Determining the post-fledging movement of juveniles.

B. Methods

Study Area.-- The study area will be Prince William Sound, using the same sites surveyed in 1995 - Valdez Arm, Unakwik Inlet, Naked Island, central Port Nellie Juan, northern Knight Island, and Jackpot Bay / Dangerous Passage (Fig. 1). These areas were selected because they have sufficient numbers of murrelets and at least four of them will be surveyed by forage fish studies to be conducted in 1995 - 1997. They are also separated by approximately 16 km, which is the average direct-line distance traveled between feeding and nest sites by

murrelets in PWS, and twice the distance that the tagged juvenile murrelet moved from its nest over a 2 week period (Kuletz et al. 1995).

Background. -- Ideally, a reproductive index would be ground-truthed by an independent measure of reproduction. One type of independent test would be to follow the reproductive success of individual murrelet nests; nests could be located by radio-tagging adults and using telemetry to find nests and monitor their outcome. This method is expensive and, to date, has only provided a small sample size. The productivity of other seabirds, such as the pigeon guillemot or black-legged kittiwake, may serve as indicators of general environmental conditions, but may not always be indicative of murrelet reproductive success. Pigeon guillemots feed on a variety of bottom fish not used by murrelets, and thus the effect of changes in surface schooling fish abundance on guillemot reproduction may be less drastic than for murrelets. Kittiwakes are surface feeders and would not have access to fish in deeper water. In this study, we will ground-truth the murrelet productivity index by making among-site comparisons over 3 years.

Because murrelets can not be counted at their nests, researchers at lower latitudes have attempted to use the ratio of marbled murrelet juveniles to adults at sea as an index of reproductive success (Beissinger 1995, Ralph and Long 1995). Juvenile murrelets, once fledged, are on their own and usually solitary, or mix with adults at feeding areas in late summer (Sealy 1975, Sealy and Carter 1984). The problems that arose included: (1) Juveniles were difficult to distinguish from adults in winter plumage, particularly after late August (Carter and Stein 1995). (2) The best time to survey was not well defined, because murrelets were not as highly synchronized as colonially breeding seabirds (De Santo and Nelson 1995) and juveniles fledged from late May to late September (Hamer and Nelson 1995). (3) The post-fledging movements of juveniles and adults were unknown, and there was no independent measure of the total population; thus the interpretation of counts or ratios was subject to error. (4) The number of juveniles on the water was low (2-5%; Beissinger 1995, Ralph and Long 1995) and the number of adults was also low, so that obtaining sufficient numbers of birds per survey for rigorous analysis was unlikely.

In 1994, as part of restoration project 94102 (Kuletz et al. 1995), we conducted a pilot study to survey juvenile murrelet counts at two sites in PWS - Naked Island and Port Nellie Juan. Peak numbers of juveniles were observed from 9 - 29 August, during which time the total number of murrelets declined sharply, as adults appeared to leave both areas. The post fledging movements of 1 chick we radio-tagged at its nest suggested that juveniles remain in the general vicinity (< 12 km, and remaining in a 10 km² area) of the nest for at least 2 weeks. With peak numbers of >500 murrelets per survey, we encountered enough murrelets to detect changes in juvenile/adult ratios; (we assumed a minimum of 2% juveniles, and to detect a change of 50% with 95% probability, at least 100 birds should be encountered).

Prince William Sound may be uniquely suited for development and application of a murrelet reproductive index because of its large murrelet population, its relatively compressed breeding season (Hamer and Nelson 1995, Kuletz unpubl. data), and the apparent migration of adults from the area soon after breeding. Additionally, the foraging ranges of adults has been studied (Burns et al. 1994, Kuletz et al. 1995) and the total population has been, and will continue to be monitored regularly by a separate study.

Sub-Objective a: Timing and abundance of juveniles relative to adults

Data Collection.-- We will survey 6 sites to examine trends in the timing and abundance of juveniles. In late summer, adult murrelets at Naked Island were concentrated nearshore (Kuletz et al. 1994b). However, in Oregon and California, Beissinger (1995) found that because adults occurred offshore (>1 km) more than juveniles, the ratio of juveniles in nearshore water tends to be inflated 2 or 3 times that of the true local population. Ideally, surveys would be conducted nearshore and offshore to determine true juvenile ratios. However, to obtain a sample size adequate for examining seasonal and among-site variation, we will focus on habitat where juveniles concentrate. At 2 sites we will survey offshore transects as well as shoreline transects. If sufficient numbers of juvenile murrelets are found in the offshore regions, and the total number of adults fluctuates among years relative to pelagic or shoreline habitat, we will modify surveys to include more pelagic habitat.

Surveys will be conducted by 2 crews of 3 observers operating from 25 ft. vessels or 14 ft inflatables and using FWS protocol (Klosiewski and Laing 1994). Complete shoreline surveys (<200 m from shore) will be conducted at 6 sites, and randomly selected 2 km transects within 2 km of shore will be surveyed at two of these sites. The shoreline surveys will follow established FWS shoreline transects that are digitized on Atlas/GIS files (Strategic Mapping, Inc. 1992). The surveyed coastline will be approximately 50-60 km at each site, which in 1994, was the area that could be surveyed between 0600-1600 hours on the same day (murrelet counts vary significantly earlier or later in the day [Carter and Sealy 1990]).

The first surveys will be conducted in June to obtain a baseline adult murrelet population index. Juvenile surveys will be conducted at the same 6 locations between mid-July and late August twice weekly. Thus for baseline surveys, each site will be surveyed at least twice, for a total of 12 surveys. In the late summer surveys, the number of surveys will depend on the variability within and among sites surveyed in 1995; currently, each site is planned to have 10 surveys, for a total of 60 surveys.

The observers will count all birds $\leq$ 200 m from shore. Records for each transect (averaging 3 km) will be kept separate to allow for microhabitat classifications. Observers will be trained to score birds by plumage and behavioral characteristics using photos, study skins, drawings and on-sight training to standardize observers. In 1994 the percentage of unidentified black/white murrelets and juveniles were closely correlated by date, suggesting that many of the black/white birds were juveniles. Results from 1994 will be used to refine the data collection format. In 1995 and 1996 we will record more detailed data for each black/white bird, to improve our identification criteria: the quality of the observation, presence of an egg tooth, absence of white on the upper mandible, presence of a dusky breast band, dusky flecking on the flanks, percentage of white on the breast, back and flanks, missing or rounded primaries during a wing stretch, diving or flying behavior.

Data analysis. -- We will test for similar trends among sites in juvenile counts by graphing the frequency distribution of juveniles by date. If the null hypothesis that the seasonal distributions of numbers of juveniles does not differ among sites is not rejected, it will suggest that the chronology indicated by juvenile surveys is a reasonable measure of murrelet breeding activity throughout Prince William Sound. We will use power tests on the 1995

results to determine the probability of Type II errors.

We will also test for differences in the absolute numbers and ratios of juveniles among sites. For the 2-week peak in juvenile numbers for each site, the ratio of juveniles (average number counted each day, by site) will be calculated relative to total murrelets (average of 2 surveys per site) in June (presumably the local breeding population). The average number of juveniles per survey will also be used to derive an index relative to average number of adult murrelets during the same survey. We will use a 2 x 6 contingency table to test the hypothesis that there is no difference in juvenile ratios among sites. If the null hypothesis is rejected, we will use results from sub-objective b to determine if environmental features are related to local variation in productivity. In the long-term, we will compare trends in murrelet productivity and the total population estimates for Prince William Sound.

Sub-Objective b: Factors influencing the occurrence of juveniles

Data collection. -- For each transect we will record water depth and temperature, presence of freshwater runoff, glacial ice or kelp beds, sea conditions, precipitation, cloud cover, time and observed feeding activity. At 4 stations within each area, we will measure water clarity and surface salinity to obtain a daily average. We will calculate tide for each transect's start time with a Paradox (Borland, Inc. 1992) script (Kuletz / FWS files). The general bathymetry of the transect, the associated underwater and shoreline features, and the distance from shore of offshore transects will be obtained by GIS. We will also record other boat and low-flying activity during the transect. The relative abundance of forage fish (as determined by 96163), among sites and years, will be included as a variable.

Data analysis. -- We will combine data from 1995-1997 juvenile surveys to develop a descriptive model of influences on juvenile abundance. First, we will use parametric and nonparametric regression analysis to test the null hypothesis that juvenile abundance is not influenced by habitat or annual variation in marine conditions. The independent variables will include year, weather and sea conditions, time and tide, water depth and clarity, distance offshore, distance to underwater sill, shoreline type, bathymetric features (rocky, mud, plateau, shelf edge), presence of foraging flocks and relative fish abundance. Multivariate analysis will be used to determine what combination of factors best describe the variation in juvenile numbers. Based on previous studies, we predict that juvenile abundance will be positively related to freshwater runoff, protected coastlines, proximity to underwater sill or shelf edge and forage fish abundance. Juvenile numbers should be negatively correlated with water depth, distance offshore and boat traffic. There is insufficient data for the remaining variables to make predictions.

Sub-Objective c. Post fledging movement of juveniles

The ratio of adults to juveniles, and the validity of among-site comparisons, will be affected by the post-fledging movement of juveniles and adults, and perhaps their habitat preferences. Sub-Objective b will address the possible influence of habitat latter, and study 94102 addressed the foraging ranges of adults. In 1994 we radio-tagged a juvenile the day before it fledged from its nest. However, without tagging adults in 1996 it is unlikely we will have this opportunity. To determine the amount of juvenile movement within and away from a

survey area, we will attempt to capture and radio-tag individual juveniles and track their movements during the survey period.

Data collection and analysis. -- We will attempt to capture 5 -10 juveniles on the water. We will begin trapping efforts once juveniles appear on the water and continue through August. Juveniles will be caught using spotlights and dipnets during darkness (Chris Iverson, pers. comm.). The capture efforts will concentrate in areas where we have frequently observed juveniles, such as Cabin and McPherson Bay on Naked Island, and the mouths of West and East Finger Inlets in Port Nellie Juan. Each juvenile will be measured and weighed and a 1.5g Holohil transmitter glued to its back. Picric acid will be put on the whites of the wings, neck and rump to facilitate visual observations from a distance. We will search for the juveniles during surveys and with spotting scopes from land when possible.

Although we will not know the juvenile's exact nest location or its fledging date, we will determine the average length of attendance in an area over time. The average distance covered over the length of observations (among all marked juveniles) will be used to adjust the design protocol.

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C. Contracts and Other Agency Assistance

When possible, we will be refueling our survey vessels at Whittier or Valdez. However, to economize on gas and time, we will also contract a barge to deliver gas barrels for storage at sites in Prince William Sound.

Several camp locations will be necessary to cover all 6 areas on this tight schedule. Most of the areas are part of the Chugach National Forest, and permits will be obtained from the U.S. Forest Service for camp sites on Naked Island (shared with the pigeon guillemot portion of project 96163), Eleanor Island, (shared with the kittiwake portion of project 96163) and Port Nellie Juan. We will request temporary lodging and gas storage at the Unakwik Inlet and Main Bay hatcheries from the Prince William Sound Aquaculture Association. The Jackpot Bay location, which will be shared with the pigeon guillemot study, will be leased from Chenega Native Corporation.

We have the expertise and technical support to perform the majority of our geographic information system (GIS) needs. As coverages are developed for nearshore and pelagic areas of Prince William Sound by other projects, we may require agency support to obtain files. Our study could eventually integrate data on forage fish and oceanographic conditions obtained by NOAA and the PWS Systems Studies.

D. Location

The study sites will be Jack and Galena bays in Valdez Arm, Unakwik Inlet, Naked Island, northern Knight Island, central Port Nellie Juan, and Jackpot Bay/Dangerous Passage near Chenega Island (Fig. 1). Our boats will operate out of Whittier and Valdez, where we will rent dock space and purchase some supplies and services. On most days in the field, crews will camp at sites near survey areas.

SCHEDULE

A. Measurable Project Tasks for FY 96

Start up to April 14	Order radio tags, obtain capture and camping permits, begin hiring of personnel, arrange logistics.
April 15 - May 15	Hire personnel, safety training for field, purchase commodities.
May 16 - May 30	On-site training for at-sea surveys, establish field camps.
June 1 - June 15	Conduct baseline at-sea surveys.
June 16 - July 14	Data entry, purchase commodities, training on murrelet plumages.
July 15 - August 31	Conduct juvenile at-sea surveys, capture and follow tagged juveniles.
Sept.1 - October 31	Data entry, GIS analysis and analysis of field data.
Nov. 1 - Dec. 31	Data analysis and report writing.
April 1997	Annual report on FY 96 data.

B. Project Milestones and Endpoints

FY 95	Collect data to address sub-objectives a and b
FY 96	Preliminary analysis of FY 95 field data Collect data to address sub-objectives a, b and c.
FY 97	Preliminary analysis of FY 96 field data Collect data to address sub-objectives a, b and c
FY 98	Final analysis of data from FY 95 - 97 Final report addressing the primary objective

C. Project Reports

1996 - 1998	
December 15	Draft annual report submitted for internal review
February 15	Draft annual report submitted to Chief Scientist for peer review
April 15 1996	Annual report with preliminary analysis on FY 95 data:
April 15 1997	Annual report with preliminary analysis of FY 96 data:
April 15 1998	Final report with analysis of data from 1995 - 1997:

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will share logistical support in the use of barges, fuel storage and temporary camps with the Harlequin Duck project (96427) and the pigeon guillemot and kittiwake components of the APEX project (96163). This study will complement and benefit from the APEX project; project 96031 was designed to overlap the study areas surveyed by the APEX project so that we can eventually examine the hypothesis that food is limiting recovery of murrelets in Prince William Sound. The murrelet project could also benefit from information obtained through components of the PWS System Investigation related to forage fish (Isotope Tracers [95320I], Physical Oceanography [95320M], Nearshore Fish [95320N]). Project 96031 will use the total murrelet population estimates for Prince William Sound provided by the marine bird surveys (96159) to compare trends in juvenile abundance to trends in the total

population.

ENVIRONMENTAL COMPLIANCE

Under DOI guidelines for the National Environmental Policy Act (NEPA) this project qualifies for a Categorical Exclusion.

PERSONNEL

Project Leader: Kathy Kuletz

Kathy Kuletz received her B.S. degree in Biology from California Polytechnic State University, San Luis Obispo (1974), and her M.S. degree in Ecology and Evolutionary Biology from University of California, Irvine (1983). Her thesis was on the foraging and reproductive success of pigeon guillemots at Naked Island, Prince William Sound. Ms. Kuletz has worked in Alaska since 1976 for Dames and Moore Consulting, LGL Alaska Research and the U.S. Fish and Wildlife Service. Since 1989 she has been Principal Investigator for the marbled murrelet damage assessment and restoration studies. She has been working with the Pacific Seabird Group Marbled Murrelet Technical Committee to develop protocols for inland and at-sea murrelet surveys.

Pertinent reports and publications (also, see Literature Cited)

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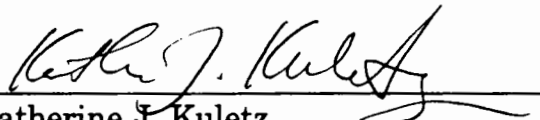
characteristics and reproductive success of marbled murrelet tree nests in Alaska.
In: S.K. Nelson and S.G. Sealy (eds), Biology of Marbled Murrelets: Inland and
At Sea. Symposium Proceedings. Northwestern Naturalist. Vol 75 (3).

Field Supervisor/GIS expert: Steve Kendall

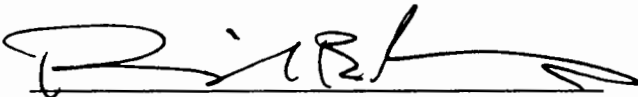
Mr. Kendall will supervise data collection in the field in the absence of the project leader. He will prepare maps of survey transects, coordinate logistics with other projects, assist in data entry, conduct at-sea surveys and provide GIS data and analysis for reports. He has extensive experience conducting at-sea surveys in Alaska from his work on USFWS boat surveys, as a boat operator and biologist.

Biotechnician and GIS expert: Debbie Flint

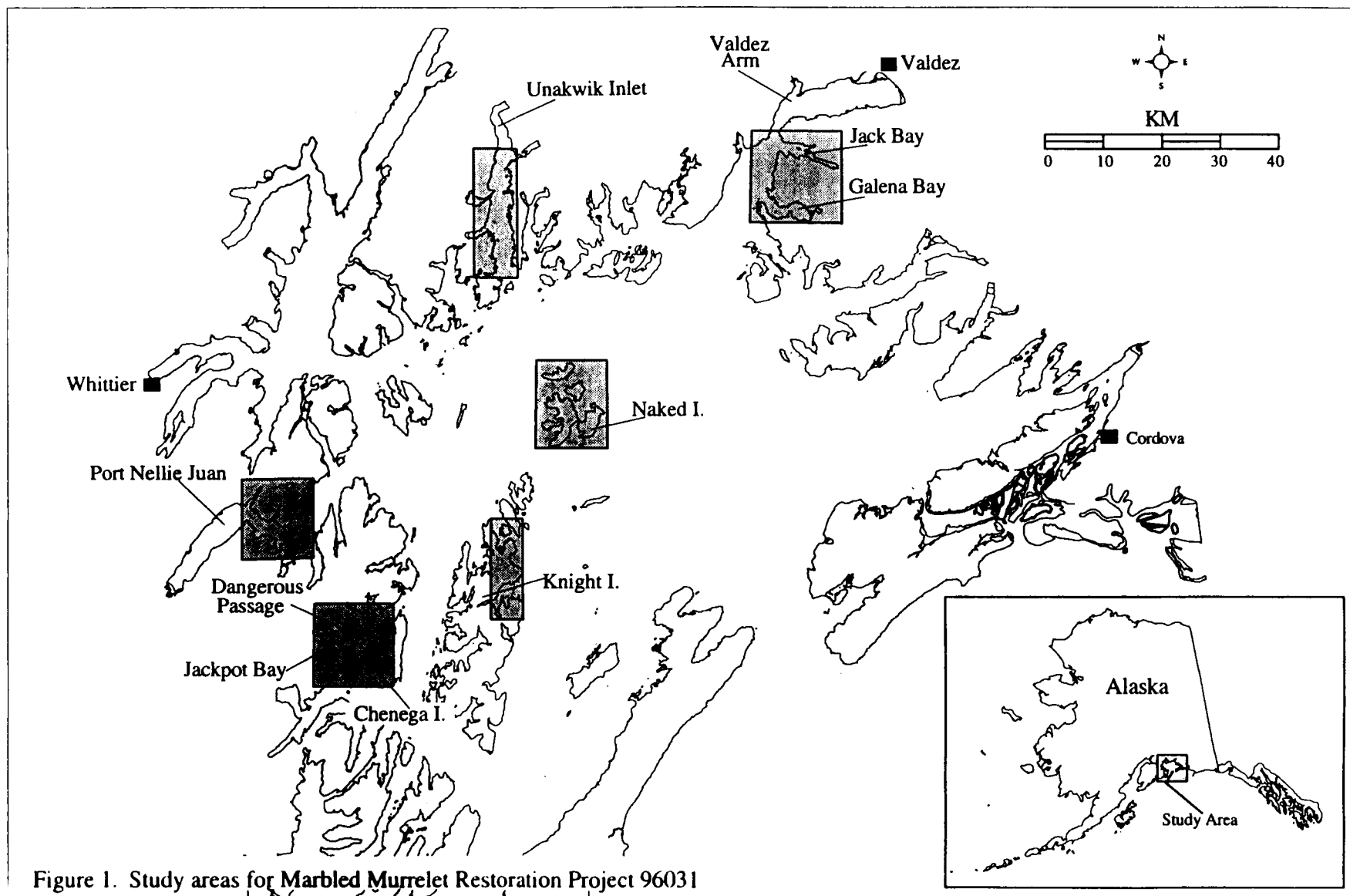
Ms Flint will assist in logistics, data collection, data entry and GIS support needs. She has worked in Prince William Sound and other areas for ABR consultants and provided GIS support for project 94102.



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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996							
Personnel		\$57.1							
Travel		\$1.4							
Contractual		\$0.5							
Commodities		\$0.0							
Equipment		\$0.0							
Subtotal	\$0.0	\$59.0	LONG RANGE FUNDING REQUIREMENTS						
General Administration		\$8.6	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Project Total	\$0.0	\$67.6	\$254.6	\$39.9					
Full-time Equivalents (FTE)		1.2							
Other Resources			Dollar amounts are shown in thousands of dollars.						
Comments: Six months of the Project Leader's time will be directed towards writing the report for 95031, plus drafting the synthesis papers. Two months of the Project Leader's time will be used to finalize the report for 95031 following peer review and completing synthesis papers.									

1996

Prepared:

1 of 4

Project Number: ⁶95031 - Close out
 Project Title: Brachyramphus Murrelet Productivity Index -
 Agency: DOI- Fish and Wildlife Service

**FORM 3A
 AGENCY
 PROJECT
 DETAIL**

7/21/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

[illegible]

1996

Project Number: 95031 - Close out
Project Title: Brachyramphus Murrelet Productivity Index
Agency: DOI - Fish and Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Publication Page Charges		0.5
When a non-trustee organization is used, the form 4A is required.		Contractual Total
		\$0.5
Commodities Costs:		Proposed
Description		FFY 1996
None		0.0
Commodities Total		\$0.0

1996

Project Number: 95031 - Close out
Project Title: Brachyramphus Productivity Index
Agency: DOI - Fish and Wildlife Service

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
	None			0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:			Number of Units	Inventory Agency
Description				
	None			

1996

Project Number: 95031 - Close out
Project Title: Brachyramphus Murrelet Productivity Index
Agency: DOI - Fish and Wildlife Service

FORM 3B
Equipment
DETAIL

Coastal Habitat Intertidal Monitoring

Project Number: 96037 *Revised*

Restoration Category: Monitoring

Proposer: Drs. Raymond C. Highsmith and Michael Stekoll

Lead Trustee Agency: ADF&G

Cooperating Agencies: University of Alaska

Duration: 4 years

Cost FY96: ~~533.1~~ 530.0

Cost FY97: ~~530.0~~ 530.0

Cost FY98: ~~530.0~~ 530.0

Cost FY99: 360.0

Geographic Area: Prince William Sound
Cook Inlet-Kenai Peninsula

Injured Resource/Service: Intertidal Invertebrates and Algae

ABSTRACT

The Coastal Habitat Injury Assessment study (CHIA) showed continued injury to intertidal algal and invertebrate populations as of the last sampling date in 1991. A limited number of sites have been monitored in Prince William Sound and along the Kenai Peninsula through 1994 that have continued to show damage. This study proposes to revisit original CHIA sites to determine their recovery status. Intertidal communities are integral to the nearshore ecosystem and monitoring is critical for understanding long-term effects of the spill.

INTRODUCTION

The Coastal Habitat Injury Assessment Study (CHIA) was designed to measure the effects of the *Exxon Valdez* oil spill on intertidal invertebrates, fish and plants. This study encompassed three geographic regions: Prince William Sound (PWS), Cook Inlet-Kenai Peninsula (CIK), and Kodiak-Alaska Peninsula (KAP). The experimental design of the study allowed inductive statistical inferences of injury to the entire universe of oiled shorelines

through random selection of sites within habitat categories. Thus, the results of these studies can be applied in the assessment of injury to other components of the community including higher trophic levels. At the conclusion of the 1991 field season, several species of algae and invertebrates still showed significant injury to their populations. For most of these populations the recovery status is unknown.

This new study will revisit some original CHIA sites to determine the degrees and rates of recovery of injured species. The project will begin in FY96 and continue through FY99. Sampling will occur during the first year (FY96) in PWS and CIK. Data collection will include measurements of percent cover, biomass, and abundance of key species on sheltered rocky, coarse textured and estuarine habitats, and percent cover on exposed rocky habitats. Sample sorting will be initiated in FY97 and completed in FY98. A final report will be submitted in FY99.

The intertidal will, by definition, be "recovered" when the community composition, population abundance and biomass of component species, and ecosystem function in each injured habitat have returned to levels that are found on the matched, unoiled sites. Results from this study will relate to the injury assessment of organisms found at higher trophic levels such as nearshore studies of fish, birds, and mammals.

NEED FOR THE PROJECT

A. Statement of the Problem

Intensive sampling and research by the CHIA project showed that the spill and subsequent cleanup had serious and persistent effects on intertidal algae and invertebrates through 1991. Most regions and habitats have not been monitored since the summer of 1991. Thus, the recovery status of the intertidal community is unknown. The results of the CHIA study generally showed lower percent cover and biomass of algal species on oiled sites compared to reference sites. There was a corresponding increase in the amount of bare rock at the oiled sites. In addition, the dominant intertidal alga, *Fucus gardneri*, was not as reproductive and had higher levels of epiphyte infestation on oiled sites. Other effects were found such as the enhancement of some red alga species in the mid to lower intertidal. By 1994, many of the algal taxa, including *Fucus*, still showed significant injury and little recovery at sheltered rocky sites in PWS and CIK. Analyses of intertidal invertebrate abundance and biomass revealed differences between oiled and reference sites for several major taxa. These were grazers (*Tectura persona*, *Littorina sitkana*, and *L. scutulata*), barnacles (*Chthamalus dalli*, *Semibalanus balanoides* and *Balanus glandula*), mussels, amphipods, and oligochaetes. Oiling effects and recovery varied between each region, habitat, and tidal elevation zone but many of the taxa showed incomplete recovery by the last sampling date in 1991.

B. Rationale

This project proposes to address the explicit need stated in the "Invitation to Submit Restoration Projects for Fiscal Year 1996" to monitor the injured intertidal resources. Intertidal communities were subjected to the most severe impacts of the spill and subsequent

cleanup operations. The intertidal is a very productive and diverse ecosystem, providing food for higher organisms. Algae constitute a major portion of the ecosystem structure, providing protective habitat and forage for many fish and invertebrate species that are, in turn, resources for birds and otters. The results of the CHIA study implicated oiling effects in all three regions and four habitats studied. In general, recovery of some damaged species had occurred by 1991 in all regions and habitats. However, without monitoring data beyond 1991, it is not possible to determine when recovery has or will occur for many injured invertebrate and algal species or for the intertidal community as a whole. The basic design of the original CHIA study has been retained so that regional recovery can be monitored and evaluated by statistical procedures in the context of a data base extending back to 1989. Without returning to these sites, a comprehensive understanding of the effects of the spill on injured intertidal resources and the rates of their recovery will be unknown.

C. Summary of Major Hypotheses and Objectives

The objective of this study is to determine the extent of remaining injury to the intertidal ecosystem and to estimate the time of recovery for intertidal algal and invertebrate communities affected by the *Exxon Valdez* oil spill.

D. Completion Date

Because the intertidal ecosystems studied by the CHIA project still showed injury to those sites monitored through 1994, the recovery status of the intertidal is not known. This project will monitor the status of the intertidal in the PWS and CIK regions in FY96. We will determine if population structures of damaged species have recovered and stabilized. Preliminary results will be presented in annual progress reports, and our final report will be submitted in FY99.

COMMUNITY INVOLVEMENT

This project will utilize personnel that were involved in the original CHIA study due to the many years of experience they have acquired for the collection, taxonomic identification, and analysis of algae and invertebrate samples and data. However, during the field sampling in the two geographic regions, we may occupy shorelines that are of interest to other groups. It should be possible to share space on our sampling platform with people interested in areas specific to their interests. Annual preliminary progress reports will be provided in June of FY97 and FY98, and will be available to the general community through the OSPIC office. In addition, a final report will be provided by the summer of FY99.

FY 96 Budget

Personnel	242.5
Travel	9.9
Contractual	163.8
Commodities	10.3
Equipment	0.0
Subtotal	426.5
Overhead (25% TDC)	106.6
Total	533.1
With ADF&G Costs	550.0

PROJECT DESIGN**A. Objectives**

The overall objective of the study is to conduct a comprehensive monitoring program of intertidal communities in all areas impacted by the *Exxon Valdez* oil spill to determine the extent of remaining injury and the time to recovery for injured species. To be comprehensive, the study will include the original matched oiled and control sites within the PWS and CIK regions and will include sheltered rocky, coarse textured, exposed rocky, and sheltered estuarine habitats.

B. Methods

The null hypothesis for this study is there are no significant differences in the intertidal communities between oiled and matched control sites. The basic study design implemented in the CHIA project will be maintained as a means of monitoring the recovery of the randomly selected oiled sites compared to their matched controls. Monitoring of the original PWS and CIK CHIA study sites will take place during FY96. Sheltered rocky, coarse textured, exposed rocky, and sheltered estuarine habitats will be sampled (45 sites).

Measurements will be taken for intertidal algae biomass and percent cover, and for the abundance and biomass of epifaunal and infaunal invertebrates on sheltered rocky sites. Collection quadrats will be located along each of six vertical transects at the first, second, and third meters of vertical drop (MVD) below the mean high high water (MHHW) line. Collections for biomass and abundance measurements will be taken at quadrats along a transect line placed three meters to the left of each transect sampled in the summer of 1991. On estuarine and coarse textured sites, similar collections will be made, however the abundance and biomass of only selected invertebrates will be determined. No sample collections will occur on exposed rocky sites. However, percent cover data of algae and invertebrates will be collected from all sites.

The methods proposed have been selected from the original standard operating procedures employed during the CHIA project when possible, given the time and budget constraints..

An alternative, less time-intensive method of field counting of common rocky shore organisms was rejected as it would result in the loss of information and would not allow for direct comparisons to 1991 sampling data. We have determined that most organisms are significantly undercounted in the field compared to counts made in the laboratory from scraped plots. Furthermore, there is no way to obtain direct counts of infaunal organisms without removing substrate and sorting organisms from sediment in the laboratory. Without biomass data, community level analyses (such as multi-dimensional scaling) of combined invertebrate and algal data would not be possible. Specific data collection methods are outlined below.

1. Methods for Algal Sampling

Percent cover of benthic algae will be determined on all undisturbed quadrats using a point contact method developed by the CHIA studies. In addition, we will perform estimations of percent cover for understory ("turf") algae and invertebrates and characterize the substrate at each quadrat. Samples will also be collected from sheltered rocky, coarse textured, and estuarine sampling plots marked by a 20 x 50 cm quadrat frame. These samples will be sorted to acquire biomass data on all algal taxa and for specific measurements of *Fucus* plants.

2. Methods for Invertebrate Sampling

Collections will be made of all invertebrates within a 20 x 50 cm quadrat frame at sheltered rocky sites. At coarse textured and sheltered estuarine sites, collections will be made within the same size quadrat frame, but will include the upper 10 cm of substrate. All samples will be preserved in the field and returned to Fairbanks for sorting. Due to the time intensive nature of the taxonomic sorting, full sorting as was accomplished for the original CHIA study will take place only for sheltered rocky sites. For these sites, samples will be washed through a 1 mm mesh sieve and all organisms retained by the sieve will be sorted, identified, counted, and weighed. The complete sorting of sheltered rocky samples will allow community-level analyses, such as species diversity indices and multi-dimension scaling. For coarse textured and estuarine sites, only those species that still showed injury during the last sampling in 1991 will be sorted from samples. These species include all barnacles, limpets, littorines, mussels, amphipods and oligochaetes. This procedure will allow for comparisons of abundance and biomass of selected organisms on matched oiled and reference sites, but will not allow for community level analyses.

3. Methods for Statistical Analyses

Statistical analyses will be identical to those utilized in the CHIA study. The basic experimental design is an After Control-Impact Pair design in which an oiled site is statistically compared to a matched control or reference site that was unoiled. We will use fixed effects analysis between matched pairs (one-way ANOVA or t tests), Fisher's and Stouffer's meta analysis tests for combining p-values within a habitat, power analysis, and community level multi-dimensional scaling (MDS) analysis.

Recovery of a habitat will be defined as having occurred when all species have the same biomass and abundance levels at oiled sites as at reference sites. Our operational definition for recovery for a particular taxon is when a taxon shows no significant difference between oiled and reference sites at $p < 0.05$ by both Fisher's and Stouffer's tests, and the statistical power of the data is high. Since the statistical power was not inherently high with most of the past CHIA data, we also will employ a secondary definition of recovery. This definition will use convergence of the site mean values as an indication of recovery in the absence of high power. We will thus rely on data collected in 1989 to 1991 (and sometimes to 1994) to estimate convergence. Convergence of site pairs from a community viewpoint will be estimated using MDS analysis of biomass data.

C. Contracts and Other Agency Assistance

The original CHIA project was implemented by the ADF&G (Phase I) and the USFS with a contract to the University of Alaska Fairbanks (Phase II). At this time the project will be implemented by the University of Alaska Fairbanks through the Habitat and Restoration Division of the ADF&G. The University possesses all historical records of the sites and all raw and processed data from 1989 to 1991. The University is in the best position to assure the consistency of the data to allow for comparisons to the previously collected data. ADF&G is also currently involved in the monitoring and restoration of the nearshore through existing contracts with the University for work in the subtidal (S. Jewett) and the intertidal in Herring Bay (R. Highsmith and M. Stekoll).

Principal investigators from the University of Alaska Fairbanks, School of Fisheries and Ocean Sciences will cooperate to provide expertise on algal and invertebrate taxonomy and ecology. A contract will be issued for the use of research vessels able to support the field work. All mobilization and demobilization efforts associated with the charter will be accomplished through the Seward Marine Center in Seward, Alaska. An additional contract will be established for air taxi support between Anchorage and the study sites when needed.

D. Location

This study will be undertaken in the intertidal zone of PWS and CIK sheltered rocky, exposed rocky (PWS only), coarse textured, and sheltered estuarine sites in FY96. All sample and data analysis will occur at the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks and the Juneau Center for Fisheries and Ocean Sciences, using available computers and established data management services.

Our sites are located near several remote communities that may utilize areas near our sites. We do not expect that our sampling procedures will be intrusive or negatively effect the activities of local villagers. However, the intertidal zone supports an extensive invertebrate and algal community which is linked to many vertebrate species, such as birds and otters, within the nearshore food web. Thus, any community with strong ties to a nearshore marine environment and researchers studying nearshore vertebrate and fish populations could benefit from our findings.

SCHEDULE

A. Measurable Project Tasks for FY96

This is a multi-year study involving sampling during a field season in one fiscal year with laboratory sorting and data analysis continuing into the next two fiscal years. A list for those tasks that will be undertaken during FY96 follows:

October 1995:	Receive award
January-April 1996:	Arrange logistics/charters (boats, equipment, subcontracts, etc.)
May-July 1996:	Sample on PWS and CIK sites

B. Project milestones and Endpoints

The overall objective of this study is to determine the extent of continued injury and rates of recovery of injured intertidal communities in the PWS and CIK regions. The collection of samples in these regions will occur in FY96. A determination of continued injury or recovery in the intertidal for the entire study will not be possible until all laboratory sorting and data analysis is complete in FY99. A summary of the project milestones and an endpoint follows:

FY96

January-April 1996:	Arrange logistics/charters (boats, equipment, subcontracts)
May-July 1996:	Sample PWS and CIK sites

FY 97

October-April 1996-97:	Sample sorting from PWS sites
April-June 1997:	Begin data entry and analyses of PWS data
June 1997:	Submit draft annual progress report

FY 98

October-June 1997-98:	Sample sorting from CIK sites
June-July 1998:	Begin data analyses of CIK data
June 1998:	Submit draft annual progress report

FY99

October-May 1998-99	Continue data analyses of PWS and CIK data
Summer 1999	Submit Final Report

C. Project Reports

Annual preliminary progress reports will be submitted in June 1997 and in June 1998. A draft final synthesis report will be submitted during the summer of 1999.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This multi-disciplinary study will be conducted by a team of scientists with first hand

experience in the monitoring of the effects of oil on intertidal communities. These investigators have worked together over the past six years to evaluate the effects of the *Exxon Valdez* oil spill on intertidal algal and invertebrate communities across the entire spill region, including detailed studies conducted in Herring Bay. Principal investigators from the University of Alaska Fairbanks campuses in Fairbanks and Juneau will coordinate efforts to study interactions between key algae and invertebrate species. The data will be combined for community-level analyses. Much of the equipment used during this study was acquired during other Trustee Council-funded research including the CHIA and Herring Bay Experimental and Monitoring studies. This proposed study will have direct utility to studies of oystercatchers, harlequin ducks and sea otters.

ENVIRONMENTAL COMPLIANCE

We anticipate that this project will be categorically excluded from all NEPA regulations. State scientific collection permits will be obtained prior to the start of each field season from ADF&G.

PERSONNEL

H. Personnel Qualifications

Dr. Raymond Highsmith, Professor, Director West Coast National Undersea Research Center, UAF/SFOS, Fairbanks.

Dr. Highsmith has been the Coordinator and Principal Investigator of two *Exxon Valdez* Oil Spill projects; the Coastal Habitat Injury Assessment project and the Herring Bay Experimental and Monitoring studies. His specialties include ongoing research of recruitment and population biology in the intertidal zone and he is familiar with the effects of the oil spill on intertidal invertebrates throughout the spill-impacted area.

Dr. Michael Stekoll, Professor, UAS and UAF/JCFOS, Juneau.

Dr. Stekoll has been a principal investigator on three *Exxon Valdez* Oil Spill projects: the Coastal Habitat Injury Assessment project, the Herring Bay Experimental and Monitoring Studies and the Shallow Subtidal Assessment project. His specialties include marine pollution biology, the biology and ecology of *Fucus*, *Macrocystis* and other seaweeds in Alaska, and the mariculture of kelps and red seaweeds.

Susan Saupe, Crew Leader/Technician, UAF/SFOS, Fairbanks.

Susan has been involved with Trustee Council funded projects since the field season of 1990. She has acted as a chief scientist on research vessels during the CHIA and Herring Bay studies from 1990-1994. She has had overall responsibility for invertebrate data analysis, presentation, and report writing for the CHIA project since 1991 and for the Herring Bay studies since 1993. She will continue in these capacities for the proposed study.

Tama Rucker, Lab Supervisor/Technician, UAF/SFOS, Fairbanks.

Tama has been involved with Trustee Council funded projects since the field season of 1989. She helped develop sampling methods and trained many of the personnel involved with the collection and identification of intertidal invertebrates during the CHIA studies in 1989-1991. Tama was one of the key personnel responsible for the successful lab analyses, integration of data, and writing for the final CHIA report. She will continue in these capacities for the proposed study.

Mandy Lindeberg, Algal Lab Supervisor/Technician, JCSFOS, Juneau.

Mandy has been involved with Trustee Council funded projects since the field season of 1990. She has worked extensively in the field and laboratory sampling and identifying intertidal algae. She helped develop sampling methods and trained many of the personnel involved with the collection and identification of algae during the CHIA and Herring Bay studies from 1990-1994. Mandy was one of the key personnel responsible for the successful lab analyses, integration of data, and presentation of results for the final CHIA report. She will continue in these capacities for the proposed study plus supervise the lab sorting of algae.

Laboratory Assistants, IMS/SFOS and JCSFOS

The personnel who will be collecting and sorting invertebrate and algal samples for the proposed study were trained during the original CHIA study. They each have several years experience in field collections and taxonomic identification of intertidal algae or invertebrates. They have also been responsible for data entry, quality control, and graphics presentation for the CHIA and Herring Bay studies. They will continue in these capacities for the proposed study.

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Dr. Joe Sullivan
Restoration Program Mgr.
Habitat and Restoration Division / ADF&G
333 Raspberry Road
Anchorage, AK 99518-1599
(907) 267-2213

TWO FIELD SEASON PLAN

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
FY96								Preparations and field sampling in PWS		Begin sorting PWS samples		
FY 97		Continue sorting PWS samples					Data entry, analyses, report writing PWS					
FY98						Preparations and field sampling in CIK				Begin sorting CIK samples		
FY99		Continue sorting CIK samples						Data entry, analyses, report writing CIK				

ONE FIELD SEASON PLAN

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
FY96								Preparations and field sampling in both PWS and CIK				
FY 97		Begin and finish sorting for PWS samples						Begin data analysis PWS				
FY98			Begin and finish sorting for CIK samples/continue PWS analyses							Begin data analyses CIK		
FY99			Continue data analyses PWS and CIK/submit overall final									

██████████ = No money available for laboratory sorting or data analyses

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996 *DRAFT*

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$5.2						
Travel		\$0.0						
Contractual		\$533.1						
Commodities		\$0.0						
Equipment		\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$538.3	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$11.7						
Project Total	\$0.0	\$550.0	\$549.8	\$549.8	\$375.7			
Full-time Equivalents (FTE)		0.1						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:

1996

Project Number: 96037
 Project Title: Coastal Habitat Intertidal Monitoring
 Agency: ADF&G

**FORM 3A
 AGENCY
 PROJECT
 DETAIL**

Prepared:

1 of 8

7/27/95

8/25/95 version

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October 1, 1995 - September 30, 1996 *DRAFT*

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FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 *DRAFT*

Contractual Costs:		Proposed
Description		FFY 1996
Contract with non-trustee agency		533.1
When a non-trustee organization is used, the form 4A is required.		Contractual Total
		\$533.1
Commodities Costs:		Proposed
Description		FFY 1996
None		
Commodities Total		\$0.0

1996

Project Number: 96037
Project Title: Coastal Habitat Intertidal Monitoring
Agency: ADF&G

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 *DRAFT*

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
None				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				
None				

1996

Project Number: 96037
Project Title: Coastal Habitat Intertidal Monitoring
Agency: ADF&G

FORM 3B
Equipment
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 *DRAFT*

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$242.5						
Travel		\$9.9						
Contractual		\$163.8						
Commodities		\$10.3						
Equipment		\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$426.5	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Indirect		\$108.8						
Project Total	\$0.0	\$533.1	\$530.0	\$530.0	\$360.0			
Full-time Equivalents (FTE)		3.8						
Dollar amounts are shown in thousands of dollars.								
Other Resources								

Comments:

Indirect costs are calculated at 25% TDC. The total FY96 budget will go towards preparation and carrying out a 2.5 month field season in both PWS and CIK. No money will be available for laboratory sorting beyond the field season which will end in late July 1996. Estimated costs for FY97 and FY98 are for laboratory sorting and some initial data analyses. The funds requested for FY99 are for completion of all data analyses and synthesis of an overall report.

Personnel costs are high because the field sampling requires three technicians for algal data collections and six technicians for invertebrate sample collections in order to finish one site per day. The money budgeted for FY96 will be zeroed out for most personnel within a three to four month period. Overtime is calculated at 1.5 times regular rate for anything over 40 hours per week. Two semesters worth of tuition have been wrapped into Personnel Salaries for the graduate student.

The University of Alaska does not cover office, computer, lab, or field supplies nor does it cover long distance phone and Fax charges associated with research projects. Principal investigators must solicit support for these costs through the proposal process as done here. Warehouse space is needed in both locations because of the complexity of the study. Both algal and invertebrate groups have separate and distinct sampling gear, supplies, and post-processed samples that must be stored and archived. No on-campus storage facilities are available at present and this space is leased from a public warehouse.

1996

Project Number: 96037
Project Title: Coastal Habitat Intertidal Monitoring
Name: University of Alaska

FORM 4A
Non-Trustee
DETAIL

Prepared:

5 of 8

7/27/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 DRAFT

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1996
R. Highsmith	Co-Principle Investigator/Project Leader		2.0	10,368		20.7
M. Stekoll	Co-Principle Investigator		2.0	8,859		17.7
S. Saupe	Technician (IMS/SFOS)		3.0	4,497		13.5
S. Saupe	Crew Leader		2.5	5,395	8,487	22.0
T. Rucker	Tech (IMS/SFOS)		3.5	4,945	0	17.3
M. Lindeberg	Tech.(JCSFOS)		4.0	4,177	6,570	23.3
Vacant	Tech. (JCSFOS)		4.0	3,302	5,193	18.4
Egan	Field/Lab Asst. (IMS/SFOS)		4.0	3,619	5,313	19.8
Will	Field/Lab Asst. (IMS/SFOS)		4.0	3,401	4,994	18.6
Moreland	Field/Lab Asst. (IMS/SFOS)		4.0	3,302	4,847	18.1
Vacant	Field/Lab Asst. (IMS/SFOS)		2.5	3,301	4,847	13.1
Vacant	Field/Lab Asst. (IMS/SFOS)		2.5	3,301	4,847	13.1
Vacant	Graduate Student (JCSFOS)		8.0	2,357	5,313	24.2
Vacant	Graduate Student Tuition		8.0	338	0	2.7
Subtotal			46.0	60,822	50,411	
					Personnel Total	\$242.5
Travel Costs:			Ticket	Round	Total	Proposed
Description			Price	Trips	Days	FFY 1996
RT Juneau/Seward (field season)	5 Travelers		400	5	10	2.4
RT Fairbanks/Seward (field season)	6 Travelers		250	8	16	2.6
RT Fairbanks/Juneau (Project Meetings)	2 Travelers		450	2	8	1.9
RT Juneau/Anchorage (Annual Oil Spill Workshop)	1 Traveler		311	1	7	1.2
RT Fairbanks/Anchorage (Annual Oil Spill Workshop)	1 Traveler		200	1	7	1.0
Car Rental					20	0.8
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	\$9.9

1996

6 of 8

Project Number: 96037
 Project Title: Coastal Habitat Intertidal Monitoring
 Name: Contractor

FORM 4B
 Personnel
 & Travel
 DETAIL

7/27/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 *DRAFT*

Contractual Costs:		Proposed
Description		FFY 1996
Fairbanks	Vessel Charter w/fuel (2550 x 60 days) (110' vessel, w/12 berths, large deck space for 4 zodiacs and sample processing)	153.0
	Computer Maintenance	0.3
	Long distance telephone/Fax	1.0
	Warehouse/Storage for field gear and samples	0.8
	Seward Marine Center for field mobilization and demobilization.	1.1
	Freight/Shipping of field gear and samples	1.8
	Xeroxing/Printing Services of field data sheets	0.3
	Maintenance agreements	0.5
	Air Taxi (Anchorage/PWS) 2 trips @ \$300/trip	0.6
Juneau	Freight/Shipping (JCSFOS)	1.5
	Computer Maintenance	0.3
	Long distance telephone/Fax	1.0
	Warehouse/Storage for field gear and samples	0.6
	Warehouse/Storage (JCSFOS)	0.5
	Maintenance agreements	0.5
Contractual Total		\$163.8
Commodities Costs:		Proposed
Description		FFY 1996
Fairbanks	Field Supplies (Formaldehyde, sediment jugs, whirlpaks, rain gear, quadrat frames etc...)	1.8
	Field outboard gas (10 gallons/day X 60 days X \$1.50/gallon)	0.9
	Laboratory supplies (alcohol, counters, shell vials, petri dishes, microscope replacement parts, etc...)	1.3
	Office Supplies	0.8
	Computer Supplies (paper, disks, printer cartridges, software and upgrades)	1.0
Juneau	Field supplies (Formaldehyde, whirlpaks, quadrat frames, tyvek field notes, etc...)	1.5
	Laboratory supplies (counters, glass jars, sorting trays, microscope replacement parts, etc...)	1.0
	Office Supplies	0.8
	Computer Supplies (paper, disks, printer cartridges, software and upgrades)	1.2
Commodities Total		\$10.3

1996

Project Number: 96037
 Project Title: Coastal Habitat Intertidal Monitoring
 Name: Contractor

FORM 4B
 Contractual &
 Commodities
 DETAIL

P.18/19

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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996 *DRAFT*

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
N	486 computer w/ gigabyte hard drive, 16 meg RAM (Moved to FY97)	0	3,600	0.0
N	Laserjet 4 printer (Moved to FY97)	0	1,400	0.0
R	Personal Flotation Devices	0	200	0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units		
Description				
	Inflatable skiff and motors (17' with 25 hp motors)	4		
	Marine VHF Radios	4		
	Survival Suits	12		
	12 Dissecting Microscopes, 1 Compound Scope	13		
	Two 486 computers, Two 386 computers	4		

1996

Project Number: 96037
Project Title: Coastal Habitat Intertidal Monitoring
Name: Contractor

FORM 4B
Equipment
DETAIL

Publication of Seabird Restoration Workshop

Project Number: 96038
Restoration Category: General Restoration
Proposer: Pacific Seabird Group
Lead Trustee Agency: U.S. Fish and Wildlife
Cooperating Agencies: None
Duration: October 1995 - September 1996
Cost FY 96: \$31,000
Geographic Area: No field work in this project
Injured Resource: Common Murre, Harlequin Duck, Marbled Murrelet, Pigeon Guillemot

ABSTRACT

To further the emerging discipline of seabird restoration, the Pacific Seabird Group (PSG) is holding a workshop in September 1995. The workshop will bring together experts in seabird biology and restoration. It will include discussions of the theoretical and practical aspects of seabird restoration and provide recommendations to allow the establishment of restoration plans founded on the best available scientific information and opinion. This proposal seeks funds for the writing and publishing of manuscripts summarizing the workshop discussions.

INTRODUCTION

The *Exxon Valdez* Oil Spill (EVOS) in 1989 caused the mortality of an estimated 100,000 to 300,000 birds totaling 90 species (Piatt *et al.* 1990). Many seabird species suffered only minor mortalities while others that had many individuals die apparently did not suffer population level impacts. In 1992 six species had not yet recovered from the effects of the spill. These were the Bald Eagle, Black Oystercatcher, Harlequin Duck, Common Murre, Pigeon Guillemot and Marbled Murrelet. By 1993 the Bald Eagle and Black Oystercatcher were considered to have recovered. (Draft EVOS Restoration Plan, 1993). In addition the status of other seabird species is currently being considered by the EVOS Trustees: Kittlitz's Murrelet, Black-legged Kittiwake, Common and Yellow-billed Loons, cormorants, Arctic Terns and Scoters.

Seabird restoration as discipline is in its infancy and represents a new approach to seabirds. Over the past twenty years seabird biologists have conducted studies on the natural and anthropogenic factors that can contribute to fluctuations in numbers or effect productivity. Seabird managers working for agencies have been primarily concerned with cataloguing and maintaining populations. Only recently have scientists and managers had to decide how best to spend restoration funds in the wake of an oil spill or other pollution event believed to have affected seabird populations.

To address this problem the Pacific Seabird Group will hold a workshop of recognized experts in seabird biology and management to discuss the current state of seabird restoration. The workshop is being held

in Alaska in late September 1995 and, through plenary sessions and small group discussions, will allow the attendees to address the theoretical and practical basis for seabird restoration plans. The workshop will produce:

- 1) A summary of the type of baseline data needed to develop effective restoration plans and a listing of the information needed to develop restoration plans for the species that have still not recovered from the EVOS.
- 2) A summary of the type of post-spill research and monitoring that needs to be conducted to assess the degree and reasons for the state of recovery.
- 3) A summary of known restoration techniques (what is included in the EVOS categories of general restoration and habitat acquisition) and an evaluation of these techniques for the EVOS seabirds that have yet to recover.
- 4) A list of untested techniques judged to have enough potential that further research is warranted.

As of late April the selection of 25 attendees is nearly complete and a list of subgroup discussion topics has been developed. Principal subgroup topics are:

- Pre-spill baseline data sets
- Damage assessment and post-spill monitoring
- Restoration techniques
- Seabird population biology

Additional topics and detailed items to be addressed by each subgroup will be developed in the next two months.

NEED FOR THE PROJECT

A. Statement of Problem

Some seabird species affected by the *Exxon Valdez* Oil Spill have failed to attain pre-spill population levels. Little discussion has occurred on how funds allocated to restore seabird populations can best be spent. Much of the work done in restoration ecology has addressed restoration of habitats that are not expected to recover without human assistance or direct restoration of species that have declined to the point where recovery without human intervention appears doubtful. Most seabirds, however, have populations that naturally fluctuate and natural recovery from major declines caused by episodic natural or anthropogenic effects is common. The ability to recover naturally has complicated the development of seabird restoration plans since for restoration activities to be effective they must substantially increase the rate of recovery over what would occur naturally. Additionally much of the discussion of restoration options that has occurred has been conducted in a litigious setting where an unbiased scientific examination of hypotheses and theories may not be possible.

B. Rationale

To provide for the first open scientific discussion of seabird restoration the Pacific Seabird Group is holding a seabird restoration workshop in FY95 to bring together recognized experts on seabirds, marine

ecology, and restoration to examine seabird restoration needs and options. The current proposal seeks to continue this examination after the workshop through the preparation of manuscripts on the discussions that occurred at the workshop and topics identified by workshop participants as being of sufficient importance to warrant additional attention and review articles. In the months following the workshop PSG will solicit information and opinions from seabird biologists and managers who were not able to attend the workshop but whose information and opinions will enhance the final publication. Additionally, by publishing the results of the workshop, information on the current state of seabird restoration will be available to a larger audience.

C. Summary of Major Hypotheses and Objectives

Development and implementation of seabird restoration plans have suffered from a lack of discussion of the practical and theoretical issues relating to seabird restoration. The seabird restoration workshop being held in September 1995 will address many issues in need of consideration by trustee councils. The Pacific Seabird Group believes that major progress can be made through the convening of a workshop on seabird restoration and publication of the workshop discussions.

D. Completion Date

It is anticipated that the manuscripts generated by this work will be accepted for publication during FY 96.

COMMUNITY INVOLVEMENT

The publication of the results of the seabird restoration workshop will provide the first attempt to define and discuss seabird restoration. It will provide the public, a document that will discuss in detail the types of baseline and post-spill monitoring needed to develop restoration plans and the current restoration techniques available to seabird managers. This information should be of interest to those communities and organizations in the spill area concerned attempting to understand the recovery of spill-impacted species.

FY 96 BUDGET

Personnel	0.0
Travel	2.5
Commodities	28.5
Equipment	0.0
Subtotal	31.0
Gen. Admin.	0.0
Total	31.0

PROJECT DESIGN

A. Objectives

1. To allow input from experts not able to attend the 1995 Seabird Restoration Workshop.
2. To allow completion of manuscripts summarizing the results of the 1995 Seabird Restoration Workshop.
3. To publish a book containing the "white papers" and summaries of discussions from the 1995 Seabird Restoration Workshop.

B. Methods

Papers presented at the Pacific Seabird Group's 1995 Seabird Restoration Workshop, summaries of small group discussions and some papers written after the workshop will be published in a book or professional scientific journal. These papers will include summaries of relevant literature and the information and opinions from recognized experts in seabird biology and restoration.

C. Contracts and Other Agency Assistance

All work will be done by contract with contracts being awarded by a steering committee composed of PSG officers. Selection of persons receiving contracts will be done through the solicitation of proposals or through recognition of individuals who are in a unique position to write an article. U.S. Fish and Wildlife biologists will be asked to provide summaries of damage assessment and previous restoration activities.

D. Location

The workshop will be held in Girdwood, Alaska in September-October 1995. Manuscript preparation and editing will take place at offices of the authors, editors and PSG.

SCHEDULE

A. Measurable Projects Tasks for FY 96

September 29 - October 2	Seabird Restoration Workshop at Alyeska
November 1	Drafts of workshop discussions submitted
November - December	White papers and workshop discussion papers circulated to experts unable to attend the workshop
November - March	Preparation of review articles based on recommendations of workshop attendees
January-March	White papers and workshop discussion papers revised by authors based on information and opinions from reviewers

July Final drafts of white papers, workshop discussions and review articles submitted to editors for publication in articles in a journal or chapters in a book.

B. Project Milestones and Endpoints

Manuscripts on subgroup discussions, post-meeting discussion and literature review will be completed on the following schedule:

November 1	Drafts of workshop discussions submitted and sent out for review by discussion group members and outside reviewers
January 1	Review of draft manuscripts completed March 1 - Final draft of manuscripts submitted to technical editor
July 1	Technical editor completes editing of manuscripts and submits articles to a publisher.

Schedule of publication after manuscript submission will be determined by the publisher.

C. Project Reports

November 1	Draft report of the workshop (funded with FY 95 funds) will be submitted on November 1 and complete the work done with FY 95 funds
April 15	Progress report including recent drafts of all articles being prepared for publication and information on the proposed publication outlet

Another report will be submitted when a publisher has been found, including details of the publishing arrangements. The final report will be submitted when after publication.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Organizers of the seabird restoration workshop have discussed its objectives and format with U S Fish and Wildlife Service and non-agency biologists conducting the recovery of seabirds from the *Exxon Valdez* oil spill. This has included conversations with investigators from the following Trustee Council funded projects:

94039 Common Murre Population Monitoring	DOI-USFWS
94066 Harlequin Duck Recovery Monitoring	ADFG
95159 Marine Bird and Sea Otter Boat Surveys	DOI-USFWS
94506 Pigeon Guillemot Recovery	DOI-USFWS

Additionally scientists contracted with Exxon have been consulted regarding their views on to how best to frame the discussion of restoration options. The implementation of restoration plans is the responsibility of a trustee council, however, the gathering of baseline data that is essential to the

development of restoration plans is the responsibility of normal agency management. The guidelines that will be generated by the workshop will examine the nature and quantity of baseline data that should be gathered through normal agency management activities.

ENVIRONMENTAL COMPLIANCE

Not applicable.

PERSONNEL

The project leaders are Craig S. Harrison, PSG Vice-Chair for Conservation, and Kenneth Warheit, Coordinator PSG Restoration Committee. The steering committee is composed of the two project leaders and PSG officers Mark Rauzon, Chair; John Piatt, Past Chair, and Bill Everett, Chair-elect. Harrison practices environmental law in the Washington, D.C. office of Hunton and Williams. Mr. Harrison was a wildlife biologist with the U.S. Fish and Wildlife Service (1975-83), supervising seabird research programs regarding oil and gas development in surveys under the Outer Continental Shelf Environmental Assessment Program in the EVOS area. He also conducted research on marine environmental issues as the East-West Center's Environment and Policy Institute in Honolulu. Mr. Harrison has written extensively in peer-reviewed journals on wildlife biology and conservation, natural resource law and policy, and pollution. In 1990, Cornell University Press published Mr. Harrison's *Seabirds of Hawaii: Natural History and Conservation*, which was nominated for the Wildlife Society's book award. He has served on the Executive Council of the PSG for 12 years, is currently the Vice-Chair for conservation and has been the primary author of the PSG's comments on the EVOS recovery plan and annual work plans.

Kenneth Warheit received his doctorate from the University of California, Berkeley, in 1990. Research conducted by Dr. Warheit at U.C. Berkeley concerned the community ecology of rocky intertidal systems, and ecology, systematics, morphometry, and paleontology of seabirds, particularly sulids and eastern Pacific Common Murres. From 1990 through 1993 Dr. Warheit was postdoctoral fellow at California Academy of Sciences and Smithsonian Institution. During this time, he continued his work on systematics, morphology, and ecology of seabirds. In 1993, Dr. Warheit received a Research Associateship from the Burke Museum, University of Washington, Seattle, and was project leader and coordinator for a National Science Foundation funded project to sort and salvage seabirds killed by the *Exxon Valdez* oil spill. In 1993 Dr. Warheit also joined the Washington Department of Fish and Wildlife and is now the statewide coordinator for oil spill resource damage assessments. The design and implementation of seabird restoration projects for the *Tenyo Maru* and *Nestucca* oil spills are among his primary responsibilities. He is Coordinator of the PSG's Restoration Committee, and his duties include preparing response to proposed restoration proposals.

Authors of subgroup summaries and the technical editor will be determined by the PSG steering committee.

Craig Harrison

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Vice-chair for Conservation
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fax:
e-mail:

5/1/95

Date prepared

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$6.0	\$0.0						
Travel	\$30.0	\$2.5						
Contractual	\$35.0	\$28.5						
Commodities	\$0.0	\$0.0						
Equipment	\$0.0	\$0.0						
Subtotal	\$71.0	\$31.0	LONG RANGE FUNDING REQUIREMENTS					
Indirect	\$3.4		Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$74.4	\$31.0						
Full-time Equivalents (FTE)		0.0						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments: Management of the project will be done by an unsalaried project coordinator and a four-person steering committee. PSG will contract for editing and writing of technical documents for publication and reimburse authors for expenses incurred during manuscript preparation (i.e. phones, fax, copying).								

1996

Project Number: 96038
Project Title: Publication of Seabird Restoration Workshop
Name: Pacific Seabird Group

FORM 4A
Non-Trustee
DETAIL

Prepared 29 April 1995

5/1/95

1996 EXXON VALDEZ TRUSTEE INCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1996
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
Subtotal			0.0	0	0	
Personnel Total						\$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FFY 1996
Trustee required travel to Anchorage for one-week workshop		600	1	5	150	1.4
Trustee required travel to Anchorage for three-day workshop		600	1	3	150	1.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
Travel Total						\$2.5

1996

Project Number: 96038
Project Title: Publication of Seabird Restoration Workshop
Name: Pacific Seabird Group

**FORM 4B
Personnel
& Travel
DETAIL**

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Editing and writing of technical documents for publication		10,000.0
Incidental expenses incurred by authors and editors during manuscript preparation and publication		3,500.0
Printing of seabird restoration workshop		15,000.0
Contractual Total		\$28,500.0
Commodities Costs:		Proposed
Description		FFY 1996
Commodities Total		\$0.0

1996

Project Number: 96038
Project Title: Publication of Seabird Restoration Workshop
Name Seabird Group

FORM 4B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE NCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
	None			0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units		
Description				

1996

Project Number: 96038
Project Title: Publication of Seabird Restoration Workshop
Name: Pacific Seabird Group

FORM 4B
Equipment
DETAIL

96043A

Cutthroat Trout and Dolly Varden Char Population and Habitat Monitoring

Project Number: 96043 *A*

Restoration Category: Monitoring

Proposer: USFS Cordova Ranger District

Lead Trustee Agency: USFS

Cooperating Agencies: N/A

Duration: Two fiscal years. FY 1996, FY 1997

Cost FY 96: \$29,600

Cost FY 97: \$22,700

Geographic Area: Prince William Sound

Injured Resource: Cutthroat Trout, Dolly Varden Char

ABSTRACT

Beginning in 1993, a weir has been operated at Mile 18 Creek near Cordova to monitor the populations of anadromous cutthroat trout and Dolly Varden char, determine population variability, estimate survival rates, and learn more about migration patterns and habitat requirements. Continued study at the weir in 1996 and 1997 will complete the data needed for determining survival rates for several year classes and will give a good indication of the population variability. At this point, both populations appear to be relatively small and highly variable. Preliminary habitat results indicate that additional protection may be needed for small headwater and muskeg runoff streams. Restoration efforts in other watersheds may need to be directed at these types of streams.

INTRODUCTION

This project is a continuation of 95043.

A full-capture weir has been operated on Mile 18 Creek near Cordova to assess the populations of cutthroat trout and Dolly Varden char, determine the variability of these populations, estimate survival rates, and learn more about migration patterns and habitat requirements. Cutthroat trout have also been radio-tagged to identify their spawning areas. The spawning substrate has been analyzed, and other stream characteristics such as water velocity, depths, channel width, and channel type have been noted.

The preliminary results show that the number of outmigrants for both species is highly variable and the

survival rates appear to be low. The number of outmigrating Dolly Varden char fell from 990 in 1993 to 144 in 1994, while the number of cutthroat fell from 243 to 110. Exact survival rates cannot be calculated yet. Given the survival rates for these species reported by Hepler et al. (1993), the Mile 18 Creek populations could be severely affected by heavy fishing pressure or other impacts during these low production years.

The radio-tracking has shown that cutthroat trout are spawning in all sections of the system, but are using areas with low water velocities (less than 0.5 to 0.8 f/s). The substrates also contained high percentages of fine material, 43.2% to 52.4% less than 0.25 inches. This causes some concern since laboratory experiments showed that cutthroat egg-to-fry survival rates were low when fine sediment levels were in this range (Weaver and Fraley 1993). One other surprising result was that a spawning pair was found in a muskeg runoff stream approximately 2 ft. wide and 6 inches deep. Thus, it appears that many small, low-volume streams, which have not been regarded as anadromous fish habitat, may be important areas for cutthroat spawning.

In FY 1995, this spawning habitat information will be put to use in the Eyak Lake watershed near Cordova. A number of small streams flowing into the lake will be surveyed to see if cutthroat trout are using similar spawning areas and to see if these areas have been impacted by road construction or other development. This work will be used to validate the findings in the Mile 18 Creek study, and, if needed, provide direction for restoration projects in the future.

The operation of the weir, radio-tracking, and substrate sampling will continue in 1995, 1996, and 1997. This will give us survival estimates for several year classes of fish and a better idea of the variability of the populations. Additional spawning area and substrate information is needed, since only a limited number of fish have been tracked so far.

NEED FOR THE PROJECT

A. Statement of Problem

Hepler et al. (1993) reported that the survival rates and growth of Dolly Varden char and cutthroat trout were adversely affected by the oil spill. Although the extent of the damage or the rate of recovery are unknown, there is still widespread concern over the populations. The Alaska Department of Fish and Game imposed emergency closures on cutthroat trout fishing in Prince William Sound for several years following the oil spill. Local fishermen in the Cordova area have also provided anecdotal information indicating that the cutthroat trout populations have decreased significantly since the mid-1980's. In response to the declining numbers, ADF&G has closed cutthroat trout fishing during the spawning season and has lowered the bag limit at other times.

The most important problem is the lack of basic information about cutthroat trout and Dolly Varden char populations. Preliminary results from Mile 18 Creek and the data presented by Hepler et al. (1993) indicate that populations are highly variable, which makes it uncertain whether the apparent declines in populations are part of a natural cycle or the result of some other factor. Until these questions are resolved, management decisions and restoration projects cannot be fully evaluated.

Additional information is also needed on habitat requirements, especially spawning areas and substrates. As mentioned earlier, cutthroat trout were utilizing areas previously thought to be of no value for fish production. As timber harvest and other activities increase in the Prince William Sound area, there will be a need to better define the critical habitats so they can be protected or restored if they have already been damaged.

B. Rationale

The information this project will provide will help us better monitor and evaluate habitat restoration projects that have been completed in other parts of Prince William Sound. As stated in the restoration objectives for cutthroat trout and Dolly Varden char, most of the work so far has been to enhance populations to protect them from future impacts. With a better understanding of the variability of the populations we will be better able to tell how successful these enhancement efforts have been. The habitat information will also be used for proposed restoration efforts in logged areas. Much of the information on small stream utilization for spawning will help us determine what sort of impact there has been.

C. Summary of Major Hypothesis and Objectives

The main objectives for FY 1996 and FY 1997 are to continue to monitor the anadromous populations, determine survival rates and population variability for several year classes, and identify a sufficient number of cutthroat spawning areas to adequately characterize the preferred habitat and substrate composition.

Based on the findings of Hepler et al. (1993) and House (1995) in undisturbed habitats, it is hypothesized that the populations could vary considerably, perhaps as much as 100% to 300%. Survival rates are expected to be between 24% and 35% (Hepler et al. 1993). If survival rates are substantially lower or the populations decrease more dramatically, it would be an indication that some external factor, such as sportfishing, is affecting the fish and that protective management is necessary.

Another hypothesis, based on observations and anecdotal information, was that cutthroat trout were using smaller streams for spawning than has been reported in the literature. Our preliminary work has shown that the spawners are utilizing areas with depths, substrate sizes, and flows at the extreme lower ranges of those reported in literature reviews by Trotter (1989) and Pauley et al. (1989). As additional spawners are tracked, we will find whether these smaller streams are providing an important percentage of the spawning area in the system or whether their use is relatively infrequent.

D. Completion Date

The project should be completed in 1997. By then we should have sufficient data to accomplish the stated objectives.

COMMUNITY INVOLVEMENT

The Cordova Flyfishers have shown particular interest in this project. Presentations have been made at the group's meetings, and in the discussions afterwards, the members have contributed a great deal of

information on past populations, run timing, and habitat. This group will continue to be informed and consulted as the project continues.

FY 96 BUDGET

Personnel	22.7
Travel	1.5
Contractual	1.5
Commodities	0.4
Equipment	0.0
Subtotal	26.1
Gen. Admin..	3.5
Total	29.6

PROJECT DESIGN

A. Objectives

The objectives for FY 1996 and FY 1997 are:

1. Monitor the populations of anadromous cutthroat trout and Dolly Varden char to establish the range of variation over a five-year period.
2. Determine the survival rates of both species.
3. Radio-track cutthroats to determine spawning areas and characterize preferred stream conditions and substrate composition.

B. Methods

To determine the number of anadromous fish, a full-capture weir is operated from the beginning of April to late June or July at the mouth of Mile 18 Creek. The weir captures fish moving both upstream and downstream. In the past years, few or no fish have been captured during the first several days of operation, so we are confident that we are missing very few fish. The weir is taken down after the migration has ceased. Thus, we can obtain a direct and total count of the anadromous populations.

The fish are marked with a unique clip for each year, measured, and weighed. Fish recaptured from previous years are identified. Scales are taken from the cutthroat trout for age determination. The trout are also checked to see if they are sexually ripe, as determined by the presence of milt or eggs, and spawning color.

Survival will be determined using the Jolly-Seber model described in Bernard and Hansen (1992). For cutthroat trout, scale samples will allow determination of age and in turn, survival of year classes. This is important since survival may vary by age. Dolly Varden char scales are small and generally not reliable for

aging, but general age groups can be made based on length (Hepler et al. 1993; Armstrong 1971).

Radio-tagged cutthroat trout are tracked to determine where they are spawning. The stream segments are characterized using channel types described by Paustian et al. (1992). Water depths and velocities are measured. Substrate samples are collected with a McNeil sampler (McNeil and Ahnell 1964) and sieved to determine particle size distribution. A regression equation relating particle size and percent by weight can then be calculated for each sample and can be compared with equations for samples in other areas (Tappel and Bjornn 1983).

C. Contracts and Other Agency Assistance

No contracts will be needed.

D. Location

The project area encompasses the Mile 18 Creek watershed, 18 miles east of Cordova, Cordova B-4 quadrangle, T16S, R1E, sections 18, 19, 30, 31 and R1W sections 13, 24, 25. Although this project will be conducted in the Cordova area, the information will be applicable to cutthroat trout and Dolly Varden char populations throughout the Sound. Thus it will benefit all of the Sound communities.

SCHEDULE

A. Measurable Project tasks for FY 96

March:	Purchase equipment, arrange logistics.
April:	Set up weir at ice-out and begin operations.
April - July:	Operate weir.
August:	Check for cutthroat fry emergence, conduct substrate samples.
September - November:	Analyze data and write report.

B. Project Milestones and Endpoints

All data collection will end with the close of the field season FY 97. Final analysis will take place at that time, and the final report will be completed by April 1998.

C. Project Reports

The annual report for FY 1996 should be completed by November 1997 and will include survival rates for fish captured in the first year, substrate analyses, and additional population data.

COORDINATION AND INTEGRATION OF RESTORATION EFFORTS

This project will not require coordination with other restoration efforts. The information gained from this project will, however, be useful in the monitoring of other cutthroat trout habitat enhancement projects

currently being undertaken. The habitat information can also be used with proposed restoration work in logged areas in Prince William Sound.

The role of the U.S. Forest Service is primarily to manage habitat, while the Alaska Department of Fish and Game is generally responsible for managing populations. ADF&G Sport Fish Division is a partner in this project, providing some equipment and material, but is unable to provide other assistance. Thus, the main effort is being conducted by USFS personnel, although it is not a part of the agency's normal management responsibility.

ENVIRONMENTAL COMPLIANCE

This project is a study of limited scope and intensity, and thus is categorically excluded from documentation in an Environmental Assessment or Environmental Impact Statement. A project or case file is not required.

No permits or other authorization are required.

PERSONNEL

Project Leader:

Ken Hodges
USDA Forest Service, Cordova Ranger District
P.O. Box 280, Cordova, AK 99574
(907) 424-7661 (telephone)
(907) 424-7214 (Fax)

Responsibilities: Carry out project, analyze data, write reports.

Ken Hodges is a fisheries biologist on the Cordova Ranger District. He has a B.S. degree in fisheries from Humboldt State University. Before coming to the District in 1989, he had worked as a seasonal employee for the Oregon Dept. of Fish and Wildlife and conducted a one-year study on steelhead genetics in Northern California. In Cordova he has worked as a fisheries technician and now as a biologist.

Project Manager:

Ray Thompson
USFS
Chugach National Forest
3301 C Street, Suite 300
Anchorage, AK 99503
phone (907) 271-2500

Date Prepared

Literature cited

Armstrong, R.H. 1971. Age, food, and migration of sea-run cutthroat trout, *Salmo clarki*, at Eva Lake, southeastern Alaska. Transactions of the American Fisheries Society. 100:2:302-306.

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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$19.1	\$22.7						
Travel	\$1.8	\$1.5						
Contractual		\$1.5						
Commodities	\$0.8	\$0.4						
Equipment		\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$21.7	\$26.1	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$3.5						
Project Total	\$21.7	\$29.6	\$21.5	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Full-time Equivalents (FTE)	0.5	0.5						
Dollar amounts are shown in thousands of dollars.								
Other Resources	\$18.0	\$18.0	\$18.0					

Comments:

Other resources: USFS funding for habitat work. Population study is outside of normal USFS management responsibility.

1996

Project Number: 96043 - A

Project Title: Cutthroat Trout and Dolly Varden Char Population and
Habitat Monitoring

Agency: USFS

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared

14/28/95
1 of 8

1/1/95

1996 EXXON VALDEZ TRUST DUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996	
PM	Name	Position Description						
	D.Schmid	Project Leader	GS-11-5	0.5	4,620	0	2.3	
	J. Hodges	Project Support	GS-9-3	0.5	3,864	0	1.9	
	GS-7 -one	Fisheries tech	GS-7	2.4	3,339	0	8.0	
	GS-5-one	Fisheries tech	GS-5	1.2	2,058	0	2.5	
	GS-4-one	Fisheries tech	GS-4	1.2	1,764	0	2.1	
*	R. Thompson	Program Manager	GS-13	1.0	5,928		5.9	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
Subtotal				6.8	21,573	0		
Those costs associated with program management should be indicated by placement of an *.							Personnel Total	\$22.7
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996	
PM	Description							
	One trip to Anchorage for EVOS Workshop		224	1	5	138	0.0	
	One trip to Anchorage for EVOS Workshop		224	1	3	138	0.9	
							0.6	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
							0.0	
Those costs associated with program management should be indicated by placement of an *.							Travel Total	\$1.5

1996

Project Number: 96043 - A
 Project Title: Cutthroat Trout and Dolly Varden Char Population and
 Habitat Monitoring
 Agency: USFS

**FORM 3B
 Personnel
 & Travel
 DETAIL**

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Report publication/printing		1.5
When a non-trustee organization is used, the form 4A is required.		Contractual Total
		\$1.5
Commodities Costs:		Proposed
Description		FFY 1996
Miscellaneous supplies		0.4
Commodities Total		\$0.4

1996

Project Number: 96043 - A
 Project Title: Cutthroat Trout and Dolly Varden Char Population and
 Habitat Monitoring
 Agency: USFS

FORM 3B
 Contractual &
 Commodities
 DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.			New Equipment Total	\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				
			0	

1996

Project Number: 96043 - A
Project Title: Cutthroat Trout and Dolly Varden Char Population and
Habitat Monitoring
Agency: USFS

FORM 3B
Equipment
DETAIL

96043B

Monitoring of Cutthroat Trout and Dolly Varden Habitat Improvement Structures

Project Number:	96043 - B
Restoration Category:	Monitoring
Proposer:	USFS
Lead Trustee Agency:	USFS
Cooperative Agencies:	None
Duration:	5 Years
Cost FY 96:	\$40,400
Cost FY 97:	\$27,700
Cost FY 98:	\$27,700
Cost FY 99:	\$18,400
Cost FY 00:	\$ 8,000
Geography Area:	Western Prince Williams Sound
Injured Resource / Service	Cutthroat Trout and Dolly Varden

ABSTRACT

This project provides for monitoring of habitat improvement structures and their effects on cutthroat trout and Dolly Varden populations. These structures were installed in 1995 under EVOS Restoration Project number 95043B. Additionally this proposal would provide for a project completion report of project number 95043B.

INTRODUCTION

In 1989 the oil tanker *Exxon Valdez* ran aground on Bligh Reef spilling millions of gallons of crude oil into Prince William Sound (PWS). The ensuing oil spill damage assessment identified oil spill related injuries to the cutthroat trout (*Onchorhynchus clarki*) and Dolly Varden char (*Salvelinus malma*) populations among other species in PWS. Information collected in 1989-1991 by the Natural Resources Damage Assessment (NRDA) studies documented lower growth rates for cutthroat trout and Dolly Varden char in oiled areas than in unoiled areas. The reduced growth rates persisted into 1991 when

studies were discontinued. It is unknown if growth rates have since returned to normal. Mortality rates for sea-run Dolly Varden char in oiled areas were significantly higher than rates from sites in the non-oiled areas of eastern PWS (EVOS Trustee Council, 1994).

Cutthroat trout in PWS are at the northern extent of the species' North American range. Generally speaking, species inhabiting the extreme limits of their habitat exhibit higher sensitivities to environmental stresses than the same species well within the habitat limits. Little is known of the genetic diversity, distribution, or life histories of cutthroat trout in PWS. The cutthroat trout stocks known to exist within PWS are few in number. The Otter Creek population, as well as others, appear to be discrete populations with limited interbreeding with other cutthroat stocks. It is highly possible that there have been unique genetic adaptations in these populations due to local conditions and their relative isolation from other stocks. The population in a given stream system rarely number more than 1,000 individuals. Several stocks of cutthroats within PWS appear to be anadromous and have a limited home range within streams (Heggenes et al., 1991). The number of streams within PWS that have cutthroat trout populations is unknown. Of 143 streams surveyed for spawning salmon in 1989, anadromous cutthroat trout were found in only 10 streams. 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, peaking in September and October (Trotter 1989; Wedemeyer 1993). In Prince William Sound, field observations indicate cutthroat are spring spawners.

Sampling by Glacier Fisheries Crews in 1994 indicated that cutthroat trout densities were greatest in the medium gradient tributary stream to Otter Lake and in the upper reaches of Otter Creek. This is consistent with studies that have shown that cutthroat trout juveniles are pushed to less desirable habitats by the more dominant coho salmon juveniles (Glova and Mason, 1976). Interspecific competition with juvenile coho salmon limits cutthroat trout production. Quality pool rearing habitat is a key factor in cutthroat trout production.

During the 1995 field season Glacier Ranger District crews will be installing habitat improvement structures at Otter Lake, Gunboat Lakes, Red Creek and Billy's Hole to improve cutthroat trout and Dolly Varden habitat in PWS. These structures were installed under EVOS Restoration Project Number 95043B. The distribution and densities of cutthroat trout, Dolly Varden and coho salmon would be monitored at these locations using standard mark recapture techniques and snorkel surveys. If suitable control streams can be located they would also be monitored. Instream structures installed in 1995 would also be monitored. The existing habitat that may be effected by the structures would be physically measured and microhabitats classified accordingly on an annual basis for comparison. Monitoring would commence on an annual basis and continue for four years.

NEED FOR THE PROJECT

A. Statement of Problem

Limited information is available on the genetic diversity, distribution, competitive interactions or general life histories of cutthroat trout in PWS.

B. Rationale

Additional information on cutthroat trout distribution, habitat utilization and competitive interaction with juvenile coho in PWS will assist managers in making future decisions that may affect cutthroat trout.

Monitoring prior to and after the installation of improvement structures will provide necessary information to ascertain the effectiveness of the various projects or of a particular structure.

C. Summary of Major Hypotheses and Objectives

The number of cutthroat trout at the project locations will increase due to the habitat improvements made in 1995.

This projects objectives are to determine the relative abundance and distribution of cutthroat trout and juvenile coho salmon after improvement structure installation and the effectiveness of the habitat improvements made in 1995 for a period of one life cycle of coho salmon.

D. Completion Date

Baseline data will be collected prior to any habitat improvement work in 1995. Data to meet the project objective will be collected in 1996, 97, 98, with a final field survey and project completion report in 1999

COMMUNITY INVOLVEMENT

On January 20, 1994 letters were mailed to 156 individuals, agencies and organizations requesting comments on the proposed habitat enhancement for cutthroat trout in Otter Creek that this proposal is designed to monitor.

In January of 1994, the "Chugach National Forest Schedule of Proposed Actions for Environmental Analysis" was mailed to more than 600 individuals, agencies and organizations. This document has since been mailed on a quarterly basis. The mailings included the Otter Creek project and a contact person for additional information concerning the project.

Given the degree with which the project to install the structure was circulated for review and the lack of response, it is anticipated that monitoring of the project will generate even less input. The locations of these projects are remote and presently there is no known significant use of cutthroat trout in these areas by communities affected by the oil spill.

FY 96 BUDGET

The following is the estimated cost for the project in federal FY 96.

Personnel	23.4
Travel	6.4

Contractual	1.5
Commodities	4.1
Equipment	1.4
Subtotal	36.8
Gen. Admin..	3.6
Total	40.4

PROJECT DESIGN

A. Objectives

The objective of this project in general is to monitor and document the response of cutthroat trout to modifications made to their environment.

Specific objectives are:

1. Measure abundance and distribution of cutthroat trout and juvenile coho in the proposed project locations for the period specified.
2. Measure and monitor cutthroat and juvenile coho utilization of newly installed habitat improvements
3. Measure and monitor the effects that structures have on adjacent aquatic microhabitats.
4. Provide a project completion report on project number 95043B.
5. Provide annual project reports on the proposed project.
6. Provide a project completion report and a summary of our findings on the effectiveness of the habitat structures installed in 95.

B. Methods

The major hypotheses for this project states that the number of cutthroat trout at the project locations will increase due to the habitat improvements made in 1995. To test this hypotheses and meet the projects objectives five working hypotheses have been developed.

Working Hypotheses:

- Hypotheses 1. The abundance of cutthroat trout at the project sites will increase over the project duration.
- Hypotheses 2. The current distribution of cutthroat trout within the project area will change over the duration of the project.
- Hypotheses 3. Cutthroat trout will be the predominant species to utilize the newly created habitat

structures.

Hypotheses 4. Aquatic microhabitats adjacent to areas of improvement will be affected by the structures installed in 1995.

Hypotheses 5. The structures installed in 1995 benefited cutthroat trout at those project locations.

To test hypotheses number one through three baseline data on the relative abundance, distribution and habitat of cutthroat trout at the project locations will have to be collected during the 1995 field season and then on an annual basis there after for the proposed project duration.

Cutthroat abundance will be estimated using a method described in Hankin's (1986) report, Sampling Designs for Estimating the Total Number of Fish in Small Streams. The specific method will be of a two stage stratified random sampling design utilizing auxiliary variables to bias estimators. This method is described in detail as Design B: Ratio Estimation in Hankin's report. The technique for population estimation in each primary unit will be the mark-recapture method known as the Petersen Index using Bailey's (1951) formula to correct for bias. Collection will be conducted using baited minnow traps and fish will be marked by subcutaneous injection of fluorescent dyes. Project area streams will be surveyed and habitats classified using the Hankin and Reeves (1988) methodology.

The stream habitat surveys will be conducted during the early part of the 1995 field season in conjunction with the installation of the improvement structures. Data collected from the surveys will be analyzed and the associated habitat units characterized. Primary units (those to be sampled) will then be selected by stratified random sampling. The strata will consist of various size pools, riffles, glides and any other habitat type discovered to be closely associated with cutthroat trout.

Once primary units have been selected population estimations will be made using the method described earlier. These estimations should be done in mid to late summer to minimize bias due to seasonal migration of 1+ fish within the stream, estimations will focus on this age class of fish. The selected primary units will become the permanent trapping sites for population estimations in subsequent years. Annual population estimates of the primary units for the project duration should provide enough information to detect a change in the relative abundance and distribution of 1+ cutthroat trout at the project sites.

Structures and their effects on adjacent habitat types will also be monitored by physical measurements and habitat classification. Additionally an annual photographic record of each structure will be established and maintained over the project duration.

Hankin in his (1986) report discusses errors of estimation of the total number of fish in a stream arising from two sources: (1) extrapolation from the small number of sampled sections to the entire stream, and (2) errors of estimated fish numbers within sampled sections. Hankin demonstrated that errors arising from the first source will usually be far greater than those from the second source, and that total errors of estimation can be reduced by making sampled sections equivalent to natural habitat units. By stratifying these habitat units and selecting sampling units randomly the precision of estimators can be improved and information on the distribution of cutthroat trout within the stream can be gathered.

Mark-recapture population estimates for primary units utilizing minnow trapping techniques will lead to errors in estimated fish numbers for sampled sections due to size selectivity and inefficiency of minnow traps to capture all individuals within a population. There is however a correlation between the sampled catch and the true population for a given size of individuals within a population. This is discussed in a 1976 paper by Arthur M. Bloom, Evaluation of Minnow Traps for Estimating Populations of Juvenile Coho Salmon and Dolly Varden. Cutthroat trout of 1+ age class fall within this size range. Currently ADF&G restricts the use of electrofishing in streams containing trout.

C. Contracts and Other Agency Assistance

This project will be implemented by the U.S. Forest Service no contracts are expected at this time.

D. Location

Monitoring will occur at the project sites listed for the Cutthroat Trout / Dolly Varden Habitat Improvement Project, number 95043B.

Otter Creek, Bay of Isle, Night Island, PWS.
Gunboat Creek, Eshamy Bay, Western PWS.
Red Creek, Esther Passage, PWS.
Billy's Hole, Long Bay, Northern PWS.

SCHEDULE

A. Measurable Project Task for FY 96

June 12 - Aug 9 (1995): Install habitat structures, Perform habitat surveys, Select sampling units
Aug 14 - Aug 31 (1995): Conduct mark-recapture population estimates of primary units.
April 15 (1996): Project completion report on project number 95043B.
April 15 (1996): Report on preliminary finds of population and distribution estimations.
Aug 12 - Aug 31 (1996): Inspect and measure effects of installed structures. Conduct population estimates of primary units.

B. Project Milestones and Endpoints

June 12 - Aug 9 (1995): Install habitat structures, Perform habitat surveys, analyze data. Select sampling units.
Aug 14 - Aug 31 (1995): Conduct mark-recapture population estimates of primary units. Establish permanent sampling locations.
April 15 (1996): Project completion report on project number 95043B. Objective (4) completed.
April 15 (1996): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (5) completed.
Aug 12 - Aug 31 (1996): Inspect and measure effects of installed structures. Conduct population estimates of primary units.

April 15	(1997): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (5) completed.
August	(1997): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15	(1998): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (5) completed.
August	(1998): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15	(1999): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (5) completed.
August	(1999): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15	(2000): Provide a final report for peer review summarizing project results. This will satisfy objectives (1, 2, 3, 6).

C. Project Reports

April 15	(1996): Project completion report on project number 95043B.
April 15	(1996): Report on preliminary findings of population and distribution estimations.
April 15	(1997): Report on findings of population and distribution estimations.
April 15	(1998): Report on findings of population and distribution estimations.
April 15	(1999): Report on findings of population and distribution estimations.
April 15	(2000): Provide a final report for peer review summarizing project results.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The proposed project is an integration of project number 95043B, Cutthroat Trout and Dolly Varden Habitat Restoration in PWS. This project is designed to monitor the long term effects of implementing project number 95043B. The proposal is a response from a primary land and resource manager (Forest Service) in Prince William Sound to the effects of the *Exxon Valdez* oil spill. The Forest Service has focused on this species as a result of the injury incurred from the oil spill. The proposal is not part of the normal Forest outyear planning program, therefore no funds have been directed towards this project within the Forest Service budgeting process.

ENVIRONMENTAL COMPLIANCE

All NEPA requirements have been satisfied to implement this project. The monitoring activities listed in this proposal were outlined in two EA's currently under review. The EA's mentioned are: Otter Creek Cutthroat Trout Habitat Improvement Project and Gunboat, Billy's Hole and Red Creek Cutthroat Trout Habitat Improvement Project. The Glacier Ranger District annually applies for and receives a Fish Resource Permit (Scientific Collections) from the Alaska Department of Fish and Game. The project locations are listed on that permit.

PERSONNEL

Cliff Fox, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Resource Staff Officer on the Glacier District. Has 20 years experience in natural resource management with State and Federal Agencies in California, Idaho and Alaska. Has years experience in project planning, implementation, and monitoring. Has multi-resource experience holding positions in fisheries, wildlife, timber, minerals, recreation, fire, real-estate, cultural resources, Forest Planning and environmental coordination. Presently oversees the District's fisheries, wildlife, timber, ecology, minerals and air quality programs. Would be designated project manager for this proposal. Would be responsible for project oversight during implementation, environmental compliance, agency coordination, budget management and reporting.

Dan Gillikin, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Fisheries Technician and acting Fisheries Biologist on the Glacier District. He has seven years of experience as a fisheries technician with Private and Federal Agencies in Washington and Alaska. He is currently the acting Fisheries Biologist for the Glacier District and manages the District's Fisheries Program. He would work with the project manager and conduct project implementation, environmental compliance, agency coordination, budget management and reporting.

Dan Gillikin, Project Leader
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FAX (907) 271-3992

Date prepared

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$23.4						
Travel		\$6.4						
Contractual		\$1.5						
Commodities		\$4.1						
Equipment		\$1.4	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$0.0	\$36.8	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration		\$3.6						
Project Total	\$0.0	\$40.4	\$27,700.0	\$27,700.0	\$18,400.0	\$8,000.0		
Full-time Equivalents (FTE)		0.5						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96043 - B
Project Title: Monitoring of Cutthroat Trout and Dolly Varden Habitat
Improvement Structures
Agency: USFS

**FORM 3A
AGENCY
PROJECT
DETAIL**

Prepared:

1 of 4

5/1/95

October 1, 1995 - September 30, 1996

1996

FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Report publication/printing		1.5
When a non-trustee organization is used, the form 4A is required.		Contractual Total
		\$1.5
Commodities Costs:		Proposed
Description		FFY 1996
WCF SEA RANGER BOAT FUEL		2.4
WCF FLEET TRUCK FUEL		0.2
CAMP SUPPLIES		0.4
CAMP FOOD		0.5
HIP BOOTS		0.2
MISC		0.4
Commodities Total		\$4.1

1996

Project Number: 96043 - B
 Project Number:
 Project Title: Monitoring of Cutthroat Trout and Dolly Varden Habitat
 Project Title:
 Improvement Structures
 Agency:
 Agency: USFS

FORM 3B
 Contractual &
 Commodities
 DETAIL

October 1, 1995 - September 30, 1996

1996

Project Number: 96043 - B
Project Title: Monitoring of Cutthroat Trout and Dolly Varden Habitat Improvement Structures
Agency: USFS

FORM 3B
Equipment
DETAIL

Cutthroat Trout Habitat Improvement Structures

Project Number:	96043 - C
Restoration Category:	General Restoration
Proposer:	U.S. Forest Service
Lead Trustee Agency:	USFS
Cooperative Agencies:	None
Duration:	4 Years
Cost FY 96:	\$100,200
Cost FY 97:	\$10,000
Cost FY 98:	\$5,000
Cost FY 99:	\$5,000
Cost FY 00:	\$2,500
Geography Area:	Western Prince William Sound
Injured Resource / Service:	Cutthroat Trout

ABSTRACT

This project has the same focus as EVOS restoration Project 94043/95043B approved by the EVOS Trustee Council in 1994. The objective of the project is to improve cutthroat trout rearing habitat within selected streams of Western Prince William Sound. The Forest Service proposes to identify up to 4 additional streams during the 1995 field season which contain cutthroat trout populations and that indicate a potential for effective habitat enhancement opportunities. A detailed evaluation and environmental analysis would be conducted and finalized prior to the 1996 field season when implementation of the stream enhancements would take place. The project proposes placement of trees and other cover structures in the streams to increase the available cover habitat for rearing fish and to maintain and improve existing stream flows for rearing. The improvements would focus on those reaches of the streams where the highest population densities of cutthroat trout have been found to exist.

INTRODUCTION

The Forest Service is proposing to continue its cutthroat trout habitat enhancement projects within western Prince William Sound (PWS). The EVOS Trustee Council approved a similar proposal in 1994 focused on instream improvements for cutthroat trout (*Onchorynchus clarki*) and Dolly Varden char (*Salvelinus malma*). Project numbers are 94043 and 95043B as defined by the EVOS Work Plans for the previously approved projects. This proposal requests to further the enhancement work for cutthroat trout by the same methods approved in 1994. These methods focus on instream rearing habitat improvements placed in stream reaches where significant populations of cutthroat trout reside. During the 1995 field season the Forest Service will locate and survey up to 4 stream reaches which have a potential for enhancement.

The project proposes placement of trees and other cover structures in the streams to increase the available cover habitat for rearing fish and to maintain and improve existing stream flows for rearing. The improvements would focus on those reaches of the streams where the highest population densities of cutthroat trout have been found to exist.

NEED FOR THE PROJECT

A. Statement of Problem

In 1989 the oil tanker *Exxon Valdez* ran aground on Bligh Reef spilling millions of gallons of crude oil into Prince William Sound. The ensuing oil spill damage assessment identified oil spill related injuries to the cutthroat trout (*Onchorynchus clarki*) and Dolly Varden char (*Salvelinus malma*) populations among other species in PWS. Information collected in 1989-1991 by the Natural Resources Damage Assessment studies documented lower growth rates for cutthroat trout and Dolly Varden char (these species were studied together and have similar life histories) in oiled areas than in unoiled areas. In 1992 it was reported that "The highest concentrations of petroleum hydrocarbon metabolites in bile of all fish sampled in 1989 were found in Dolly Varden. Tagging studies demonstrated that the annual mortality of adult Dolly Varden in oiled areas was 32 percent greater than in unoiled areas. The larger cutthroat trout also showed higher levels of mortality in oiled than in unoiled areas. In 1989-1990, there was 57 percent greater mortality, and in 1990-1991, a 65 percent greater mortality, in oiled streams versus unoiled streams. Additionally, cutthroat trout growth rates in oiled areas were 68 percent in 1989-1990 and 71 percent in 1990-1991 of those in unoiled areas. Although concentrations of bile hydrocarbons were greatly reduced in 1990 and 1991, indicating less exposure to oil, it is unclear why differences persist in survival rates between oiled and unoiled streams." (EVOS Trustee Council, 1992).

B. Rationale

Cutthroat trout in PWS are at the northern extent of the species' North American range. Generally speaking, species inhabiting the extreme limits of their habitat exhibit higher sensitivities to environmental stresses than the same species well within the habitat limits. Little is known of the genetic diversity, distribution, or life histories of cutthroat trout in PWS. The cutthroat trout stocks known to exist within PWS are few in number. The target populations for this proposal are most likely discrete populations with limited interbreeding with other cutthroat stocks. It is highly possible that there have been unique genetic

adaptations in these populations due to local conditions and their relative isolation from other stocks. The population in a given stream system rarely number more than 1,000 individuals. Several stocks of cutthroats within PWS appear to be anadromous and have a limited home range within streams (Heggenes *et al.*, 1991). The number of streams within PWS that have cutthroat trout populations is unknown. Of 143 streams surveyed for spawning salmon in 1989, anadromous cutthroat trout were found in only 10 streams.

Stream surveys focusing on location of cutthroat trout populations will further the information base on this species. Enhancements to cutthroat trout rearing habitat should result in increased survival opportunity for the species. The increase in habitat should result in a measurable increase in the local populations. This increase would assist in the species recovery from the effects of the oil spill and provide a slight overall increase in the species presence in Prince William Sound.

Through the monitoring program proposed for this project and the monitoring program for the previously approved project, additional information specific to cutthroat trout distribution, habitat utilization, and competitive interaction with juvenile coho salmon (*Onchorynchus kisutch*) can be gained. This information will assist resources managers in making future decisions that may affect cutthroat trout.

C. Summary of Major Hypotheses and Objectives

The proposed habitat improvements would improve the quality and increase the available rearing habitat for cutthroat trout. This increase in habitat should result in an increase in cutthroat trout in Prince William Sound.

D. Completion Date

Instream habitat improvements would be completed in 1996. Monitoring of those instream improvements would continue until 1999.

COMMUNITY INVOLVEMENT

The Forest Service currently has no specific plans to involve the local communities beyond the normal contacts the Agency makes through the environmental analysis process and periodic meetings with the communities dealing with other issues. The Forest Service will provide Chenega, Tatitlek, Eyak, Cordova, and Whittier with information regarding this proposal through the environmental analysis scoping process. This interaction could stimulate a partnership opportunity from any of the communities or interested individuals within those communities.

FY 96 BUDGET

The following is the estimated cost for the project in federal FY 96.

Personnel	62.1
Travel	10.0

Contractual	1.5
Commodities	17.2
Equipment	0
Subtotal	90.8
Gen. Admin.	9.4
Total	100.2

PROJECT DESIGN

A. Objectives

The objective of the project is to improve cutthroat trout rearing habitat within selected streams of Western Prince William Sound

B. Methods

The project proposes use of standard instream habitat improvement techniques. The western portion of Prince William Sound is within a wilderness further study area where the least intrusive habitat enhancement methods would be implemented. The project proposes to place approximately 10 instream enhancement structures in each of 4 streams. These enhancements include to following list of structures and techniques.

Channel Blocks:

Channel blocks consolidate braided channels into a single, deeper channel and, subsequently, create additional fish holding habitat. These structures may also be used to maintain stream meanders where flood flows have eroded a channel through the meander. These structures hold normal or moderately high flows in the meander channels, but still allow flood waters to overflow in the blocked channels. They can also collect gravels suitable for spawning.

Boulder Placement:

Boulders provide overhead cover and resting areas. Added depth is also created by scouring as a result of reduced channel capacity and increased velocity.

Cover Logs and Rootwads:

These structures provide overhead cover in sections of stream where existing water depth may be adequate but cover is lacking.

Tree Covers:

Trees placed in proper locations provide excellent overhead cover and an ideal substrate for

aquatic organisms. In addition, trees serve as deflectors which constrict wide, shallow channels and increase stream velocity. This results in sediment flushing and the creation of deeper scour pools and pockets of spawning substrate.

Bank Cribs with Cover Logs:

These structures protect unstable banks, while at the same time providing excellent overhead cover for fish.

Log and Bank Shelters:

Log and bank shelters provide overhead cover. Some streambank protection is also provided, although less than with cribs. Brush and other woody material attached to the platforms provide additional benefit by harboring insects and other fish food organisms.

Single-Wing Deflectors:

These structures constrict and divert water flow so that stream meanders and pools and pockets of spawning gravel are formed by scouring and relocation of fine sediment and gravel.

Double-Wing Deflectors:

Double-wing deflectors create mid-channel pools through scouring action in shallow sections of streams.

Deflectors and Cover Logs:

Deflector and cover logs are similar to a single-wing deflectors. Cover logs ensure bank stability where suitable boulders, tree stumps, or stable banks are lacking.

Channel Constrictors:

These structures serve as modified deflectors designed to create overhead cover similar to that provided by undercut banks.

Cross Log and Revetment:

Cross log and revetments create scour pools by the action of water pouring over or under cross logs. Revetment logs create overhead cover and protect the bank at the same time.

Wedge Dam and K Dam:

These structures create pools or deeper water through scouring action in shallow sections of stream. In continuous, steep gradients, the short, upstream break in gradient also provides resting and spawning area, often holding more fish than the deeper pool below. The quiet water above

the structure and the edges of the pool below also act as a trap for spawning gravel and organic material used as food by stream invertebrates.

Gabions:

Where proper size rocks are available, gabions can be used in lieu of logs for structure designs such as deflectors, dams, and bank abutments.

Brush Bundles:

Brush bundles can be used to provide fish hiding cover in a stream or lake which can decrease interspecific competitive interactions, allowing more fish to inhabit preferred habitats.

C. Contracts and Other Agency Assistance

No specific contracts or other agency assistance, other than normal agency coordination, are anticipated.

D. Location

The project will be undertaken in Western Prince William Sound. The Forest Service will survey known and suspected cutthroat trout streams in 1995 to determine opportunities for stream enhancements.

SCHEDULE

A. Measurable Project Task for FY 96

June to September 1995:	Field inventory
June 1995:	Initiate NEPA
October to January 1996:	Evaluate field data and public comments
January to April:	Finalize NEPA compliance
June to September:	Implement project
August 1997:	Monitoring
August 1998:	Monitoring
August 1999:	Monitoring

B. Project Milestones and Endpoints

April 1996:	NEPA decision, environmental compliance and coordination
September 1996:	Instream habitat enhancements completed

December 1996:	Interim report
December 1997:	Interim report
December 1998:	Interim report
April 2000:	Final report

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is linked with EVOS Restoration Project 94043/95043B. It is a proposed continuation of instream cutthroat trout habitat restoration activities. The proposal is a response from a primary land and resource manager (Forest Service) in Prince William Sound to the effects of the *Exxon Valdez* oil spill. The Forest Service has focused on this species as a result of the injury incurred from the oil spill. The proposal is not part of the normal Forest outyear planning program, therefore no funds have been directed towards this project within the Forest Service budgeting process.

ENVIRONMENTAL COMPLIANCE

The Forest Service would conduct an environmental analysis of this project including public and other agency input. Through this process, complete environmental law and regulation compliance will occur.

PERSONNEL

Cliff Fox, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Resource Staff Officer on the Glacier District. Has 20 years experience in natural resource management with State and Federal Agencies in California, Idaho and Alaska. Has years experience in project planning, implementation, and monitoring. Has multi-resource experience holding positions in fisheries, wildlife, timber, minerals, recreation, fire, real-estate, cultural resources, Forest Planning and environmental coordination. Presently oversees the District's fisheries, wildlife, timber, ecology, minerals and air quality programs. Would be designated project leader for this proposal. Would be responsible for project oversight during implementation, environmental compliance, agency coordination, budget management and reporting.

Dan Gillikin, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Lead Fisheries Technician on the Glacier District and is acting Fisheries Biologist. He has 7 years of experience as a fisheries technician with private and Federal Agencies in Washington and Alaska. He will be responsible for onsite implementation of the project and monitoring activities.

Cliff Fox, Project Leader
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Ray Thompson, Project Manager
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Chugach National Forest
3301 C Street, Suite 300
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Date prepared

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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$62.1						
Travel		\$10.0						
Contractual		\$1.5						
Commodities		\$17.2						
Equipment		\$0.0						
Subtotal	\$0.0	\$90.8	LONG RANGE FUNDING REQUIREMENTS					
General Administration		\$9.4	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$0.0	\$100.2	\$10,000.0	\$5,000.0	\$5,000.0	\$2,500.0		
Full-time Equivalents (FTE)		1.6						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96043 - C
Project Title: Cutthroat Trout Improvement Structures
Agency: USFS

FORM 3A
AGENCY
PROJECT
DETAIL

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
	Fox	Resource Officer	GS 11/7	1.0	4,860		4.9
	Gillikin	Lead Fish Technician	GS 9/1	3.5	3,900		13.7
	Biologist	Fish Biologist	GS 9/1	1.8	3,900		7.0
	Seasonal	Fish Technician	GS 7/1	3.9	3,300		12.9
	Seasonal	Fish Technician	GS 5/1	2.7	2,200		5.9
	Seasonal	Fish Technician	GS 5/1	2.7	2,200		5.9
	Seasonal	Fish Technician	GS 5/1	2.7	2,200		5.9
*	R. Thompson	Program Manager	GS 13	1.0	5,928		5.9
							0.0
							0.0
							0.0
							0.0
Subtotal				19.3	28,488	0	
Those costs associated with program management should be indicated by placement of an *.							Personnel Total \$62.1
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
	Alaska Railroad Tickets		2000	1			2.0
	Float Plane		1000	8			8.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.							Travel Total \$10.0

1996

Project Number: 96043 - C
Project Title: Cutthroat Trout Habitat Improvement Structures
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Report publication/printing		1.5
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$1.5
Commodities Costs:		Proposed
Description		FFY 1996
WCF Ranger Boat Rental including fuel		8.0
Field food		2.0
Earth Anchors		3.0
Wire Rope		0.3
Rigging		0.5
Camp fuel		0.8
Assorted Hand Tools		0.4
Misc Field Supplies		2.2
Commodities Total		\$17.2

1996

Project Number: 96043 - C
Project Title: Cutthroat Trout Habitat Improvement Structures
Agency: USFS

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				

1996

Project Number: 96043 - C
Project Title: Cutthroat Trout Improvement Structures
Agency: USFS

FORM 3B
Equipment
DETAIL

8/25/95
Vers 1
Addl to DPD

NATURAL RESOURCES CONSULTANTS, INC.

4055 21ST AVENUE WEST, SUITE 200
SEATTLE, WASHINGTON 98199, U.S.A.
TELEPHONE: (206) 285-3480
TELEFAX: (206) 283-8263

12 July 1995

Sandra Schubert
Exxon Valdez Oil Spill Trustee Council
Restoration Office
645 G Street, Suite 401
Anchorage, AK 99501-3451

Subject: Response to peer review comments on Project 96048-BAA/ Historical Analysis
of Sockeye Salmon Growth Among Populations Affected by Overescapement
in 1989.

Dear Ms. Schubert:

The analysis of sockeye scale radii measurements, which represent an index of growth during freshwater and each year at sea, will have several steps. Table 1 shows the salmon populations and years of data that will be examined. Note that we have already measured scales from some of these populations.

During the first step, we will graph frequency distributions of scale radii measurements of the dominant age class for each population, life history stage (e.g. freshwater, first year at sea), and year. These graphs will visually indicate whether growth of sockeye salmon in areas receiving overescapement in 1989 (or other years) was reduced compared to previous years. Furthermore, the graphs will visually indicate the freshwater growth of the populations up to three years after the oil spill so that the "recovery" of these stocks can be examined. The graphs will also be used to look for reduced growth of the Coghill population that migrated through Prince William Sound in 1989. The frequency distributions will be viewed for normality, which is a prerequisite to subsequent statistical analyses.

At least two statistical approaches will be applied to the scale growth data. First, we will conduct a one-factor ANOVA for each stock where the factor is year. A multiple comparison test, such as the Dunnett Test, will be conducted to determine whether growth during 1989 or subsequent years was statistically different from growth during return years 1970-1988. Sockeye scales from the 1989 overescapement and subsequent years are expected to be smaller than all or most other years, based on concerns by the Alaska Department of Fish and Game (note: the large overescapement to the Kenai R. in 1987 and 1988 may have also caused reduced growth).

The ANOVA will be performed on stocks that were affected less or not at all by overescapement in 1989, i.e., Crescent Lake, Kasilof River, Black Lake and Wood River. We expect that freshwater scale radii measurements of these less affected populations will be reduced little or not at all compared to the earlier years. Thus, these populations will serve as a control to show that all sockeye populations did not experience unusually slow growth during and following the oil spill.

Second, we plan to regress mean scale radii measurements on escapement estimates for each stock for years 1970-1989. We expect an inverse relationship for stocks that have experienced both large and small escapements over the years of investigation (note: we will include air temperature data as an additional variable to explain growth when statistically significant). The mean scale radii estimate and its associated escapement during years following the oil spill will be compared with this regression to determine whether it falls outside the 95% confidence interval. If overescapement had a negative effect on the growth of post-spill brood years, then we would expect the scale growth of post-spill broods to be significantly lower at the estimated escapement level (and/or temperature). This analysis will indicate whether the growth of sockeye populations influenced by overescapement have "recovered" during years following the spill.

We have proposed a sample size of 100 scales per year for each stock. All of these scales will be examined for scale quality in order to insure that the scale was selected from the preferred area. The power of detecting a true difference among annual means when performing an ANOVA with a sample size of 100 scales per year exceeds 95% ($\alpha = 0.05$, $Q = 3.5$). This estimate of power was based on 100 scale measurements from Wood River sockeye salmon and the calculated error MS and group MS. Thus, the power of this test greatly exceeds the general guideline that $\beta \leq 4 * \alpha$. The smallest detectable difference between two means, given $\alpha = 0.5$, power = 0.8 and $n = 100$ scales, is 26 μ . This difference translates to approximately 4 mm in juvenile fish length. Within a given sockeye population, the range in mean freshwater size at age-1 can be approximately 70-95 mm, i.e., a difference of 25 mm. Given the large overescapement to several sockeye systems as a result of the oil spill and ADFGs concern about unusually slow growth, we expect a sample size of 100 scales per year to be adequate to determine a statistical difference between sockeye growth influenced by the spill and growth prior to the spill.

The Budget Review suggested that the indirect rate appears to be high. We will work with NOAA to reach an agreement on the indirect cost rate during contract negotiations.

Thank you for considering this proposal. It is our intention to conduct a quality experiment that will lead to publication in a peer-reviewed journal. Please feel free to contact me again should questions arise.

Sincerely,

Gregory T. Ruggerone, Ph.D.

Table 1. Sockeye salmon populations that will be used in the scale growth study.

Population	Management Area	Oil Spill Concern	Sample Period (return yr)	Sample Period (brood yr)	Scales Previously Measured	Sample Size per Year
Kenai River	Upper Cook Inlet	Overescapement reduced growth	1970-1997	1965-1992	None	100
Kasilof River	Upper Cook Inlet	Less impact	1970-1997	1965-1992	None	100
Crescent Lake	Upper Cook Inlet	Less impact	1970-1997	1965-1992	None	100
Akaluta L.	Kodiak	Overescapement reduced growth	1985-1997	1980-1992	None	100
Red Lake	Kodiak	Overescapement reduced growth	1970-1997	1965-1992	None	100
Chignik Lake	Chignik	Overescapement reduced growth	1970-1997	1965-1991	1950-90 (50 scales/yr)	100
Black Lake	Chignik	Indirect effect-reduced growth	1970-1997	1965-1992	1950-1990 (50 scales/yr)	100
Coghill Lake	Prince William Sound	reduced growth in PWS	1970-1997	1965-1992	None	100
Wood River	Bristol Bay	None	1970-1997	1965-1992	1950-1990 (100 scales/yr)	100
Total scales to be measured:						16,500

Historical Analysis of Sockeye Salmon Growth Among Populations Affected by Overescapement in 1989

Submitted Under the BAA

Announcement No. 52ABNF500082

1 May 1995

96048 - BAA

Restoration Category:

Monitoring and Research

Proposer:

**Dr. Gregory T. Ruggerone
Natural Resources Consultants, Inc.**

**Dr. Donald E. Rogers
Fisheries Research Institute
University of Washington**

Lead Agency:

NOAA

Duration:

October 1 1995 to September 1 1996

Cost FY 96:

\$86,700

Cost FY 97:

\$15,000

Geographic Area:

**Kenai River, Akalura Lake, Red Lake, Coghill Lake,
Chignik Lake, Kasilof River**

Injured Resource:

**Sockeye salmon from Cook Inlet, Kodiak Island, Prince
William Sound, and Chignik**

ABSTRACT

Overescapement of sockeye salmon in several areas of Alaska occurred in 1989 as a results of the *Exxon Valdez* oil spill. Overescapement appears to have reduced salmon growth, leading to reduced survival. However, few records of sockeye growth in these systems occurred before 1989. We propose to use adult sockeye scales to reconstruct the growth of sockeye salmon before, during, and after the oil spill event. These data will be used to document the effects of the spill and the subsequent recovery of the sockeye stocks.

INTRODUCTION

The Exxon Valdez Oil Spill Trustee Council (EVOSTC) has identified several sockeye salmon stocks that were influenced by the overescapement caused by the *Exxon Valdez* oil spill. Injured sockeye salmon stocks include sockeye from the Kenai River in Upper Cook Inlet, and Akalura Lake and Red Lake on Kodiak Island. Additionally, the EVOSTC is funding a restoration project on Coghill Lake near Prince William Sound (lake fertilization to enhance growth), although the declining sockeye runs have not been linked to the oil spill. Although the EVOSTC did not list Chignik Lake as a potentially injured lake, Chignik Lake received more than twice its escapement goal as a result of the oil spill in 1989. Monitoring of Chignik Lake in relation to the overescapement has not been conducted; the effect of overescapement in Chignik Lake on adult production will not be known until summer 1995, the year when the dominant age group (i.e., age 2.3) of the 1989 brood year return.

Overescapement of sockeye salmon to these lake systems is believed to have led to exceptionally high densities of salmon in the lakes, which in turn has caused reduced growth. Schmidt et al. (1993) suggested that small sockeye fry in the fall cause exceptionally high mortality during winter, a period when sockeye salmon may lose 10% body weight because few or no prey are available (Ruggerone 1993).

Presently, the EVOSTC and the Alaska Department of Fish and Game (ADF&G) are monitoring fry abundance and size in the Kenai River system and smolt abundance and size in Akalura Lake and Red Lake. However, monitoring of sockeye smolt lengths in these systems began only recently. Few years of data are available for comparison before and after the overescapement. Thus, the effect of overescapement on salmon growth is difficult to evaluate. Furthermore, growth of sockeye smolts may have been reduced when migrating through oiled waters, especially in Prince William Sound. This effect has been

documented for pink salmon (Willette et al. 1993). To our knowledge, the early marine growth of sockeye salmon from the areas affected by the *Exxon Valdez* oil spill has not been examined.

Measurements of adult sockeye salmon scales offer a relatively inexpensive means to evaluate the effect on sockeye salmon growth of overescapement in freshwater and oil in the marine environment. Scale measurements can also be used to inexpensively evaluate the recovery of the sockeye populations. Sockeye salmon scales are correlated with fish length and have been used to describe sockeye salmon growth in lakes (Henderson and Cass 1991, Zimmermann 1991, Bumgarner 1993, Ruggerone 1994) and the ocean (Rogers and Ruggerone 1993).

NEED FOR THE PROJECT

A. Statement of Problem

The declining sockeye runs to the Kenai River, Red Lake, and Akalura Lake are believed to be related to reduced growth caused by overescapement. The effect of large escapement on sockeye salmon growth in Chignik Lake has not been evaluated. Additionally, the effect on growth of Coghill Lake sockeye migrating through oil-contaminated waters in Prince William Sound has not been evaluated, although Willette (1993) demonstrated that growth of pink salmon in Prince William Sound was reduced.

B. Rationale

Analysis of sockeye salmon growth, based on adult scale measurements, is needed because efforts to monitor the size of sockeye salmon smolts emigrating from these lakes began only recently and few data are available for comparison prior to the oil spill (D. Waltemyer, ADF&G, pers. comm.). In order to document the magnitude of the effects and the recovery of salmon in these areas, measurements prior to the spill, during the spill, and subsequent to the spill are needed. Scale measurements, which are an index of salmon growth, offer an inexpensive means to monitor the recovery of sockeye salmon in these affected areas. Furthermore, detailed analyses of freshwater and marine growth of sockeye from oil-affected and unaffected stocks over the past 20 years could help identify non-spill factors influencing growth and production (see Rogers and Ruggerone 1993). Thus, the use of scale measurements of a variety of sockeye stocks will enable us to distinguish effects of the oil spill from other environmental factors.

C. Summary of Major Hypotheses and Objectives

Objectives:

1. Measure annual growth zones of sockeye salmon before, during, and after the oil spill from systems affected by the oil spill (Kenai River system, Akalura Lake, Red Lake, Coghill Lake, Chignik Lake)
2. Measure annual growth zones of sockeye salmon from systems less affected by the oil spill (Kasilof River, Crescent Lake, Black Lake, and the Wood River Lake system)
3. Compare trends in annual growth zone measurements of sockeye from systems affected by overescapement or oil in the marine environment with that of sockeye not affected
4. Determine the relative magnitude of reduced sockeye growth in freshwater or first year at sea as a result of overescapement or the presence of oil in the marine environment and evaluate the recovery of sockeye growth in years subsequent to the spill.

Hypotheses:

1. Overescapement significantly reduced the growth of sockeye salmon
2. Migration of sockeye salmon through marine waters contaminated with oil caused reduced growth

D. Completion Date

A final report will be completed by 30 September 1996.

FY 96 BUDGET

1 October 1995 to 30 September 1996

Personnel	52.2
Travel	2.3
Contractual	0.0
Commodities	0.9
Subtotal	55.4
Indirect Cost	31.3
Total	86.7

PROJECT DESIGN

A. Objectives

1. Measure annual and seasonal growth zones of sockeye salmon before, during, and after the oil spill from systems affected by the oil spill (Kenai River system, Akalura Lake, Red Lake, Coghill Lake, Chignik Lake)
2. Measure annual and seasonal growth zones of sockeye salmon from systems less affected by the oil spill (Kasilof River, Crescent Lake, Black Lake, and the Wood River Lake system)
3. Compare trends in growth zone measurements of sockeye from systems affected by overescapement or oil in the marine environment with that of sockeye not affected
4. Determine the relative magnitude of reduced sockeye growth in freshwater or first year at sea as a result of overescapement or the presence of oil in the marine environment and evaluate the recovery of sockeye growth in years subsequent to the spill.

B. Methods

Adult sockeye salmon scales will be obtained from ADF&G for each population described above. ADF&G collects these scales as part of their normal management activities. Scales are available back to at least 1970 for sockeye stocks in the Kenai River, Kasilof River, Red Lake, and Coghill Lake stocks (D. Waltemyer, B. Barrett, ADF&G, pers. comm.). Akalura scales are available back to at least 1985. Scales for Chignik Lake, Black Lake, and Wood River Lakes sockeye stocks are available back to 1920; these scales have already been measured through 1990. Thus, scales measurements need to be updated for these stocks.

At least 100 scales from the dominant age groups of each stock will be measured for each year. This sample size was determined to be adequate by Zimmermann (1991). The scales will be measured by the Optical Pattern Recognition System (OPRS) at Dr. Donald E. Rogers' scale laboratory at the University of Washington. The scale measurement methodology will follow that described by Zimmermann (1991), who was a graduate student supervised by Dr. Rogers and Dr. Ruggerone.

Annual frequency distributions of scale measurements will be plotted and analyzed for normality. Skewness of the frequency distributions may indicate size-biased mortality, which may indicate the effect of predation on smaller individuals. Trends in scale growth measurements will be analyzed within and among sockeye stocks in relation to the overescapement and oil spill events. For example, we will statistically test whether salmon growth in freshwater and in the first year at sea was significantly reduced by overescapement or the presence of oil in the marine environment.

Scales available through 1995 will be measured, analyzed, and reported during FY96. Scales collected during 1995 represent the last progeny of the 1989 brood year. Scales collected during 1996 and 1997 represent progeny of sockeye spawning after the spill. These scales would also be measured. Thus, we recommend two additional years of investigation (FY96, FY97) to examine the recovery of the sockeye stocks. These two years of investigation would be conducted at a much lower cost. We plan to publish the results of the investigation in a peer-reviewed journal.

C. Location

The geographical areas that will be investigated include the Kenai and Kasilof River systems in Cook Inlet, Red Lake and Akalura Lake on Kodiak Island, Coghill Lake in Prince William Sound, and Chignik Lake on the Alaska Peninsula.

SCHEDULE

A. Project Tasks for FY96

October 1 - November 15:	Collect and press scales, if needed.
November 15 - 31 January:	Age scales and select scales for measurement
December 1 - July 31:	Measure scales
August 1 - August 30:	Analyze data
September 1 - 30 September:	Prepare report

B. Project Milestones and Endpoints

September 1996:	Effects of overescapement on sockeye growth
December 1997:	Growth during recovery period (measurements of scales from 1996 and 1997)

C. Project Reports

The primary analysis and report preparation will be completed during FY96. An update report will be prepared after measurements have been made of adults returning in 1996 and 1997. We anticipate that a final report would be prepared by December 1997. We plan to publish the results of the investigation in a peer-reviewed journal.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The ADF&G will provide sockeye scales for each of the stocks described above. These scales were collected as part of the ADF&G's routine management activities. Sockeye scales from Chignik Lake and the Wood River system have already been measured and transferred to a computer database for return years 1950 to 1990. Thus, scale measurements for these stocks need only to be updated.

ENVIRONMENTAL COMPLIANCE

This project is not a field investigation. No specific environmental laws and regulations apply.

PERSONNEL

The project will be conducted by Dr. Gregory T. Ruggerone, Natural Resources Consultants, and Dr. Donald E. Rogers, Fisheries Research Institute, University of Washington. Both Ruggerone and Rogers have extensive first-hand experience with interpretations of scale measurements and have published several papers involving

sockeye salmon scales. This team offers excellent qualifications and has available the needed equipment to conduct the investigation.

Dr. Gregory T. Ruggerone will supervise the scale measurement process and conduct the data analysis. He will also age sockeye scales and select scales for measurement. He has extensive experience with scale aging and measurement techniques. In 1981, he assisted the stock identification program by scale pattern analysis in the Upper Cook Inlet Management Area. In 1984 and 1985, he performed scale measurements of adult Chignik sockeye salmon for stock management applications (Conrad and Ruggerone 1984). He guided graduate students at the University of Washington in major studies involving life history interpretations from sockeye salmon scales collected from the Wood River Lakes and Chignik Lakes (Zimmermann 1991, Bumgarner 1993, Ruggerone 1994). Recently he used scale measurements to assess density-dependent growth of Bristol Bay sockeye salmon in the Pacific Ocean (Ruggerone and Rogers 1993).

Dr. Donald E. Rogers, University of Washington, will assist with project coordination and the interpretation of sockeye salmon growth measurements. Dr. Rogers has over 30 years experience with sockeye salmon in Alaska. He has been the chairperson of four graduate students whose theses were based on scale measurements. Dr. Rogers maintains an Optical Pattern Recognition System in his lab.

REFERENCES

Bumgarner, J.D. 1993. Long-term trends in the growth of sockeye salmon from the Chignik Lakes, Alaska. M.S. Thesis. University of Washington, Seattle.

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Rogers, D.E., and G.T. Ruggerone. 1993. Factors affecting the marine growth of Bristol Bay sockeye salmon. Fisheries Research. 18: 89-103.

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Willette, M. 1993. Impacts of the *Exxon Valdez* oil spill on migration, growth, and survival of pink salmon in Prince William Sound. Pp. 112-114 in *Exxon Valdez* Oil Spill Symposium. Anchorage, Alaska.

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April 28, 1995
Date prepared

1996 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$7.0						
Travel		\$0.0						
Contractual		\$101.7						
Commodities		\$0.0						
Equipment		\$0.0						
Subtotal	\$0.0	\$108.7	LONG RANGE FUNDING REQUIREMENTS					
General Administration		\$8.2	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$0.0	\$116.9						
Full-time Equivalents (FTE)		1.2						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96048
 Project Title: Historical Analysis of Sockeye Growth/Overescapemt.
 Agency: NOAA

**FORM 3A
 AGENCY
 PROJECT
 DETAIL**

Prepared: 1 of 4

8/14/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$7.0						
Travel		\$0.0						
Contractual		101.7 ~~\$86.7~~						
Commodities		\$0.0						
Equipment		\$0.0						
Subtotal	\$0.0	\$93.7	LONG RANGE FUNDING REQUIREMENTS					
General Administration		\$7.1	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$0.0	\$100.8	0.0 ~~\$23.1~~					
Full-time Equivalents (FTE)		1.2						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96048

Project Title: Historical Analysis of Sockeye Growth/Overescapemt.

Agency: NOAA

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared:

1 of 4

8/14/95

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08/14/95 MON 15:22 FAX 907 789 6608

8/14/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$0.0
Commodities Costs:		Proposed
Description		FFY 1996
Commodities Total		\$0.0

1996

Project Number: 96048
Project Title: Historical Analysis of Sockeye Growth/Overescapemt.
Agency: NOAAFORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRL E COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				

1996

Project Number: 96048
Project Title: Historical Analysis of Sockeye Growth/Overescapemt.
Agency: NOAAFORM 3B
Equipment
DETAIL

96052

96C52A

LETTER OF TRANSMITTAL

**To: Exxon Valdez Oil Spill Trustees Council
EVOS Restoration Office**

**From: Jim Sinnett, Program Planner
Chugach Heritage Foundation**

Date: May 1, 1995

Re: Final draft submission of EVOS FY-96 Project Application

Project Title: Community Involvement & Use of Traditional Knowledge

**Subtitle: Community Assumption of: Project 95052 - "Community Interaction /
Traditional Knowledge" - Responsibilities**

**Proposer: Chugach OSIR Communities Consortium: A Consortium of the Oil
Spill Impacted Region (OSIR) Villages and Alaska Native Communities of
Chenega, Tatitlek, Port Graham, Nanwalek, Eyak, Seward, and Valdez**

Project Originator: The Tatitlek Village IRA Council

The following Project Application is submitted under authorization and on behalf of the participating Chugach region oil spill impacted communities. The project purposes were arrived at through discussion and consensus of the participating communities. It is expected that the project details will continue to be refined through the EVOS review process and EVOS negotiations with the participating communities. Chugach region communities, not having already done so, are to provide project application submission authorization letters by May 29, 1995. Final Resolutions of participation will be considered for adoption after review of the project as finally negotiated with the EVOS Trustees Council.

Given the limited time for preparation, The project applicants reserve and request opportunity to further refine this project application, and submit an amended version after initial EVOS review.

A detailed line-item project budget, prepared on the "Excell" software program, will be submitted after initial review is completed by the EVOS Restoration Office.

Project Title: **Community Involvement & Use of Traditional Knowledge**
Subtitle: Community Assumption of: Project 95052 - "Community Interaction / Traditional Knowledge" - Responsibilities

Project Number: ~~95052~~ 96CS2A

Restoration Category: General Restoration

Proposer: **Chugach OSIR Communities Consortium:** A Consortium of the Oil Spill Impacted Region (OSIR) Villages and Alaska Native Communities of Chenega, Tatitlek, Port Graham, Nanwalek, Eyak, Seward, and Valdez

Project Originator: **Tatitlek Village IRA Council - Martha Vlasoff**

Lead Trustee Agency: Department of the Interior: National Park Service, Div. of Subsistence

Cooperating Agencies: Department of Natural Resources, Department of Fish and Game, Department of Community & Regional Affairs

Regional Assistance: Chugachmiut, Chugach Regional Resource Commission, Chugach Heritage Foundation, Chugach Alaska Corporation

Duration: Multiple years / Seven (7) fiscal years, FY 1996 to FY 2002

Cost FY 95:	\$152,000	.50 Pilot Year - Agency Assisted Start-up
Cost FY 96:	\$210,000	.75 Service Year - Community Assumption
Cost FY 97:	\$215,000	1.0 Full Service Year
Cost FY 98:	\$215,000	1.0 Full Service Year
Cost FY 99:	\$215,000	1.0 Full Service Year
Cost FY 00:	\$185,000	.75 Service Year
Cost FY 01:	\$152,000	.50 Service Year
Cost FY 02:	\$ 75,000	.25 Closeout Year

Geographic Area: Oil Spill Area Wide: a Service Delivery Area inclusive to all unincorporated and Alaska Native subsistence communities within the oil spill impacted area.

Injured Resource/Service: All Injured Resources / Services

The identification of injured resources, services and purposes of Project 95052 have been previously reviewed and approved by the EVOS Trustees Council. Project 95052 first-year startup-implementation responsibilities were assigned to the Alaska Department of Fish and Game, Division of Subsistence.

ABSTRACT

This Community Involvement & Use of Traditional Knowledge Project proposal provides for the FY-1996 to FY-2002 assumption of all consolidated Project 95052 responsibilities, by a consortium of oil spill impacted region (OSIR) communities. The proposal calls for transfer of all lead agency responsibilities from the ADFG Division of Subsistence to the Department of Interior, National Park Service - Division of Subsistence. The Department of Interior is the recognized and utilized cognizant agency for the Alaska Native communities within the oil spill impacted area. Project 95052 field service responsibilities would be carried out through a Community Service Office established for the purposes of this EVOS project and such other EVOS projects where a region-wide community-based service approach is appropriate and cost effective. Under memorandums of understanding, primary technical assistance staff support is to be provided by regional organizations with long-standing service association to the OSIR communities. The projects' long-term purposes would be integrated and continued under P.L. 638 -Tribal Compacting Agreements.

Introduction:

In FY-95, the Exxon Valdez Oil Spill Council funded a project intended to increase the involvement of spill area communities in the restoration efforts of the Trustee Council, and to improve the communication of findings and results of restoration efforts to spill area inhabitants (Project 95052 - Community Interaction / Traditional Knowledge). This is an application for local level - community-based assumption of responsibilities and continuation of a previous project approved by the EVOS Trustees Council.

The project sought to improve the involvement of the impacted communities in restoration activities by providing funding to allow local people to serve as facilitators. A pilot study was to be conducted as a part of this project. Local facilitators were to have been funded in three communities, Chenega Bay and Tatitlek in Prince William Sound, the area most impacted by the oil spill, and Port Graham, selected as a representative community for the Lower Cook Inlet.

Under the project assumption proposal, the project would be expanded to include additional communities in the facilitator network, as well as, expanding the geographic range of the project beyond the Chugach Region to include communities in the Kodiak region and Bristol Bay / Alaska Peninsula. The consortium communities, project assumption applicants, would utilize the services of their regional organizations to provide project accounting, administrative, technical assistance, overall coordination of the facilitator network. No new arrangement between the communities and their regional organizations is required in order to accomplish Project 95052 service delivery, as the communities all currently have a contracted support relationship with their regional service organizations.

The Trustee Council's approval of assumption of the Project, by the consortium communities, would represent a formal broad-based and uniform cooperative agreement with the oil spill impacted Villages and Alaska Native subsistence communities for the provision of community involvement, interaction, and the exchange and use of traditional and scientific / research knowledge. As a cost savings over and with greater effectiveness than FY-95 state agency efforts, community assumption of the project would require no additional contracting layers in order to finally fully implement the project, employ local and regional facilitators, and carry out and accomplish Project 95052 tasks.

The modified, or expanded, FY-96 Project 95052 budget would provide funding for the (entire oil spill impacted area) region-wide coordinator, and local facilitators in the Villages and Alaska Native subsistence communities of Chenega Bay, Tatitlek, Port Graham, Nanwalek, Cordova, Seward and Valdez, and a regional facilitator for the Kodiak villages, and a regional facilitator for the Alaska Peninsula region villages.

The project assumption proposal calls for transfer of all lead agency responsibilities from: the A D F& G Division of Subsistence to: the Department of Interior, National Park Service - Division of Subsistence. The Department of Interior is the recognized and utilized cognizant agency for the Alaska Native communities within the oil spill impacted area.

Project 95052 field service responsibilities would be carried out through a Community Service Office established - by the consortium communities - for the purposes of this EVOS project and such other EVOS projects where a region-wide community-based service approach is appropriate and cost effective. Under (MOUs) memorandums of understanding, primary technical assistance / staff support is to be provided to the consortium communities, by regional organizations with long-standing service association to the OSIR communities. The projects' long-term purposes would be integrated and continued under P.L. 638 -Tribal Compacting Agreements.

NEED FOR THE PROJECT

Statement of Problem:

The original Project 95052 narrative stated; the Exxon Valdez oil spill caused severe disruption of the lives of many people living in the spill impact area. The spill also caused residents of the area to be concerned about the safety of their wild food resources, and the integrity of the surrounding natural environment. While scientific studies aimed at restoring the resources and services damaged by the oil spill have occurred throughout the spill area, most of the researchers work for agencies or institutions based in Anchorage, Fairbanks, or outside Alaska. Local community leaders and residents have complained of a lack of involvement by spill area communities in the restoration efforts, and incomplete communication to spill area inhabitants of study proposals and results. At the same time, researchers have recognized that local residents have traditional knowledge that could help them answer questions they have not been able to answer through conventional scientific means.

The following statement of problem narrative represents an informal evaluation of FY-95 Project 95052 progress, from the perspective of the communities and their regional service organizations. It is expected that a formal progress report would be made by the Alaska Department of Fish and Game, Division of Subsistence, the lead agency assigned responsibilities for implementing and coordinating the consolidated activities of Project 95052.

Project 95052 was originally proposed by OSIR community members and representatives. It was envisioned that Project 95052 should be directed from the local community level and supported with coordinated technical assistance primarily from their regional service organizations, as well as, the state and federal task force agencies. The original, community initiated, proposal was then refined for submission with the technical assistance of the Alaska Division of Parks and Outdoor Recreation staff.

The original proposal called for a RFP process to select a (community-based and directed) regional coordinator / contractor to provide for Project 95052 service delivery. However, the project was ultimately assigned to the AD&FG, Division of Subsistence and no RFP solicitation was issued for a community-based and directed regional coordinator / contractor. FY-95 (startup or pilot demonstration year) funds for Project 95052 were then assumed and included as a supplemental to the Division of Subsistence budget. ADFG division staff supplanted for "local" and "regional" staff originally proposed.

This project sought to improve the involvement of the impacted communities in restoration activities by providing funding to allow local people to serve as facilitators. However, to date, the formal hiring of local facilitators is well over six months behind on the original schedule assigned to the ADFG Division of Subsistence. The state Division of Subsistence is, only now, entering into separate cooperative agreement with the Village Council in each of the three pilot communities to provide facilitator services.

The original proposal anticipated community involvement would mean reasonable lead-time technical assistance to OSIR communities in their preparation of FY-1996 EVOS Project applications. With respect to the primary purposes of community involvement, or interaction, and use of traditional knowledge, Project 95052 (local involvement / interaction) activities were to have begun by October or November, 1994. However, it appears delays resulted in rescheduling of key community involvement activities, including hire of local facilitators in the pilot communities. The delayed startup and delivery of adequate lead-time technical assistance to the communities has placed the communities at a disadvantaged in the timely preparation of the requested "detailed" EVOS project proposals / applications.

Statement of Problem: (continued)

This project sought to improve the involvement of the impacted communities in restoration activities by providing funding to allow local people to serve as facilitators. However, to date, the formal hiring of local facilitators is well over six months behind on the original schedule assigned to the ADFG Division of Subsistence. The state Division of Subsistence is, only now, entering into separate cooperative agreement with the Village Council in each of the three pilot communities to provide facilitator services.

Project 95052 was designed to mitigate these problems. However, one year later, these problems remain, communication is still limited, coordination with the communities and their regional service organizations is sporadic, and the state division has yet to enter into meaningful collaborative efforts involving all the key players at the local community level, or regional service level.

The original concept proposal called for engagement of local resident outreach facilitators for each OSIR community, assisted by a regional liaison coordinator. In the revised and approved FY 95 project, a pilot demonstration approach was taken and local outreach facilitators were limited to three pilot communities. The opinion has been expressed by some OSIR communities that the pilot approach will prove to be divisive and place the communities at odds and competitive disadvantage with each other and other outside competitors. A pilot approach or demonstration is generally reserved as a prerequisite to what will be a long-term and permanent program. Pilot demonstrations are generally not appropriate to short-term and limited projects. In this case, by the time the necessity of "community involvement" is proven by the pilot demonstration, there will be actual little time left to benefit from this discovery.

B. Rationale:

People living in the spill area have detailed knowledge about the conditions of the resources, which can significantly add to data collected a part of scientific studies, and possibly even enhance the success of restoration efforts. Local communities, community leaders, and residents have expressed a desire to be involved in all aspects of restoration projects, and a willingness to work with researchers. Community assumption of Project 95052 will assure the most direct and coordinated means of involvement.

This FY - 1996 proposal for assumption of Project 95052 would "localize and regionalize" FY-1996 to FY 2002 funding for community involvement and technical assistance. The contracting barriers and delays encountered by the ADFG Division of Subsistence would be alleviated through Project assumption by the communities. Assumption would provide for a more "direct" and improved communication, coordination, and collaborative linkage between the communities and the EVOS Trustees, PAG, and Restoration Office. Assumption would provide for greater cost efficiencies and effectiveness. The state lead agency could then return to it's more traditional and focused role of technical assistance provision and response to the needs determined at the local community level.

Assumption of Project 95052 responsibilities by the consortium's Community Service Office is expected to immediately and significantly improve the quality of community involvement and communication between the communities, the EVOS Restoration Office, project scientists, and assigned federal / state lead agencies. Assignment of regional service organization staff to the OSIR Community Office will assure direct coordination and communication with the communities and technical assistance support for their selected local community outreach facilitators. The OSIR Community Office staffing is to be supplemented and supported under memorandums of understanding (MOUs) with OSIR regional service organizations, Alaska Native village and regional non-profit and profit corporations.

B. Rationale: (continued)

The communities have extensively called upon their regional service organizations for technical assistance in the preparation of EVOS community project proposals, supplementing the technical assistance provided by the federal / state agencies. Oft time the agencies and regional service organizations are unaware of the t/a being provided by the other. One of the purposes of the original community involvement proposal was to improve communication and coordination between the technical assistance providers. To date this has not been accomplished and the level and quality of technical coordination still remains a significant problem. Trustee Council approval of Project 95052 assumption, by the oil spill impacted communities, will assure a more effective delivery of service, supplemented by the resources and carried out in conjunction with the existing community and regional (involvement and service) programs.

Community assumption of Project 95052 will further the Trustee Councils' goals of facilitating the involvement of spill area residents and resource users in the restoration process.

C. Summary of Major Hypotheses and Objectives

Trustee Council approval of community assumption of Project 95052 will represent a major step in accomplishing the objective calling for the broad and meaningful involvement of the communities. A key objective of the project is to increase the involvement of spill area communities in the restoration efforts of the Trustee Council, and to improve the communication of findings and results of the restoration efforts to spill area inhabitants and the appropriate regional organizations. Approval of project assumption will achieve this objective quickly and directly. It is expected that by doing so, this project will increase the effectiveness of over-all restoration efforts.

Otherwise, generally, the project objectives narrated in the FY-95 proposal remain the same. However, through the FY-96 review process and negotiations, the consortium of communities hope to enhance and modify and, consider new objectives that would improve the overall provisions for community involvement in the EVOS restoration efforts.

Regional service delivery and support would include assistance with: proposals, reviews, evaluations, negotiations, performance monitoring, preparation of monthly reports and invoices, publications production (printed and electronic / computer media). The consortium staff would prepare quarterly and annual activity reports.

With the federal National Park Services / Division of Subsistence serving as the FY-96 lead agency, the ADFG Division of Subsistence would have a smaller role in the project. All Project Lead Agency duties would be assumed by the federal cognizant agency selected by the oil spill impacted communities served by Project 95052. It is expected that the ADFG division would be more focused on and still continue delivery of services and technical assistance, that is generally and already available to the public upon request.

D. Completion Date

The project, supported by EVOS funding, would conclude in FY 2002, with the integration - of resulting community involvement components - into the existing community and region-wide service program structures. As shown in the proposed budget for FY-96 to FY 2002, the communities anticipate and provide for a transition from declining EVOS funding to be supplementation with other resources available to the communities and their regional service organizations. Including those available under P L. 638 - tribal compacting.

COMMUNITY INVOLVEMENT

This project is the one under which the community involvement components of all other restoration projects will be coordinated. The core of this project is meaningful community involvement.

FY 96 BUDGET

Personnel	\$ 30,000
Travel	\$ 5,000
Contractual	\$204,500
Commodities	\$ 500
Equipment	0.0
Subtotal	\$240,000
General Administration 9%	\$ 21,600
Project Total	\$261,600

PROJECT DESIGN

A. Objectives

1. To increase the involvement of spill area communities in the restoration efforts of the Trustee Council
2. To improve the communication of findings and results of restoration efforts to spill area inhabitants and the appropriate regional organizations
3. To improve the communication of traditional and local knowledge, which can significantly add to data collected as part of scientific studies
4. To enhance the success of restoration efforts

B. Methods

The specific objective task / methods the local and regional facilitators are expected to undertake include, but not be limited to, the following restoration support efforts:

- a) Work with the projects' region-wide coordinator, lead agency and Trustee Council staff to identify those restoration projects for which a community outreach component would be appropriate.
- b) Work with the principal investigators of those project identified (as part of "a" above) to design and implement community outreach components. This would include:

Communication of research proposals to community residents.

Assisting restoration project principal investigators in setting up community meetings.

Identifying ways in which local, traditional knowledge can be used by principal investigators to supplement conventional research.

Communication of local concerns to principal investigators.

Communicating study results to community residents in an appropriate manner.

Informing community residents about restoration work planned in the area.

- c) Communication of traditional knowledge and local interests to project researchers.

B. Methods (continued)

The specific objective task / methods the local and regional facilitators are expected to undertake include, but not be limited to, the following restoration support efforts:

- a) Work with the projects' region-wide coordinator, lead agency and Trustee Council staff to identify those restoration projects for which a community outreach component would be appropriate.
- b) Work with the principal investigators of those project identified (as part of "a" above) to design and implement community outreach components. This would include:
 - Communication of research proposals to community residents.
 - Assisting restoration project principal investigators in setting up community meetings.
 - Identifying ways in which local, traditional knowledge can be used by principal investigators to supplement conventional research.
 - Communication of local concerns to principal investigators.
 - Communicating study results to community residents in an appropriate manner.
 - Informing community residents about restoration work planned in the area.
- c) Communication of traditional knowledge and local interests to project researchers.
- d) Assisting principal investigators in local hire and facilitating local logistical support such as boat rental, and lodging, consistent with federal laws and standards followed by the Chugach regional service organizations which are federally contracted community service providers.

Local facilitators, working with their local community Council, would identify local people with particular expertise, interests and skills, including their availability for hire on restoration projects. Local hire assistance and referrals would be provided by the facilitators, and the appropriate regional service organizations and community-based programs which provide job counseling assistance.

- e) Local facilitators, again assisted by their regional service organizations, would assess community attitudes and keep the Trustee Council apprised, through the projects' region-wide coordinator, of upcoming community meetings, and restoration issues and problems.
- f) Facilitators would attend meetings in Anchorage to coordinate efforts of the project. Facilitators would also attend other key meetings to share information and represent their communities.

The effectiveness of project objectives and methods will be evaluated on an quarterly basis.

C. Contracts and Other Agency Assistance

The Chugach OSIR Communities Consortium - would establish a Community Service Office, with support provided by the participating regional service organizations. Chugachmiut would be designated the Lead RSO for the purposes of this project, and thus only one Memorandum of Agreement for Support Services would be required. All other regional service organizations would operate and provide services to the consortium of communities, and the Consortium CSO, under this master support service MOA. No other contracting requirement is anticipated.

B. Methods (continued)

The specific objective task / methods the local and regional facilitators are expected to undertake include, but not be limited to, the following restoration support efforts:

- a) Work with the projects' region-wide coordinator, lead agency and Trustee Council staff to identify those restoration projects for which a community outreach component would be appropriate.
- b) Work with the principal investigators of those project identified (as part of "a" above) to design and implement community outreach components. This would include:
 - Communication of research proposals to community residents.
 - Assisting restoration project principal investigators in setting up community meetings.
 - Identifying ways in which local, traditional knowledge can be used by principal investigators to supplement conventional research.
 - Communication of local concerns to principal investigators.
 - Communicating study results to community residents in an appropriate manner.
 - Informing community residents about restoration work planned in the area.
- c) Communication of traditional knowledge and local interests to project researchers.
- d) Assisting principal investigators in local hire and facilitating local logistical support such as boat rental, and lodging, consistent with federal laws and standards followed by the Chugach regional service organizations which are federally contracted community service providers.

Local facilitators, working with their local community Council, would identify local people with particular expertise, interests and skills, including their availability for hire on restoration projects. Local hire assistance and referrals would be provided by the facilitators, and the appropriate regional service organizations and community-based programs which provide job counseling assistance.

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- f) Facilitators would attend meetings in Anchorage to coordinate efforts of the project. Facilitators would also attend other key meetings to share information and represent their communities.

The effectiveness of project objectives and methods will be evaluated on an quarterly basis.

C. Contracts and Other Agency Assistance

The Chugach OSIR Communities Consortium - would establish a Community Service Office, with support provided by the participating regional service organizations. Chugachmiut would be designated the Lead RSO for the purposes of this project, and thus only one Memorandum of Agreement for Support Services would be required. All other regional service organizations would operate and provide services to the consortium of communities, and the Consortium CSO, under this master support service MOA. No other contracting requirement is anticipated.

D. Location

The project will be undertaken throughout the oil spill area, including the Chugach, Kodiak and Alaska Peninsula regions.

Local facilitators will be employed in the Villages and Alaska Native subsistence communities of Chenega Bay, Tatitlek, Nanwalek, Port Graham, Valdez, Seward, and Cordova; and regional area facilitators for Kodiak and Alaska Peninsula communities.

The project benefits will be realized both in the communities and involved and in the habitat of the injured resources. Better communication among the Trustee Council staff, researchers, and residents of the communities impacted by the spill should improve the effectiveness of restoration efforts.

SCHEDULE

A. Measurable Project Tasks for FY 96

08-01-95: Mobilization of Project staff, technical assistance and support resources
09-01-95: Community Involvement Planning Conference (in conjunction with Elders / Youth Conference)
10-01-95: Community assumption of Project 95052 responsibilities
11-15-95: Hire of balance of Local and Regional Facilitators
12-01-95: Facilitator Network in Place and Operating
10-01-96: Annual Report on FY 96 Work

B. Project Milestones and Endpoints

C. Project Reports

Monthly progress reports, Quarterly Accomplishment Reports, Annual Review Reports.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The community outreach efforts of other restoration projects will be coordinated under this project, including information exchange and local hiring. This activities are included within the current mission of the consortium communities' - regional service organizations.

ENVIRONMENTAL COMPLIANCE

This project is categorically excluded under NEPA guidelines.

PERSONNEL

Dr. Lora L. Johnson	Chugach Regional Archaeologist
Martha Vlasoff	Alutiiq Language Preservation Coordinator

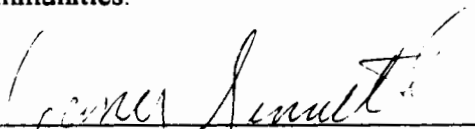
Project Title: **Community Involvement & Use of Traditional Knowledge**
Subtitle: **Community Assumption of: Project 95052 - "Community Interaction / Traditional Knowledge" - Responsibilities**

Dr. Lora L. Johnson
Chugach Regional Archaeologist
4201 Tudor Centre Drive, Suite 210
Anchorage, Alaska 99508
Phone: (907) 561-3143
FAX: (907) 563-2891
e-mail address / will be available August, 1995.

Don Callaway
National Park Service
3303 "C" Street
Anchorage, Alaska
Phone number Fax number
e-mail address/

Prepared this 29th day of April, 1995

Submitted under authorization and on behalf of the participating Chugach region oil spill impacted communities.



James Sinnett
Chugach Heritage Foundation
4201 Tudor Centre Drive, Suite 210
Anchorage, Alaska 99508
Phone Number: (907) 561-3143
FAX Number: (907) 563-2891
e-mail address / will be available August, 1995.

Project Title: Community Involvement/Traditional Ecological Knowledge

Project Number: 96052 *Revised*
 Restoration Category: General Restoration
 Proposer: Chugach Regional Resources Commission
 Lead Trustee Agency: Alaska Department of Fish and Game
 Cooperating Agencies: None
 Duration: 7 years
 Cost FY 96: 261,000
 Cost FY 97: 250,000
 Cost FY 98: 250,000
 Cost FY 99: 250,000
 Cost FY 00: 250,000
 Cost FY 01: 250,000
 Cost FY 02: 250,000
 Geographic Area: Oil spill area
 Injured Resource/Service: All Injured Resources/Services

ABSTRACT

Project 96052 would continue and expand on the original concept of increasing community involvement in the restoration process begun under 95052. This project would have two major components: community involvement and traditional ecological knowledge. Under the community involvement component a spill area-wide coordinator would be hired through a contract with Chugach Regional Resources Commission (CRRC) to serve as a liaison between the communities, and the existing network of scientists, agency personnel, restoration office personnel and the Trustee Council. Through direct communications with a network of local facilitators the spill area-wide coordinator, would actively involve local residents in the restoration program, particularly on-going scientific studies. The second project component, Traditional Ecological Knowledge (TEK), would consist of pilot a effort with the potential to integrate western science and local traditional knowledge to further the Trustees Council's restoration program.

INTRODUCTION

This project was initiated in 1995 as 95052 . Three local facilitators have been hired through cooperative agreements with the village councils of Tatitlek, Chenega Bay and Port Graham. Under 96052 the number of community facilitators would be expanded to include the communities of Nanwalek, Cordova, Seward, Valdez, Kodiak region, and Alaska Peninsula region.

Through a contract with CRRC a full-time, spill-area-wide coordinator, working out of the Restoration Office would be hired to accomplish the following tasks:

Community Involvement Component:

1. Increase involvement of community members throughout the spill region in restoration projects (local hire, use of local equipment, etc.). This would require becoming familiar with projects funded by the Trustee Council. identifying those that that would benefit by a community component, and working with Principal Investigators (PIs) to develop and implement.
2. Subcontract with and serve as contact point for community facilitators in each of nine participating communities (Tatitlek, Chenega, Port Graham, Nanwalek, Cordova, Seward, Valdez, Kodiak region, Alaska Peninsula region). Spill area-wide coordinator tasks would include:
 - a. Assisting communities in the development of new project ideas, and working with Trustee Council staff and agencies to develop project proposals.
 - b. Coordinating participation of community liaisons in annual Restoration Workshop and other workshops/meetings.
 - c. Distributing a brief report/update twice-monthly to each community liaison, via regional computer network bulletin board service. Update could include information, on research proposals, study results, restoration work planned in the area, Restoration Office activities, Trustee Council actions, etc.
3. Organize the annual round of Trustee Council/Restoration Office meetings held in conjunction with Invitation/Draft Work plan. This would include presentations in certain communities by select PIs.
4. Work with community members and PIs to develop protocols for community visits by PIs.
5. Provide input at the Restoration Work Force meetings.
6. Provide input to the newsletter (Restoration Update) editorial board.
7. Prepare quarterly project status reports and coordinate annual/final reports.

Traditional Ecological Knowledge Component:

Under a Cooperative Agreement to be developed and entered into by ADF&G and CRRC, the Subsistence Division and the spill area-wide coordinator, along with other CRRC staff and in consultation with the communities, would jointly:

1. Develop guidelines, procedures, and protocols for the systematic collection and analysis of TEK. This would be done in consultation with the tribal councils and with the Chief Scientist to ensure data is collected in a manner that allows EVOS researchers to integrate it into their restoration projects.
2. Identify suites of injured resources that could be incorporated into the TEK approach in FY 96. This would also be done in consultation with the Chief Scientist.
3. Train the Community Facilitators in the collection of TEK, and supervise the collection of TEK.
4. Develop a database for management of TEK, and protocols for the use of the database. The database should be integrated with other similar databases, so that it can be made available to all Trustee Council agencies and scientists, local communities and regional Native organizations, and other user groups.
5. Provide training for and assistance to EVOS researchers/scientists on the interpretation and potential application of TEK to their restoration projects. This might include a special session at the Annual Restoration Workshop, a separate workshop at a different date, and/or ongoing involvement with select researchers.
6. Coordinate these efforts with other ongoing TEK efforts (e.g., Project 96244/Harbor Seals).

The specific tasks the local facilitators are expected to undertake include the following:

Community Involvement Component:

1. Inform the spill area-wide coordinator of community Issues/ concerns/questions. Issues could be identified through community meetings conducted by the community facilitators or through other means, and could include ideas for new projects.
2. Assist the spill area-wide coordinator in increasing community involvement in restoration projects. Tasks might include identification of community members with available boats and other equipment; who's available to work and what their skills are; assisting in local coordination of the annual round of Trustee Council community meetings as well as community visits from project PIs; etc.
3. Disseminate to community members the twice-monthly update from the spill area-wide coordinator.
4. Attend annual Restoration Workshop and certain scientific review sessions (on SEA, persisting oil, marine mammal projects, etc.).

Traditional ecological knowledge components

1. Assist in defining protocols for the collection and use of TEK.
2. Assist in identifying injured species on which TEK should be collected.
3. Receive training in the collection of TEK
4. Collect TEK under the supervision of the spill area-wide coordinator and Subsistence Division.

Subsistence Division/ADF&G would enter into a Cooperative Agreement with CRRC to facilitate cooperation on the project on the tasks previously identified on the previous page. In addition, ADF&G would:

1. Serve as contact point for community assistants trained under 95279 (food safety testing) to handle samples of abnormal resources, facilitate processing of samples, and communicate findings back to communities.
2. Provide technical expertise and general assistance to the Restoration Office, Trustee Council, spill area-wide coordinator, and PIs on subsistence restoration, including assistance in development of project proposals.
3. Prepare monthly reports for the Trustee Council Executive Director summarizing interactions by Subsistence Division staff with the public on oil spill restoration topics.

NEED FOR THE PROJECT

A. Statement of Problem

The *Exxon Valdez* oil spill caused severe disruption of the lives of many people living in the spill impact area. The spill also caused residents of the area to be concerned about the safety of their wild food sources, and the integrity of the surrounding natural environment. While scientific studies aimed at restoring the resources and services damaged by the oil spill have occurred throughout the spill -area, most of the researchers work for agencies or institutions based in Anchorage, Fairbanks, or outside Alaska. Residents have voiced concern over a lack of involvement by spill area communities in the restoration efforts, and incomplete communication to spill area inhabitants of study proposals and results. At the same time, researchers have recognized that local residents have traditional knowledge that could help them answer questions they have not been able to answer through conventional scientific means.

B. Rationale

People living in the spill area have detailed knowledge about the condition of resources, which can significantly add to data collected as part of scientific studies, and possibly even enhance the success of restoration efforts. Local people have expressed a desire to be involved in all aspects of restoration projects, and a willingness to work with researchers.

This project furthers the Trustee Council's goal of facilitating the involvement of spill area residents and resource users in the restoration process.

C. Summary of Major Hypotheses and Objectives

The objectives of the project will be to:

1. Increase the involvement of spill area communities in the restoration efforts of the Trustee Council, and
2. Improve the communication of findings and results of restoration efforts to spill area inhabitants and the appropriate regional organizations. It is expected that by so doing, this project will increase the effectiveness of over-all restoration efforts.
3. Integrate western science and local traditional knowledge with the intent of furthering the Trustee Council's restoration program in a way that is sensitive to the needs of the affected communities.

D. Completion Date

Since the objective of this project is to integrate the local communities into the restoration program we see a need to continue this program until spill restoration is complete. The project should be evaluated on a yearly basis to determine how it can best serve the needs of the Trustee Council and the local communities.

COMMUNITY INVOLVEMENT

The core of this project is community involvement.

FY 96 BUDGET

<u>Budget Line Items</u>	<u>CRRC</u>	<u>ADF&G</u>	<u>Total</u>
Personnel (including Fringe)	\$48,000.00	\$52,700.00	\$100,700.00
<i>Spill Area Wide Coord.</i>	48,000.00	0.00	
<i>TEK Component (Miraglia)</i>	0.00	38,900.00	
<i>TEK Oversight (Simeone)</i>		8,800.00	
<i>ADF&G Program Management</i>		5,000.00	
Travel	5,000.00	6,000.00	11,000.00
Contractual	108,00.00	2,500.00	110,500.00
<i>Community Liaisons/</i>	108,000.00	0.00	
<i>TEK Contractual Costs</i>	0.00	2,500.00	
Commodities	0.00	2,200.00	2,200.00
Equipment	0.00	0.00	0.00
Capital Outlay	0.00	0.00	0.00
Subtotal	\$161,000.00	63,400.00	224,400.00
General Administration	16,100.00	20,500.00	36,600.00
Project Total	\$177,100.00	\$83,900.00	\$261,000.00

PROJECT DESIGN

A. Objectives

1. To increase the involvement of spill area communities in the restoration efforts of the Trustee Council.
2. To improve the communication of findings and results of restoration efforts to spill area inhabitants and the appropriate regional organizations.
3. To improve the communication of traditional ecological knowledge from local residents to scientists, which can significantly enhance the value of Trustee Council restoration efforts.

B. Methods

The project will be implemented by a Spill Area Wide Coordinator hired through a contract with the Chugach Regional Resources Commission, and the local facilitators, with the assistance of the Alaska Department of Fish and Game's Division of Subsistence.

The objectives will be achieved using the following methods:

A contract will be let by ADF&G Subsistence Division to CRRC for overall coordination of the facilitators and spill area wide coordinator. The contractor will be expected to arrange for the hiring and coordination of local facilitators in the communities of Chenega Bay, Tatitlek, Port Graham, Nanwalek, and Cordova, Seward, Valdez, and regional coordinators for the Kodiak Island and Alaska Peninsula regions.

Working with the community facilitators, the Spill Area Wide Coordinator will identify those projects funded by the Trustee Council for which a community outreach component would be appropriate, and will work with the principal investigators of those projects to design and implement community outreach components. The goal of community outreach will be to continue the informal partnership, begun under 95052, between the people of the oil spill region and scientific researchers. Outreach will include communication of traditional knowledge and local interests, as well as communication of research proposals and study results. The TEK portion of the project is integral to its success in that the project objectives can only be achieved through a cooperative working relationship between the participating agencies wherein guidelines/protocols are developed, people are trained, and databases shared.

The effectiveness of the project will be evaluated on an annual basis, by the Trustee Council staff working in cooperation with the Spill Area Wide Coordinator, the communities in the oil spill region and the Subsistence Division of ADF&G.

C. Contracts and Other Agency Assistance

A contract will be let to CRRC for overall coordination of a facilitator network through a Spill Area Wide Coordinator. The contractor will be expected to arrange for the hiring and coordination of local

facilitators in the communities of Chenega Bay, Tatitlek, Port Graham, Nanwalek, Seward, Valdez, and Cordova, and regional coordinators for the Kodiak Island and Alaska Peninsula regions.

These tasks are being contracted out for three reasons:

1. The project is expanding in scope and the use of a regional organization as opposed to a state agency would better serve the needs of the local community members.
2. The Trustee Council has encouraged contracting tasks out to the private sector as much as possible, and as appropriate.
3. The state procurement system makes it difficult to contract directly with the communities in the oil spill region. It should prove simpler to contract out the coordination of the facilitator network on a sole source basis with an organization that has an established working relationship with the communities.

D. Location

The project will be undertaken throughout the oil spill region. Local facilitators will be hired in the communities of Chenega Bay, Tatitlek, Port Graham, Nanwalek, Seward, Valdez and Cordova, and regional facilitators will be hired from the Kodiak Island and Alaska Peninsula region. However, all other communities in the oil spill impact area will also be included in outreach efforts, even though a local facilitator will not be hired in each community.

The project's benefits will be realized both in the communities involved and in the restoration of the injured resources. Better communication among the Trustee Council staff, researchers and residents of the communities impacted by the spill, should improve the effectiveness of restoration efforts.

SCHEDULE

A. Measurable Project Tasks for FY 96

October 1, 1995	ADF&G and CRRC enter into contract for coordination of facilitator network
October 1-30, 1995	MOU drafted between ADF&G and CRRC
October 15, 1995	Spill Area Wide Coordinator hired
October - December, 1995	Guidelines/protocols developed for TEK
November, 1995	Identification of injured species for TEK
November, 1995 - January 1996	Preparation for Annual Workshop
January, 1996	Facilitator Network in Place and Operating
January, 1996	Participate in Annual Workshop
January, 1996	Training Workshop for local community facilitators
April, 1996	Training Workshop for local community facilitators
January - September, 1996	Database developed

B. Project Milestones and Endpoints

The project should be continued as long as there are significant restoration efforts underway. The project should be evaluated on a yearly basis to determine the most efficient way to continue to keep the communities involved in the Trustee Council Restoration Program.

C. Project Reports

Annual reports will be compiled in coordination with the Alaska Department of Fish & Game, and provided each year by CRRC on April 15th, describing and summarizing the progress made during the previous federal fiscal year. In addition, bi-monthly reports will be provided to the participating communities by the Spill Area Wide Coordinator.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This community outreach effort is in fact a novel effort to coordinate the Restoration Program with the local residents and builds on the established relationship between CRRC and the communities in Prince William Sound. Under this project CRRC will work to establish new relationships with Kodiak Island and Alaska Peninsula area residents

ENVIRONMENTAL COMPLIANCE

This project is categorically excluded under NEPA guidelines.

PERSONNEL

Patty Brown-Schwalenberg: Ms. Brown-Schwalenberg is the Executive Director of Chugach Regional Resource Commission (CRRC). She has worked for the past 11 years in such positions as Tribal Administrator for the Lac du Flambeau Band of Lake Superior Chippewa Indians, Society Administrator for the Native American Fish & Wildlife Society, Office Manager of the Bering Sea Commercial Fisheries Development Fund, and as a private contractor, assisting Alaska Native communities in obtaining funding for natural resource management programs, and setting up their administrative systems. CRRC and the previous organizations that Ms. Brown has operated have consistently met all standards of proper management, including annual program and financial audits.

Martha Vlasoff: CRRC will subcontract with Ms. Vlasoff to be the Spill-Area-Wide Coordinator for this project. She is currently an intern with the Chugach Heritage Foundation. She has been active in spill area issues for five years and currently serves as an at-large representative on the Public Advisory Group to the Trustee Council. Ms. Vlasoff was a resident of Tatitlek for 15 years and has been very active in native issues within the state of Alaska. Ms. Vlasoff is also on the Alaska Conservation Foundation Board of Directors.

Rita Miraglia: Ms Miraglia has served as the oil spill coordinator for the Division of Subsistence since 1990. As such, she has organized and participated in the subsistence resource collection and testing programs of 1990 and 1991. She has also been the lead communicator of study findings to communities through organizing community meetings and writing newsletters. She has also assisted the Oil Spill Health Task Force's activities.

Bill Simeone: Dr. Simeone was added to the Division staff in 1995 as a Subsistence Resource Specialist. He has extensive prior research experience in most communities in the oil spill area.

Proposed Project Leader: Patty Brown-Schwalenberg
Chugach Regional Resources Commission
4201 Tudor Center Drive, Suite 211
Anchorage, Alaska 99508
phone number: 907/562-6647
fax number: 907/563-4939

Proposed Project Manager:
Dr. Joseph R. Sullivan
Habitat & Restoration Division
Alaska Department of Fish & Game
333 Raspberry Road
Anchorage, Alaska 99518
phone number: 267-2213
fax number: 522-3148

Date Prepared

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
None				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.			New Equipment Total	\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				
None				

1996

Project Number: 96052
 Project Title: Community Involvement & Use of Traditional Knowledge
 Agency: AK Dept. of Fish & Game

FORM 3B
 Equipment
 DETAIL

1996 EXXON VALDEZ TRU: COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
CRRRC Contract for Coordination and Facilitation of Community Outreach (includes subcontracts with communities)		177.1
Postage (food safety information)		0.5
Shipping of biological samples and sampling supplies		1.0
Long distance phone charges		0.5
Photocopying		0.5
When a non-trustee organization is used, the form 4A is required.		
Contractual Total		\$179.6
Commodities Costs:		Proposed
Description		FFY 1996
Replacement of sampling kit components		2.0
Audio tapes		0.2
Commodities Total		\$2.2

1996

Project Number: 96052
 Project Title: Community Involvement & Use of Traditional Knowledge
 Agency: AK Dept. of Fish & Game

FORM 3B
Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
*	Miraglia	Subsistence Resource Specialist III	18A	8.0	4,857	0	38.9
	Simeone	Subsistence Resource Specialist II	16B	2.0	4,418	0	8.8
	PCN 117064	Fish Biologist III (Project Manager costs)	18C	1.0	5,000	0	5.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Subtotal				11.0	14,275	0	
Those costs associated with program management should be indicated by placement of an *.							Personnel Total \$52.7
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
	Anchorage-Chenega Bay		900	1	2	150	1.2
	Anchorage-Tatitlek		550	1	2	150	0.9
	Anchorage-Port Graham/Nanwalek		200	2	3	150	0.9
	Anchorage-Kodiak City		190	1	2	150	0.5
	Anchorage-Valdez		160	1	2	150	0.5
	Anchorage-Cordova		200	2	3	150	0.9
	Anchorage-Chignik Bay		800	1	2	150	1.1
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.							Travel Total \$6.0

1996

Project Number: 96052
 Project Title: Community Involvement & Use of Traditional Knowledge
 Agency: AK Dept. of Fish & Game

FORM 3B
 Personnel
 & Travel
 DETAIL

0/2000 - 10/2000

1996 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$51.7	\$52.7						
Travel	\$14.8	\$6.0						
Contractual	\$72.0	\$179.6						
Commodities	\$0.7	\$2.2						
Equipment	\$0.0	\$0.0						
Subtotal	\$139.2	\$240.5	LONG RANGE FUNDING REQUIREMENTS					
General Administration	\$12.8	\$20.5	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$152.0	\$261.0	\$261.0	\$261.0	\$261.0	\$261.0	\$261.0	\$261.0
Full-time Equivalents (FTE)	0.9	0.9						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Prepared: R. Miraglia

1 of 4

Project Number: 96052
 Project Title: Community Involvement & Use of Traditional Knowledge
 Agency: AK Dept. of Fish & Game

FORM 3A
 AGENCY
 PROJECT
 DETAIL

8/18/95

PROJECT TITLE: A MASS-BALANCE MODEL OF TROPHIC FLUXES IN PRINCE WILLIAM SOUND.

Project Number: 96054

Restoration Category: Monitoring

Proposer: Fisheries Centre, University of British Columbia, Vancouver, British Columbia, V6T 1Z4, Canada.

Lead Trustee Agency:

Cooperating Agencies:

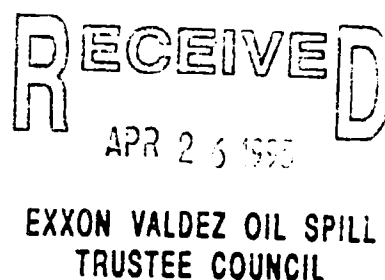
Duration: 2 years

Cost FY 96: \$105,900

Cost FY 97: \$75,000

Geographic Area:

Injured Resource/Service: All injured resources and all damaged services



ABSTRACT

Support is requested for four elements of this 2 year project: an initial workshop, an extended study by a graduate student, a final evaluation meeting and the production of an educational video for the public domain linked to an interactive graphic version of the software for display in the Alaska Sealife Center.

An initial one-week workshop is proposed during which the participants, invited from various projects already running under this scheme and from other experts, would assemble the elements required for a mass-balance model of trophic fluxes in the Prince William Sound area.

Model construction would be performed using the well-documented ECOPATH II approach which has now been applied to nearly a hundred aquatic ecosystems throughout the world.

A graduate student would collate the results, update the model, provide feedback and prepare material for the evaluation meeting at which the use of the ECOPATH II model as a rapid means of providing a trophic overview will be considered.

INTRODUCTION

The aim of this study would be to provide a trophic framework to unite some of the various research components of the Prince William Sound ecosystem study. One aspect of the North Pacific ecosystem(s) which has been largely neglected - at least since T. Laevastu and colleagues' heroic attempt at a spatially-structured simulation model of the entire Bering Sea - is the "trophic context" of the key species, i.e., their food consumption and requirements, and their contribution to the diet of predators. Such context

provides powerful constraints to the estimation of biomasses and to the fluxes that can occur between them, and can thus be used to validate published estimates.

In this study, emphasis would be given to the estimation of fluxes relating, for example via common prey species, marine mammals and seabirds with the fisheries and predator - prey relationships within the fish communities of Prince William Sound, i.e., of fluxes whose value have important implications for conservation and/or fisheries management.

Many reasons may be invoked to explain why marine and fisheries scientists tend to prefer working on single species, or on interactions among few species, rather than on models of entire ecosystems. One of these reasons is that "ecosystem modelling" is perceived as a specialized and long-term activity, leading to large, unwieldy products, perhaps best illustrated by the Bering Sea model alluded to above.

Practical demonstrations of the scope, power and versatility of the fast and tractable ECOPATH II approach may help in the rapid evaluation of whole-system attributes, increasingly required in an age of human mistakes and global change.

NEED FOR THE PROJECT

A. Statement of Problem

In a multi-faceted research program it is often easy to lose track of the relevance and position of each individual project in the overall picture that is being created. Organisms are related to their ecosystem through their interactions with its other components; the trophic interaction is one of the most significant, especially when considering how to restore a damaged environment and to monitor the potential flows of toxic substances through that environment. Without a clear picture of the quantitative relationships between species in an environment it may be difficult to correlate the results and implications of the various research projects.

B. Rationale

A rapidly-achieved overview of the trophic structure of Prince William Sound and the relationships between the different species and groups that inhabit the area would assist both in individual projects and in planning future policy. For example, the ECOPATH II model would be able to indicate whether there has been a shift in the Prince William Sound trophic structure since the oil spill that is hindering the recovery of seabirds and marine mammals, while a quantitative analysis of the relationships between seabird foraging and hatchery released fish would help to identify problems in the restocking program. The versatility of the ECOPATH II system allows it to produce a fast and cost-effective overview of any part of the system.

C. Summary of Major Hypotheses and Objectives

The basic idea of this project is that the use of a mass balance model such as ECOPATH II will allow easy identification of areas of trophic flux that will be of great interest to all workers involved in the restoration project. The initial workshop would allow the input of data and ideas from a range of people from different projects, while the subsequent analysis of the output from the model would provide feedback and ideas to the researchers in the individual projects. The final evaluation meeting would provide a forum for validation of the use of this relatively simple model in studies of this nature.

Production of an educational video and interactive software will be ideal ways of explaining basic ecological principles to the general public.

D. Completion Date

The initial workshop would last for one week and we expect that a major part of the project objectives, i.e. the production of a trophic flux model of Prince William Sound, would be achieved by the end of this workshop in FY 96.

Ongoing analysis of the data and refinement of the model by the graduate student would take another 15 months to complete and it is expected that the other aims of the project, i.e. the final evaluation meeting and the production of video and software products, would be achieved by the end of FY 98

COMMUNITY INVOLVEMENT

Although the main thrust of the workshop would be to input data from a range of researchers into different aspects of the Prince William Sound restoration scheme, it is envisaged that local knowledge and traditions would provide an invaluable source of ideas and data. The ECOPATH II concept is simple and easy to explain and will provide an easy route to the understanding of ecosystem processes to the community.

FY96 BUDGET

1.	Personnel	\$39,300
2.	Travel	\$31,100
3.	Contractual services	\$15,500
4.	Commodities	\$1,000
5.	Equipment	\$12,000
6.	General administration	\$7,000

PROJECT DESIGN

A. Objectives

1. To appraise the utility of a rapid mass-balance model of trophic fluxes in the Prince William Sound area.
2. To analyze the output from this model to the benefit of the restoration as a whole and individual projects in particular.
3. To produce an educational video for the public.
4. To design an interactive version of the ECOPATH II software for use as a teaching and information aid at the Alaska Sealife Center.

B. Methods

Based on work of Dr. J.J. Polovina (1984), of the US National Marine Fisheries Service, Drs. D. Pauly and Villy Christensen, both then at the International Center for Living Aquatic Resources Management (ICLARM) in Manila, Philippines, have developed an approach, implemented as well-documented

software for personal computers, which allows for rapid construction and verification of mass-balance models of ecosystems (Christensen and Pauly 1992 a, b). The steps involved consist essentially of:

- (i) Identification of the area and period for which a model is to be constructed;
- (ii) Definition of the functional groups (i.e. "boxes") to be included;
- (iii) Entry of a diet matrix, expressing the fraction that each "box" in the model represents in the diet of its consumers;
- (iv) Entry of food consumption rate, and of production/biomass ratio or of biomass, and of fisheries catches, if any, for each box;
- (v) Balance the model, or modify entries (iii&iv) until input = output for each box;
- (vi) Compare model outputs (network characteristics, estimated trophic levels and other features of each box) with estimates for the same area during another period, or with outputs of the same model type from other, similar areas, etc.

These steps can be implemented easily if basic parameters can be estimated, especially as numerous, well-documented examples already exist of ECOPATH II applications to aquatic ecosystems, ranging from aquaculture ponds and flooded rice paddies to shelf systems (see Pauly and Christensen 1993, and contributions in Christensen and Pauly 1994), notably the North Sea, and George's Bank.

Each participant would cover a functional group and its associated fluxes: phytoplankton and primary production, marine bacteria and their consumption of detritus, zooplankton and secondary production, major fish species and their fisheries, marine mammals and birds and their food consumption. Rate and biomass estimates would be standardized for the area and for two different periods (pre spill and post spill).

Ongoing analysis of data and model updating will provide a means of incorporating new information from the various projects and also a route for identification of important omissions in current research. The work of the graduate student can be tailored to requirements identified during the workshop and could also be aimed at a comparative study between Prince William Sound and a more pristine Alaskan environment.

The final evaluation meeting will be the forum for presentation of the results and conclusions of the study and will provide important information on the use of such methods for the future.

References

Christensen, V. and D. Pauly (editors) 1994. Trophic Models of Aquatic Ecosystems. ICLARM Conference Proceedings. 26, 390 p.

Christensen, V. and D. Pauly 1992a. ECOPATH II - A system for balancing steady-state ecosystem models and calculating network characteristics. *Ecol. Modelling* 61:169-185.

Christensen, V. and D. Pauly 1992b. A guide to the ECOPATH II software system (version. 2.1). ICLARM Software 6. 72 p.

Pauly, D. and V. Christensen 1993. Stratified models of large marine ecosystems: a general approach and an application to the South China Sea, p. 148-174. *In* K. Sherman, L.M. Alexander and B.D. Gold (editors). Stress, mitigation and sustainability of large marine ecosystems. AAAS Press, Washington, D.C.

Polovina, J.J. 1984. Models of a coral reef ecosystem I: the ECOPATH model and its application to French Frigate Shoals. *Coral Reefs* 3(1):1-11.

C. Contracts and Other Agency Assistance

The initial workshop would be held in a hotel in Anchorage.

The production of a video would be contracted to the private sector.

D. Location

The workshop would probably be held in Anchorage; all other research would be at the Fisheries Centre at UBC. The video production would be contracted to a company in the Prince William Sound area.

SCHEDULE

A. Measurable Project Tasks for FY 96

October 1995:	Draw up list of participants, send details and invitations
January 1996:	Arrange venue, accommodation etc. Start designing and commissioning video.
March 1996	Send pre-workshop literature and modelling requirements
April 1996:	Arrange travel schedule. Initial work on interactive graphic software.
May 1996:	Collation of preliminary data to look for shortcomings.
July 1996:	7 day workshop, collection of results. Start data analysis. Start video production and software design.
September 1996:	Preliminary publication of initial results

B. Project Milestones and Endpoints

1. Initial rapid mass-balance model of trophic fluxes in the Prince William Sound area -completion by July 1996
2. Further analysis of the output from this model to the benefit of the restoration as a whole and individual projects in particular - completion by September 1997
3. Production of an educational video for the public - completion by September 1997.
4. Production of an interactive version of the ECOPATH II software for use as a teaching and information aid at the Alaska Sealife Center - completion by September 1997.
5. Final evaluation meeting - completion by September 1997

C. Project Reports

Project reports will be submitted at the following approximate times:

Preliminary workshop report - September 1996

First year progress report - November 1996

Final project report - March 1998

Publication of results in peer-reviewed journals will be on an "as soon as possible" basis.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The main thrust of this proposed project is one of coordination and integration. It is hoped that representatives of all the major research projects in Prince William Sound will contribute to the workshop.

ENVIRONMENTAL COMPLIANCE

None required.

PERSONNEL

Signed Mark Essen pp D. Pauly

Dr. Daniel Pauly (Project Leader), Resume attached
Professor,
Fisheries Centre,
University of British Columbia,
2204, Main Mall,
Vancouver, V6G 1K5,
British Columbia, Canada
Phone 604 822 1201
Fax 604 822 8934
e-mail pauly@bcu.ubc.ca

Signed Tony Pitcher

Dr. Tony Pitcher (Project Manager), Resume attached
Director,
Fisheries Centre,
University of British Columbia,
2204, Main Mall,
Vancouver, V6G 1K5,
British Columbia, Canada
Phone 604 822 2731
Fax 604 822 8934
e-mail pitcher@bcu.ubc.ca

Graduate student - vacant
Software developer - vacant

Workshop participants will be invited from all major projects in the Prince William Sound restoration scheme and from other experts, in particular Dr. V. Christensen from Denmark who, with Dr. Pauly, developed the ECOPATH II model.

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel		\$39.3						
Travel		\$31.1						
Contractual		\$15.5						
Commodities		\$1.0						
Equipment		\$12.0						
Subtotal	\$0.0	\$98.9	LONG RANGE FUNDING REQUIREMENTS					
Indirect		\$7.0	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$0.0	\$105.9	\$75,000.0					
Full-time Equivalents (FTE)		18.5						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments: Indirect project costs are for general administration and are calculated as 15% of personnel costs and 7% of contractual costs								

1996

Prep 24th April 1995

1 of 4

Project Number:

Project Title: A mass-balance model of trophic fluxes in Prince William

Sound

Name:

FORM 4A
Non-Trustee
DETAIL

24/04/95

October 1, 1995 - September 30, 1996

1996	Project Number: Project Title: A mass-balance model of trophic fluxes in Prince William Sound Name:	FORM 4B Personnel & Travel DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Communication (including setting up a World Wide Web page)		3.0
Printing		1.5
Workshop Venue and costs		5.0
Equipment lease (computers for workshop)		1.0
Video production (first year)		5.0
Contractual Total		\$15.5
Commodities Costs:		Proposed
Description		FFY 1996
Miscellaneous		1.0
Commodities Total		\$1.0

1996

Project Number:
Project Title: A mass-balance model of trophic fluxes in Prince William Sound
Name:

FORM 4B
Contractual &
Commodities
DETAIL

October 1, 1995 - September 30, 1996

1996	Project Number: Project Title: A mass-balance model of trophic fluxes in Prince William Sound Name:	FORM 4B Equipment DETAIL

Updated short C.V., November 1994

Dr Daniel Pauly, Principal Science Adviser

International Center for Living Aquatic Resource Management (ICLARM)

Other organizations:

Professor, Fisheries Centre, University of British Columbia,

Editorial Boards:

Naga, the ICLARM Quartely (Editor of the Fishbyte section)

Reviews in Fish Biology and Fisheries

Education:

Diplom (= M. sci.); Fisheries Biology, Zoology and Botany from Christian-Albrechts-Universitaet (CAU), Kiel Germany (1969-1974);

Dr rer. nat. (= PhD); Fisheries Biology, Zoology and Oceanography from CAU (1977-1979);

Habilitation (≈ Dr sci.); CAU, 1984-1985.

Publications:

Authored, co-authored and (co-)edited well over 250 scientific articles, reports and books; a recent book: "On the Sex of Fishes and the Gender of Scientists: a collection of essays" (1994, Chapman & Hall, London, 250 p.) summarizes much previous work.

Recent international symposia:

Fisheries Management: Global Trends (Seattle, June 1994); keynote speaker;

Sixth INTECOL Symposium (Manchester, August 1994); keynote speaker.

Field of work:

Tropical fisheries management, fish population dynamics, comparative studies of growth and related processes in fish.

Hobbies:

Reading, writing, SCUBA diving.

Languages:

French, German, English, Spanish.

Citizenship, place and date of birth:

France, Paris, May 2, 1946.

Marital status:

Married to Sandra (née Wade), since December 1978.

Children:

One son (Ilya), one daughter (Angela).

Religion: (none, skip field)

Mailing addresses:

ICLARM, MC P.O. Box 2631, 0718 Makati, Metro Manila, Philippines

Fax (63-2) 816 3183 and

Fisheries Centre, University of British Columbia,
2204 Main Mall, Vancouver, BC., Canada, V6T 1Z4.

Fax (604) 822 8934.

Residential address:

Wack Wack Apartments, D2, Wack Wack Road, Mandaluyong,
Metro Manila, Philippines. Tel (63-2) 783749.

Curriculum vitae

DANIEL PAULY

Dr. Daniel Pauly is a French citizen, 47 years of age. He completed high school and his university studies in the Federal Republic of Germany where he acquired an MSc in 1974 and a PhD in Fisheries Biology in 1979. He joined ICLARM on a 2-year Post Doc contract in 1979 but was given a permanent position after one year. Presently, he is the Director of ICLARM'S Coastal Resources Systems Program.

His scientific output comprises authored and edited books, reports and scientific papers - a total of well over 200 items. The methods and software he has developed while at ICLARM are in use throughout the world.

POSITIONS HELD:

1. October 1974 to December 1976 - Employee of the German Society for Technical Cooperation (GTZ) with assignment to the Indonesian-German Demersal Fisheries Project in Jakarta and Semarang, Indonesia, from May 1975 to December 1976.
2. September 1978 to April 1979.- Research assistant at the Dept. of Fishery Biology, Institute for Marine Sciences, Kiel.
3. July 1979 to June 1980 - Post Doctoral Fellow, ICLARM.
4. July 1980 to June 1985 - Associate Scientist, ICLARM.
5. July 1985 to present - Senior Scientist, ICLARM.
6. July 1986 to December 1992 - Director, Resources Assessment and Management Program, ICLARM (renamed "Capture Fisheries Management Program" in December 1988).
7. January 1993 to present - Director, Coastal Resources Systems Program, ICLARM.

MEMBERSHIP IN SOCIETIES, EDITORIAL BOARDS, PANELS, ETC.:

- o Asian Fisheries Society, 1984 to present
- o Fisheries Society of the British Isles, 1987 to present
- o American Fisheries Society, 1981 to 1987 and 1993 to present
- o Network of Tropical Fisheries Scientists, 1982 to present
- o Network of Tropical Aquaculture Scientists, 1987 to present
- o Common Property Resource Network, 1986 to present
- o Deutsche Gesellschaft für Meeresforschung, 1982 to present
- o Philippine Fisheries Research Society, 1980 to present
- o British Sub-Aqua Club/Philippine Sub-Aqua Club, 1988 to present

- o **Sociedad Mexicana de Historia Natural (Corresponding member), 1987 to present**
- o **Editorial Board of "Asian Fisheries Science" (Journal of the Asian Fisheries Society), 1987 to June 1993**
- o **Editorial Board of the "Journal of Applied Ichthyology (Paul Parey Verlag, Hamburg and Berlin); Subject Editor for Fisheries in Developing Countries, 1985 to present**
- o **Editor of "Fishbyte" (Newsletter of the Network of Tropical Fisheries Scientists), 1988 to 1991; since 1992, editor of Fishbyte section in NAGA, the ICLARM Quarterly.**
- o **Member of the Guiding Group of Experts of the Ocean Science and Living Resources Program of the Inter-governmental Oceanographic Commission (IOC) and Food and Agriculture Organization (FAO), 1984 to present**
- o **Biological Rapporteur of the IOC/SCOR Committee on Climate Changes and the Oceans, 1987 to 1988**
- o **Scientific Adviser of the Asian Fisheries Society Research Fellowship Award Scheme, 1988 to present**
- o **Member, Committee on Marine Science, Pacific Science Association, 1986 to 1988**
- o **Thesis co-adviser, Universidad Nacional Autónoma de México, México D.F., México, 1987-1989**
- o **Lecturer, thesis adviser and external examiner, University of the Philippines, Philippines, 1980 to present**
- o **Privat-Dozent (lecturer), thesis adviser and external examiner, University of Kiel, Fed. Republic of Germany, 1985 to December 1991**
- o **Privat-Dozent, thesis adviser and external examiner, University of Bremen, Fed. Republic of Germany, 1990 to present**
- o **Adjunct Professor of Oceanography, Graduate School of Oceanography, University of Rhode Island, Kingston, U.S.A., January 1982 to December 1984.**
- o **Editorial Board member, "Reviews in Fish Biology and Fisheries", 1991 to present**

AWARDS RECEIVED:

- o **Villigst Foundation Fellowship 1970-1974 [a fellowship awarded (by the Protestant Church of Germany) to highly gifted ("hochbegabte") university students]**
- o **ICLARM Post-Doctoral Fellowship (July 1979-June 1980)**
- o **Elvira Tan Award for Best Paper in Marine Fisheries ("Status of Philippine demersal stocks: inference from underutilized data", with Messrs. G. Silvestre and R. Regalado), July 1988**

COURSE ATTENDED (post-doctoral only)

- o CGIAR Management Course for Senior Staff, Wintergreen, Virginia, USA, Washington, USA (29 June - 10 July 1992)

CONFERENCE/WORKSHOPS ORGANIZED: *

- o ICLARM/CSIRO Workshop on the Theory and Management of Tropical Multispecies Stocks, 12-21 January 1981, Cronulla, Australia
- o *Ad hoc* Consultation on Fish Stock Assessment in Coral Reefs, ICLARM, Manila, Philippines, 25-26 May 1981
- o ICLARM/KISR Conference/Workshop on the Theory and Application of Length-Based Methods in Stock Assessment, Mazara del Vallo, Sicily, Italy, 10-15 February 1985
- o Workshop on Models for Yield Prediction in the Peruvian Upwelling Ecosystem, Callao, Peru, 24-28 August 1987
- o Poster session on "Construction and Comparison of Trophic Models of Aquatic Ecosystems", International Council for the Exploration of the Seas, Copenhagen, 4-9 October 1990
- o Mid-Term Planning Workshop for ICLARM's Coastal Resources System Program, ICLARM headquarters, 1-3 October 1992

PUBLICATIONS:

See attachments.

CONSULTANCIES (EXCEPT TRAINING COURSES):

- Reviewing the Theory of Tropical Multispecies Fisheries, ICLARM Headquarters, Manila, Philippines, July-August 1978 (on behalf of the International Center for Living Aquatic Resources Management, Manila);
- Advising the Ecuadorian-British Fisheries Development Project in Guayaquil, Ecuador, on the interpretation of project data (visit sponsored by the Overseas Development Agency), November-December 1981;
- Introducing staff of the Programa Peruano-Alemán de Investigación Pesquera and of the Instituto del Mar del Perú to advanced stock assessment methods and assisting with the preparation of various publications (including two books) in Callao, Peru on November/December 1981, 30 April-7 May 1983; 19 February-14 March 1985; 7-26 October 1986; 17 August-2 September 1987; September 1988; and 22 July-5 August 1989 (all visits on behalf of the Deutsche Gesellschaft für Technische Zusammenarbeit);
- Advising on analysis of fishery survey data and research planning, 15-27 August and 8-17 December 1983, Sea Fisheries Research Unit, Rangoon, Burma (on behalf of the Food and Agriculture Organization of the United Nations);

* Conferences and workshops that were simply attended are not listed (but see list of publications for papers presented at the conferences/workshops attended)

- Providing Advice on Microcomputer Use and Shrimp Stock Assessment to the FAO/SIDA Bay of Bengal Programme, Madras, 3-5 December 1983;
- Review and support of the (1) Fish and Shrimp Management Program, and (2) Fishery Research of the Mariculture and Fisheries Department, Kuwait Institute of Scientific Research, Kuwait (April and December 1985; January 1986);
- Developing (with P. Fox, I.R. Smith and E. Cruz) a project plan for a fish stock assessment/pilot fishery management component of the Rain-fed Resource Development Project, September-November 1985 (on behalf of the U.S. Agency for International Development, Philippine Mission);
- Advising staff and the Secretary of the Intergovernmental Oceanographic Commission (IOC) on the status of shrimp recruitment research in the Western Pacific area, 4-5 June 1987, Paris;
- Reviewing (with three other team members) the achievements of the ASEAN/US Coastal Area Management Project, January 1988 (on behalf of the U.S. Agency for International Development);
- Planning of FAO/DANIDA training courses: October 1982 in Charlottenlund, Denmark, and September 1982 and February 1989 at FAO/Headquarters, Rome, Italy (on behalf of the FAO/DANIDA Project on Tropical Fish Stock Assessment);
- Acting as leader of a World Bank mission to Kenya, Malawi, Mozambique and Zimbabwe, as a part of the "Study of International Fisheries Research" 7-26 January 1990;

TEACHING ACTIVITIES AND THESES SUPERVISION:

Courses and lectures at various institutions in the Philippines

- o Regular lectures at the University of the Philippines, Diliman Campus, Quezon City
 - WS 1980/1981: Management of aquatic resources
 - WS 1981/1982: Management of aquatic resources
 - WS 1985/1986: Tropical fish population dynamics
- o BFAR/PCARRD/SCSP/ICLARM Course on Fisheries Resources Assessment, Ateneo de Manila University, 3-15 May 1982
- o MSL/ICLARM Course in Fish Population Dynamics, Marine Science Laboratory, Silliman University, Dumaguete, June 1982
- o CRSP/GTZ/ICLARM Course on Fish Stock Assessment, College of Fisheries, University of the Philippines, October 1986
- o FAO/DANIDA Follow-up Training Course in Stock Assessment in the Tropics, 12 January - 6 February 1987

Courses and lectures at the Institut für Meereskunde, University of Kiel, Kiel, Federal Republic of Germany

- Einführung in die Fischereibiologie der Tropen (Einstündige Vorlesung, WS 1984/1985)
- Theorie und Praxis der Datenanalyse in der Fischereibiologie (Vorlesung mit Übung, 2 Stündig, SS 1985)
- Aufbaukurse zur Populationsdynamik Tropischer Fische: neue Konzepte und Methoden (2-Stündig. Blockkurs, 20-26 Juni 1988)
- Aufbaukurse zur Populationsdynamik der Fische: neue Konzepte und Methoden (2-Stündig. Blockkurs, 20-26 Juni 1989, 10-15 July 1989 and 25-29 Juni 1990)

Master of science theses supervised in the Philippines*

- Aniceto, M. Hernando, Jr. 1981. Contributions to the taxonomy and biology of *Formio niger* (Bloch) in Lingayen Gulf. College of Arts and Sciences, University of the Philippines, Diliman, Quezon City, 103 p.
- Navaluna, Noli A.N. 1982. Population dynamics of the tiger-toothed croaker *Otolithus ruber* in San Miguel Bay. College of Arts and Sciences, University of the Philippines, Diliman, Quezon City, 73 p.
- Pagdilao, R. Cesario. 1982. Taxonomy, growth and mortality of slipmouths (Order Perciformes, Family Leiognathidae) in Manila Bay. College of Arts and Sciences, University of the Philippines, Diliman, Quezon City, 114 p.
- Mangaoang, Inocencio Jr., D. 1982. Age and growth of three species of *Siganus* in the wild and in captivity: comparative study based on their otoliths' daily rings. College of Arts and Sciences, University of the Philippines, Diliman, Quezon City, 88 p.
- Cortes-Zaragoza, Ester. 1983. Morphometric and relative abundance of tunas (Perciformes: Scombridae) caught off Darigayos Cove, La Union. College of Arts and Sciences, University of the Philippines, Diliman, Quezon City, 85 p.
- Cabanban, Annadel S. 1984. Some aspects of the biology of *Pterocaesio pisang* (Bleeker 1853) (Pisces: Caesionidae) in Central Visayas. College of Science, University of the Philippines, Diliman, Quezon city, 69 p.
- Tandog, Dulce D. 1984. State of exploitation and population dynamics of skipjack tuna (*Katsuwonus pelamis*) in waters off Misamis Oriental. College of Fisheries, University of the Philippines in the Visayas, Diliman, Quezon City, 93 p.
- Norte, Annabelle Glenda del. 1986. Some aspects of the growth, recruitment, mortality and reproduction of the Asian moon scallop, *Amusium pleuronectus* (Linne) in the Lingayen Gulf, Philippines. College of Science, University of the Philippines, Diliman, Quezon City, 117 p.

*This supervision was performed in various formal (and sometimes informal) roles, including "adviser", "co-adviser", "field adviser", "critic", "reader", etc., but implied in all cases that the student in question worked on themes and/or with methods suggested by Dr. Pauly and that various drafts were reviewed and edited.

- Palomares, Ma. Lourdes. 1987. Comparative studies on the food consumption of marine fishes with emphasis on species occurring in the Philippines. College of Science, University of the Philippines, Diliman, Quezon City, 107 p.
- Sarmiento, Loida. 1987. Spatial relationships of macro-epifauna on pier pilings. College of Science, University of the Philippines, Diliman, Quezon City, 49 p.
- Peñaflor, Grace. 1987. Growth of *Leiognathus splendens* (Cuvier 1829) based on daily otolith rings validated through length-frequency analysis. College of Fisheries, University of the Philippines in the Visayas, Diliman, Quezon City, 51 p.
- Manrique, Amalia S. 1988. Simple productivity indices for lake ecosystems: the case of Sampaloc lake. University of the Philippines at Los Baños, 121 p.
- Soliman, Victor. 1989. Population dynamics of Sinarapan (*Mistichthys luzonensis* Smith) in Lake Manapao, Buhí, Camarines Sur, Philippines. Central Luzon State University, Muñoz, N. Ecija, 73 p.
- Balgos, Miriam C. 1990. Age and growth of the squid *Sepiotheuthis lessoniana* Lesson (1830) in Bolinao, Pangasinan, by statolith observation and length-frequency analysis. MSI/Coll. Sci. Univ. Philippines, 78 p.
- Sambilay, V.C. Jr. 1991. Depth-distribution patterns of demersal fishes of the Samar Sea, Philippines, and their use for estimation of mortality. Institute of Marine Fisheries and Oceanology, University of the Philippines in the Visayas, Iloilo, 66 p.
- Espinosa, J.S. 1991. Aspects of the feeding biology of *Siganus fuscescens* Houttuyn (Pisces: Siganidae). Marine Science Institute, College of Science, University of the Philippines.

Theses presented to European Institutions

- "Diplomarbeit" of Mr. B. Ziegler (topic defined, field work and data analysis supervised on behalf of Prof. Hempel, Director, Abteilung Fischereibiologie, IfM). The thesis was: Ziegler, B. 1979. Growth and mortality of some fishes from Manila Bay Philippines, as estimated from the length-frequencies. Math.-Nat.wiss. Fakultät, University of Kiel, 116 p.
- "Diplomarbeit" of Mr. J.M. Vakily (topic defined and Philippine field work supervised on behalf of Prof. Dr. G. Hempel (see above). The thesis was: Vakily, J.M. 1980. The exploitation of a fishing ground in the Philippines. Math-Nat. wiss. Fakultät, Universität Kiel, 104 p.
- "Diplomarbeit" of Mr. Mark Prein supervised (including definition of topic and acting as "Korreferent" on behalf of Prof. Dr. W. Nellen, Abteilung Fischereibiologie, IfM). The thesis was: Prein, M. 1985. The influence of environmental factors on fish production in tropical fish ponds investigated with multiple regression and path analysis, Math-Nat. wiss. Fakultät, Universität Kiel, 104 p.
- M. Phil. thesis of Mr. Paul Dalzell (topic formulation and methodological guidance on behalf of Prof. N. Polunin, Univ. of Newcastle, U.K.). The thesis was: Dalzell, P. 1989. The biology of surgeon fishes (Family: Acanthuridae), with particular emphasis on *Acanthurus nigricauda* and *A. xanthopterus* from Northern Papua New Guinea. Master thesis, University of Newcastle, 285 p.

- Supervision of doctoral thesis: Isaac, V. 1989. The accuracy of length-based methods for fish population studies, Doktorarbeit, Math-Nat. wiss. Fakultät, Universität Kiel, 143 p. (Published in December 1990 as ICLARM Tech. Rep. No. 27, 81 p.).
- Supervision of doctoral thesis: Prein, M. 1990. Multivariate analysis of tilapia growth experiments in ponds: case studies from the Philippines, Israel, Zambia and Peru. Math-Nat. wiss. Fakultät, Universität Kiel, 125 p.
- Supervision of doctoral thesis: Vakily, J.M. 1990. Determination and comparison of growth in bivalves, with emphasis on the tropics and Thailand. Math-Nat. wiss. Fakultät, Universität Kiel, 125 p.
- Supervision of doctoral thesis: Palomares, M.L. 1991. La consommation de nourriture chez les poissons: études comparatives, mise au point d'un modèle prédictif et application à l'étude des réseaux trophiques Institut National Polytechnique de Toulouse, 211 p.
- Supervision of doctoral thesis: Opitz, S. 1991. Quantitative models of trophic interactions in Caribbean coral reefs. Math. Nat. wiss. Fakultät, Universität Kiel, 470 p.
- Supervision of doctoral thesis: Mendo, J. 1991. Stock identification of Peruvian anchoveta (*Engraulis ringens*): morphometrics, tagging/recapture, electrophoretic and ecological studies. Fachbereich 2 (Biologie), Universität Bremen, 161 p.
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Courses in miscellaneous institutions and countries

- FAO/DANIDA Regional Training Course on the Methodology of Fishery Sciences (Biology), Mombasa, Kenya, 19 May - 4 June 1980.
- Regional Training Course on Fishery Stock Assessment and Fishery Statistics, sponsored by the Asian Development Bank, FAO/SCSP, FAO/SIDA and the Government of Thailand, Samutprakarn, Thailand, 1-9 October 1981.
- FAO/DANIDA Training Course in Tropical Fish Stock Assessment, Mombasa, Kenya, 28 May - 20 June 1983.

- FAO/DANIDA Training Course in Tropical Fish Stock Assessment, Cochin, India, 25 November - 2 December 1983.
- FAO/DANIDA National Training Course in Tropical Fish Stock Assessment, Penang, Malaysia, 5 November - 1 December 1984.
- Taller sobre Métodos Simples en la Dinámica de Poblaciones de Peces e Invertebrados, Univ. de Trujillo, Perú, 17-19 October 1985.
- Workshop of the General Council for the Fisheries of the Mediterranean on Simple Analytical Methods for Stock Assessment, Sidi Fredj, Algeria, 16-18 November 1985.
- FAO/DANIDA National Training Course in Tropical Fish Stock Assessment, Manila, Philippines, 13 January - 5 February 1986.
- Training Course in Fish Stock Assessment, sponsored by NORAD and held at the Instituto de Investigacao Pesqueira, Maputo, Mozambique, 22 February - 14 March 1986.
- CIFAD Training Course on Fishery Data Management Using Microcomputers, Corvallis, Oregon, U.S.A., 4-8 August 1986.
- FAO/DANIDA Follow-up Training Course in Tropical Fish -Stock Assessment, Hirtshals, Denmark, 5-24 May 1986.
- FAO/DANIDA Follow-up Training Course in Tropical Fish Stock Assessment, Manila, 12 January - 6 February 1987.
- Training Course on the use of Microcomputers and of Length-Frequency Data for Fishery Stock Assessment, Instituto del Mar del Perú, Callao, Perú, 29 August - 2 September 1987.
- *Ad hoc* Training Course on Quantitative Methods in Marine Biology, given to staff of the Laboratory for Ichthyology and Coastal Systems (Inst.Mar.Sci.Limn.), Universidad Nacional Autónoma de México, México, D.F., Mexico, 7-11 September 1987.
- HEST/TAFIRI/FAO/DANIDA Regional Training Course in Tropical Fish Stock Assessment, Mwanza, Tanzania, 4-26 February 1989.
- FAO/DANIDA Regional Training Course in Fish Stock Assessment, 15 October - 9 November, 1990 Cumaná, Venezuela.
- *Ad hoc* Training course on length-based assessment and the Compleat ELEFAN software. Executed for the Caribbean Fisheries Council and the Puerto Rico Dept. of Fisheries at Mayaguez, Puerto Rico, July 30 to August 1, 1990.
- IMARPE/FAO/DANIDA Training course in Fish Stock Assessment, Callao, Perú, 3-28 September 1990.
- Population dynamics and trophic interactions of fish and aquatic invertebrates. Alfred-Wegener Institut für Polar und Meeresforschung/University of Bremen, 4-8 November 1991, Bremerhaven, Germany.
- Population dynamics and trophic interactions of fish and aquatic invertebrates. Zentrum für Marine Tropenköologie, University of Bremen, 11 May 1992, Bremen, Germany.

- Population dynamics and trophic interactions of fish and aquatic invertebrates. University of Bergen, 20-22 May 1992, Bergen, Norway.
- Population dynamics and trophic interactions of fish and aquatic invertebrates. EPOMEX, Universidad Autónoma de Campeche, 9-18 November 1992, Campeche, Mexico.

SOFTWARE DEVELOPMENTS^{**}:

- HP 67/97 and HP 41 calculator programs for fish stock assessment (see item nos. 90 and 136 in Section C; item no. 39 in Section E; item nos. 41 and 179 in Section I of list of publications)
- Calculator and computer programs for estimation of fish growth parameters from seasonally oscillating size-at-age data (see item nos. 19 and 27, Section I and item no. 203, Section E)
- "Kiel" version of the ELEFAN software for analysis of length-frequency data (see item no. 34 in Section A, nos. 94 and 167 in Section B, nos. 123 and 175 in Section C, nos. 26, 84, 100, 101, 118, 128 and 146 in Section E, nos. 32, 44 and 68 in Section H and no. 28 in Section I of list of publications)
- The Compleat ELEFAN software package (see item no. 176 in Section C and item nos. 211, 231 and 234 in Section E of list of publications)
- MAXIMS, a program for estimating food consumption rates from stomach contents data (see item nos. 135, 207 and 224 in Section A; item nos. 260 in Section B; item nos. 240 in Section C and item nos. 212 in Section I of list of publications)
- ECOPATH II, a program for construction and analysis of trophic ecosystem models (see item nos. 238 and 252 in Section C; item nos. 242, 243 and 244 in Section I and ICLARM Conf. Proceedings No. 26 in Section D of list of publications)
- Contributions to FISHBASE, the computer encyclopedia (see last item in Section C; item nos. 263 and 269 in Section E and ICLARM Contribution No. 854 in Section I of list of publications)

^{**}Generally in cooperation with a colleague, as D. Pauly's modest programming skills peaked in the early 1980s (only software are included that were well documented, distributed externally, and that are now widely used).

Daniel Pauly

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List of Publications*

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*The numbers attached on the next pages, to the items in A-K, refer to the chronological sequence of all items; the numbers on this page (in brackets) refer to the number of items as of April 1993.

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5. Pauly, D. 1975. On the ecology of a small West African lagoon. *Berichte der Deutschen Wissenschaftlichen Kommission für Meeresforschung* 24(1):46-62.
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11. Pauly, D. 1977. The Leiognathidae (Teleostei): Their species, stocks and fisheries in Indonesia, with notes on the biology of *Leiognathus splendens* (Cuvier). *Marine Research in Indonesia* No. 19:73-93.
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Tony J. Pitcher – Curriculum Vitae

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*Tony J. Pitcher:**One-Page Resume*

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Current Appointments **Professor of Fisheries & Director of the Fisheries Centre**, University of British Columbia, Vancouver, Canada (*since 1993*)
Founding Editor, *Reviews in Fish Biology and Fisheries*, published by Chapman & Hall (*since 1990*)
Series Editor, *The Fish and Fisheries Book Series*, published by Chapman & Hall (*since 1989*)
Visiting Professor: University of Concepción, Chile (*since 1994*)

Career Achievements

1. Performed multidisciplinary research in a wide range of fields producing over 130 publications
2. Authored a well-regarded textbook on fisheries ecology
3. Set up and ran an international Masters course in fisheries
4. Set up and ran international fisheries development and assessment projects
5. Founded a new international review journal for fish and fisheries
6. Established a world-wide reputation for field and laboratory research on shoaling ecology and behaviour in fishes

Previous Appointments

1990 - 1993	Special Research Fellow , Renewable Resources Assessment Group, Imperial College, London, UK
1988 - 1990	Reader in Biology , University of Wales, Bangor, UK
1987 - 1987	Professor of Fisheries , Institut für Meereskunde, Christian-Albrechts University of Kiel, Germany
1984 - 1987	Senior Lecturer in Zoology, University of Wales, Bangor, UK
1982 - 1987	Course Director , M.Sc. in Fisheries Biology and Management, University of Wales, Bangor, UK
1981 - 1987	Assistant Editor , <i>Journal of Fish Biology</i> (Academic Press)
1978 - 1984	Lecturer in Zoology, University of Wales, Bangor, UK
1970 - 1978	Lecturer in Biology, New University of Ulster, Coleraine, Northern Ireland
1966 - 1970	NERC Research Student , Department of Zoology, Oxford University, UK
1963 - 1966	Postmaster (Open Scholarship) Merton College, Oxford University, UK

Research – Publications

I have a total of over 130 research publications, including an international textbook, eight edited volumes, almost 100 papers and over 25 contract research reports. Publication details are listed in a separate document: over 25 years I have averaged over 5 publications per year.

FOUNDING EDITOR OF JOURNAL

In 1989 I became founding editor of *Reviews in Fish Biology and Fisheries*, an international quarterly review journal published by Chapman & Hall that meets the need for a synoptic review journal for fish biology. The aim is to mitigate the literature explosion by publishing short, well-focused, peer-reviewed articles which synthesise recent advances in fish physiology, evolutionary biology, taxonomy, zoogeography, behaviour, ecology and fisheries. In its first four years *Reviews in Fish Biology and Fisheries* has published over 40 articles in 14 issues, produced a special volume on Molecular Genetics in Fisheries, has attracted over 450 subscribers world wide, and is now listed in Current Contents and the major abstracting journals.

Previous journal experience includes six years as an Assistant Editor on *Journal of Fish Biology* published by Academic Press.

TEXTBOOK

A second edition of my text with Dr Paul Hart on *Fisheries Ecology* is in preparation. The first edition, published in 1982, has been well-received world-wide; the book was issued in paperback in 1983 and has since been reprinted six times. Although primarily an advanced student text, it helped to pioneer concepts such as the assessment of risk and multiple objectives in fishery management.

BOOK SERIES EDITOR

As Series Editor for the Chapman & Hall *Fish and Fisheries Series* my task is to solicit, appraise and edit research books across a wide field. The Series now comprises 19 volumes and has established a reputation as the premier series in the field:

- 1 *Ecology of Fishes* Bob Wootton
- 2 *Cyprinids* ed. Ian Winfield & Joe Nelson
- 3 *Cichlids* ed. Miles Keenleyside
- 4 *Early Life of Fishes* Eva Kamler

- 5 *Fisheries Acoustics* Dave MacIennan & John Simmonds
- 6 *Fish Chemoreception* ed. Toshiaki Hara
- 7 *Behaviour of Teleost Fishes* ed. Tony Pitcher
- 8 *Genetics of Fish Breeding* Colin Purdom
- 9 *Fish Ecophysiology* ed. Cliff Rankin & Frank Jensen
- 10 *Fish Swimming* John Videler
- 11 *On the Dynamics of Exploited Fish Populations*, facsimile reprint, Ray Beverton & Sidney Holt
- 12 *Sea Bass* Mike Pawson & Graham Pickett
- 13 *Fish Bioenergetics* Malcom Jobling
- 14 *On the Sex of Fish and the Gender of Scientists* Daniel Pauly
- 15 *Hake: Fisheries, Ecology & Markets* ed. Jürgen Alheit & Tony Pitcher
- 16 *Environmental Biology of Fishes* Malcom Jobling
- 17 *Impact of Species Changes in African Lakes* ed. Tony Pitcher & Paul Hart
- 18 *Electric Fishes* Peter Möller
- 19 *Pike* John Craig

MULTI-AUTHOR EDITED TEXTS

Multi-author edited texts serve a valuable function in allowing leading experts in a field to address common themes, pinpoint areas of agreement and areas of controversy, and thereby establish the ground from which new research directions may be taken. The editors task is to ensure that such volumes achieve these aims and are therefore more than the sum of their parts by identifying themes, shaping topics and picking a good stable of authors. I have commissioned and edited three texts of this type, in each case contributing major new work to the volume.

Impact of Species Changes in the African Lakes published in 1995, (page proofs May 95) addresses ecological, economic and social issues engendered by fisheries for introduced Nile perch and freshwater sardines in African lakes. A major section covers Lake Victoria where introduced piscivorous Nile perch had had a major impact on biodiversity but has brought considerable economic benefits. Benefits have also accrued from the introduction of planktivorous sardines to human-made lakes like Kariba. The book also includes reviews of species changes caused by fishing in lakes, such as Lake Malawi, that have suffered no introductions.

Hake: Fisheries Ecology and Markets, published in 1995, is the only volume focussing on this important group of fish. Each of the major hake fisheries is covered in a separate chapter that covers oceanographic features, reproduction, early life history, feeding and growth, migration, population dynamics, stock assessment, fleet

structure, exploitation status and future prospects. Economics, markets and product quality are surveyed in separate chapters. The book puts forward a new theory for the remarkable resilience of hake fisheries in the face of heavy exploitation.

In 1993 a completely revised second edition of my 1986 text on *The Behaviour of Teleost Fishes* was published. This 19-chapter volume covers the genetic, motivational, developmental and sensory basis of, and evolutionary ecology of the behaviour of fishes. This book is regarded as one of the leading advanced student texts in the field.

An interdisciplinary text on *The New Pacific Community* is in preparation, and I have plans for a book that focusses on the problems of fisheries by-catch.

OTHER EDITORIAL WORK

In 1990, I edited and desk-top published the first volume of papers from the British Government's development programme in Central Africa with Dr Chuck Hollingworth. Third world authors often experience considerable difficulties in publishing, and so one of the aims of this volume was to revise papers with more help from international peer-review than is normal. Among the contributions to volume one are two important papers on usipa, a commercially valuable pelagic cyprinid in Lake Malawi.

With Dr Gary Carvalho, I jointly planned and edited *Molecular Genetics in Fisheries* in 1995. The Fisheries Society of The British Isles sponsored an international symposium on *The Behaviour of Fishes* in Bangor in July 1986. I organised the conference and edited the resulting *Special Issue of Journal of Fish Biology*.

CONTRACT REPORTS

The presentation and quality of contract reports often leaves a lot to be desired. In my contract reports for government organisations I have attempted to maintain high standards of scientific analysis and presentation; many have led to formal publications.

Research – Topics

My current research comprises two areas: first, the assessment and management of commercial fisheries and its links with shoaling behaviour and secondly, ways of

conflating social, economic and biological evaluation of fisheries. The following is a synoptic overview of my research work. A list of research grants and contracts is given in Appendix 6. Numbers in the text refer to the separate publication list.

RESEARCH ON FISHERIES

The primary focus of my current research is the factors that determine resilience in fisheries. This field has brought together my experience in both fisheries and behavioural fields in a new and constructive fashion. My initial publication in this area (91) examines the role of individual fish behaviour in catchability-led stock collapse through shoal-driven instabilities and through range collapse (78). The resilient hake (85) contrast in this respect on account of cannibalism. Currently, with a graduate student, I am working on a number of models of shoaling behaviour that can simulate the ill-understood range-collapse phenomenon. Work in preparation, and recently presented in seminars, examines how behaviours may mitigate such collapses.

I am also interested in global concepts and issues and in particular techniques of conflating measures of fisheries status from different ecological, economic and social disciplines in innovative ways that may be employed in management. For example, in two recent papers (90, 84) I examine the sustainability of fisheries in relation to economic and social pressures and the current forecasting ability of fisheries assessment science. A recent development of links with South Africa has stimulated me to work on the extension of equity to disadvantaged groups of stakeholders (1 grad student at present). A paper on the impact of first-world fishers on 3rd world fisheries in draft at present.

My broad interest in the ecology and management of commercial fisheries stemmed from my early research on new methods of growth analysis (6,7), ageing using length based methods (22,67) and simulation modelling (46). I was involved in developing and testing an innovative length-based assessment package (LFDA) at Imperial College sponsored by ODA. I have carried out work on a wide variety of topics, including environmental and physiological aspects of daily ageing in fish otoliths (61,66,74), artisanal fishing effort (56), and multispecies assessment using simulation (72). I have been able to link my behavioural work on shoaling in applied studies (24) with sonar stock assessment work jointly with Scottish (43,45,48,71) and Norwegian (96) sonar scientists. I have been concerned with all aspects of the ecology and assessment of important tropical fish stocks, both freshwater (46,56,83,88) and

marine (58,62,70,85) including innovative approximate techniques (70, 90).

At RRAG I directed a joint two-year investigation with two Italian laboratories (IRPEM, Ancona and ITTP, Sicily) aimed at providing an assessment of Adriatic sardine and anchovy fisheries, which have suffered a serious decline in recent years. These shoaling fish have proved intractable for analysis using conventional methods. An EC-funded project aimed at determining stock structure in this fishery using molecular techniques was linked to this project (93, 94 and in prep).

I have experience of working in research teams using biochemical methods to identify stock structure (64,81,93,94). Work on Adriatic anchovies has revealed unexpected genetic relatedness in fish shoals. The implications of this finding for resilience in mitigating stock collapse are being explored and may reveal an illustrative difference between anchovies and sardines, where no evidence of relatedness was found (in prep). Previous work using mtDNA, allozymes and nuclear DNA single-locus probes to investigate shoal structure and integrity freshwater minnows found no evidence of relatedness (81), so there are clear differences among species. I have also worked on stock structure using morphometric methods, for example on Indian Ocean yellowfin tuna (in prep) and commercial Lake Malawi cichlids (65, 85).

I have considerable experience of fisheries research in the developing countries of Africa and South America, having been involved in projects in Malawi, Zimbabwe, Kenya, Uganda, Chile, Ecuador and Mexico. I also had experience working on floodplain fisheries in Thailand and Sumatra. Appendix 7 summarises my overseas experience in this respect.

For two years I ran a major research project on Lake Malawi for the UK Overseas Development Administration (ODA). The target species was a pelagic herbivorous cichlid known as chambo and the aim was to assess the suitability of this commercial food fish for introductions to man-made impoundments. Work on the diet in the wild (75), experiments on diet selection (73,86), taxonomy (66,85), and reproduction (76) have been published.

My research interests in Lake Kariba have developed since I established a university link with Zimbabwe for British Council in 1987. At present I am involved in a NORAD-sponsored project with the Lake Kariba Fisheries Research Institute (LKfri), and currently have a Ph.D. student from that laboratory. I have taken part in three acoustic and sampling research cruises for juvenile sardine:

Limnothrissa introduced from Lake Tanganyika. I have published an assessment of the Lake Kariba sardine (83).

In London, I directed an ODA development project aimed at a synthesis of ecological information on species changes in African lakes, including the effects of introduction of species like kapenta and the Nile perch. A symposium workshop was held in March 1991 and the synthesis volume is completed (B9).

I was co-investigator in an ODA-funded project on pelagic clupeids in Central Africa jointly with Dr Carvalho of the Fish Genetics Unit at Swansea, UK. The project evaluated genetic diversity and stock structure of introduced populations of sardine in Lake Kivu and Lake Kariba to compare with original stocks at the northern (Burundi) and southern (Zambia) ends of Lake Tanganyika (2 papers in prep).

Following four visits to Chile, I am reinforcing my interest in Chilean fisheries (sardines & anchovies in the central and northern zones; demersal, sublittoral and salmon fisheries in the southern zone) by establishing more formal links with the fisheries group at the Austral University, Valdivia (Dr Carlos Moreno). I also have worked with the fisheries group at EPOMEX at Campeche, Mexico (Dr Francisco Arreguin) working on the Yucatán red grouper fishery using innovative length-based methods, and with fisheries ecologists at UNAM.

RESEARCH ON FISH SHOALING

Apart from work that links shoaling behaviour with fisheries resilience (covered above), my most recent purely behavioural work attempts to provide insight of shoals in the wild. Links with Norway led to a paper (96) on herring schools using visualization with a new high-tech side-scan sonar. Four more publications are in preparation and I will be taking part in a further sonar/herring cruise in October 1995.

Centred on the functions and physiology of shoaling behaviour in the light of insight from theory, my research on shoaling led to significant advances in the understanding of fish social behaviour and ecology. In 1986 the status of my research group in fish shoaling at Bangor was acknowledged by the appointment of a Royal Society University Research Fellow.

From the late 1970s, the realisation that individual fish constantly re-appraise decisions to join, leave or remain with social groups (17,29) proved a fruitful line of research with which to augment my earlier work on the three-dimensional structure of shoals (4,10,11,20,21,25). The

general finding is that the behaviour of shoaling fish intimately reflects the balance of costs and benefits to fitness (49,53,80). In shoaling fish, behaviour shifts rapidly in response to foraging opportunities and predator risk as a consequence of social interaction (29,31,32,35,42,44, 54,59,60,77,95).

The work has encompassed empirical field work (33,48,96) and theoretical studies (34,52,80) as well as experimental tests of hypotheses. My research projects on shoaling examined the trade-off between foraging and risk of predation (60); size (54); light intensity (55); spatial heterogeneity and time in shaping behaviour in multispecies shoals (51); the role of hunger in shifting behavioural decisions in shoals (59,63,68); the influence of hormonal state on individuals behaviour in shoals (37,47), and pioneering work on the genetic basis of shoaling (57). Genetic and developmental aspects were later thoroughly investigated using laboratory-raised fish by a senior worker in the group; anti-predator behaviour fitted Konrad Lorenz' 'innate schoolmistress' paradigm.

From a theoretical viewpoint, one of the most interesting parts of the work was centred on predator inspection behaviour by fish in shoals, a behaviour first analysed in my group in Bangor (50). Work has confirmed that information is passed from inspectors to other shoal members, reduces the effectiveness of predator attack and allows attack anticipation. Quantitatively, inspection carries a risk of attack (77). Inspection behaviour may support the tit-for-tat' hypothesis, a simple route to the evolution of cooperation which is not dependent on kinship or long-term reciprocal altruism. But recent experiments do not support this explanation (79) and we now have evidence of anticipation of attack (95).

Relatedness in fish schools has often been put forward as a route to the evolution of cooperation. Minnows turned out not to have high kinship (81). Nevertheless, a joint project with the Centre for Fish Genetics in Swansea University has shown genetic relatedness in anchovy schools (92,93), as outlined above.

Administrative Experience

I believe in team effort and in promoting ways of harnessing individual brilliance to achieve common agreed goals. This aspiration is now both fulfilled and challenged by my role as Director of a new interdisciplinary institute located at one of North America's premier universities.

Much of my own best research work has been carried out jointly. My work in London augmented my considerable previous experience of team management. For example, while in Bangor the publication rate of my group averaged 11.2 papers per year over ten years. In addition to supervision of Ph.D. and Masters students, I have made a conscious attempt to maximise the potential of short-term research contracts. Wherever possible, I have taken the science forward while creating valuable employment for young fishery scientists in the process. A list of scientists who are or have been members of my group is given in Appendix 6.

THE UBC FISHERIES CENTRE

I was appointed as the first Director of the new interdisciplinary Fisheries Centre at UBC in January 1993. Since that time I have been working actively to establish a sound cooperative research agenda because I believe that the Centre can make a difference to the parlous state of fisheries both in Canada and world-wide. Initially set up with 4 faculty, the Fisheries Centre has rapidly doubled in size: for example we have attracted one of the world's leading fisheries scientists, Dr Daniel Pauly, to a tenured position. In 1995 the Centre was awarded one of 15 Women's' NSERC Faculty Chairs to Dr Amanda Vincent. The Centre now has a day-to compliment of around 30 graduate students, postdocs and staff. Current full-time faculty at the Fisheries Centre are listed in Appendix 9.

Among our achievements in the first two years, we have set up two major research programmes focussing on estimating the true world fish catch, the resilience of fisheries and the importance of marine reserves. An International Advisory Council has been established, we have initiated a workshop series leading to our own research report series, and set up a seminar programme for our own staff, students and visitors. We are currently negotiating our own interdisciplinary graduate programme in Fisheries.

Apart from our own paid faculty we have attracted 12 other faculty from across the UBC campus, including arts, social sciences, economics and aquaculture, who are willing to focus some of their research efforts through the FC. We have also appointed over 20 Adjunct Professors from other academic institutions, government research institutes and the fishing industry. Independent consultants in law, policy, aboriginal peoples, and planning also work with the Centre on specific research projects.

RESEARCH PROJECT MANAGEMENT

Many challenging logistic and administrative problems present themselves in today's research climate, especially in work which involves developing countries. The conventional academic research project funded by a grant from a research council is nowadays only one of the many facets of University-based fundamental research in fish and fisheries. Approaches developed in pure strategic research can often be invaluable for more focussed research in fisheries. It is essential to retain the flexibility to respond rapidly to contract proposals, which may be funded from a wide variety of governmental departments and international agencies and commercial sources. Following considerable contract research at Bangor, including running an ODA Fisheries survey of the EEZ around St Helena (D12, D15), I gained valuable experience in managing contract work at the Renewable Resources Assessment Group (RRAG) and its associated consultancy company, the Marine Resources Assessment Group (MRAG). Based at Imperial College in London, we formed the foremost fishery consultancy group in Europe. Meeting the clear deadlines of contract research can help to build staff motivation and morale.

In my new post as Director of the Fisheries Centre at UBC I am attempting to bring this experience to bear in the Canadian arena.

CONSTRUCTION OF RESEARCH FACILITIES

I feel that I have gained considerable experience in the gathering of resources, money and manpower to set up facilities for research and training.

While in Bangor I built up extensive research facilities: two fisheries research laboratories and seven research aquarium rooms, including a tropical air-conditioned lab. and large arena tanks. The equipment included microcomputer and video apparatus, algal culture units, and equipment for otolith work.

In my first staff appointment at the University of Ulster, which was the last of the new 1960s universities in the UK to be founded, I also had considerable experience of planning and setting up research facilities, including animal houses, teaching laboratories and aquaria.

CONFERENCES AND SEMINARS

I am currently on the organising committee for the 5th Pan-Pacific University Presidents Conference. An international workshop and symposium for the ODA on Species Changes in African Lakes was organised by me in London in March 1992. In November 1991 I helped to organise an international workshop on Hake Fisheries at Bremerhaven, Germany. In 1986 I organised a major

international conference on Fish Behaviour for the Fisheries Society of the British Isles. In 1982 I helped to organise an international conference on Fish Physiology.

For five years I organised the departmental seminar programme, introducing an annual programme card available at the start of the year. A substantial number of visitors from within the UK and overseas were brought to speak in Bangor during the 1980s.

MASTERS PROGRAMME IN FISHERIES BIOLOGY & MANAGEMENT

As founding Course Director for the MSc in Fisheries Biology and Management for five years I had major administrative responsibility which involved planning, budgeting, timetabling and organising all aspects of the course, including examinations and the delegation of responsibilities to other staff and demonstrators. I was largely responsible for setting up this course, which trained an average of 20 students per year to Masters level, about 80% of whom were from overseas. The course was intensive, the work being completed in just one year. A great deal of practical and quantitative material was covered, including the biological, mathematical and economic bases to the assessment and management of commercial fisheries.

EXAMINATIONS

For five years I was examinations officer for Animal Biology, a task which entailed extensive work in Bangor. In this job I introduced computerised student performance profiles, an innovation for the University at that time.

OTHER ADMINISTRATIVE EXPERIENCE

I have served on a wide range of University committees including Promotions and Tenure, Library, Financial Planning, Computer Services and Staff-Student Relations. While at the University of Ulster in Coleraine in the 1970s I enjoyed rather more experience in planning and administration than would have been usual for junior staff.

Community Service

Outside the university sphere, I am currently on the Board of the Vancouver Aquarium. I served on the Council of the Fisheries Society of the British Isles (1981-84, and 1985-1989), the Council of the Association for the Study

of Animal Behaviour (1980-84), and the Zoological Society of Wales (1979-83).

Teaching Experience

UNDERGRADUATE

At present I teach a 4th level 3-credit course on fish behaviour for the Zoology Dept. at UBC. Formerly, my main undergraduate teaching responsibilities have been in courses at 1st, 2nd & 3rd year level on Animal Behaviour, Behavioural Ecology, Evolutionary Biology, and Fisheries Ecology. In addition, I have taught a wide range of zoological topics, computer programming, and have extensive experience in teaching statistics to biologists.

In Coleraine during the 1970s I played a large part in designing and implementing a B.Sc. in Ecology, one of the first degree courses of this kind in the UK.

POSTGRADUATE

I currently teach about 6 credits worth of graduate course material at the Fisheries Centre.

While in Bangor I introduced the new M.Sc. in Fisheries Biology and Management, a vocationally-oriented one year intensive Masters course covering the assessment and management of commercial fisheries. The course is now recognised by national and international funding bodies such as ODA, British Council, NERC, Commonwealth Secretariat, FAO, NORAD and UNESCO. In six years this course enrolled over 130 students, most of whom were from overseas: job capture was over 80%. The course has left me the legacy of a large number of contacts in fisheries throughout the world.

I have acted as External Examiner for over 20 Ph.D. students and a large number of Masters students.

PROFESSIONAL

In recent years I have run a number of training courses for fisheries professionals (Appendix 3). Although these have been founded on my master's course background, they generally involve detailed work at a high level. I have written workshop manuals for the courses: in particular I developed a 70-page manual for length-based methods.

ADULT

I worked in adult education *via* the Open University from 1969 to 1978 (Ecology and Behaviour), and have run courses on Statistics and Ecology for the Field Studies Council at Field Centres in the 1970s.

EXTRAMURAL

I have given extra-mural 'evening' courses for the general public on The Biology of Fishes in Oxford and in Northern Ireland.

APPENDIX 1A: Invited Papers

- Las Palmas, Gran Canaria 1994, Keynote address on *Impact of Pelagic Fish Behaviour on Fisheries*, Symposium on Pelagic Fish, Spain.
- Rhodes, Greece, April 1993, Keynote address on *Adriatic Pelagic Fisheries: an integrated approach to assessment*, Greek symposium of fisheries and Oceanography.
- Iceland, September 1992, Keynote papers on *Predation on and by fish shoals*, Nordic Council workshop on Predation processes, Stykkisholmur, Iceland.
- Bremerhaven, December, 1991, Hake Workshop, Keynote paper on *What makes a Hake: biology and global fisheries for hake?* (with Dr J. Alheit).
- Monterey, California, October 1991, Workshop on Animal Aggregations, Invited paper on *Structure and Dynamics of fish shoals*.
- The Hague, Netherlands, August 1991, International Ichthyological Congress, Session Organiser on Behavioural Ecology and Invited Keynote paper on *The Evolution And Function of Predator Inspection Behaviour*.
- Salzburg, Austria, September 1989, International Symposium on the Environmental Biology of Cyprinid Fishes, Invited paper on *Decision rules and exploitation in multispecies cyprinid shoals*.
- Grygynog, Wales, July 1989, NATO Workshop on Foraging Behaviour, Invited paper on *The Role of the Optimal Diet Predator in Multispecies Fishery Assessment*. (with G.F.Turner).
- Hamburg, FRG, September 1986, Annual meeting of the German Society of Ethologists, Invited Keynote paper on *The functions of shoaling behaviour*.
- Quebec, Canada, November 1985, International Symposium on The Advantages Conferred by Life in Groups, Invited Keynote paper on *Predators and food as the keys to understanding fish shoals*.
- Liverpool, March 1983, British Freshwater fisheries conference, Invited paper on *Shifts of behaviour with shoal size in cyprinids*. (with Dr J.R.Allan)

Liverpool, March 1979, British Freshwater fisheries conference, Invited paper on *Links between the behaviour and ecology of fishes*.

APPENDIX 1B: Contributed Papers

- Anchorage, Alaska, October 1992, Contributed paper on *Management of introduced species in the African Lakes*, Alaska Sea Grant Symposium. (with A.Bundy)
- London, March 1992, ODA Symposium on the Impact of Species Changes in the African Lakes, Contributed paper on *An analysis of species changes in Lake Victoria and an assessment of the potential yield of Nile Perch*. (with A.Bundy).
- Bangor, July 1986, FSBI International Symposium on the Behaviour of Fishes, Contributed paper on *Size segregation in minnow shoals*.
- Brisbane, August 1983, International Ethological Conference, Contributed paper on *Costs and benefits in shoaling behaviour*. (with A.E.Magurran).
- Reading, April 1981, ASAB conference, Contributed paper on *Foraging benefits in fish shoals*. (with A.E.Magurran).
- Glasgow, July 1980, ASAB Conference on predators and prey, Contributed paper on *Information and foraging in fish shoals*.
- Vancouver, September 1979, International Ethological Conference, Contributed paper on *The consequences of fish shoal volumes*.

APPENDIX 1C: Poster papers

- Utrecht, Netherlands, August 1989, International Ethological Conference, *New findings about Predator Inspection Behaviour in Fish shoals*. (with K. Murphy).
- Aberdeen, July 1989, FSBI International Symposium on Fish Population Biology, *Assessment of Indian Ocean Yellowfin Tuna using Data from a Sport Fishery*. (with S.Hemphill, Kenya).

Bangor, July 1989. ASAB conference on Predation. *Conditional approach and tit-for-tat during inspection behaviour in minnow shoals (with K.Murphy).*

Bangor, July 1986. FSBI International Symposium on the Behaviour of Fishes. *Danger at dawn (with J.R.Turner).*

APPENDIX 2 Professional Workshops and training courses

December 1994. Training Course (3 weeks). New Developments in Fisheries Management. University of Concepcion, Chile.

April 1994 Workshop (5 days) on Fish Schooling Behaviour and Dynamic Programming techniques. University of Bergen, Norway.

September 1993 Workshop Session Chair (5 days) on Tropical Groupers and Snappers at EPOMEX, Campeche, Mexico.

March 1992. Workshop (4 days) on multivariate methods in Fish Community Analysis, Imperial College, London.

January 1992. Training Course (1 day) on *Developments in Length-Frequency Analysis* for the SADACC Zambia/Zimbabwe Fisheries Project, Kariba, Zimbabwe.

December 1991. Training course (2 days) on *Non-parametric length-frequency analysis and Virtual Population Analysis*, for Bangor University.

November 1991. Training course (1 day) on *Aims and strategy in fishery Management*, for University of Cork, Ireland.

October and December 1991. Training course (5 days) on *Approximate assessment methods and length-frequency analysis*, for ODA, at RRAG, London. (UK Govt.).

July 1991. Training course (5 days) on *Approximate assessment methods and length-frequency analysis*, for ODA, at RRAG, London. (UK Govt.).

April 1991. Training course (5 days) on *length frequency analysis*, for ODA, at RRAG, London. (UK Govt.).

February 1991. Training course (1 day) on *Fisheries for Economists: an Introduction*. Overseas Development Administration, London. (UK Govt.).

February 1991. Workshop (2 days) on the ecosystem effects of fisheries at Instituto de Ciencias del Mar y Limnología, Autonomous University of Mexico, Mexico City, Mexico. (UNAM)

January 1991. Workshop (2 days) on the assessment of Southern Chilean fish stocks, at the Austral University of Chile, Valdivia, Chile. (British Council)

January 1991. Training course (5 days) on *length frequency analysis*, University of Concepcion, Chile. (UNDP)

November 1990. Training course (1 day) on *Fisheries for Economists: an Introduction*. At Overseas Development Administration, London. (ODA)

September 1990. Training course (5 days) on *length frequency analysis and approximate assessment methods*, Polarmar GmbH, Bremerhaven, Germany. (German Govt.)

August 1990. Training course (2 days) on *non-parametric length frequency analysis methods*, Lake Kariba Fisheries Research Institute, Zimbabwe. (NORAD)

July 1990. Training course (10 days) on *length frequency analysis methods*, Luanda, Angola. (Swedish Govt.. SIDA)

December 1989. Workshop (10 days) on *Behavioural Ecology and Trophodynamics of Fishes* (with Dr P.J.B.Hart), at University of Concepcion Marine Field Station, Dichato, Chile. (Fondacion Andes)

May 1989. Training course (2 days) on *fisheries assessment methods*, University Lake Kariba Research Station, Zimbabwe. (British Council)

May 1988. Training course (4 days) on *fisheries assessment methods*, held in Bangor for students of the University of Bremen, Alfred Wegener Institut für Polar-und Meeresforschung, Bremerhaven, West Germany.

APPENDIX 3: Consultancies

October 1994. Evaluation Panel, for South Africa's new interdisciplinary research programme in fisheries and marine science (SANCOR).

April 1994 Consultancy (with Dr G. Polovina) to evaluate the fisheries research programme at ICLARM, Manila, Philippines.

January 1993 - Sept. 1994, Consultancy on African Lakes, MRAG Ltd., London.

November 1992. Consultancy (MRAG) to appraise and report on the Assessment of Floodplain Fisheries in South East Asia.

September 1992. Consultancy (Head of MRAG group of 3) to appraise and report on the Assessment of Adriatic Sardine and Anchovy Fisheries, ITPP, Mazara del Vallo, Sicily.

May-Dec. 1991. Consultancy (Head of MRAG group of 2-5) to assist in the Assessment of Adriatic Sardine and Anchovy Fisheries.

November-August 1991. Consultancy (MRAG) to advise on development of length-based fisheries analysis software package (LFDA).

August 1990. Consultancy to appraise growth and mortality estimates of introduced *Limnothrissa miodon* (kapenta) in Lake Kariba, for NORAD Zambia Zimbabwe Fisheries Project, NORAD.

May 1990. Consultancy (with Dr K.Stokes) to appraise ODA project on *Commercial pelagic fisheries* at the Instituto Nacional de Pesca, Guayaquil, Ecuador.

July 1983. Consultancy to appraise field experiments on shoaling and sonar for DAFS Marine Laboratory, Aberdeen.

APPENDIX 4: Invited research visits, research cruises and seminars

December 1994. Invited Seminar and research visit on Fish Behaviour as a key determinant of resilience in

fisheries. Austral University, Valdivia and Puerto Montte, Chile.

May 1994 Research Cruise on RV G.O.Sars, in the Barentz and Norwegian seas on rebuilding Arcto-Norwegian herring and high-resolution & assessing schools using sidescan sonar.

April 1994 Research Visit on fish stock genetics and Invited seminar on Pelagic fish behaviour, University of Swansea, UK.

April 1994. Research visit to IRPEM, Ancona, Italy. (Adriatic bluefish).

May 1993. Research cruise and acoustic sampling in RV *Pelican* at Lake Kariba Fisheries Research Station, recruitment in sardine fishery.

April 1993. Research visit to IRPEM, Ancona, Italy. (Adriatic bluefish and stock structure).

July 1992. Research visit and seminar at CIEA, Mérida, Yucatán; EPOMEX, Campeche; and UNAM, México City, México.

May 1992. Research visit to IRPEM, Ancona, Italy. (Adriatic bluefish).

February 1992. Research visit to Pemba Channel Fisheries, Shimon, Kenya. (*yellowfin tuna ecology*)

February 1992. ODA Scientific Observer at FAO-CIFA 6th Subcommittee on Fisheries in Lake Victoria, Jinja, Uganda.

February 1992. Research Visit to FAO Chambo Research Project visit at Monkey Bay and Mangochi, Malawi.

February 1992. Research visit to SADACC Usipa project at Salima, Malawi.

January 1992. Research cruise and sampling cruise in RV *Pelican* to Lake Kariba Fisheries Research Station, recruitment in kapenta fishery.

February 1991 Research visit and seminar at CIEA, Mérida, Yucatán, México.

January 1991 Research visit and invited seminar to IFOP, Santiago, Chile.

April 1990. Invited seminar on *Shoaling behaviour in Fishes* at the Marine Biology Department, Groningen, Netherlands.

October 1989. Invited seminar on *New findings about Predator Inspection Behaviour in fish shoals* at the Austrian Academy of Sciences, Vienna.

May 1989. Research visit and sampling cruise in *R/V Pelican* to Lake Kariba Fisheries Research Station, recruitment in kapenta fishery.

May 1989. Invited seminar on *Shoaling behaviour in Fishes* at the University of Zimbabwe, Harare (British Council Link).

May 1989. Research visit (ODA) to Cape Maclear Research Station, Malawi. (*sampling chambo for mt-DNA analysis*)

March 1989. Research visit to Pemba Channel Fisheries, Shimoni, Kenya. (*yellowfin tuna ecology*)

February 1989. Research visit (ODA) to Cape Maclear Research Station, Malawi. (*Behavioural ecology of chambo and usipa*) (with Dr G. Turner).

November 1987. Establishment of research link (ODA) with Malawi Fisheries Laboratory at Monkey Bay and Cape Maclear, Malawi (with Dr A.S. Grimm)

August 1987. Establishment of British Council Link between University of Zimbabwe Lake Kariba Research Station and Bangor.

July 1987. Invited seminar on *Fundamental and Applied aspects of Shoaling Behaviour* at the Alfred-Wegener Institut für Polar- und Meeresforschung, Bremerhaven, West Germany.

May 1987. British Council Exchange Fellowship: Seminars on *The Functions of Shoaling Behaviour* delivered at the Universities of Vienna, Salzburg and Innsbruck, Austria in association with the Austrian Royal Academy.

Other Invited Research Seminars given since 1980: 1994 Seattle (USA), Bergen (Norway) Swansea (UK); 1993 Nanaimo (Canada); 1992 Vancouver (Canada), Newcastle (UK); 1991 Bergen (Norway), Cork (Ireland), Valdivia (Chile), Merida (Yucatan, Mexico), London; 1990 Swansea; 1989 Berne (Switzerland), Bangor; 1988 Liverpool; 1987 Maryland (USA), Bremerhaven, Hamburg, Kiel (West Germany); 1986 Dundee; 1985 Lowestoft; 1983 Stirling,

Manchester, Nottingham; 1982 Newcastle, Reading; 1980 Cardiff, Aberystwyth, Leicester.

Appendix Sa: Former Members of Research Group

This list includes all students and assistants under my supervision during my career to date, with the exception of Masters Students in the UK.

Postdoctoral Researchers

Dr Gary Carvalho (1988-90) Postdoctoral Fellow. Left for Postdoctoral Research Post in Southampton. Currently Senior Lecturer in University of Swansea.

Dr Daniel Hoggarth (1986-87). Postdoctoral Research Assistant on Sumatra/Thailand project, formerly Research Assistant and Demonstrator on Masters course. Left for Operation Raleigh, then research posts at Imperial College, National Rivers Authority and currently with MRAG Ltd. working on Thailand and Sumatra floodplains.

Dr Charles E. Hollingworth (Canada: 1986-date). Research assistant, then editorial assistant. Currently Assistant Editor for Reviews in Fish Biology & Fisheries.

Dr Anne E. Magurran (1979-1988) Postdoctoral Research assistant on fish shoaling functions project, then SERC Postdoctoral Fellow, then Royal Society University Research Fellow. Left for research post at Oxford. Currently Reader in Zoology, University of St Andrews, Scotland, UK.

Dr George F. Turner (1985-1990) Postdoctoral Research Assistant on Malawi project. Formerly, PhD research student, Left for FAO Research Officer post in Malawi, currently Lecturer in Biology at Aberdeen.

Dr John Turner (1985-87) NERC Postdoctoral Research assistant on multispecies project. Left for lectureship in Marine Biology.

Ph.D. Students

Dr John R. Allan (1983-88) Research student, research assistant. Left for research post with Ministry of Agriculture and fisheries.

Dr Paco Arreguin Sanchez. (Mexico) Length-based assessment methods and the management of a grouper fishery in Yucatan. (external supervisor for Technical University of Mexico Ph.D.) Awarded Ph.D. December 1992. Now deputy director of EPOMEX, Campeche, Mexico.

Dr Theodore Djama (Cameroon) (1985-92, *part time Ph.D.*). Interaction of artisanal and industrial rivermouth fisheries in Cameroon. Left to become Director of Fisheries Lab at Limbe, Cameroon.

Dr Alejandro Gallego. (Spain) Shoaling in larval and juvenile herring and anchovy. (jointly with the Marine Laboratory, DAFS, Aberdeen). Ph.D. 1993. Currently Postdoc at same Institute.

Dr Moshin Al Hossaini (Kuwait: 1986-89) Research Student. Left to resume post in KISR, Kuwait. (*Fortunately, still alive and well*)

Dr Gersham Kennedy (1973-76) Research Student. Left for research post with Dept. Agriculture Northern Ireland. Currently Director of Fisheries Research Lab. Northern Ireland.

Dr Qun Liu (China: 1987-90) Research student. Left to for lecturing post at Qingdao University, China.

Dr Carlos Robinson Mendoza (Mexico: 1987-91) Research student. Left for research post at UNAM, Mexico.

Dr Kim E. Murphy (previously research assistant) Information and inspection behaviour in shoaling fish. Ph.D. 1993. Currently Lecturer at Oceanography Institute, University of Ensenada, Mexico.

Dr Kerry-Anne Naish (Zimbabwe: Beit scholar) Fish shoal and fish stock structure using molecular techniques. (jointly with Centre for Fish Genetics, Swansea): Ph.D. 1993. Prize for Best Student Paper, FSBI Conference, Conwy, UK, 1993. Currently Postdoc, PBS-DFO, Nanaimo, Canada.

Dr John Wilson (Ireland: 1975-78) Research Student. Left for research post with Dept. of Agriculture and Fisheries, Scotland. Currently computer systems consultant, Antibes, France.

Dr Ian Winfield (1979-80) Research student. Left for post in UEA, then Royal Society Postdoctoral in Sweden.

then Lectureship in Ulster. Currently research fellow with IFE, Windermere.

Dr Soetikno Wirjoatmodo (Indonesia: 1975-78) Research Student. Currently Director of Ichthyology Section, LIPI, Bogor, Indonesia.

Dr Christopher Wyche (1982-85) Research student (joint with DAFS, Marine Laboratory, Aberdeen). Left for research contract post with DAFS. Left to become a game park warden in Africa.

Dr Z. Zhang (China: 1987-90) Research student. Left for postdoctoral in Bergen, Norway. Currently on staff at PBS-DFO, Nanaimo, Canada.

Research Assistants and Others

Portia Chifamba (1990-91) (Zimbabwe). M.Sc. on the measurement and standardisation of fishing effort in the Lake Kariba kapenta fishery. Left to become acting Director, LKFRI, Kariba, Zimbabwe.

Pia Geisel (Australia: 1986-88) Research assistant and demonstrator on Masters course in Fisheries Biology and Management. Left for research studentship in Australia.

Deborah Green (1986) Research assistant. Left for technical post in Oxford.

Jan Hoogesteger (1986-1988). ODA Research Officer. Left for research post with ODA in Tanzania.

Kate Hughes (1987-88) Research Assistant and Demonstrator on Masters course. Young Science Journalist of the Year 1988. Left for teaching post

Paul Levesley (1986-88) Research assistant. Left for unknown post.

Helen Loney (1987-88) Research assistant. Left for research technician post.

Douglas Graham (1987-88) Research Assistant. Left for research studentship at Pitlochry.

Dr Rosannah Robinson (1988-89) Research Assistant. left for research studentship in Southern Africa. Ph.D. gained 1995.

Judson Vanier (Canada) 1994- Masters student (transferred to Dr D. Pauly)

Appendix Sb: Current Members of Group

Simon Hemphill (Kenya). Thesis expected June 1995. The use of sport fishery data in the assessment of the Indian Ocean yellowfin tuna stock. *External (part time) Ph.D. Student*

Alida Bundy (UK). Thesis expected 1996. Interactions of artisanal and industrial fisheries. Ph.D. student. *(Transferred with me from Imperial College London to UBC).*

Ramon Bonfil Sanders. (Mexico) Thesis expected 1995. The assessment and management of fisheries for elasmobranchs. Ph.D. student. *(Transferred with me from Imperial College London to UBC).*

Morris Mtsambiwa (Zimbabwe) Thesis in draft May 1995. Pre-recruit ecology and recruitment in Lake Kariba kapenta. Ph.D. student. *(Transferred with me from Imperial College London to UBC).*

James Njiru (Kenya) M.Sc. Student. Thesis expected June 1995. Use of otoliths to assess age and mortality rates in the Lake Victoria pelagic cyprinid fishery.

Ratana Chuenpagdee (Thailand) Ph.D. Research and Technical Assistant responsible for professional training courses, seminars and workshops.

Trevor Hutton (South Africa) Ph.D. Research on allocation and property rights in fisheries.

Martin Esseen (UK) (Formerly M.Sc. and contract research assistant) An ex-commercial fisherman, M.Sc. work on measurement of fishing effort for shoaling fish using fishermen's log books in the Adriatic. Current topic on fishermen's behaviour and the true world fish catch.

Sylvia Salas (Mexico) 1994- artisanal fishery assessment. Ph.D. student.

Taja Lee (Canada). 1994- Masters/Ph.D. student. Refugia project. NSERC grant.

still in progress overseas

Lorenz Hauser (1992-) Research Assistant (jointly with Swansea). Status of exploited and introduced Kapenta stocks and biochemical genetics and introduced Nile Perch.

APPENDIX 6: RESEARCH GRANTS AND CONTRACTS

Sponsor	Dates	Topic	£
1. SRC	1973-76	3-d structure fish schools	1500
2. RSoc	1976	Sensory basis & structure of fish schools	600
3. NUU	1976	Experiments on school structure and volume	280
4. NERC	1979-82	Antipredator tactics in fish schools	53875
5. NERC	1982-83	Shoal size, predation and provenance	11198
6. RSoc	1982	Sea-caged fish behaviour	720
7. DAFS	1982	Shoaling and sonar echos	2636
8. DAFS	1983	Shoaling in sea-caged gadoids	2590
9. DAFS	1984	Shoaling in sea-caged mackerel	2827
10. DAFS	1984	Shoaling in sea-caged herring	3615
11. DAFS	1985	Computer analysis of shoaling fish images	1700
12. DAFS	1985	Sea-caged cod & mackerel behaviour	4910
13. NERC	1985-88	Space & time in fish shoals	39019
14. ODA	1985-86	St. Helena fishery assessment	19950
15. DAFS	1985	3-D calibrations for sea cage	590
16. MAFF	1986	Fish image analysis using automated methods	11690
17. EEC	1986	Lake Malawi fish taxonomy	5850
18. DAFS	1986	Sea-caged herring behaviour	3764
19. ODA	1986-87	St. Helena fishery assessment	8590
20. UCNW	1987-88	Hormones and shoaling behaviour	2250
21. ODA	1987-88	St. Helena fishery assessment	9936
22. FIG	1987	Biochemical stock identification of Falklands squid	9490
23. ODA	1987-90	Malawi <i>Oreochromis</i> lidole biology	205000
24. FIG	1988	Biochemical stock identification of Falklands squid	15964
25. DAFS	1988	Herring shoal dimensions using digital sonar	3828
26. ODA	1989	Malawi chambo biochemical (mtDNA) taxonomy	10842
27. ODA	1990	Malawi fish research publications	3115
28. FAO	1990	Malawi chambo biochemical (mtDNA) taxonomy	15000
29. NORAD	1990	Kariba: introduced kapenta growth	1250
30. UNDP	1991	<i>Trachurus</i> fishery in Chile	600
31. ODA	1991-93	Species changes in African Lakes	148000
32. Italy	1991-92	Adriatic clupeid assessment	38000
33. ODA	1991-93	<i>Limnothrissa</i> stocks & diversity	62473
34. ODA	1991-94	S.E. Asian artisanal fisheries	72000
35. EC	1992-4	Adriatic clupeid stocks & shoals	28647
36. ODA	1992	Malawi fish research publications	15294
37. NSERC	1993/4	UBC Start up grant	\$25000
Total Grant Capture (UK)			£ 817593
Canada			\$ 25000

BC = British Council; DAFS = Dept. for Agriculture and Fisheries Scotland; EEC = European Economic Community; FAO = Food and Agriculture Organisation of the United Nations; FIG = Falklands Island Government; MAFF = Ministry of Agriculture Fisheries and Food; NERC = Natural Environment Research Council (UK); NSERC= National Science and Engineering Research Council (Canada); ODA = UK Overseas Development Administration; RSoc = Royal Society; SERC/SRC = Science and Engineering Research Council (UK).

Professor Tony J. Pitcher — SUMMARY OF AFRICAN EXPERIENCE

1. South Africa

Topic: Social, economic and biological issues in South African Fisheries Research
Issues: multi-disciplinary assessment; modelling; extension of equity
Aims: training & research
Duration: 1994 - date: 1 visit
Sponsors: SANCOR
Outputs: 1 Ph.D. student: 1 Report

2. Zimbabwe & Zambia

Topic: Lake Kariba commercial fishery for introduced sardines
Issues: assessment; modelling; recruitment ecology; extension of equity
Aims: training, research
Duration: 1986 - date: 8 visits
Sponsors: NORAD, ODA, British Council
Outputs: 1 Ph.D. student: 3 Masters Students
 1 UK Ph.D. student
 3 Training Courses; 3 Research Cruises
 3 Reports; 2 publications, 1 pending

3. Malawi

Topic: Artisanal & commercial fisheries
Issues: sectoral conflict, conservation of endemic species, assessment,
Aims : training, research; new local journal
Duration: 1987-1991: 6 visits
Sponsors: ODA, FAO, Malawi Govt.
Outputs: 4 Masters students; 1 UK Postdoc
 3 training courses
 8 publications

4. Uganda, Tanzania, Zaire, Kenya, Zambia, Zimbabwe, Malawi, Mozambique, Burundi, Rwanda: (20 lakes)

Topic: Impact of Species Changes in the African Lakes
Issues: Introduced Nile Perch and sardine fisheries, heavy exploitation: ecological, social and economic impacts, mitigation, new introductions to man-made lakes; Sub-project: genetic and conservation and genetics. Ongoing component in Canada: Lake Victoria small pelagic artisanal fishery
Aims: research, putative new introductions, training
Duration: 1990-1993; 1 visit (Genetics sub-project to 1995); & ongoing
Sponsors: ODA, FAO; UK Royal Society (genetics);CIDA
Outputs: International Conference London 1991 (120: 50 from Africa)
 Book: 24 Chapters (*refereed*): 1995 (*Chapman & Hall*)

FAO - CIFA Committee
 6 other publications; 6 reports; 4 papers pending
 1 UK Ph.D. student: 1 Masters student (CIDA)
 3 training courses

5. Kenya

Topic: Large coastal pelagics, especially Yellowfin Tuna
Issues: sportfishing impact; assessment
Aims: research, training
Duration: 1988-date: 2 visits
Sponsors: Kenya,
Outputs: 1 Ph.D. student
 1 publication (2 pending)

6. Angola

Topic: Length-based Assessment of artisanal and commercial fisheries
Issues: assessment
Aims: training
Duration: 1990: 1 visit
Sponsors: SIDA (Swedish Govt)
Outputs: 1 Training Course

7. Cameroon

Topic: Conflict between small and large-scale coastal fisheries
Issues: economic and biological evaluation and modelling
Aims: research, training
Duration: 1989-1992
Sponsors: World Bank
Outputs: 1 Ph.D. student
 3 publications

8. Ghana

Topic: Coastal artisanal fishery for sea-bream
Issues: length-based assessments; modelling
Aims: training, research
Duration: 1986
Sponsors: Commonwealth
Outputs: 1 Masters Student
 1 publication

Masters students from: Cameroon; Egypt; Eritrea; Ethiopia; Ghana; Kenya; Liberia; Malawi; Mozambique; Nigeria; Sierra Leone; Tanzania; Uganda; Zaire; Zambia; Zanzibar; Zimbabwe.

Professor Tony J. Pitcher — Summary of Latin American & Asian Experience

1. Chile

Topic: Social, economic and biological issues in Chilean Fisheries
Issues: fisheries modelling & assessment; decision analysis; shoaling behaviour
Aims: teaching, training & research
Duration: 1989 - date: 4 visits
Sponsors: British Council, Fondation Andes, Canadian Govt.
Outputs: 4 training courses
1 Ph.D. student

2. Mexico

Topic: Groupers and artisanal fisheries in Yucatan & Campeche. Sardines in Baja.
Issues: assessment & modelling; shoaling behaviour
Aims: training, research
Duration: 1990 - date: 3 visits
Sponsors: British Council, Mexican govt.
Outputs: 1 Ph.D. student: 3 Masters Students
2 Training Courses
3 publications

3. Ecuador

Topic: assessment of pelagic commercial fisheries
Issues: assessment and collapse
Aims: research, project evaluation
Duration: 1989: 1 visit
Sponsors: ODA.
Outputs: 1 Masters student
1 report
1 publication

4. Indonesia

Topic: Floodplain fisheries in Sumatra; estuarine fishes in Java
Issues: fishers self-governance; floodplain sustainable catch
Aims: research, training
Duration: 1979-80 (estuarine fish); 1993 1 visit
Sponsors: ODA, British Council
Outputs: 1 Ph.D. student; 3 masters students
1 report

5. Thailand

Topic: Floodplain fisheries
Issues: fishers self-governance; floodplain sustainable catch
Aims: research, training
Duration: 1993: 1 visit
Sponsors: ODA
Outputs: 1 report

6. Philippines

Topic: Length-based Assessment of artisanal and commercial fisheries
Issues: management, aquaculture
Aims: evaluation
Duration: 1994: 1 visit
Sponsors: ICLARM
Outputs: 1 report

7. Sri Lanka

Topic: Length-based Assessment of artisanal and commercial fisheries
Issues: assessment
Aims: training
Duration: 1987
Sponsors: British Council
Outputs: 1 Masters student
1 publication

8. Malaysia

Topic: Length-based Assessment of artisanal and commercial fisheries
Issues: Fisheries Assessment and population dynamics
Aims: training
Duration: 1990:
Sponsors: Malaysian Govt.
Outputs: 1 training course

Masters students from: Sri Lanka, Indonesia, Malaysia, Ecuador, Chile, Mexico, Costa Rica, Argentina, Uruguay, Brazil, Belize, Vanuatu.

Professor Tony J. Pitcher - List of Publications

PUBLISHED PAPERS

97. Pitcher, T.J., Misund, O.A., Ferno, A., Totland, B. & Melle, V. (1995) Adaptive behaviour of herring schools in the Norwegian Sea as revealed by high-resolution sonar. (submitted)
96. Murphy, K.E. & T.J. Pitcher Attack anticipation by predator inspection in shoaling minnows. (submitted)
95. Hauser, L., Carvalho, G.C. & Pitcher, T.J. (199x) Morphological and genetic differentiation of the African clupeid *Limnothrissa miodon* 34 years after its introduction to Lake Kivu. (submitted).
94. Bembo, D., Pitcher, T.J., Cingolani, N. & Carvalho, G.R. (199x) Electrophoretic analysis of stock structure in northern Mediterranean anchovies, *Engraulis encrasicolus* L (ICES J. Mar Sci. submitted)
93. Bembo, D., Snow, M., Cingolani, N., Pitcher, T.J. & Carvalho, G. (199x) Stock discrimination in European anchovies, *Engraulis encrasicolus*, by analysis of PCR-amplified mitochondrial DNA.. (Fishery Bulletin submitted)
92. Bonfil, R., Bundy, A. & Pitcher, T.J. (1995) Perspectives on the Management of High Seas Fisheries: the UN Conference on Straddling and Highly-Migratory Fish stocks: a fisheries scientist's point of view. Reviews in Fish Biology & Fisheries 5: 117-119.
91. Pitcher, T.J. (1995) The Impact of Pelagic Fish Behaviour on Fisheries. Scientia Marina (in press).
90. Pitcher, T.J. (1995) Thinking the Unthinkable: a Candidate Model for Predicting Sustainable Yields of Introduced Fish Species in African Lakes. Chapter 23 in Pitcher, T.J. & Hart P.J.B. (eds) *Impact of Species Changes in the African Lakes*. Chapman & Hall, London. (in press)
89. Pitcher, T.J. (1995) Species Changes and Fisheries in African Lakes: introduction to the issues. Chapter 1 in Pitcher, T.J. & Hart P.J.B. (eds) *Impact of Species Changes in the African Lakes*. Chapman & Hall, London. (in press)
88. Pitcher, T.J. & Bundy, A. (1995) Assessment of the Nile perch fishery in Lake Victoria. Chapter 9 in Pitcher, T.J. & Hart, P.J.B. (eds) *Impact of Species Changes in the African Lakes*. Chapman & Hall, London. (in press)
87. Bundy, A. & Pitcher, T.J. (1995) An analysis of species changes in Lake Victoria: did the Nile perch act alone? Chapter 7 in Pitcher, T.J. & Hart, P.J.B. (eds) *Impact of Species Changes in the African Lakes*. Chapman & Hall, London. (in press)
86. Robinson, R.L., Turner, G.F., Grimm, A.S. & Pitcher, T.J. (1994) An experimental study of phytoplankton feeding in three tilapia cichlids. Journal of Fish Biology (in press).
85. Pitcher, T.J. & J. Alheit (1995) What Makes A Hake? A Review of the Critical Biological Features that Sustain Global Hake Fisheries. Pages 1-15 in T.J. Pitcher & J. Alheit (eds) *Hake: Fisheries, Ecology and Markets*. Chapman & Hall, London.
84. Pitcher, T.J. (1995) Stewardship and Sustainability of Pacific Fishery Resources: the Need for Critical Insight and an Encyclopaedia of Ignorance. Proc. 4th Int. Symp. Conf. Asian Pan-Pacific University Presidents, Anchorage, Alaska. (in page proof).
83. Pitcher, T.J. & Bundy, A. (1994) Successful Species Introductions in the African Lakes: Assessment, Uncertainties and Strategies for Fishery Management. Pages 545-570 in Kruse, G., Eggers, D.M., Marasco, R.J., Pautzke, C. & Quinn, T.J. (eds) *Management Strategies for Exploited Fish Populations*. Alaska Sea Grant College Program 93-02, Fairbanks, Alaska, 825pp.
82. Turner, G.F., Robinson, R.L., Grimm, A.S. & T.J. Pitcher (1994) A test of a multivariate morphometric method for identifying Lake Malawi *Oreochromis (Nyasalapia)* species. Journal of Fish Biology (in press).
81. Naish, K.-A., Carvalho, G.R. & T.J. Pitcher (1993) The genetic structure and microdistribution of shoals of *Phoxinus phoxinus*, the European minnow. J. Fish Biol. 43 (Suppl.A): 75-89.
80. Pitcher, T.J. & J. Parrish (1993) The Functions of Shoaling Behaviour. Pages 363-439 in T.J. Pitcher (Ed.) *The Behaviour of Teleost Fishes: 2nd Edition*. Chapman & Hall, London, 715pp.
79. Pitcher, T.J. (1992) Who dares wins: the Function and Evolution of Predator Inspection Behaviour in shoaling fish. Netherlands Journal of Zoology 42: 371-391.
78. Patterson, K.R., T.J. Pitcher & T.K. Stokes (1993) A stock collapse in a fluctuating environment: the chub mackerel *Scomber japonicus* (Houttuyn) in the eastern central Pacific. Fisheries Research 18: 199-218.
77. Murphy, K.E. & T.J. Pitcher (1991) Individual behavioural strategies associated with predator inspection in minnow shoals. Ethology 88: 307-319.
76. Turner, G.F., J. Wtimani, R.L. Robinson, A.S. Grimm & T.J. Pitcher (1991) Reproductive isolation and the nest sites of Lake Malawi Chambo, *Oreochromis (Nyasalapia)* spp. Journal of Fish Biology 39: 775-782.
75. Turner, G.F., A.S. Grimm, O.K. Mhone, R.L. Robinson & T.J. Pitcher (1991) The diet of *Oreochromis lidole* and other chambo species in Lakes Malawi and Malombe. Journal of Fish Biology 37: 15-24.
74. Zhang, Z., N.W. Runham, & T.J. Pitcher (1991) A new technique for preparing fish otoliths for examination of daily growth increments. Journal of Fish Biology 38: 313-315.
73. Robinson, R.L., G.F. Turner, A.S. Grimm & T.J. Pitcher (1990) A comparison of ingestion rates of three tilapia species fed on a small planktonic alga. Journal of Fish Biology 36: 269-270.
72. Pitcher, T.J. & G.F. Turner (1990) The role of the optimal diet predator in multispecies fishery assessment. Pages 847-861 in Hughes, R.N. (Ed.) *Behavioural Mechanisms of Food Selection*. NATO ASI Series G:20, Springer-Verlag, Berlin.
71. MacIennan, D.N., A.E. Magurran, T.J. Pitcher & C.E. Hollingworth (1990) Behavioural determinants of fish target strength. Rapp. P.-v. Reun. Cons. Int. Explor. Mer 189: 245-253.
70. T.J. Pitcher & S. Hemphill (1989) Stock assessment of Indian Ocean yellowfin tuna based on data from a sport fishery Fishbyte 7(3): 15-17.

69. Badrudin, M. & T.J.Pitcher The recovery of demersal fish stocks and the stock parameters of the pony-fish *Leiognathus splendens* in the North coast of central Java. Fisheries Research (accepted: under revision)
68. Robinson, C.M. & T.J.Pitcher (1989) Hunger as a promotor of different behaviours within a shoal of herring: selection for homogeneity in a fish shoal. Journal of Fish Biology 35: 459-460.
67. Lui, Q., T.J.Pitcher & M. Al-Hossaini (1989) Ageing with fisheries length-frequency data, using information about growth. Journal of Fish Biology 35(A): 169-177.
66. Al-Hossaini, M., Q.Liu & T.J.Pitcher (1989) Otolith microstructure indicating growth and mortality among plaice, *Pleuronectes platessa* L. post-larval sub-cohorts. Journal of Fish Biology 35(B): 81-90.
65. Turner, G.F., T.J.Pitcher & A.S.Grimm (1989) Identification of Lake Malawi *Oreochromis (Nyasalapia)* spp. using multivariate morphometric techniques. Journal of Fish Biology 35: 799-812.
64. Carvalho, G.R. & Pitcher, T.J. (1989) Biochemical genetic studies on the Patagonian squid *Loligo gahi* d'Orbigny II. Population structure in Falkland waters using isozymes, morphometrics and life history data. J. Exp. Mar. Biol. Ecol. 126: 243-258.
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62. Djama, T. & T.J. Pitcher (1989) Comparative stock assessment of two sciaenid species: *Pseudotolithus typus* (Bleeker, 1863) and *Pseudotolithus senegalensis* (Valenciennes, 1833) off Cameroon. Fisheries Research 7: 111-125.
61. Alhossaini, M. & T.J.Pitcher (1988) The relation between daily rings, body growth and environmental factors in plaice, *Pleuronectes platessa* L., juvenile otoliths. Journal of Fish Biology 33: 409-418.
60. Pitcher, T.J., S.H.Lang & J.R.Turner (1988) A risk-balancing trade-off between foraging rewards and predation hazard in shoaling fish. Behavioral Ecology and Sociobiology 22: 225-228.
59. Pitcher, T.J. & A.C.House (1987) Foraging rules for group feeders: area copying depends upon food density in shoaling goldfish. Ethology 76: 161-167.
58. Koranteng, K. & T.J.Pitcher (1987) Population parameters, biannual cohorts and assessment in the *Pagellus bellottii* (Sparidae) fishery off Ghana. Journal du Conseil Int. Explor. Mer. 43: 129-138.
57. Magurran, A.E. & T.J.Pitcher (1987) Provenance, shoal size and the sociobiology of predator evasion behaviour in minnow shoals. Proc. Roy. Soc. (Lond.) B 229: 439-465.
56. Amarasinghe, U. & T.J.Pitcher (1986) Assessment of fishing effort in Parakrama Samudra, an ancient man-made lake in Sri Lanka. Fisheries Research 4: 271-282.
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54. Pitcher, T.J., A.E.Magurran & J.R.Allan (1986) Size segregative behaviour in minnow shoals. Journal of Fish Biology 29: 83-95.
53. Pitcher, T.J. (1986) Predators and food are the keys to understanding fish shoals: a review of recent experiments Naturaliste Canadien 113: 225-233.
52. Turner, G.F. & T.J.Pitcher (1986) Attack abatement: a model for group protection by combined avoidance and dilution American Naturalist 128: 228-240.
51. Allan, J.R. & T.J.Pitcher (1986) Species segregation during predator evasion in cyprinid fish shoals. Freshwater Biology 16: 653-659.
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OIL SPILL TRUSTEE COUNCIL

GENTLEMEN, IN THE 1930's - 1940's

SEA OTTERS WERE A RARE SIGHT IN P.W.S. THEIR
POPULATION ESTIMATED AT ABOUT 12 PAIRS!

DURING THE 1920's THRU THE 1950's CORDOVA
WAS KNOWN AS THE RAZOR CLAM CAPITOL OF THE
WORLD! THERE WAS ABOUT A DOZEN CLAM CANNERS
LOCALLY, MANY FAMILY OWNED. CRABING WAS ALSO
A LARGE PART OF CORDOVA'S ECONOMY. MILLIONS
OF POUNDS OF CRAB AND CLAMS WERE
HARVESTED ANNUALLY AND SHIPPED OUT OF THE
TERRITORY. BY THE LATE 1950's SEA OTTERS WERE
ON THE REBOUND BUT STILL SELDOM SEEN BY
CORDOVANS. BY THE EARLY 1960's SEA OTTERS
STARTED APPEARING AROUND CORDOVA. IN 1964
CORDOVA'S CLAM BEDS WERE DEVASTATED BY
THE '64 EARTHQUAKE. 50% TO 70% OF THE
BEDS WERE CRUSHED OR DRIED UP DUE TO

~~THE UPLIFT. BECAUSE THE SEA OTTER WAS PRO-~~
~~TECTED THERE WAS NO STOPPING ITS INTRUSION~~
~~ONTO THE CORROVA MUD FLATS AND IMMEDIATE~~
~~AREAS. THEIR POPULATIONS INCREASED DRAMATICALLY~~
~~WRECKING HAVOC ON THE REMAINING CLAM BEDS~~
~~COMMERCIAL CLAMMING WAS STOPPED. AS THE~~
~~OTTERS MAIN FOOD SOURCE DWINDLED THEY TURNED~~
~~TO FEEDING ON CRABS, ETC.~~

SOON COMMERCIAL CRABING WAS STOPPED. TODAY,
30 YEARS LATER, CRABING IS STILL CLOSED.
THE CLAM BEDS ARE ALL BUT GONE. AND
THE LOCAL SEA ~~OTTER~~ POPULATION HAS SOARED
TO AN ESTIMATED 4000 STRONG! CORDOVA'S
LIFE STYLE HAS CHANGED FOREVER. NO
LONGER ARE CLAMS AND CRAB MEAT PART
OF OUR EVERYDAY DIET! WE HAVE ALSO LOST
MILLIONS OF DOLLARS ANNUALLY FROM THIS
ONCE VIABLE AND SUSTAINABLE SOURCE.

THEREFORE, WE WOULD LIKE TO MAKE
PROPOSAL TO REVERSE THIS TRAGIC TREND.

PART I: WITH THE LOSS OF THOUSANDS OF
SEA OTTER DUE TO THE OIL SPILL, WE PROPOSE
TRANSFERRING ALL BUT ABOUT 300 SEA OTTERS
FROM THE CORDOVA AREA TO THE CENTRAL
AND SOUTHERN PORTIONS OF P.W.S.

PART II: RESTOCKING OUR RAZOR CLAM BEDS
WITH STOCK FROM, SAY, TURNAGAIN AREA BEDS,
AND RESTOCKING DUNGELESS CRAB, FROM, SAY,
CAPE YANATAGA AREAS.

THANK YOU FOR CONSIDERATION OF THE
PROPOSAL.

SINCERELY,

CORDOVA OLD TIMERS

Landowner Assistance Project

Project Number: 96058

Restoration Category: General Restoration

Proposer: USFS/ADF&G

Lead Trustee Agency: USFS/ADF&G

Cooperating Agencies: None

Duration: 1 Year; possible extension after FY96

Cost FY 96: 205.9

Cost FY 97: Unknown

Cost FY 98: Unknown

Geographic Area: Exxon Valdez oil spill area

Injured Resource/Service: Harlequin duck, marbled murrelet, pink salmon, sockeye salmon, Dolly Varden, cutthroat trout, river otter, sea otter, harbor seal, bald eagle, recreation, wilderness, cultural resources, subsistence.

ABSTRACT

Landowners in the oil spill area have expressed an interest in receiving assistance and advice on how to do a better job of protecting and/or enhancing habitat during resource development activities. Impacts often occur because landowners and development contractors lack an awareness of resource sensitivities during pre-project planning. The project, on an as needed basis, will attempt to make development and restoration objectives compatible so that land use activities do not impede natural recovery.

INTRODUCTION

The project is proposed to take advantage of opportunities to enhance or restore injured species habitats or service values on private lands throughout the oil spill area. This differs from the Comprehensive Habitat Protection Process by focusing on site-specific mitigation and enhancement opportunities that can be implemented in conjunction with on-going development activities.

The proposed project expands on a successful pilot effort to provide information and assistance to private landowners who wish to minimize the impacts of their on-going and proposed activities on injured resources and services. The pilot project (95058) contacted 58 major landowners and operators throughout the spill area offering general restoration assistance. As a result, the following projects were identified:

1. Assist Eyak corp. identify and mitigate logging caused impacts to cutthroat trout habitat

2. Assist the village of Chenega inventory fish habitat for potential enhancement.

NEED FOR THE PROJECT

A. Statement of Problem

Too often, impacts occur because landowners and development contractors lack an awareness of resource sensitivities during pre-project planning. This is especially true of many spill-injured resources and services that are not specifically protected by law but nevertheless are important elements of a healthy and diverse ecosystem. Moreover, these resources may need additional levels of protection during their recovery period.

B. Rationale

Landowners in the oil spill area have expressed an interest in receiving assistance and advice on how to do a better job of protecting and/or enhancing habitat during resource development activities. By providing assistance to private landowners in designing and implementing resource development projects in the oil spill area, injured resources will be better protected. The enhancement/supplementation efforts that will be coordinated by the project provide "on-site survival benefits to natural fish populations", an element of supplementation as described in the FY96 Workplan Invitation. The species that are expected to benefit directly include pink salmon, Dolly Varden and cutthroat trout. The projects will increase available fish habitat and enhance service values for subsistence, commercial fishing and recreation.

C. Summary of Major Hypotheses and Objectives

The major objective of the Landowner Assistance Program and the various subprojects it identifies is to demonstrate that restoration and development goals can be compatible. In many cases, information may be all that is needed to properly plan and implement development activities that avoid causing additional impacts to recovering species. In other cases, opportunities for enhancing injured species habitats or resource service values may be found in new areas, or technologies, that had not previously been considered.

D. Completion Date

The completion date for the landowner assistance project is September, 1996. If successful, and supported by the Trustee Council, the project may be continued in FY 97.

COMMUNITY INVOLVEMENT

Community involvement is an important element of the LAP. In many cases, the effects of landowner development activities have a direct influence on community function and well-being. The project proposes to involve affected communities by providing information on LAP activities and direction

on how development can be made compatible with local community concerns. To the extent that sub-projects can utilize local residents to assist in construction or logistics an effort will be made to do so.

FY 96 BUDGET

Personnel	147.8
Travel	15.5
Contractual	12.6
Commodities	7.0
Equipment	0.0
Subtotal	182.9
Gen. Admin.	23.0
Total	205.9

PROJECT DESIGN

A. Objectives

1. Meet with landowners to provide information and data interpretation of recent and ongoing studies, identify data sources, review development plans, and assess landowner interests in pursuing restoration opportunities.
2. Coordinate and oversee the design and development of LAP supplementation projects

B. Methods

In addition to providing information on injured resource habitats and service values, the project can assist landowners in identifying potential restoration opportunities. Restoration opportunities may be considered within the context of three general categories:

1. Supplementation projects - increasing production by constructing fish passes, spawning channels, rearing areas, and overwintering sites; developing coastal wetlands with impoundments; increasing bird production by constructing nesting boxes or islands; installing recreational use amenities including trails and other access-related improvements.
2. Mitigation projects - expanding stream buffers; modifying timber slash removal techniques, providing wildlife corridors; maintaining adequate wildlife cover; removing debris dams, modifying the design or areal scope of development, timing and siting of support facilities to minimize impacts to critical life stages and key habitats.
3. Reclamation/rehabilitation projects - modifying planting techniques or plant species to accelerate revegetation; tree planting to accelerate forest maturity; stabilizing or revegetating discontinued logging roads.

The supplementation projects proposed in FY 96 will benefit restoration by expanding the habitat of

wild fish stocks and providing additional fish for local and regional harvest. The projects have been approved by the Prince William Sound Regional Planning Team (RPT), thereby attesting to the feasibility and acceptable risk associated with implementation. There are no suitable alternatives to the projects, other than to maintain the status quo.

C. Contracts and Other Agency Assistance

There are no contracts anticipate. Assistance from other Trustee agencies may be requested as projects are developed.

D. Location

The project will be undertaken throughout the oil spill area. Specific projects planned for FY 96 are all located in Prince William Sound.

SCHEDULE

A. Measurable Project Tasks for FY 96

The primary goal of this project is to determine landowner interest in this type of assistance. If projects are identified they will be reported in the project final report along with a summary of landowner interest.

B. Project Milestones and Endpoints

As a project to provide assistance to private landowners the endpoint will be a final report that details that assistance.

C. Project Reports

A final report will be submitted in October 1996 documenting all project activities. The report will a summary of landowner interest and make recommendations for follow up activities.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Project personnel will serve as liaisons between the Trustee Council's restoration office, resource agencies and private landowners to accomplish objectives such as identifying opportunities for mitigating development impacts, conveying information on best management practices, and assessing the potential for supplementation activities. This will require coordination with principal investigators and agency personnel that are knowledgeable about planned development activities and injured species habitat.

The project enhances, but does not duplicate, normal agency management. As noted earlier, many injured species are not specifically protected by law; although spill recovery may be a consideration in permit reviews it will not be a significant factor in stipulating, modifying or otherwise conditioning permits for most development activities. This is because agency authorities do not extend to

mitigating development for oil spill restoration. Therefore, the project provides a service that is generally lacking within the context of normal agency operations.

ENVIRONMENTAL COMPLIANCE

No environmental compliance is required for this project, but any project(s) develop as a result of assistance provided by this project will have NEPA done as require. In addition all projects will comply with all state and federal requirements. This may include but not limited to Title 16, Fish Transport, COE, and ACMP.

PERSONNEL

Mark Kuwada - Habitat Biologist with the Alaska Department of Fish and Game for 14 years. Extensive experience in coordinating departmental policy and mitigating major project impacts: Project Manager for Federal OCS Oil and Gas Leasing Program; Susitna Hydroelectric Project; Bradley Lake Hydroelectric Project; Diamond Chitna Coal Project. ADF&G Response Coordinator, Exxon Valdez oil spill.

Ken Holbrook - Fisheries Biologist and District Ranger with 20 years experience in coastal Alaska. Extensive experience in fisheries/wildlife management, enhancement and restoration. Supervised the design and construction of many fish stream improvements, fish passes, and other habitat protection projects on Forest Service lands. Member of the Habitat Protection work group for the Trustee Council.

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Date signed

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996	PROPOSED FFY 1996 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
				\$108.1		\$94.1		
Personnel	\$90.0	\$147.8						
Travel	\$7.5	\$15.5						
Contractual	\$4.5	\$12.6						
Commodities	\$0.0	\$7.0						
Equipment	\$0.0	\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	\$102.0	\$182.9	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
General Administration	\$13.8	\$23.0						
Project Total	\$115.8	\$205.9						
Full-time Equivalents (FTE)	0.0	2.2						
			Dollar amounts are shown in thousands of dollars.					
Other Resources	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Comments: Restoration Assistance to Landowners.								

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Lead Agency: USFS/ADF&G

FORM 2A
PROJECT
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$30.0	\$67.1						
Travel	\$2.5	\$8.8						
Contractual	\$1.5	\$7.8						
Commodities		\$3.5						
Equipment		\$0.0						
Subtotal	\$34.0	\$87.2	LONG RANGE FUNDING REQUIREMENTS					
General Administration	\$4.6	\$10.6	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$38.6	\$97.8						
Full-time Equivalents (FTE)		1.1						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: USFS

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared:

2 of 13

5/1/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
*	Holbrook R. Thompson	Restoration Manager Program Manager	GS-12/5	12.0	5,100.0		61.2
			GS-13/6	1.0	5,928		5.9
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Subtotal				13.0	11,028	0	
Those costs associated with program management should be indicated by placement of an *.						Personnel Total	\$67.1
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
	Anchorage to Juneau Anchorage to Cordova Anchorage to Homer Anchorage to Kodiak		444	2	4	225	1.8
			224	2	8	225	2.2
			180	2	8	225	2.2
			386	2	8	225	2.6
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.						Travel Total	\$8.8

1996

Project Number: 96058
Project Title: Resoration Assistance to Landowners
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUST DUNCIL PROJECT BUDGET
October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Air Charter	12 hours @ 400/hour	4.8
Report publication/printing		3.0
Contractual Total		\$7.8
When a non-trustee organization is used, the form 4A is required.		
Commodities Costs:		Proposed
Description		FFY 1996
supplies and materials		2.0
software upgrades		1.5
Commodities Total		\$3.5

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: USFS

FORM 3B
Contractual &
Commodities
DETAIL

October 1, 1995 - September 30, 1996

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: USFS

FORM 3B
Equipment
DETAIL

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$30.0	\$80.7						
Travel	\$2.5	\$6.7						
Contractual	\$1.5	\$4.8						
Commodities		\$3.5						
Equipment		\$0.0						
Subtotal	\$34.0	\$95.7	LONG RANGE FUNDING REQUIREMENTS					
General Administration	\$4.6	\$12.4	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$38.6	\$108.1						
Full-time Equivalents (FTE)		1.1						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: ADF&G

FORM 3A
AGENCY
PROJECT
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
*	Kuwada Program Manager	Habitat Biologist Agency Staff	18	12.0 1.0	6,100 7,500		73.2
							7.5
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Subtotal				13.0	13,600	0	
Those costs associated with program management should be indicated by placement of an *.						Personnel Total	\$80.7
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
	Anchorage to Juneau Anchorage to Cordova Anchorage to Homer Anchorage to Kodiak		444 224 180 386	2 2 2 2	4 8 8 8	150 150 150 150	1.5
							1.6
							1.6
							2.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.						Travel Total	\$6.7

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed
Description		FFY 1996
Air Charter	12 hours @ 400/hour	4.8
Contractual Total		\$4.8
When a non-trustee organization is used, the form 4A is required.		
Commodities Costs:		Proposed
Description		FFY 1996
supplies and materials		2.0
software upgrades		1.5
Commodities Total		\$3.5

1996

Project Number: 96058
Project Title: Restoration Assistance to Landowners
Agency: ADF&G

FORM 3B
Contractual &
Commodities
DETAIL

October 1, 1995 - September 30, 1996

1996

Project Number: 96058 Project Title: Restoration Assistance to Landowners Agency: ADF&G

FORM 3B
Equipment
DETAIL

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996						
Personnel	\$30.0	\$0.0						
Travel	\$2.5	\$0.0						
Contractual	\$1.5	\$0.0						
Commodities		\$0.0						
Equipment		\$0.0						
Subtotal	\$34.0	\$0.0	LONG RANGE FUNDING REQUIREMENTS					
General Administration	\$4.6	\$0.0	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
Project Total	\$38.6	\$0.0						
Full-time Equivalents (FTE)		0.0						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
Comments:								

1996

Project Number: 95058
Project Title: Restoration Assistance to Landowners
Agency: ADNR

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared:

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5/1/95

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1996
PM	Name	Position Description					
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Subtotal				0.0	0	0	
Those costs associated with program management should be indicated by placement of an *.							Personnel Total \$0.0
Travel Costs:			Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1996
PM	Description						
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
Those costs associated with program management should be indicated by placement of an *.							Travel Total \$0.0

1996

Project Number:
 Project Title:
 Agency:

FORM 3B
 Personnel
 & Travel
 DETAIL

1996 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET
 October 1, 1995 - September 30, 1996

Contractual Costs:		Proposed FFY 1996
Description		
When a non-trustee organization is used, the form 4A is required.		Contractual Total
		\$0.0
Commodities Costs:		Proposed FFY 1996
Description		
		Commodities Total
		\$0.0

1996

Project Number:
 Project Title:
 Agency:

**FORM 3B
 Contractual &
 Commodities
 DETAIL**

October 1, 1995 - September 30, 1996

Monitoring, Habitat Use, and Trophic Interactions of Harbor Seals in Prince William Sound

Project Number: 96064
Restoration Category: Research, Monitoring
Proposer: Kathryn J. Frost, ADFG
Lead Trustee Agency: ADFG
Cooperating Agencies: NOAA
Duration: 3 yrs
Cost FY 96: \$381,100
Cost FY 97: \$347,000
Cost FY 98: \$100,000
Geographic Area: Prince William Sound
Injured Resource: Harbor Seals

ABSTRACT

This project will monitor the status of harbor seals in Prince William Sound and investigate the possible causes for the ongoing decline. Aerial surveys will be conducted to determine whether the population continues to decline, stabilizes, or increases. Seals will be satellite-tagged to describe their movements, use of haulouts, and hauling out and diving behavior. Samples of blood, blubber, whiskers, and skin will be collected to study diet, health and condition, and genetic relationships to other harbor seal populations.

INTRODUCTION

More than 300 harbor seals (36% of the seals in oiled areas) were estimated to have died in Prince William Sound (PWS) because of the *Exxon Valdez* oil spill (EVOS). ADFG harbor seal studies in PWS began immediately after the EVOS as part of the Damage Assessment program. They included aerial surveys to quantify mortality and necropsies to document levels of hydrocarbons and tissue damage in oiled seals. Beginning in 1991, because harbor seals were damaged by the EVOS, the Trustee Council funded a harbor seal restoration study in which ADFG continued to monitor the trend of harbor seals in PWS and began to investigate the causes of the ongoing decline.

Annual counts were made of pups and non-pups during June, and all seals during August-September. Surveys showed a normal rate of pupping, but a continued decline in overall numbers. Methodology was developed for catching harbor seals and satellite tags were attached to 26 animals. Results indicated that most tagged seals used only a few haulouts near the tagging site and did not swim far to feed. Three seals traveled to the Gulf of Alaska, then returned to PWS, and a few moved between haulouts in central PWS and glaciers in northern PWS. The deepest dives were over 1,300 ft, but most were 300-450 ft. Blood samples were collected from all seals and tested for disease to see if seals were healthy. DNA was analyzed to examine whether PWS harbor seals belong to a separate population. Analyses of stable isotopes in whiskers and fatty acids in blubber provided information about seal diets. Results of these initial investigations suggested that disease

was not the cause of the decline. Preliminary data indicate differences in the diets of young and adult seals, and seals from different areas.

During 1995, satellite tagging, sampling, and monitoring will be continued. Research will focus on reasons for the decline: 1) Is it disease? 2) Is it low pup production? 3) Is it predation by killer whales? 4) Is it mortality caused by humans (subsistence hunting and/or fishing-related mortality)? 5) Is it food limitation? Aerial surveys will be flown to monitor trends. Satellite tags will be attached to 12 seals. Blood, whiskers, blubber, skin, and measurements will be taken from all seals that are caught during tagging. Similar samples are being collected by ADFG in southeast Alaska, where harbor seals are not declining. Data will be compared to better understand why seals are doing well in some areas and declining in others.

The research being proposed for 1996-1998 is a continuation and redirection of harbor seal restoration studies that have been funded by the Trustee Council and conducted by ADFG since 1991. The proposed study will build upon previous research findings and incorporate new components to address high-priority issues regarding harbor seal recovery. Aerial surveys to monitor the trend of harbor seals in PWS will be continued in 1996-1997 and comparisons made to determine whether the decline has stopped. Satellite transmitters will be attached to 12 seals per year in 1996-1997. Fatty acid studies will be expanded to include more prey species, and seals from different seasons/locations. Information on diet will be integrated with data from forage fish studies to understand how harbor seals utilize prey and how they may depend on seasonal or area-specific concentrations of prey.

NEED FOR THE PROJECT

A. Statement of Problem

From 1984-1988, harbor seal counts at 25 trend sites in PWS declined by 43% due to unknown causes. The decline continued in 1989, aggravated in oiled areas by the EVOS. Counts of harbor seals at oiled trend count sites declined by 45%, compared to 11% at unoiled sites. More than 300 harbor seals (36% of the seals in oiled areas) were estimated to have died in PWS because of the spill. Since 1989, harbor seal numbers have continued to decline. There were 28% fewer seals in 1994 than in 1989, and 57% fewer than in 1984. The reasons for this continuing decline are unknown.

B. Rationale

Harbor seals are important to residents of PWS for subsistence. In 1985-1989, harbor seals made up 13%-27% of the subsistence foods harvested in Tatitlek and Chenega Bay. During 1992-1993, these two villages harvested less than half the number harvested annually before the spill. Native residents have noted the scarcity of seals and the impact this has had on subsistence hunting. Harbor seals are also watched and photographed by tourists and recreational users of PWS and they interact with and are incidentally killed by commercial fisheries.

Like all marine mammals, harbor seals have special federal protection under the Marine Mammal Protection Act (MMPA). Because of the ongoing decline, they are being considered for listing as depleted under the MMPA. It is essential that current population data be available so that inappropriate restrictions on human activities are not implemented. It is also important to understand what factors are limiting the population. We cannot assume, given the ongoing decline, that the number of seals in oiled areas will return naturally to pre-spill levels. It is necessary to continue monitoring trends, to identify and appropriately manage areas of particular biological significance, and to communicate information on population status to subsistence hunters and fishermen in order to minimize mortality and augment recovery in any way possible. Commercial fisheries in PWS may face greater restrictions designed to reduce incidental take of harbor seals unless something can be done to understand and reverse the population decline.

The ongoing declines of harbor seals began over two decades ago in the Kodiak area, and were detected at least a decade ago in PWS. Although periodic surveys have documented these downward trends and are useful for determining whether the recovery objective of "stable or increasing population trends" has been met, they are not adequate for determining what is causing the seal population to decline, or for designing conservation and management measures to facilitate recovery and ensure the future health of the population. Unless research is specifically designed and conducted to investigate the factors limiting harbor seals, it is likely that little progress will be made in understanding and mitigating the decline. Similar declines have occurred in Steller sea lions, also for unknown reasons. For both of these species, it has been suggested that changing prey availability may be an important factor. This is a difficult but important topic to investigate. It will require a multidisciplinary approach that incorporates an understanding of harbor seal behavior, habitat use, and energetics, with data about the distribution, abundance, and biology of prey species and predators. Information is also needed about health and disease, stock identity, and sources of mortality.

C. Summary of Major Hypotheses and Objectives

The objectives of this study are to monitor the abundance and trends of harbor seals at trend count sites in oiled and unoled areas of PWS; to gather data on the behavior and habitat use of harbor seals in PWS that can be used to design effective conservation measures; to investigate trophic interactions in order to better understand whether food is limiting the harbor seal population; to model the effects of different sources of mortality on harbor seals; to determine whether disease is contributing to the decline; to determine whether poor pup production is contributing to the decline; to determine the genetic relationships among harbor seals in PWS, and other parts of Alaska; and to provide information to subsistence hunters so they can make informed decisions about the level of harvest for harbor seals.

The hypotheses that will be tested include: 1) harbor seals in PWS have stabilized or increased since the EVOS; 2) a disease agent is causing harbor seals to decline ; 3) harbor seals in PWS belong to a separate management stock; 4) low pup production is causing harbor seals to decline; 5) killer whale predation is causing the decline or preventing recovery; 6) mortality caused by subsistence hunting and/or fisheries-related take is preventing harbor seals from recovering; and 7) a change in food availability has caused harbor seals to decline.

D. Completion Date

This project will take place in three fiscal years. Field work and laboratory analyses will be conducted during FY96 and FY97. Final data analyses will be conducted and a final report prepared in FY98.

COMMUNITY INVOLVEMENT

Information from this study will be presented at oil spill symposia, planning workshops, conferences, and in the published literature. Information will be provided to Sea Grant and ADFG Division of Subsistence for use in meetings and discussions with PWS subsistence hunters. ADFG marine mammals staff regularly attend meetings with various public groups (tourism industry, fisheries, conservation groups, subsistence communities) to inform them about status, important conservation issues, and key research needs for harbor seals.

Project investigators will cooperate with personnel from the ADFG Division of Subsistence (Project 244) in their efforts to inform residents of Chenega Bay, Tatitlek, Valdez, and Cordova about the findings of this study and to incorporate the suggestions of PWS residents in study design. Such an exchange of information will allow biologists to benefit from residents' observations about abundance and behavior of harbor seals in PWS, and will help residents to make informed decisions about their annual harvest of harbor seals.

Investigators are working with the Alaska Native community towards the creation of an Alaska Harbor Seal Commission. Investigators will assist in any way possible in developing community-based harvest monitoring and sampling programs. Project personnel will facilitate sample analysis and communication of results to community residents. A short annual report that summarizes the results of harbor seal investigations will be prepared for distribution to PWS community residents.

FFY 96 BUDGET

Personnel	133.7
Travel	11.2
Contractual	122.7
Commodities	61.8
Equipment	23.0
Subtotal	352.4
Gen. Admin.	28.7
Total	381.1

PROJECT DESIGN

A. Hypotheses and Objectives

Hypothesis 1: The PWS harbor seal population has stabilized and/or increased since the EVOS.

1. Conduct aerial surveys at PWS trend sites during pupping and molting in 1996 and 1997;
2. Correct counts for effects of date, weather, time of day, and tide using historical PWS survey data base and information from satellite-tagged seals;
3. Compare counts to data from 1989-1994 to determine trend;
4. Model the effects of mortality caused by the EVOS on harbor seal population dynamics.
5. In 1998, reevaluate all survey data collected since 1989 to evaluate whether seal numbers are continuing to decline, have stabilized, or are recovering to pre-spill levels.
6. Based on observed trend and statistical characteristics of survey data, recommend a monitoring schedule for 1998 and beyond.

Hypothesis 2: A disease agent is causing harbor seals to decline.

1. Collect blood samples and analyze them to determine whether harbor seals in PWS are infected by a viral disease that may be causing or aggravating the harbor seal decline;
2. Examine all seals that are handled during tagging for external signs of disease; and
3. Archive serum samples for future testing of currently unidentified disease agents.

Hypothesis 3: Harbor seals in PWS belong to a separate management stock.

1. Collect and analyze genetics samples from PWS seals and compare to seals from other regions to evaluate whether PWS seals constitute a genetically distinct management stock;
2. Examine regional genetic variation within PWS; and
3. Tag subadult and adult harbor seals in PWS to study their movements and site fidelity.

Hypothesis 4: Low pup production may be causing harbor seals to decline.

1. Conduct surveys during pupping in June to determine the number and proportion of pups;
2. Compare pup production in PWS with production in areas where harbor seal populations are stable or increasing; and
3. Incorporate pupping data into a population model to evaluate whether pup production is limiting population growth in PWS.

Hypothesis 5: Predation by killer whales is causing the decline or preventing recovery.

1. Estimate the number of harbor seals eaten by killer whales in PWS (in cooperation with and using data from project 012 -Comprehensive Killer Whale Investigation); and
2. Model the impact of killer whale predation on PWS harbor seals.

Hypothesis 6: Mortality caused by subsistence hunting and/or fisheries-related take is preventing harbor seals from recovering.

1. Obtain harvest data for harbor seals in PWS from community-based harvest monitoring program;
2. Obtain information on incidental take of harbor seals from NMFS observer data;
3. Model the impact of human-caused mortality on PWS harbor seals; and
4. Meet with hunter representatives and discuss the implications of population modeling.

Hypothesis 7: A change in food availability (quantity and/or quality) has caused harbor seals to decline.

1. Measure seals in PWS and develop condition indices for interannual comparisons and comparison to historical data base from the late 1970s (with project 001);
2. Provide historical and recent blubber samples to project 117 for analysis of energy content and whiskers to project 320-I for analysis of stable isotopes;
3. Compare dietary information from harbor seals in 1970s with recent data;
4. Determine individual, age-related, seasonal, and interannual differences in diets of seals as measured by fatty acid composition of lipid stores, stable isotopes of whiskers (stable isotope analyses by project 320-I), and stomach contents as available from hunters;
5. Evaluate the relative contribution of each prey type to the overall diet using measured fat content of the prey, and compare energy value of prey eaten by adults and subadults (with APEX);
6. Assess variation in the fatty acid composition of prey species (with APEX and project 012);
7. Determine feeding areas (location/depth) of seals based on satellite-tagging data and describe the use of and movements between haulouts and feeding areas;
8. Describe hauling out and diving behavior, and by inference, feeding behavior of satellite-tagged seals in PWS; and
9. Compare information about diet and feeding areas with information about forage fish distribution and abundance (incorporating data from SEA, APEX, and herring studies).

B. Methods

We are proposing two additional years of field study (1996, 1997) with final data analysis and reporting to take place in 1998. Findings from this study will be evaluated annually, and modifications in study approach will be recommended in order to incorporate recent findings from this and other PWS studies. In addition to the seven components outlined in this project description, questions about harbor seal health and condition, stable isotope analyses, predation by killer whales, and prey availability will also be addressed by other Restoration studies.

Aerial Surveys and Analysis (Objectives 1.1, 1.2, 1.3, 1.5, 1.6., 4.1, 4.2)

Harbor seal abundance will be monitored by flying aerial surveys during pupping (June) and molting (late August-early September). A fixed-wing aircraft will be used to survey 25 trend count sites at an altitude of 700-1000 ft. These haulout sites have been used by ADFG for PWS harbor seal trend counts since 1983, including NRDA and Restoration studies in 1989-1994 (Calkins and Pitcher 1984; Pitcher 1986, 1989; Frost and Lowry 1994a; Frost et al. 1994a). The trend count route includes 7 sites that were impacted by the EVOS (Agnes, Storey, Little Smith, Big Smith, Seal, and Green islands, and Applegate Rocks) and 18 unoiiled sites (Table 1, Figure 1). The survey methodology and observers will be the same as those used in PWS harbor seal studies conducted in 1989-1994 (see Frost and Lowry 1994a; Frost et al. 1994a), and as summarized below.

Maximum numbers of harbor seals are known to haul out during pupping and molting (Pitcher and Calkins 1979; Calambokidis et al. 1987). Within these periods, more animals are usually hauled out at lower stages of the tide, since availability of many haulout sites is limited by tidal stage.

Consequently, our surveys will be conducted during June (pupping) and late August/September (molting), and will begin within two hours before daylight low tides and finish within two hours after low tide. Replicate counts will be made at each site to allow statistical analysis of trend.

Power analysis of data from 1989-1994 indicates that in order to detect a 5% change per year over a five year period ($p=0.05$) with a greater than 50% probability of being right (using initial population = 1050, the number of seals at trend count sites in 1988), it is necessary to fly annual surveys with 7-10 replicates per year (Figure 2). This analysis was based on data collected by ADFG since 1984, and takes advantage of one of the most extensive data sets of its kind. The recommendation of 7-10 replicates is similar to the number of replicates recommended by Pitcher based on analysis of other harbor seal surveys in Alaska (Pitcher 1986, 1989). The number of replicates also may be influenced by weather, which can limit the number of days suitable for flying within a survey period.

Visual counts will be made of seals at each site, usually with the aid of 7 power binoculars. Pups will be counted separately during June. Photographs will be taken of large groups for later verification using a hand held 35-mm camera with 70-210 mm zoom lens and high speed film (ASA 400). Color slides will be commercially developed and the seals will be counted from images projected onto a white surface.

Aerial surveys do not estimate the total number of seals present since they do not account for seals that are in the water or seals hauled out at locations not on the trend count route. Surveys provide indices of abundance based on the number of hauled out seals. Interpretation of trend count surveys relies on the assumption that counts of harbor seals on select haulout sites are valid linear indices of local abundance. We assume that within a given biological window, such as the molting period, hauling out behavior remains the same from one year to the next, and counts can thus be compared (e.g., Harvey 1987, Pitcher 1989). Standardization of procedures minimizes the affects of variables such as tide and weather that could influence the number of seals hauled out on a given day. In addition, for all future PWS surveys the results of a multivariate analysis conducted based on survey data from 1989-1994 will be used to correct counts for weather, tide, and date. These corrections were developed in 1995 and will be presented in the 1995 Annual Report (see Figure 3). During 1995 and beyond, additional multivariate analyses will be conducted on a site-by-site basis to examine the effects of tide, date, and weather parameters on individual sites and to learn which areas produce the most stable counts and which are the most variable. Behavioral data obtained from satellite transmitters attached to seals as part of this study will help to verify these assumptions. Satellite tags will also help to provide estimates of the proportion of seals hauled out at low tide which can be used to develop correction factors for estimating the total number of seals present, not just those that are hauled out and available to be counted.

Reliable surveys of the trend count route were conducted during the molt in 1984 and 1988-1994. These data will be used for comparisons with data collected in 1995 and later. Analyses of trend count data and comparisons with other years will be conducted following statistical methodology used for previous surveys (Frost and Lowry 1994a, b; Frost et al. 1994a). For each year, daily surveys will be averaged for each site and then sites will be summed to produce yearly estimates for the oiled, unoled, and total trend count areas. The 95% confidence interval will be estimated by bootstrapping (Efron and Tibshirani 1993). The bootstrap method resamples with replacement from

the actual daily counts at each haul-out site to produce a new data set with the same sample size (number of counts) for each site in each year. This resampling will be done 2000 times for each year's data, and then the 2000 bootstrap estimates will be ordered. Ordinarily, the 50th and 1950th ordered bootstrap estimates provide a 95% confidence interval, but as recommended by Efron and Tibshirani (1993), we will use a bias-corrected version that slightly adjusts the choice of the ordered bootstrap estimates for the confidence interval endpoints.

A linear regression model will be fitted to yearly estimates at oiled sites, unoiled sites, and for the trend count area as a whole for uncorrected data and for data corrected for the effects of date, time, tide, and weather. This will be done for both pupping and molting counts. During the pupping period, only the counts of non-pups will be used in the analysis. The regression line for each group will take the form,

$$Y = b_0 + b_1(X)$$

where Y is the mean count/site summed for all sites, b_0 is the y intercept of the line, b_1 is the slope, and X is the year. The significance of regression coefficients will be tested using analysis of variance (Snedecor and Cochran 1969).

Catching and Sampling Seals (Objectives 2.1, 2.2, 3.1, 7.1, 7.2, 7.4)

Seals will be caught by entanglement in nets placed near the haulouts. Nets will be approximately 100 m long and either 3.7 or 7.4 m deep with standard floats or float line and light lead lines. Mesh openings will be about 30 cm stretched measure. Nets will be deployed from a 6 m boat assisted by one or two other small boats to assist in maneuvering the net and tending it to ensure that all captured seals are quickly detected and removed (see Frost and Lowry 1994b).

When seals become entangled, they will be brought into the boats or to shore, cut free from the tangle net, and placed into hoop nets (large stockings made of 1 cm mesh soft nylon webbing). Smaller seals will be physically restrained during handling and tagging. Larger animals will be sedated with a mixture of ketamine and diazepam administered intramuscularly at standard doses (Geraci et al. 1981). Each seal will be weighed, measured, and tagged in both hindflippers with individually numbered plastic tags. Field personnel will collect approximately 50 cc of blood from the extradural intervertebral vein. Ultrasound measurements of blubber thickness will be made whenever possible. Standard blood chemistry panels and virology screens (phocine distemper virus, herpes, and others as indicated) will be run on these samples. The following samples will also be taken: whisker(s) for stable isotope analysis (project 320-I), a small piece of skin for genetics studies, and a 0.5 cm x 2.5 cm blubber biopsy for fatty acid analysis and analysis of energy content (project 117). Seals will be selected by age and sex for instrumentation with satellite tags, as described below.

Seals will be caught in three regions of PWS to coincide with sampling areas being used by other studies (APEX, SEA, and herring studies). These will be Port Gravina; southern PWS near Montague, Green, and Little Green islands; and central PWS near Agnes, Smith, and Seal islands. This will facilitate comparison of data obtained by fish, seabird, and harbor seal researchers about important prey species and responses to changing availability of prey. Hydroacoustic and trawl data

will be available from these areas. If a suitable technique can be developed for catching seals near glacial ice, we will sample seals from a glacial fiord (probably Icy Bay where APEX bird studies will be occurring) where prey base and feeding behavior may be very different from that in other habitats. We will try to catch and sample approximately 50 seals total per year, during April-May and September. If sample analyses indicate that other areas or seasons should be sampled, we will extend or modify our sampling schedule.

Disease (Objectives 2.1, 2.2, 2.3)

Recent epidemics and mass mortality caused by phocine distemper virus in the eastern North Atlantic have highlighted the possible role of disease in marine mammal population declines (Heide-Jorgensen et al. 1992, Thompson and Hall 1993). Since 1989, as part of this and other harbor seal studies, we have been collecting samples for disease investigations. To date, 84 seals from the study area have been screened for phocine distemper virus (72 negative, 12 positive) and 97 for herpes virus (30 negative, 67 positive) (R. Zarnke, pers. commun.). Serum from 98 other seals sampled since 1991 has been sent in for analysis. Seventeen seals sampled in the Kodiak area during 1993 were tested for caliciviruses (including San Miguel sea lion virus), and all were negative (J. Lewis, pers. commun.). Swabs and/or serum from 5 Kodiak-area seals and 13 PWS seals have been screened for Chlamydia; most samples were negative (J. Lewis, pers. commun.). The only potentially pathogenic bacteria found in bacterial swabs from 27 PWS seals and 5 Kodiak seals sampled in 1993 were *Moraxella* sp., *Patuella* sp., and *Bordatella bronchiseptica*. These organisms can occasionally cause disease in domestic animals. All can occasionally cause pneumonia, and *Moraxella* sp. can cause conjunctivitis. However, in otherwise healthy seals it is unlikely that they would cause a problem (T. Spraker, pers. commun.).

Although at this time it appears unlikely that disease is responsible for the ongoing decline of seals in PWS and the Gulf of Alaska, we will continue to collect samples, conduct some analyses, and archive serum for disease screening. The cost of this component is minimal and it allows us to track the health of seals in the study area. During 1995 and beyond, blood will be collected from all seals that are handled during tagging. Serum will be obtained for viral screening, and assays will be conducted for phocine distemper virus, seal herpes virus, and any other viral agents that might be of concern. Additional serum will be archived at ADFG Fairbanks for future use.

Genetics (Objectives 3.1, 3.2)

Measures of genetic diversity are useful for evaluating gene flow among seals in different geographic locations, and in assessing whether particular groups of seals constitute separate biological stocks. This information is important for several reasons. First, it is not possible to put mortality caused by an event such as the EVOS into perspective without some understanding of population structure. In other words, did the 300 seals that died following the EVOS represent 30% of a central PWS stock, 5-10% of a stock that includes all of PWS, or a much smaller percent of either a Gulf of Alaska stock or an Alaska-wide stock? Information about stock identity and stock size is also necessary for evaluating the impact of mortality caused by subsistence hunting, incidental take by fisheries, or predation. It is not possible to recommend a safe harvest level for harbor seals in PWS without knowing the size of the stock from which the harvest is taken.

Use of molecular genetic techniques can help clarify whether seals in adjacent areas are genetically discrete from one another, and provide managers with a better concept of the overall harbor seal population structure, including estimates of gene flow between colonies and site fidelity. Lehman et al. (1993) detected geographic partitioning in harbor seals from PWS, Washington, and California based on genetic variation in minisatellite loci. However, only three seals from a single location in Alaska were included in that study. Lamont and Thomas (1994) found considerable diversity in harbor seal mitochondrial DNA sequences from Washington, Oregon, and California. Although in that study many haplotypes were unique to certain localities, small sample sizes precluded conclusions regarding the amount of gene flow.

Mitochondrial sequence diversity will be used to investigate genetic structure among groups of harbor seals in Alaska and within PWS. Small skin samples for genetics analysis will be taken from all seals that are captured during tagging operations in 1995 and beyond. Similar samples were also obtained from seals captured in PWS during 1993-1994, and from seals collected for food safety testing in 1994 (Project 95279). Comparative samples are available from the NOAA-funded ADFG harbor seal study in Kodiak and southeast Alaska.

Pieces of skin will be taken from the hind flipper of each seal using a 0.5 cm diameter skin punch, and preserved in DMSO-salt solution until they are analyzed. Analyses will be conducted by the genetics laboratory at the NMFS Southwest Fisheries Science Center in La Jolla, CA. DNA will be amplified using polymerase chain reaction procedures, and fragment and sequence analyses will be conducted. Polymorphic mitochondrial DNA sequences and polymorphic nuclear DNA alleles will be sought as markers for morphological, geographic, and management stocks. Preliminary analyses of samples from harbor seals and spotted seals in Alaska have demonstrated that this technique produces useful results (O'Corry-Crowe and Westlake 1994).

Modeling (Objectives 1.4, 4.3, 5.3, 6.3)

A demographic model will be developed and refined in cooperation with biometricians from the NMFS National Marine Mammal Laboratory, to examine the effects of predation, harvest, and incidental take on the harbor seal population in PWS. An age-specific mortality curve will be generated using life tables from PWS harbor seals developed by ADFG in the 1970s (Pitcher 1977; Pitcher and Calkins 1979). Age-specific fecundity rates will be estimated from pregnancy rates derived from this same data set. Data on the subsistence harvest will come from ADFG's Division of Subsistence (Project 244 and others), obtained in cooperation with subsistence hunters from Chenega Bay, Tatitlek, Cordova, and Valdez (see Wolfe and Mishler 1993), and from a community-based monitoring program to be developed in 1995-1996. Information on killer whale predation will be obtained from the Comprehensive Killer Whale Investigation (Project 012), as well as from other pertinent studies (e.g., Saulitis 1993). Data on incidental take in fisheries will be obtained from NMFS, and other sources such as Wynne (1990).

Estimates of mortality and reproduction will be combined to produce a population model following that proposed by Eberhardt (1985). It is unknown what specific change in mortality or fecundity has occurred since the samples were collected in the mid-1970s; all that is known is that the population has been declining. Neither is there a known change in a specific demographic parameter (for example increased mortality of pups or subadults) which should obviously be used to

modify the base-line model. Thus, the demographic parameters will be adjusted by various amounts, first individually and then together, to determine what changes would result in the observed rate of change. The amount of time for which the model will be "allowed" to produce the observed rate of change will not be greater than 10 years, approximately the amount of time between when the samples were collected in the 1970s and the start of the decline.

To address the question of how various mortality factors (subsistence harvest, killer whale predation, commercial fishery kill) may affect the population, we will first determine the estimated annual mortality at the current and 1984 levels. This estimate will be compared with estimates from various mortality factors. The mortality schedule within the model will be adjusted following the estimates, and the resulting population status explored. This modeling outline is based on the assumption of a closed population, or similarly that emigration equals immigration. Information from genetics studies and data from satellite-tagged seals will be used to evaluate this assumption.

Satellite-tagging (Objectives 1.2, 3.3, 7.7, 7.8, 7.9)

Satellite-linked telemetry can be used to gather information about habitat use, including site fidelity, movements between haulout sites and in and out of PWS, seasonal changes in hauling out patterns, habitats used for feeding, and feeding and diving behavior. Satellite-linked time-depth recorders (SLTDRs) have provided researchers with the ability to monitor location and diving behavior of marine mammals (Mate 1986, 1989, Hill et al. 1987, Stewart et al. 1989, Lowry et al. 1994, Frost and Lowry 1994b). The SLTDRs transmit to a satellite-based Doppler positioning system that calculates locations and tracks movements of animals with considerable accuracy. When combined with appropriate environmental sensors and microprocessor hardware and software, other information about an animal's environment and behavior can be transmitted to the satellite.

This study has demonstrated that SLTDRs are an effective means of monitoring the movements and haulout locations of harbor seals in PWS. During 1991-1994, significant data were received from SLTDRs attached to 26 harbor seals in PWS, including 17 males and 9 females (Table 2). Nineteen were adults and 7 were subadults. SLTDRs were attached to 17 seals from areas in central PWS that were oiled by the EVOS (Seal Island, Herring Bay, Bay of Isles, Applegate Rocks); one from eastern PWS (Gravina Island); and eight from unoiled sites in southcentral PWS (Port Chalmers and Channel Island). SLTDRs were operational for up to 10 months, and provided locations for more than 75% of those days.

SLTDRs deployed during 1991-1994 indicated that the movements of harbor seals were mostly confined to within PWS. Many seals hauled out only at the tagging location, although some also used one or two nearby locations (Frost and Lowry 1994b). Movements between terrestrial haulouts in central PWS and glaciers in northern PWS were not uncommon. Three seals made substantial movements to the Gulf of Alaska or the Copper River delta, but later returned to PWS. These movements were mostly made by subadult seals.

Most areas where seals were diving and probably feeding were within a few kilometers of haulouts. However, one seal spent several days 30 km from the nearest land in the Gulf of Alaska. The deepest dive by a tagged seal was 404 m, but most dives were to less than 200 m. SLTDR sensors indicated that 58% of 64,000 dives monitored during 1992-1993 were less than 50 m, 39% were 50-

150 m, and only 3% were deeper than 150 m. The usual maximum depth for seals smaller than 50 kg was 100-130 m, compared to 130-150 m for seals larger than 50 kg (Frost and Lowry 1994b). In combination with data being collected on abundance and distribution of forage fishes and about the prey being utilized by harbor seals in PWS, these SLTDR data will help us to better understand feeding behavior of adult and subadult seals. In addition, they should help us to develop correction factors to be used in interpreting aerial survey data (e.g., Harvey 1987).

During 1996 and 1997, SLTDRs will be attached to 12 seals per year at locations chosen because they appear to represent different habitat types, because of their apparent importance to seals, and/or for their proximity to forage fish and oceanographic stations sampled as part of other PWS ecosystem studies. This will include Gravina Bay (important herring area), southern PWS near Montague, Green, and Little Green islands (herring and fish data from here, and a large number of seals); and central PWS near Agnes, Smith, and Seal islands (APEX fish data available, and significant seal haulouts). Actual tagging locations will depend on where seals are present and can be caught. At present we have no method that is suitable for catching seals in areas with drifting glacial ice. If we can develop such a method, we will instrument some seals from glacial fiord areas (Icy Bay, Columbia Bay, etc.).

Emphasis will be placed on instrumenting subadult seals and adult females. Approximately four of the SLTDRs will be put on adult females and the remaining eight units on small subadults of either sex. This sex/age distribution of tags may be modified somewhat based on results of ongoing data analyses and/or conditions experienced in the field. Depending on the performance of tags in 1995 and whether it is considered desirable to tag additional pregnant females, it is likely that in 1996 and 1997 seals will be instrumented only in September.

Transmitters (14 cm x 10 cm x 4 cm for adults; 14 cm x 5 cm x 4.5 cm for subadults) will be attached to the mid-dorsal surface of the seal by gluing with epoxy resin (Fedak et al. 1984; Stewart et al. 1989). SLTDRs attached in autumn following the molt should remain attached until the next molt, but may not operate that long. Mean duration of operation of SLTDRs attached in fall 1993 was 182 days, with a range of 102-311 days (Frost and Lowry, unpublished). Small units suitable for subadults that were deployed in 1994 lasted up to 150 days. Tagging during the winter months is not considered cost-effective or practical. The weather is often severe, the water extremely cold making it difficult to work, and few seals are hauled out. Some SLTDRs were duty cycled in September 1994. Others will be duty-cycled in September 1995. Based on results from these tags, and if this effectively extends the data acquisition period through the pupping period, we may duty cycle all SLTDRs in 1996 and 1997.

Data will be acquired from the ARGOS satellite receiving system and initially analyzed using software provided by the manufacturer of the transmitters. Each SLTDR will transmit signals to polar-orbiting satellites whenever the seal is hauled out or when it surfaces sufficiently long for a transmission to occur. An uplink occurs when a satellite is positioned to receive the signal. Information transmitted by the SLTDR is used by Service ARGOS to calculate the geographic location of the seal. Units will be equipped with built-in programmable microprocessors to collect and summarize data for periods when animals are diving and store it for later transmission, as has been done for crabeater seals, Steller sea lions, and spotted seals (Hill et al. 1987; R. Merrick, personal communication; Lowry et al. 1994a). These data will be stored in six hour blocks and

transmitted to the satellite once the six hour data collection period is complete. Sensor information from a pressure transducer and a conductivity switch will be used to indicate when the animal is hauled out. Data from four periods will be stored in memory, providing at least a 24 hour window for transmission before the data are lost. Dive data will be summarized as histograms in depth bins of 4-20 m, 21-50 m, 51-100 m, 101-150 m, 151-200 m, 201-250 m, 251-300 m, 301-350 m, and over 350 m, and duration bins of 0-120 seconds, 121-240 seconds, 241-360 seconds, 361-480 seconds, 481-600 seconds, 601-720 seconds, 721-840 seconds, 841-960 seconds, 961-1080 seconds, and over 1080 seconds. In addition, SLTDRs will store and transmit the amount of time spent in each depth bin and the total time spent at the surface.

Each SLTDR broadcasts a unique identification code so that data can be assigned to a particular seal. Position accuracy for all geographical locational information is rated by Service ARGOS to reflect the predicted accuracy of the calculated locations (Fancy et al. 1988, Stewart et al. 1989). Locations calculated by Service ARGOS will be screened for accuracy and plotted on charts of PWS. Locational data will be compared with sensor data, when possible, to verify that information regarding whether the seal is on land or at sea is correct, since errors in calculated locations may falsely indicate that a seal is on land or at sea (see Stewart et al. 1989).

Data on the haulout patterns of tagged seals will be examined for indications of daily or seasonal variations, for example to determine whether there is a change in the frequency of haulout by season, or whether the amount of time spent hauled out changes. Plots of locations where continuous signals are received will be used to determine the degree and regularity of use of particular haulout sites. We expect to receive fewer locations of seals while at sea, because the transmitter antenna will frequently be submerged. At-sea locations will be plotted as an indication of areas used for feeding. Information on depth and pattern of diving will be compiled, and will provide additional information on the general areas used for feeding.

Dive data will be presented as graphs and histograms which indicate the range in individual behavior as well as summary data for all seals combined. Dive data histograms will present the number of dives at different depth increments and by duration of dive. Means and standard deviations for dive depth and duration will be calculated and compared for seals in different locations or habitats and at different times of day and year. Compilation of data on time and location of feeding dives will be used to identify feeding areas near different haulouts, if possible. If sensors indicating whether the seal is on land or at sea become more reliable and the necessary SLTDR software is developed to provide a continuous record of this information, then diving and hauling out cycles will be examined relative to time of day, tide, and season. Summaries of the number and quality of uplink data and at-sea position data will be presented in tabular form. Tabular summaries will also be prepared for use of different haulouts by individual seals; the number of haulout bouts relative to tidal state and time of day; and frequency of haulout and amount of time spent feeding by season.

These data will be used to develop correction factors for surveys, to evaluate site fidelity of seals, to quantify the amount of interchange among haulouts within and outside of the area impacted by the EVOS and within and outside of PWS, to determine seasonal importance of particular haulouts, to identify areas used for feeding, and to reveal differences in movements and feeding behavior of subadult and adult seals.

An alternate methodology to satellite-tagging is the use of VHF telemetry. VHF transmitters are inexpensive to purchase. They are quite reliable for short distances when signals are not obstructed by geographic barriers, and are useful for monitoring attendance at particular haulouts (e.g., Harvey 1987). However, monitoring of VHF transmitters can be expensive and labor intensive; they must be tracked either from aircraft or by field personnel stationed near the tagging location. During much of the year, weather in PWS is foggy and stormy, and flying is either precluded or dangerous. Remote monitoring stations are of limited utility because of the topography in PWS. If the seals swim more than a few miles from the monitoring station, or around an island with significant geographic relief, the signals can no longer be acquired. It would be difficult to relocate seals if they swim long distances in unpredictable directions as some of the SLTDR- tagged seals have done. In PWS, VHF technology could only give an indication of some of the haulouts that are used by a tagged seal, and of its activity patterns while it is on that particular haulout.

Satellite telemetry is a preferable alternative to VHF telemetry in PWS. SLTDRs transmit data regardless of whether investigators are in the field to monitor them. They do not require the use of aircraft or field stations. Data transmission is not limited by weather or time of day. Micro-processors allow data to be stored for a 24-hr period, greatly increasing the probability that a transmission will be sent when a satellite is overhead. Every time that a seal surfaces for a sufficiently long period of time, data are transmitted. Such data give a much more complete picture of movements and hauling out behavior than do intermittent VHF data. The SLTDRs provide data on duration and depth of dives, and the time spent in particular depth increments, that are not available from conventional VHF transmitters.

Fatty Acids (Objectives 7.3, 7.4, 7.5, 7.6, 7.9)

Recently, a method has been developed for understanding marine food webs through the use of fatty acid signatures (Iverson 1993). Fatty acids are essentially the building blocks of lipid. Organisms are able to biosynthesize and modify fatty acids, but there are biochemical limitations and differences in these processes depending on the organism. Specific fatty acids cannot be synthesized by animals and therefore can only originate from diet. Because of this, some fatty acids in the food chain can be attributed to specific origins (Cook 1985). Lipids from marine organisms are characterized by a very complex array of fatty acids. There are substantial differences in fatty acid composition among species and prey types, as well as within species by geographic region (e.g. Ackman et al. 1975, Iverson 1993). In marine mammals, dietary fatty acids are often deposited in body tissue without modification (Iverson and Oftedal 1992, Iverson et al. submitted). Consequently, it is possible to trace fatty acids obtained from the diet and to compare arrays in the tissues of the predator to those in the prey consumed.

This concept of fatty acids as trophodynamic tracers can be applied to harbor seals. In general, lipid transfer from prey to deposition in tissue is extremely efficient (Iverson 1988, Iverson et al. submitted). Because certain fatty acids cannot be biosynthesized by seals, they are known to be of dietary origin. For example, a pair of monosaturates that occur in one species of copepod act as a tracer in Atlantic cod and herring (Ackman 1980). Since most seals undergo seasonal periods of fasting and depletion of fat stores (e.g., during the breeding season or the molt) followed by intensive blubber deposition (prior to the subsequent breeding season), blubber fatty acids usually reflect the integration of diet over a period of several months. In contrast, circulating chylomicrons

in blood carry the lipid specifically from the last meal. Thus, fatty acids in blubber and blood provide information on both immediate diet as well as dietary history of the animal. Since many seals tend to feed on only a single or few selected prey species at a given time or season (e.g., Bowen 1990), this facilitates the use of fatty acid signatures.

During a pilot study in 1994, 41 blubber samples were obtained. Preliminary analysis of these samples indicated substantial individual and geographic variation, suggesting differences in feeding modes. Two adult, pregnant females from Stockdale Harbor and Port Chalmers had different fatty acid signatures than did two subadult males from the same general area (Iverson, unpubl. data). Seals from Port Chalmers had eaten very different prey than seals at Channel Island only a few kilometers away. This is unlike harbor seals from Sable Island, Nova Scotia, which show little individual variation (Iverson, pers. commun.). Ratios of particular fatty acids in PWS seals were quite different than ratios found in seals in the Atlantic or sea lions in California. It is likely, once prey species have been analyzed, that these unusual isomers can be attributed to particular prey. The stable isotope composition of the whiskers of these same seals was also quite different, both at the time of sampling and along the length of the whisker (A. Hirons, pers. commun.). Whiskers of two adult females showed large changes in $\delta^{13}\text{C}$ (-12.5 to -17.5) and $\delta^{15}\text{N}$ (18 to 13), suggesting changes in diet along the length of the whisker. In contrast, two young males appeared to have been eating prey at the same trophic level throughout the period represented by the whisker. Their isotope ratios showed little change: $\delta^{13}\text{C}$ ranged from -15.5 to -16.5 and $\delta^{15}\text{N}$ from about 17 to 16 (Hirons, unpubl. data). If whiskers are replaced annually, these stable isotope data may suggest that adult females utilize very different prey in winter than at other times of year, or that they feed in different areas.

Blubber samples will be taken from seals using routine biopsies (sterile 6 mm biopsy punches). Samples will initially be collected in spring and fall to coincide with possible seasonal changes in feeding behavior and blubber depletion/deposition. Samples will be placed in chloroform/methanol with BHT as an antioxidant, and kept frozen until analyzed. Samples will be collected from all seals that are caught during tagging operations. Blood will be collected from the same animals and centrifuged in the field. If chylomicrons are evident (milky white or cloudy serum, indicating recent feeding) the serum will be separated, preserved, and stored frozen for later fatty acid analysis. Prey species will also be analyzed by the APEX study and/or this study.

During 1996-1997, fatty acid analyses of seal blubber and serum and prey samples collected in previous years will be completed. In addition, approximately 50 additional harbor seals per year will be biopsied and analyzed for fatty acids (from both spring and fall, and representing different parts of PWS). Approximately 10 species of prey that are potentially important dietary items will be sampled during spring and fall. For each species and season, 8 individuals of the size range likely to be consumed by seals will be collected and will be analyzed separately for total fat and protein content and fatty acid composition. Prey species determined to be most important in the diet will be examined in more detail. Seals will continue to be sampled from different parts of the study area. A broader range of prey species will be selected only if the initial ones chosen were not appropriate. Samples will be obtained from herring and APEX forage fish projects. They will be frozen whole in plastic bags and stored frozen until extraction and lipid analysis.

Laboratory analysis and evaluation of data will be conducted by Dr. Sara Iverson at Dalhousie University, Nova Scotia. Fatty acids will be extracted from seal blubber and prey according to methods described in Iverson (1988). Blood samples containing chylomicrons will be processed by ultra-centrifugation after adjusting serum density with sodium bromide and layering with various density salt solutions. Chylomicrons will be decanted from other blood lipoproteins and extracted. Fatty acid methyl esters will be prepared directly from aliquots of the chloroform extract, then extracted and purified in hexane. Analysis of fatty acid methyl esters will be performed according to Iverson et al. (1992) using temperature programmed capillary gas liquid chromatography and linked to a computerized integration system. Identifications of rare isomers will be performed using techniques such as hydrogenation and silver nitrate chromatography (Iverson et al. 1992). Approximately 70 fatty acids and isomers can be separated and quantified in most marine lipids. The proper isolation of all components in any sample is critical in assessing diets and prey items; these methods are currently set up and routinely used in the Dalhousie University laboratory of Dr. Iverson.

Fatty acids will be used to evaluate food webs in two ways. The array of fatty acids in seal tissues will be statistically compared to fatty acids in prey species in order to quantify the relative contribution of each prey item to the overall diet. In addition, single unusual or unique components will be used to trace a specific prey. In the analysis and interpretation of data, fatty acids will be grouped as: 1) components which could readily be biosynthesized by the seal; 2) components that could be biosynthesized but at the measured levels are likely mostly of dietary origin; and 3) components that could only come from the diet. Categories 2 and 3 represent the "indicator" fatty acids (Iverson 1993).

Data will be analyzed using a multivariate model called a tree regression analysis (Clark and Pregibon 1992). This model has recently been applied and modified for fatty acid signature analysis (Iverson pers. commun.). The model considers all 70 component fatty acids in each sample and uses the fatty acid arrays of species to determine classification rules for types of signatures. The model builds complex trees through which predator (seal) samples are run for appropriate classification (i.e., diet). Through this method we will attempt to differentiate prey species being consumed, as well as geographical, seasonal, or interannual differences in diet. The quantitative contribution of each prey species to a given seal's diet can be estimated from its total fat content based on proximate analysis and its fatty acid signature.

The use of fatty acids to elucidate diet and trophic relationships is in the developmental stages. It is not a stand-alone method, but neither is any other currently available method for examining marine mammal diets. Stomach contents analysis is limited by our ability to obtain large enough samples, the digestive state of contents, and by the fact that food in a stomach represents a single meal. In PWS, large tidal fluctuations every 6 hours make it virtually impossible to collect scats from areas where seals haul out. Stable isotopes indicate the trophic level at which seals feed and temporal variations in prey type, but provide little information on specific prey. Studies of prey availability are necessary to establish the "menu" from which seals may choose, but they do not reflect the availability of prey to seals or the energetic costs of capturing different prey. Progress towards answering the question of "Is food limiting harbor seals?" will most likely come through the combination and integration of a variety of approaches, including analyses of fatty acids, stable isotopes, and stomach contents; investigations of the distribution and abundance of potential prey;

evaluation of body condition and changes in condition through time; blood chemistry; and analyses of blubber as an energy source. Each of these approaches will provide pieces to a very intricate puzzle, and together they will give us a better understanding of the trophic dynamics of seals in PWS. In aggregate, the studies funded by the Trustee Council for 1995 address this suite of approaches and provide an integrated approach to the "Is it food" question.

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C. Contracts and Other Agency Assistance

Survey aircraft will be chartered from the private sector. Charter aircraft for surveys will not require contracts. ADFG maintains a list of qualified air charter operators. Aircraft for surveys will be chosen from this list according to state procedures. Vessel support for tagging work will use small vessels contracts that will be completed by the Principal Investigator according the state SOP manual. Vessels will be chartered from the private sector.

Costs of acquiring SLTDR data from Service ARGOS are paid for through a contract with the National Oceanic and Atmospheric Administration (NOAA). This contract covers all ADFG Division of Wildlife Conservation satellite tagging projects (harbor and spotted seals, and caribou), not just this harbor seal restoration project, and is processed by the Division of Wildlife Conservation. Funds for data acquisition must be encumbered and guaranteed to NOAA in early February. Actual contract processing occurs later in the spring.

Satellite SLTDRs will be purchased under contract award from Wildlife Computers, a private company in Seattle, Washington. The contract award was negotiated in 1992 and will be active throughout the duration of this project. Wildlife Computers is the only company in the United States which manufactures SLTDRs with the capabilities necessary to acquire the data we require about diving behavior of seals.

Fatty acid analyses and interpretation will be done by Dr. Sara Iverson at Dalhousie University through a Cooperative Agreement between ADFG and Dalhousie. Dr. Iverson is the only person in North America with specific experience in analysis of fatty acids in seal blubber, and particularly with the sophisticated statistical analyses necessary to infer diet from the relative abundance of these fatty acids.

Genetics analyses will be done by Dr. Greg O'Corry-Crowe at the NOAA/NMFS Southwest Fisheries Science Center through a National Research Council fellowship. Dr. O'Corry-Crowe is currently working with ADFG on harbor seal genetics studies in other parts of Alaska and can conduct additional analyses of PWS harbor seals at a very modest cost.

Other assistance and cooperative work towards accomplishing the objectives of this study are provided at no cost to the project by Dr. Randy Davis, Texas A & M University (physiological studies); Kate Wynne, University of Alaska Sea Grant Program (biological sampling and field assistance); Jon Lewis, ADFG (NOAA-funded harbor seal studies in southeast Alaska and near Kodiak); and Dr. A. D. M. E. Osterhaus, National Institute of Public Health and Environmental Protection, Netherlands (phocine distemper and herpes assays).

D. Location

This project will be conducted in PWS. Aerial surveys will be flown over the 25 established trend

count sites shown in Figure 1 and listed in Table 1. Seal tagging and sampling will take place at a variety of locations throughout PWS. Tagging locations will be chosen to represent different habitats and different proximity to areas oiled by the EVOS, and will be coordinated with sampling locations for oceanographic and forage fish studies. Communities that harvest harbor seals or engage in commercial fishing activities, and therefore may be affected by or utilize the results of this study, include Cordova, Chenega Bay, Tatitlek, and Valdez.

SCHEDULE

A. Measurable Project Tasks for FY 96 and beyond

This project will be conducted during 1996 and 1997, with submission of a final report in 1998. A schedule of field activities, data analysis, and report preparation follows:

1996-1997

October - July:	Retrieve ARGOS data
October - December:	Analysis of fatty acid samples by Dalhousie
October - December:	Analysis of aerial survey data
October - September:	Analysis of genetic samples by SWFSC
October - April:	Analysis of other data, modeling
October - March:	Analyze SLTDR data from previous year
October - December:	Meet with hunters about study results, distribute newsletter
November - December:	Meet with SWFSC regarding genetics analyses
January:	Order SLTDRs for field season
January:	Attend restoration workshop
January or February:	Coordination meeting with other ADFG harbor seal projects
January - April:	Arrange logistics (boats, airplanes, equipment, contracts, supplies)
February:	Reserve ARGOS satellite channels
February - March:	Prepare annual report
April 15:	Submit annual report
April-May:	Field work to catch seals and collect samples
June 7-20:	Conduct aerial surveys during pupping
June - August:	Analysis of fatty acid samples by Dalhousie
August 20-30:	Conduct aerial surveys during molting
September 15-30:	Attach 12 SLTDRs, sampling

1998

January - September:	Final data analysis
October - December:	Prepare final report
December 30:	Submit draft final report

B. Project Milestones and Endpoints

April 15, 1996:	Report on modeling (Objectives 1.4, 4.3, 5.1, 5.2, 6.1, 6.2, 6.3)
April/May 1996, 1997:	Sampling seals in PWS (Objectives 2.1, 2.2, 2.3, 3.1, 7.1, 7.2)
June 1996, 1997:	Aerial surveys during pupping (Objectives 1.1, 4.1)

August 1996, 1997:	Aerial surveys during molting (Objectives 1.1)
April 15, 1996, 1997:	Annual report (Progress report objectives 1.2, 1.3, 2.1, 3.1, 3.2, 4.2,
September 1996, 1997:	Sampling seals in PWS (Objectives 2.1, 2.2, 2.3, 3.1, 7.1, 7.2)
September 1996, 1997:	Tag 12 harbor seals with SLTDRs (Objectives 1.2, 3.3, 7.7, 7.8)
Oct/Nov 1996, 1997:	Meet with hunter representatives (Objectives 6.4)
December 1998:	Final Report (Objectives 1.5, 1.6, 3.2, 4.2, 7.3, 7.4, 7.5, 7.6, 7.9)

C. Project Reports

April 15, 1996:	Annual report for 1995 studies; will include results of pupping and molting surveys including trend analysis; multivariate analysis of factors affecting surveys; analysis of data for SLTDRs deployed in September 1994 and May 1995; report of 1995 modeling efforts; status report on 1995 fatty acid analyses; status report on genetics study
May 30, 1996:	Report of field activities for spring field work in PWS (letter form)
June 30, 1996:	Summary of pupping surveys flown during early to mid-June (letter form)
October 30, 1996:	Report of field activities for August surveys and September tagging
April 15, 1997:	Annual report for 1996 studies; will include results of pupping and molting surveys including trend analysis; analysis of data for SLTDRs deployed in September; report of 1996 modeling efforts; status report on 1996 fatty acid analyses; status report on genetics study
June 30, 1997:	Summary of pupping surveys flown during early to mid-June (letter form)
October 30, 1997:	Report of field activities for August surveys and September tagging
December 31, 1998:	Final report for 1995-1997 harbor seal restoration studies

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project is part of an integrated MARINE MAMMAL ECOSYSTEM package. Other studies in the package include Condition and Health of Harbor Seals (Project 001, UAF); Harbor Seals and EVOS: Blubber and Lipids as Indices of Food Limitation (Project 117-BAA, UAF); and Comprehensive Killer Whale Investigation (Project 012, NMML). Although the study of Isotope Tracers - Food Web Dependencies in PWS (Project 320-I, UAF) is part of the PWS System Investigation, it will also be closely coordinated with this project and may be part of the Marine Mammal Ecosystem package in future years.

This project itself is a multidisciplinary, inter-agency undertaking. Surveys and satellite tagging will be conducted by ADFG; lipid analyses and interpretation by Dalhousie University; blood chemistry analyses at UAF; genetics analyses by SWFSC/NMFS; and demographic modeling by NMML/NMFS. Inclusion of interdisciplinary components within the same project will ensure that data are shared and interpreted in an interdisciplinary manner.

This project (064) will provide logistics, the MMPA permit to conduct sampling, and access to seals and samples for all three PWS harbor seal projects. Archived harbor seal data and blubber samples will be provided to Castellini/UAF for use in analyses of body condition and blubber. Harbor seal investigators at ADFG and UAF have been working successfully together for the last three years on

harbor seals in PWS and elsewhere, and future collaborations should be equally productive. Regular bi-weekly meetings and seminars are held by marine mammal investigators at UAF and ADFG Fairbanks to exchange information and ideas.

This study will directly interface with the PWS System Investigation study entitled Isotope Tracers - Food Web Dependencies in PWS (Fish, Marine Mammals, and Birds). Samples of seal whiskers and seal prey have and will continue to be provided to that study. Investigators of the two projects (Frost and Schell/Hirons) discuss stable isotope results at regular intervals and are pursuing preparation and publication of a joint manuscript describing preliminary findings of this study.

Prey samples for fatty acid analysis will be obtained through PWS System Investigation studies and the APEX study. Species to be analyzed will be chosen based on their collective importance to harbor seals, seabirds, and killer whales. This project will work with project 121 to avoid duplicative analyses and to share data. Information on distribution and movements of harbor seals, and diving behavior, will be shared with PWS Sound Investigation modelling studies to look at energy flow within PWS, and with forage fish investigators who may examine the effects of predation on fish population dynamics.

This harbor seal study will obtain samples of prey and incorporate results from Herring (ADFG) and Oceanographic (UAF) studies being submitted under the PWS System Investigation, and from the study Apex Predator Ecosystem Experiment. Harbor seal investigators will assist in prioritization of samples to be collected by Herring and Forage Fish studies for stable isotope and fatty acid analyses. Species to be analyzed will be chosen based on their collective importance to harbor seals, seabirds, and killer whales.

Harbor seal investigators are currently and will continue to participate in interactive discussions with subsistence hunters in PWS and the Gulf of Alaska through Project 244 (Seal and Sea Otter Cooperative Harvest Assistance) and through the newly formed Alaska Harbor Seal Commission. These discussions include the ongoing harbor seal decline, communication of results of Restoration-funded studies, suggestions for future research, and possibilities for local involvement in harbor seal investigations. The Subsistence Restoration Project - Food Safety Testing (Project 95279) has provided (and will continue to do so if it continues) samples to this harbor seal study for numerous analyses, including: genetics, stable isotopes, fatty acids, blood chemistry, and stomach contents.

This project is funded entirely by the Trustee Council as a restoration project. ADFG conducts no other studies of harbor seals in PWS that are not a part of the restoration program. ADFG has no management responsibility for harbor seals. The Subsistence Division of ADFG has been funded by the Trustee Council to monitor the harvest of harbor seals in PWS (Project 244) and to conduct food safety testing (Project 279).

ADFG is conducting studies of harbor seals in southeast Alaska and near Kodiak with funding from NOAA/NMFS. Those studies contain similar components to the PWS study and are closely coordinated to ensure that data are collected and analyzed in a similar manner. This will facilitate comparisons of data from declining populations (PWS and Kodiak) and a stable population (southeast Alaska) of harbor seals. Equipment is shared by the two projects. Consequently, it has not been necessary for the PWS project to purchase many equipment items and supplies solely for

the use of this study. Because of these other ongoing projects, the PWS harbor seal project has had access to a GIS system with which to analyze survey and tagging data.

ENVIRONMENTAL COMPLIANCE

NOAA has determined that this harbor seal study qualifies for categorical exclusion (CE) and does not require an environmental assessment, per a memo from Byron Morris, NOAA, dated 18 December 1992.

As required by the Marine Mammal Protection Act, ADFG has been authorized under Permit No. 770 to instrument harbor seals with SLTDRs and to conduct a variety of sampling activities including collection of blood, whiskers, skin, and blubber biopsies. All MMPA permit applications are reviewed by federal agencies and the U.S. Marine Mammal Commission. They are available for review by state agencies and the public through a Notice of Receipt published in the Federal Register.

PERSONNEL

Kathryn Frost has conducted research on marine mammals in Alaska since 1975. She has undertaken extensive research on natural history and ecology of seals, including aerial and photographic surveys; studies of food habits and trophic interactions; and studies of habitat use using satellite tags. She has conducted extensive aerial surveys of harbor seals in PWS and boat-based observations and sampling of harbor seals as part of NRDA studies following the EVOS. She has conducted satellite tagging studies of harbor seals in PWS from 1991 through 1994.

Lloyd Lowry is the Marine Mammals Coordinator for the State of Alaska. He has conducted research on marine mammals in Alaska since 1975, including studies of the natural history, ecology, distribution, abundance, and food habits of seals. He has participated in all NRDA and Restoration studies on harbor seals, including the development of methodology to catch and attach satellite tags to harbor seals. He has been responsible for project coordination and management of state and federally funded research projects, and is familiar with the federal marine mammal permit system.

Rob DeLong is an Analyst Programmer for ADF&G. He has developed custom software for the analysis of location and dive data from satellite-tagged seals. He was responsible for programming a PC-compatible Geographic Information System (PC ArcInfo and ArcView) that is used in presenting seal location and movements information. Mr. DeLong is also accomplished in seal catching and tagging techniques.

Dr. Jay Ver Hoef is a Biometrician for ADF&G. He has been responsible for statistical analysis of all harbor seal data during NRDA and Restoration studies. He has participated in field work in PWS and is familiar with seal catching and tagging techniques.

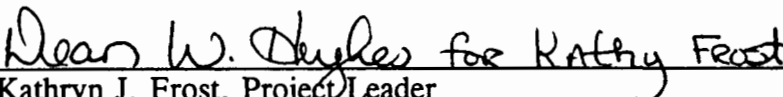
Dr. Sara Iverson is an Assistant Professor at the University of Dalhousie. She is currently conducting research at Sable Island, Nova Scotia, on the lipid metabolism of seals and the use of

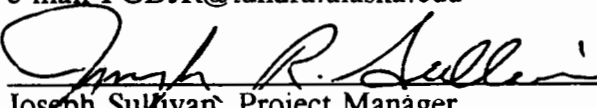
fatty acids to determine marine food webs. She received her PhD in nutritional sciences, conducting studies of the energetics of reproduction and fatty acid metabolism in seals. She developed procedures for analysis of lipids in milk, blubber and tissues of pinnipeds. Dr. Iverson has published extensively on these subjects.

Dr. Robert Small is a National Research Council Fellow at the National Marine Mammal Laboratory. He is a quantitatively oriented ecologist with experience in the analysis of demographic data, population modeling, population dynamics, the use of GIS to examine habitat utilization, aerial surveys, and predator-prey relationships.

The following is a list of key people and their responsibilities:

Kathryn Frost:	Project management and coordination, planning, data analysis, reporting, seal tagging, aerial surveys
Lloyd Lowry:	Permitting, tagging, GIS analysis of SLTDR data, coordination of genetics study, coordination with other ADFG harbor seal studies
Robert DeLong:	Tagging, programming, GIS analysis of SLTDR data
Jay Ver Hoef:	Statistical analysis of survey and other data, tagging
Robert Small:	Modelling, statistical analysis of dive and survey data, tagging
Sara Iverson:	Fatty acid analysis and interpretation
Greg O'Corry-Crowe:	Genetics analysis and interpretation
Randy Zarnke:	Coordination of disease studies, serum archival


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Date prepared

Table 1. Prince William Sound harbor seal trend count route.

Site #	Description	Status relative to EVOS
1	Sheep Bay	unoiled
2	Gravina Island	unoiled
3	Gravina Rocks	unoiled
4	Olsen Bay	unoiled
5	Porcupine Point	unoiled
6	Fairmount Island	unoiled
7	Payday	unoiled
8	Olsen Island	unoiled
9	Point Pellew	unoiled
10	Little Axel Lind Island	unoiled
11	Storey Island	oiled
12	Agnes Island	oiled
13	Little Smith Island	oiled
14	Big Smith Island	oiled
15	Seal Island	oiled
16	Applegate Rocks	oiled
17	Green Island	oiled
18	Channel Island	unoiled
19	Little Green Island	unoiled
20	Port Chalmers	unoiled
21	Stockdale Harbor	unoiled
22	Montague Point	unoiled
23	Rocky Bay	unoiled
24	Schooner Point	unoiled
25	Canoe Passage	unoiled

Table 2. Harbor seals instrumented with SLTDRs and sampled during 1991-1994. Only SLTDRs from which significant amounts of data were received are included.

Location	Date	SLTDRs							
		AdM	SubM	AdF	SubF	DNA	Blood	Fat	Whiskers
Applegate Rocks	May 92		3	1			5		
	May 93	2				5	5		
	Sep 93						1	1	1
Bay of Isles	Sep 93	1				1	1		1
Channel Island	Sep 93	1				3	3		3
	Sep 94	2			1	13	11	13	12
Gravina Island	Sep 94		1			3	3	3	3
Green Island	Apr 94					1	1		1
Herring Bay	Sep 91			1			1		
Little Green Isl.	Apr 94					1	1	1	1
Port Chalmers	Apr 94					2	2	2	2
	Sep 94			3	1	10	10	10	10
Seal Island	Apr 91						4		
	Sep 91	1					4		
	May 92						1	3	
	May 93	3		1		7	7		
	Sep 93	2	1	1		10	10		10
Stockdale Harbor	Apr 94					6	6	5	6
	TOTAL	12	5	7	2	64	78	34	60

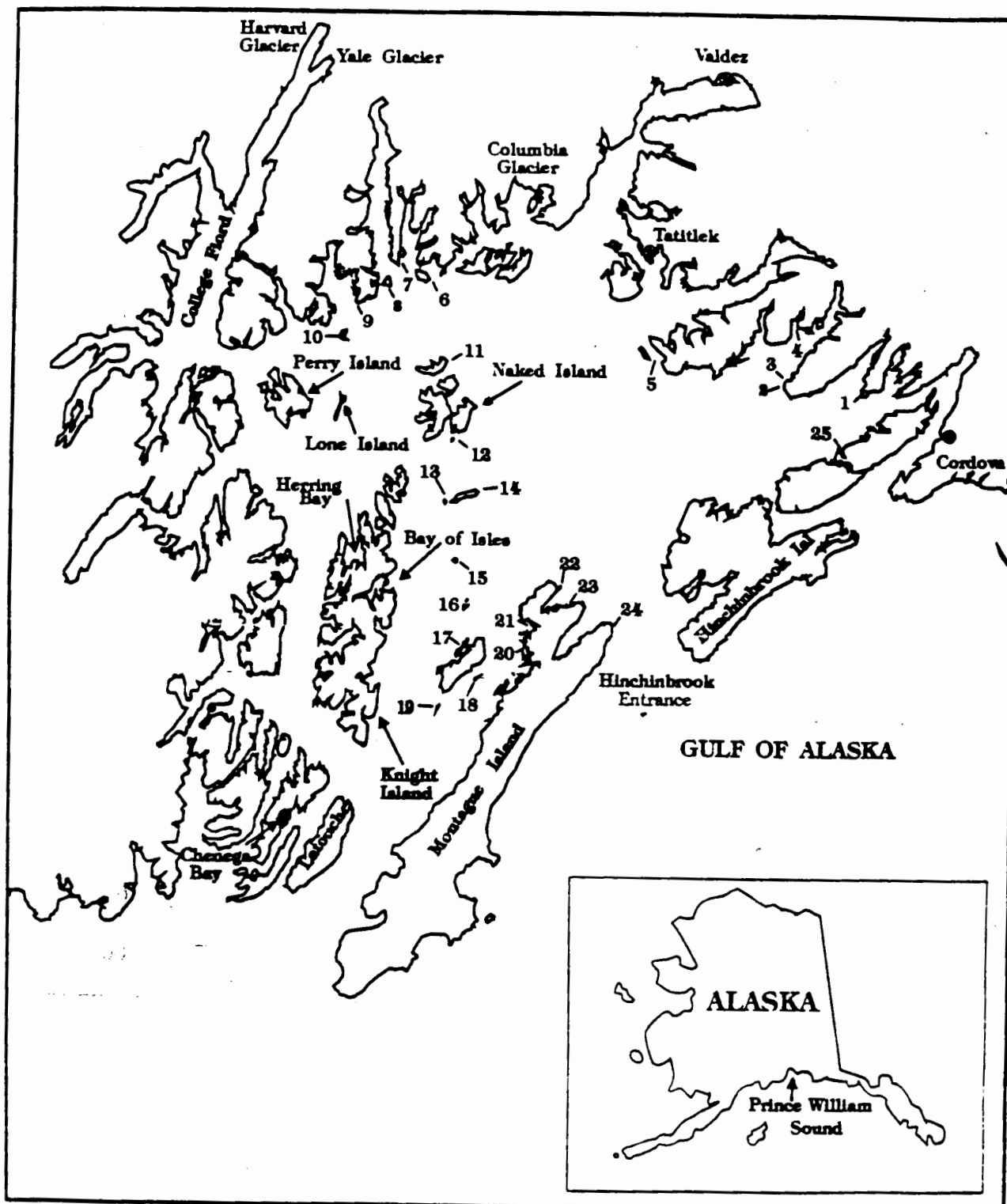


Figure 1. Map of Prince William Sound showing oiled and unoiled trend count sites and other locations referred to in text.

years = 5
initial population = 1050
alpha = 0.05

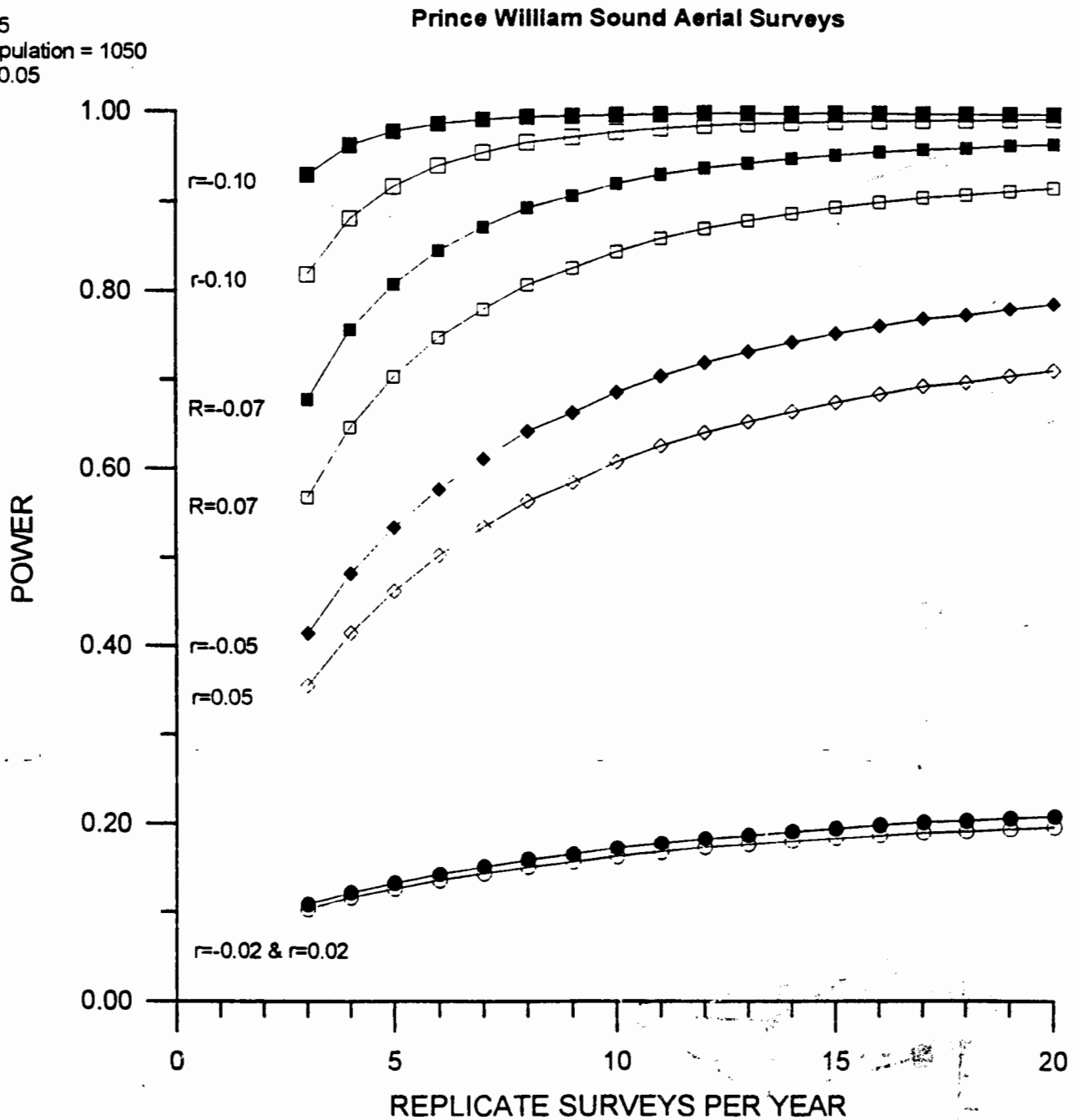


Figure 2. Power analysis for aerial surveys in Prince William Sound, 1984-1994. "R" is the annual rate of change.

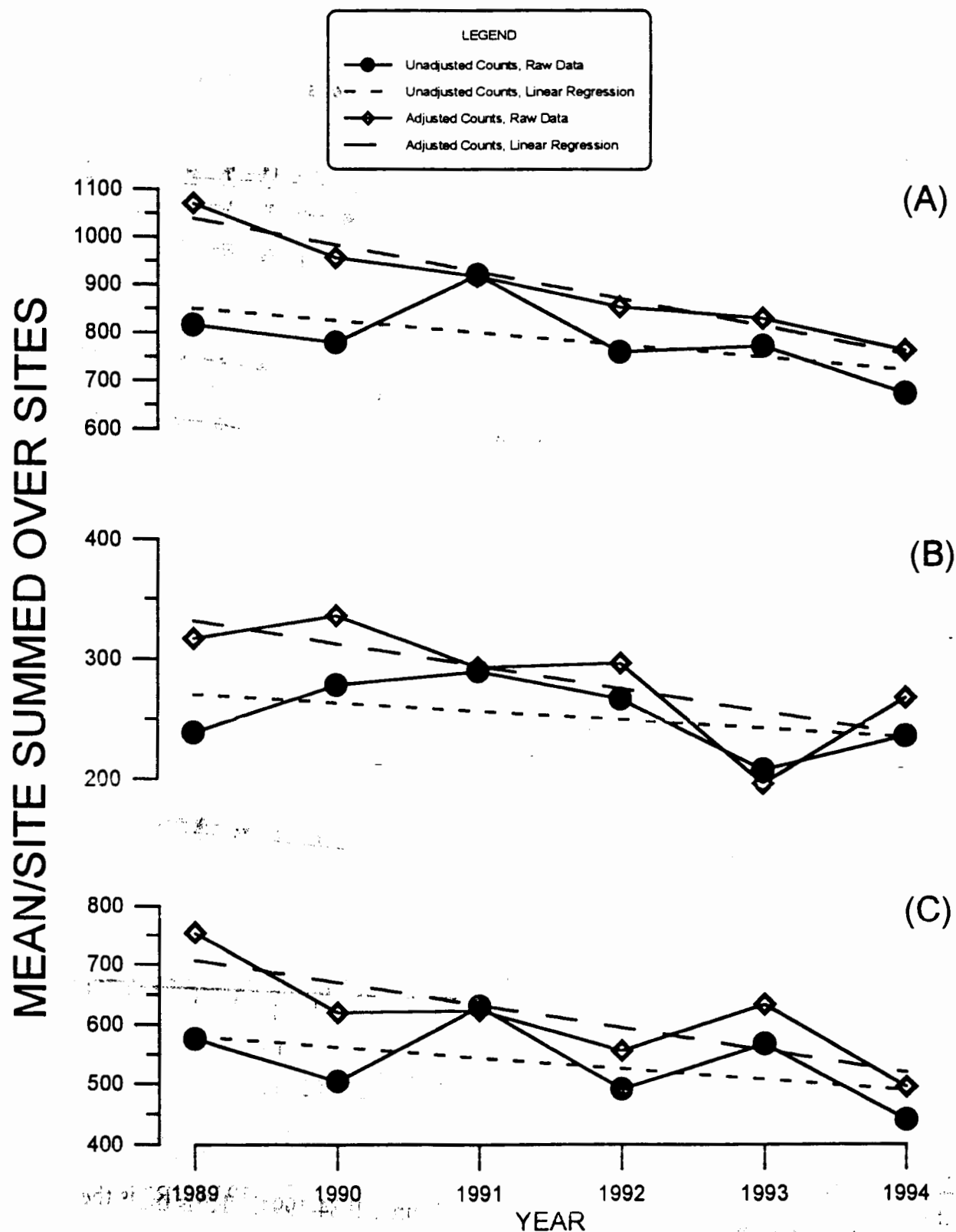
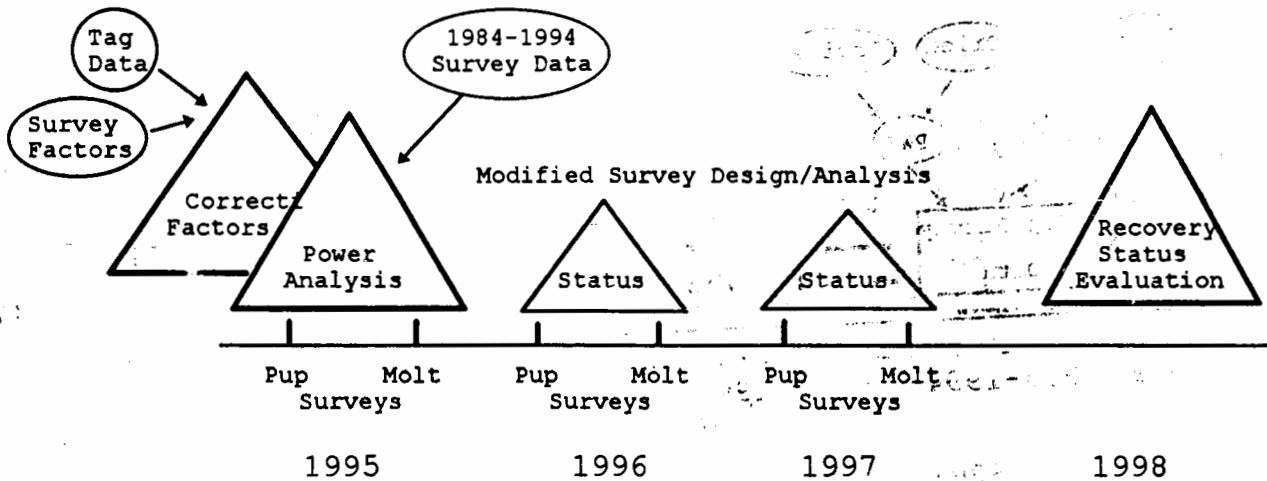
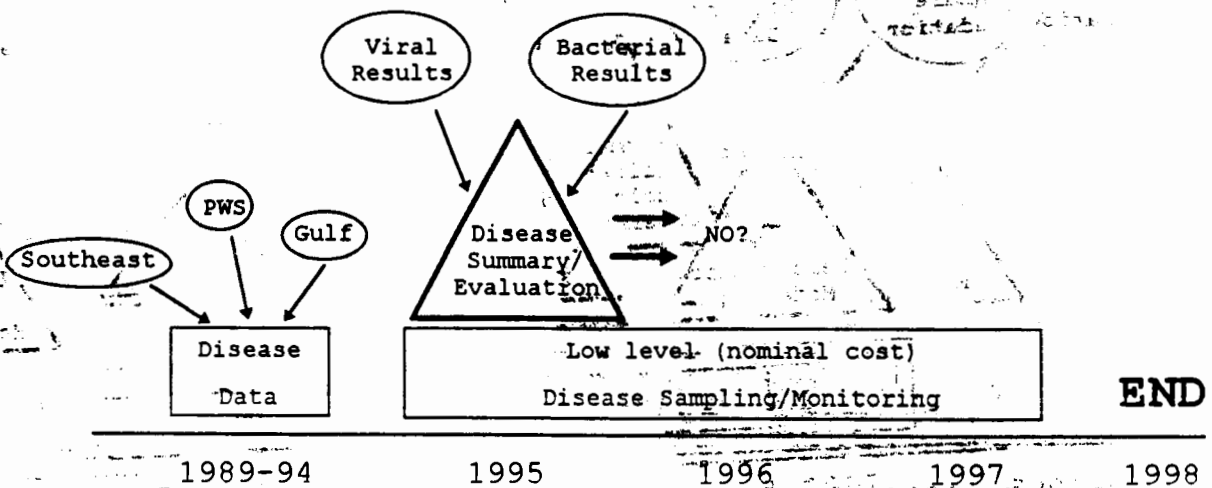


Figure 3. Uncorrected counts of harbor seals and counts corrected for the effects of date, time, tide, and weather at 25 trend count sites in Prince William Sound, August-September, 1989-1995. A - total counts; B - oiled sites; C - unoled sites.

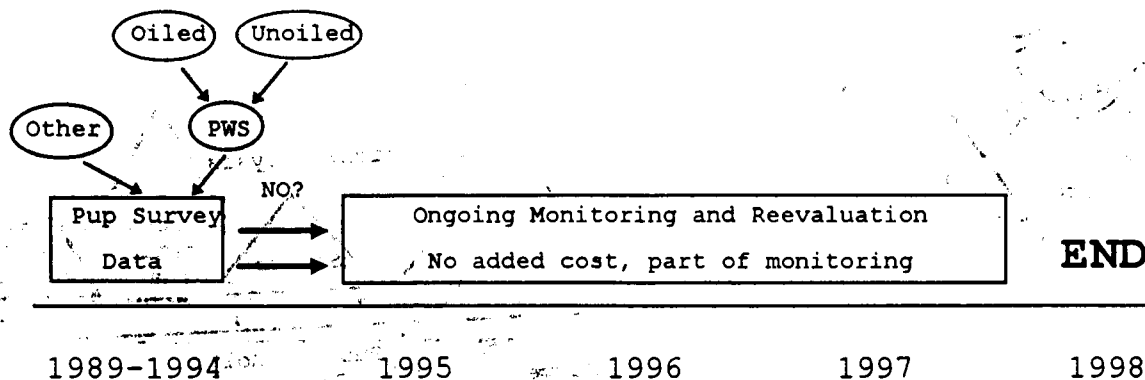
Hypothesis 1 - The harbor seal population in Prince William Sound has stabilized or increased since the EVOS.



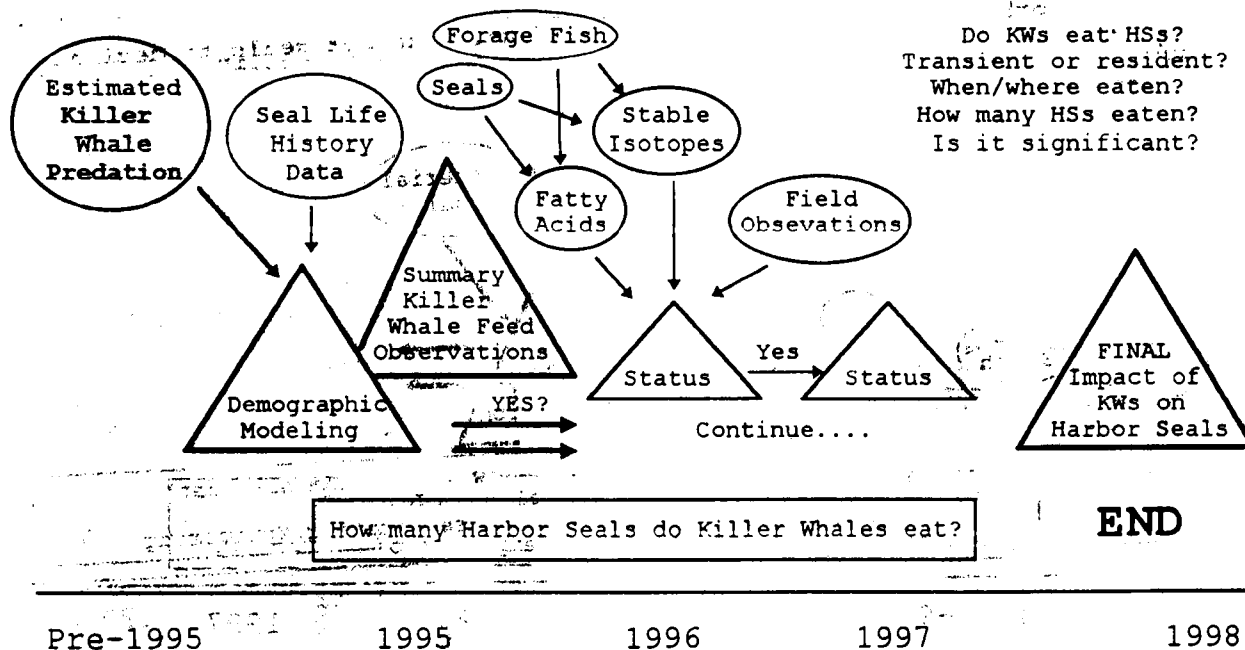
Hypothesis 2 - A disease agent is causing harbor seals to decline.



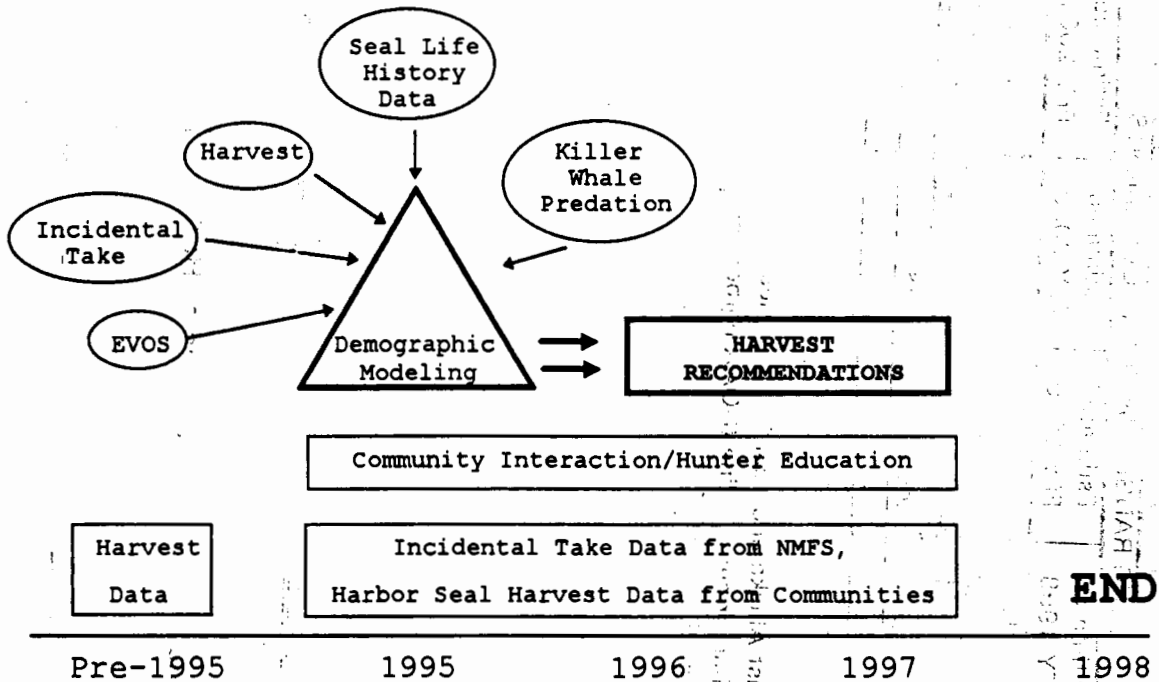
Hypothesis 4 - Low pup production is causing harbor seals to decline.



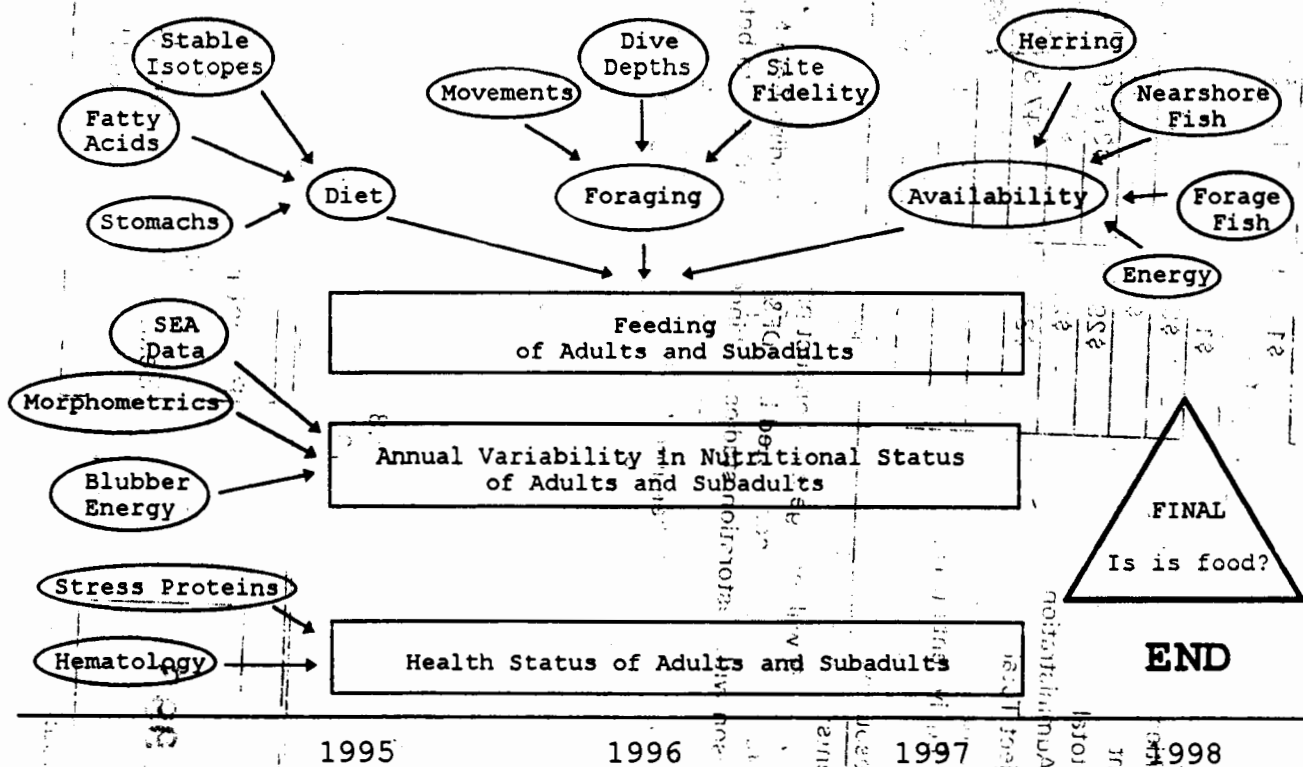
Hypothesis 5 - Predation by killer whales is causing the decline or preventing recovery.



Hypothesis 6 - Mortality caused by subsistence hunting and/or fisheries-related take is preventing harbor seals from recovering.



Hypothesis 7 - A change in food availability has caused harbor seals to decline.



1996 EXXON VALDEZ TRUE ... COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Budget Category:	Authorized FFY 1995	Proposed FFY 1996																																	
Personnel	\$119.7	\$129.4																																	
Travel	\$11.7	\$10.6																																	
Contractual	\$102.8	\$118.7																																	
Commodities	\$58.1	\$60.9																																	
Equipment	\$1.4	\$0.0																																	
Subtotal	\$293.7	\$319.6																																	
General Administration	\$27.4	\$27.7	Estimated FFY 1997	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002																											
Project Total	\$321.1	\$347.3	\$347.0	\$100.0	\$25.0																														
Full-time Equivalents (FTE)	1.7	1.8																																	
Other Resources																																			
Comments: Duties: ADF&G will manage and conduct project. *Other harbor seals are conducted by ADF&G with funding from NOAA in Southeast Alaska and near Kodiak. Results of these studies used for comparison with Restoration studies in Prince William Sound to better understand harbor seal decline (NOAA harbor seal study I \$470,000). FFY96 budget will be broken into FY95 report and FY96 field components as followings: <table border="1"> <thead> <tr> <th></th> <th>95 Report</th> <th>96 Field</th> </tr> </thead> <tbody> <tr> <td>100</td> <td>79.2</td> <td>50.2</td> </tr> <tr> <td>200</td> <td>4.1</td> <td>6.5</td> </tr> <tr> <td>300</td> <td>13.0</td> <td>83.2</td> </tr> <tr> <td>400</td> <td>2.5</td> <td>58.4</td> </tr> <tr> <td>500</td> <td>1.4</td> <td>19.6</td> </tr> <tr> <td>Subtotal</td> <td>100.2</td> <td>217.9</td> </tr> <tr> <td>GA</td> <td>12.8</td> <td>13.3</td> </tr> <tr> <td>Total</td> <td>113.0</td> <td>231.2</td> </tr> </tbody> </table> See Frost letter of July 7, 1995, for letter to justify new 96 field budget figures.										95 Report	96 Field	100	79.2	50.2	200	4.1	6.5	300	13.0	83.2	400	2.5	58.4	500	1.4	19.6	Subtotal	100.2	217.9	GA	12.8	13.3	Total	113.0	231.2
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1996

Prepared:

1 of 4

Project Number: 96064
 Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor
 Seals in Prince William Sound
 Agency: AK Dept. of Fish & Game

FORM 3A
 AGENCY
 PROJECT
 DETAIL

8/25/95 Version

October 1, 1995 - September 30, 1996

October 1, 1995 - September 30, 1996

Subtotal**Personnel Total**

\$129.4

Those costs associated with program management should be indicated by placement of an *

Travel Costs:

Travel Costs:

PM	Description

7. W.	2000
8. F.	Fbks-Cofdd

Seattle-And

1100
Ehlers-Anc66

100-443887-100

100-443881-1000

Portage-VV
2011 APR 3 12 24 PM

PBKS-Portage

1021022 / DU 10

Equipe Cordova-C

FOLK-ARCH

* 01 Fbks-AncR

*) Fbks'-Anch

* Fbks-Anch	

Travel Total

\$10.6

Those costs associated with program management should be indicated by placement of an *

DETAIL

1996

Agency: AK Dept. of Fish & Game

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1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

Contractual Costs:						Proposed
Description						FFY 1996
NOAA contract for ARGOS satellite data, FY95 obligation for Sep 95 tags						12.0
NOAA contract for ARGOS satellite data, new FY96 tags						12.0
Print graphics/slides for workshops, report reproduction, summary for villages)						0.5
Long distance phone charges						1.8
Postage (DHL, courier, etc.)						0.2
Trailer parking & launch fees, Whittier (\$70/trip x 2 trips)						0.1
Software maintenance fee (GIS)						1.2
Aircraft charter 30 hrs @ \$23/hour x 2 surveys (spring & fall)						9.2
Vessel charter for tagging/sampling @ \$1.8/day x 8 days x 2 trips						28.8
Lipid analysis contract w/ Dalhousie University						30.0
Freight and shipping of samples						0.4
RSA with UAF for data analysis and statistical support (originally was to go to NOAA NRC Fellowship for biometric support)						22.5
When a non-trustee organization is used, the form 4A is required.						
Contractual Total						\$118.7
Commodities Costs:						Proposed
Description						FFY 1996
Genetics supplies for analysis of 50-100 samples/yr						5.0
Fuel for boats and skiffs						2.0
Biopsy punches, flipper tags, epoxy, other tagging supplies, film						1.2
Small boat supplies (propellers, oars, oil, etc.)						1.2
Laboratory supplies (cryovials, vacutainers, syringes, gloves, needles, etc.)						1.0
Repair supplies for skiffs, nets, etc.						1.0
12 SLTDRs @ \$4.0/SLTDR (from Wildlife Computers)						48.0
Misc. field and meeting supplies (waterproof notebooks, bindings, marine charts, computer case, aviation charts)						0.3
Computer supplies and software for graphics, GIS, and other analyses						1.2
Commodities Total						\$60.9

1996

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Project Number: 96064

Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound

Agency: AK Dept. of Fish & Game

FORM 3B

Contractual &
Commodities
DETAIL

1996 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1995 - September 30, 1996

New Equipment Purchases:		Number of Units	Unit Price	Proposed FFY 1996
Description				
R	Rubber raft, used			0.0
R	17 ft Boston Whaler (We have been using Wildlife Conservation boats and motors since 1989, no equipment expenditures for boats to date, have used department boats hard, must replace one. We have had access to all ADF&G equipment at no cost to project.)			0.0
				0.0
				0.0
				0.0
				0.0
	THESE TWO BOATS HAVE BEEN REMOVED FROM THE 96 WORKPLAN REQUEST			0.0
	THE NET REDUCTION FROM THE ORIGINALLY SUBMITTED BUDGET IS \$18.0K.			0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total		\$0.0
Existing Equipment Usage:		Number of Units	Inventory Agency	
Description				
Equipment used by project, purchased with Oil Spill funds.				
Leitz Binoculars		1	ADF&G	
HP LIID Printer		1	ADF&G	
Compaq 286 Computer		1	ADF&G	
Equipment used by project, but purchased with non-Oil Spill funds.				
20 ft Boston Whaler		1	ADF&G	
17 ft Boston Whaler		1	ADF&G	
Seal Nets		2	ADF&G	
2 486 Computers + Plotter		3	ADF&G	
Printer		2	ADF&G	
Zodiac Raft		1	ADF&G	

1996

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Project Number: 96064

Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor
Seals in Prince William Sound

Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL