Revision 11-10-98
approved TC 12-15-98

Port Graham Salmon Hatchery Reconstruction

Project Number:	99405
Restoration Category:	General Restoration
Proposer:	E. McMullen/Port Graham Village Council
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 1 yr. project
Cost FY 99:	$781.3
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Lower Cook Inlet
Injured Resource/Service:	Pink salmon, sockeye salmon, coho salmon, subsistence, commercial fishing

ABSTRACT

This project will help rebuild the Port Graham salmon hatchery that was destroyed by fire on January 13, 1998. The Port Graham hatchery was involved in the rehabilitation and enhancement of local pink salmon, sockeye salmon and coho salmon stocks for the benefit of both the local subsistence and commercial fisheries. These stocks are of major social, cultural and economic importance to the area and sustained injuries resulting from oil spill clean-up efforts. This project will contribute partial funding for construction of a salmon hatchery to replace the one that was destroyed in the fire.

Introduction

A. Purpose and Background

This project will help rebuild the Port Graham hatchery that was destroyed in a fire on January 13, 1998. The hatchery played a major role in rejuvenating the subsistence and commercial fisheries in the Port Graham/Nanwalek area. A new hatchery is needed so that the rejuvenation effort can continue.

The Native villages of Port Graham and Nanwalek on the southwestern tip of the Kenai Peninsula rely heavily on the local salmon runs for subsistence and commercial fishing. There are local runs of sockeye salmon, pink salmon and coho salmon that have varying degrees of importance in the local subsistence and commercial fisheries. The sockeye salmon is sought after in both the subsistence and commercial fisheries. The pink salmon is generally regarded as a commercial species although it has been a major contributor to the subsistence fishery in recent years to make up for the poor subsistence harvest of sockeye and coho salmon due to poor returns. Coho salmon are harvested mostly in the subsistence fishery.

There are two river systems, the English Bay River and the Port Graham River, which supply the villages of Port Graham and Nanwalek with almost all their subsistence salmon needs. The English Bay River, the mouth of which is immediately adjacent to the village of Nanwalek at the entrance to the Port Graham fjord, lies in a moderately steep walled valley that runs about seven miles in length. The river begins near the head of the valley and is comprised of a series of five lakes each separated by varying lengths of moderately shallow stream. Total lake area in the system is around 480 acres.

The largest lake, which is the second from the mouth is about 230 acres in area and has an average depth of about 45 feet. The third lake from the mouth is about three-fourths the size of Second Lake. The other lakes in the system are a lot smaller. The river empties into a shallow (average depth; 2.5 feet at MLLW) 35-acre brackish-water lagoon. The system has a very rapid flushing rate (the amount of time it takes water entering the upper reaches of the system to reach the mouth) of less than 30 days. The river has runs of sockeye, pink and coho salmon, all of which are used for subsistence. Of these sockeye is by far the most important species to the villages and the only one on which management information is kept. The system also has a large population of both resident and anadromous Dolly Varden char, but very little use is made of these fish.

The Port Graham River, which empties into the head of the Port Graham fjord, is made up of two streams each lying in a moderately steep walled valley. One stream is about 4 miles in length and the other is about 7 miles in length. The streams come together about two miles from the mouth. The stream in the longer valley has a barrier falls about a mile up from the confluence. Both streams have numerous tributaries that feed into them providing extensive salmonid spawning and rearing habitat. There is also a large intertidal area that provides good spawning habitat for pink and chum salmon. There are no lakes in the Port Graham River system.

The advantage of lakes, other than they provide sockeye rearing habitat, is that they act as a cushion to absorb the energy of floods. Streams that lie in moderately steep walled valleys, as

these two rivers do, are prone to high energy floods caused by the frequent storms that visit the area. These floods can cause extensive bed scouring and the concurrent destruction of salmonid eggs that may be incubating there. Bed scouring is a big problem in the Port Graham River. The lakes in the English Bay River system take a lot of the energy out of the flood waters making bed scouring much less of a problem.

The Port Graham River supports runs of pink, chum and coho salmon, all of which are used for subsistence. The river is managed mostly for the pink salmon run. A program is being initiated to monitor coho escapement and some information is being collected on the chum run. The river has a large population of both resident and anadromous Dolly Varden char. Like the English Bay River, these dollies are way underutilized.

Determining the health and abundance of the various salmon runs into the Port Graham and English Bay rivers is as much an art as it is a science and requires a fair amount of detective work. The best clues come from two sources, escapement and harvest data, and anecdotal information from village residents.

The following tables provide available escapement information for the Port Graham and English Bay rivers and local subsistence and commercial catch information.

Table 1. Escapement Counts into the Port Graham and English Bay Rivers 1988 - 1998[1]

	ESCAPEMENT	
Year	Port Graham River (pink salmon)	English Bay River (sockeye salmon)
1988	7,000	2,500
1989	19,100	4,500
1990	20,100	3,300
1991	29,000	7,000
1992	5,400	6,400
1993	12,800	6,900
1994	7,600	13,800
1995	10,000	22,500
1996	7,000	12,400
1997	12,500	15,400
1998	12,600	13,600

[1] Data source: ADF&G, Comm Fish Div., Homer

Long term escapement information is only available for pink salmon in the Port Graham River and sockeye salmon in the English Bay River. The minimum escapement goal ADF&G has set for pink salmon in the Port Graham River is 20,000. That goal has been reached only three times since 1988. Pink escapement in the remaining years since 1988 has ranged between 30% and 60% of the minimum goal. Clearly, not enough pink salmon are getting into the river. The hatchery pink salmon program is not designed to directly impact the river, so its influence on escapement is lessened. The slight increase in the 1997 and 1998 escapements is probably due more to the hatchery returns absorbing more of the harvest pressure than to hatchery fish contributing directly to the escapement. As the hatchery runs build they will contribute more directly to the river escapement.

The escapement goal for sockeye into the English Bay River is 15,000. From 1988 through 1993 sockeye escapement ranged between 15% and 45% of that goal. Since 1994 the hatchery sockeye program, which is an in-river rehabilitation/enhancement program, has brought escapement levels back to the goal. This program needs to be maintained for at least four

additional life cycles to ensure an adequate nutrient supply from decomposing carcasses and to overcome Dolly Varden predation.

Table 2. Estimated Subsistence Salmon Catch in Number of Fish by Species for Port Graham and Nanwalek 1981 – 1996[1]

Year	Chinook	Sockeye	Coho	Pink	Chum	Total	Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1981	140	2769	939	919	169	4936	1991	182	635	1863	4541	219	7440
1982	110	2382	1858	2701	229	7280	1992	179	530	1019	1226	226	3180
1983	57	2850	807	432	75	4221	1993	273	1171	966	1497	245	4152
1984	39	6170	551	619	6	7385	1994	296	888	1384	1985	501	5054
1985	162	1165	720	750	24	2821	1995	517	1524	495	1110	364	4010
1986	122	657	475	1059	15	2328	1996	306	1723	933	704	252	3918
1987	23	812	896	740	114	2585							
1988	98	989	832	1762	123	3804	Average	167	1595	1023	1532	170	4488
1989	48	154	1206	1392	46	2846							
1990	126	1108	1427	3075	117	5853							

[1] Data source: ADF&G Subsistence Division, data files

Table 3. Commercial Salmon Harvest, Port Graham Subdistrict, Lower Cook Inlet, All Gear Combined, 1976 - 1998[1,2,3]

	SALMON HARVEST					
Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1976	58	13,644	471	3,899	454	18,526
1977	70	25,429	1,713	44,843	5,010	77,065
1978	297	30,465	2,558	4,033	2,412	39,765
1979	55	12,911	6,517	124,735	4,313	148,531
1980	27	16,528	7,149	30,534	2,466	56,704
1981	10	20,292	5,116	45,859	11,191	82,468
1982	17	21,461	5,241	35,373	7,372	69,464
1983	14	13,388	697	4,108	1,657	19,864
1984	5	12,531	2,104	7,920	3,568	26,128
1985	25	3,499	2,287	12,498	1,252	19,561
1986	9	1,955	1,573	8,764	849	13,150
1987	0	0	1,360	5	1,774	3,139
1988	3	1,357	1,388	10,688	1,209	14,645
1995	0	2,580	0	10,168	0	12,478
1996	0	18,118	0	1,497	0	19,597
1997	0	33,017	0	145,148	0	178,165
1998	0	17,934	0	1,358	0	19,292

[1] No commercial fishery held in the subdistrict from 1989 - 1994
[2] Includes hatchery cost recovery 1996 – 1998
[3] Data source: ADF&G commercial fisheries data files

Tables 2 and 3 present the local subsistence and commercial salmon harvests respectively. Not all the fish in these tables are from the English Bay or Port Graham rivers. All chinook and about 15% of the sockeye are from other systems. Almost all the pink, coho and chums are local. The subsistence harvest data aren't very helpful in determining run strength. These numbers also don't reflect the true subsistence harvest since not all subsistence fish that are taken are reported. It is interesting to note the increasing importance of pink salmon in the subsistence catch as the sockeye and coho runs became smaller. It is also good to see the increased sockeye harvest in 1995 and 1996 as the hatchery sockeye rehabilitation project began to produce results. Partial closures had restricted the subsistence fishery for 6 years prior to 1996. All subsistence harvest restrictions were removed beginning in 1996.

The commercial harvest data are a better indicator of run strength. About the same percent of non-local stocks occurs in the commercial harvest as occurs in the subsistence harvest. The commercial harvest shows a definite downtrend in all species. There could be a number of reasons for that including reduced fishing pressure and reduction of fishing seasons, but fewer fish available for harvest is most likely the main reason. The total closure of the commercial fishery from 1989 through 1994 is the result of too few fish. The fishery reopened in 1995 because of the English Bay River sockeye rehabilitation program. The cannery reopened in 1996 because of the renewed sockeye run and the promise of a renewed local pink salmon run.

The sockeye fishery, which is fished with set gill nets, is beginning to bring commercial fishing permits back into the village. In 1995 there were six set gill net permits. Two more permits came into the villages in 1996 and one more was added in 1997. This is a 50% increase in permits since the fishery reopened. The reestablishment of the commercial set gill net fishery also aids the subsistence fishery. Set gill nets are used extensively in the subsistence fishery. The renewed set gill net commercial fishery is bringing new, better quality gear into the village as well as improving the fishing skills of the residents. Both of these have resulted in a more efficient and effective subsistence fishery which is less wasteful, and therefore less harmful.

Village residents depend on the local salmon runs for their well being. Because of this they are very knowledgeable about river conditions and the health of the salmon runs. Anecdotal information collected from the village residents also indicated a problem with the local salmon runs. The villagers were deeply concerned about the English Bay River sockeye salmon run and the Port Graham River pink and coho salmon runs and the impact the oil spill cleanup might have on them. Numerous out-migrating fry and smolt were trapped and killed in the oil boom curtains that were placed across both the Port Graham and English Bay rivers. The fear was that the loss of these juvenile fish from runs that were already in trouble would be devastating. It was this concern that prompted the establishment of the Port Graham hatchery and the programs aimed at rehabilitating all three species.

The Port Graham hatchery was initially permitted in 1992 as a pink salmon facility. The English Bay River sockeye program was added in 1993 and the Port Graham River coho program was initiated in 1995. The Port Graham River was designated as the sole broodsource for the pink salmon program. The poor pink salmon escapement in the Port Graham River since the hatchery program was initiated has dragged out the hatchery broodstock development process. Poor returns of sockeye and coho to the area increased the harvest of pink salmon, especially hatchery pink salmon since they returned to the immediate vicinity of the Port Graham village. In 1996 The EVOS Trustee Council funded a $70,000 per year, five-year program (/225) to develop procedures for enhancing pink salmon marine survival so that the subsistence harvest could be accommodated without a significant impact on hatchery broodstock development. The program was working. Pink salmon hatchery returns in 1997 and 1998 were the first and second largest returns since the hatchery began operating. The fire destroyed the even year hatchery return so the process of building the even year broodstock will need to start all over again.

The English Bay River sockeye rehabilitation program has moved along a little more rapidly. About 30% of the funding for this program has come from EVOS criminal funds. The program has advanced to the point where sufficient fish are returning to assure adequate escapement, but

total returns are still less than the historical average. The hatchery fire also destroyed all sockeye under incubation however, unlike pink salmon, sockeye from a single broodyear return to spawn over a two to three year period, which makes the loss of the eggs in the fire less serious.

The Port Graham coho rehabilitation program was initiated because it was felt that the coho run was in trouble. Very little data had been collected on the Port Graham River coho run. However, subsistence harvest information coupled with village opinion that it was becoming more difficult to catch coho and that fewer coho were being seen in the river indicated that the run size in recent years was far below normal. The coho rehabilitation program was fully funded with EVOS criminal funds. It consisted of rearing coho in the hatchery to smolt size before releasing them into the river in late autumn. These fish would then overwinter in the river before migrating to sea the following spring. This effort would continue through a full life cycle (four years) after which a decision would be made on whether or not to continue the program. Unfortunately, only two smolt releases were accomplished before the hatchery fire caused the program to be curtailed.

The coho were being reared in a separate building from the main hatchery so the fire did not destroy them. However, it was decided that the pink and sockeye programs were a higher priority and the coho program was cut short and the facility was set up to temporarily house the pink and sockeye programs. Funds were reprogrammed from the EVOS Trustee Council Port Graham pink salmon project (98225) and additional funds were obtained from the EVOS criminal settlement fund to turn the coho facility into a temporary pink and sockeye incubation facility. This will allow these programs to maintain continuity while the replacement facility is being built. The coho program will be reestablished as soon as possible after the replacement hatchery is completed.

B. Benefit/Cost

The hatchery will be directly involved in sockeye and coho rehabilitation work throughout its 20-year life. The predominant life cycle for English Bay River sockeye is five years. The Port Graham River coho life cycle is four years. Hatchery supplementation will be needed for at least five life cycles to ensure adequate escapement while providing enough fish to satisfy the subsistence harvest and overcoming the competitive and/or predatory threat of the large Dolly Varden population in both systems. The hatchery pink salmon program will provide an indirect benefit to the Port Graham River pink salmon stock by absorbing most if not all the local pink salmon harvest.

During the hatchery's 20-year life span it will produce around 1.72 billion pink salmon fry, 20 million sockeye salmon fry and an undetermined number of coho smolt (probably less than 1 million). The total cost of building and operating the hatchery during this time will be around $17 million. This puts the cost of producing the hatchery fish at around $0.01 each. Using conservative marine survival assumptions, the hatchery will produce around 50 million harvestable pink salmon and 1 million harvestable sockeye salmon during its life span. There is not enough information available at this point to provide a reasonable estimate of the coho return. Using current exvessel prices the benefit/cost would be about 1.4:1 for the pink salmon program and 1.6:1 for the sockeye program.

The hatchery operation will become self-sustaining in 2005.

C. Funding

Appendix A. is a copy of a letter from Kumin Associates, Inc., the architects that have been hired to design both the replacement hatchery and cannery facilities. The letter gives a preliminary estimate of the cost of building the new hatchery facility as follows:

Hatchery Building – 9,600 ft^2	$816,000
Sitework/Fill	$132,000
Mechanical Systems/Equipment	$192,000
Electrical Systems/Equipment	$137,000
Standby Generators	$116,000
Hatchery Equipment	$500,000
10% Contingency	$189,360
A/E Design Fees	$104,000
Estimated Total Project Cost	**$2,186,360**

Port Graham is seeking funding from several sources. The following is the list of funding sources that Port Graham is actively working with at this time.

Source	Amount	Status
Fire Insurance[1]	$300,000	Received
Reallocation of existing ANA grant	$75,000	Received
DCRA equipment grant	$95,000	Received
EVOS criminal funds (State)	Up to $500,000	Will receive 7/1/99
Federal EDA funds	$500,000	Preliminary approval
EVOS Trustee Council	$725,000	Requested
Total	**$2,195,000**	

[1] Hatchery building destroyed in fire was leased from Port Graham Corporation. Insurance only covered lost equipment and improvements. The replacement facility will be fully insured.

The value of the Port Graham hatchery to the village would be a lot less without the existence of a processing plant in the village to provide additional employment and business opportunities. The Port Graham for profit village corporation, through loans and commitment of existing capital, is underwriting the construction of a new fish processing plant to replace the cannery that was destroyed in the fire. Current estimated cost of the new plant is $3.2 million. The village corporation is also providing land for the new hatchery and allocating a portion of its right to the village water supply for hatchery use.

NEED FOR PROJECT

A. Statement of Problem

The salmon runs to the Port Graham/Nanwalek area were at very low levels, partly as a result of the *Exxon Valdez* oil spill (trapping and killing outmigrating juvenile salmon in the oil boom aprons). As a consequence the subsistence needs of these villages were not being met and the once robust local commercial salmon fisheries were a thing of the past. Also, partly as a consequence of the oil spill causing the closure of the local commercial fisheries, the Port Graham cannery was forced to close and with it went the bulk of the employment in the two villages.

A hatchery was set up in Port Graham in 1991 and a program initiated to help restore the local salmon runs. The program was beginning to have some success. It was providing fish for the local subsistence and commercial fisheries and it helped justify reopening the Port Graham cannery. The hatchery was completely destroyed in a fire on January 13, 1998. Without the hatchery, the restoration process will cease and the progress that has been made to date will be lost.

B. Rationale/Link to Restoration

This project will help Port Graham River coho salmon stocks, and English Bay River sockeye salmon stocks recover from their low levels by providing more fish to accommodate subsistence harvest needs while ensuring adequate escapement levels. Because the entry pattern for hatchery pink salmon adults is different from the wild stock entry pattern, the wild run can be afforded significant harvest protection should that be necessary. Hatchery pink salmon will return to the hatchery, which is right in the village. This will make these fish easy to harvest in the subsistence fishery and will likely take a lot of the harvest pressure off the coho and sockeye runs.

The data (tables 2 & 3) indicate that the subsistence needs of the two villages are not being met. The relative harvest numbers are reasonably indicative of run size. In almost all cases when the local commercial harvest increases the subsistence harvest increases as well. This suggests that availability is still defining the subsistence harvest level not need. The hatchery program needs to continue to ensure that the local salmon stocks are restored to a level that will meet subsistence needs and provide adequate escapement.

In addition, the hatchery serves as an important educational tool for both children and adults. Through the hatchery program people in Port Graham and Nanwalek are learning first hand how complex the salmon life history is and how easily it can be disrupted if the habitat is not protected and/or enough fish aren't allowed to escape into the rivers to spawn. They are also coming to realize how difficult and expensive a hatchery program is as a mitigation tool for damaged natural resources.

The hatchery is already helping to revitalize the English Bay River sockeye run. The potential of a successful coho rehabilitation program won't be known until the 1999 season when the first of the hatchery produced coho will be returning. The Port Graham River pink salmon will also likely benefit from the hatchery pink salmon program by sharply reducing the commercial and

subsistence harvest on pinks bound for the river. In addition, the pink salmon program, through cost recovery, will contribute the bulk of the funding needed to operate the local salmon rehabilitation projects by underwriting almost all hatchery operational costs. Sockeye cost recovery only supports the sockeye program. The coho rehabilitation program will generate no cost recovery funds and will be totally supported by the pink salmon program.

It is uncertain how long it will take to complete a rehabilitation program for either the Port Graham River coho or the English Bay River sockeye, but it will probably take several life cycles. To be capable of sustaining a larger run size, the coho will need to reclaim habitat taken over by the large Dolly Varden char population. This will take time. For the same reason a hatchery supplementation program will be needed to ensure that coho establish themselves in the area that is being opened up by the EVOS funded fish pass (Project/263). Without a coho supplementation program above the fish pass, the tremendous numbers of Dolly Varden in the system may prove too much of an advantage for the coho to overcome.

Dolly Varden do not compete directly with sockeye for food except at a very early life stage. However, dollies are a major predator of sockeye throughout the freshwater portion of the sockeye life cycle. This heavy predation was probably one of the main reasons the English Bay River sockeye run was not able to recover on its own. A supplementation program for the English Bay River sockeye through several life cycles will help ensure that the in-lake sockeye population is large enough to incur Dolly Varden predation without being overwhelmed.
In addition to Dolly Varden predation, English Bay River sockeye also face a food shortage problem. Sockeye depend solely on secondary plankton (zooplankton) production for food. Zooplankton production depends on the phytoplankton production, which in turn depends on the nutrient load in the system. Nutrients come from two major sources, water runoff from rain and snowmelt, and from the decaying carcasses of the adult salmon escapement. The fast flushing rate of the English Bay River system makes it difficult to maintain a sufficient nutrient load from water runoff alone. Carcass decomposition is also needed to supply nutrients on a more constant basis. It will take several years of good salmon escapement in the English Bay River to build up an adequate carcass load in the system to provide the needed level of nutrients from this critical source. The sockeye supplementation program will ensure that the escapement goal continues to be met during this time.

C. Location

The project will be conducted at Port Graham with the bulk of the benefits accruing to the Port Graham and Nanwalek villages.

COMMUNITY INVOLVEMENT

The Port Graham Village Council is submitting this proposal. The Port Graham hatchery is owned and operated by Port Graham Hatchery, Inc., an arm of the Port Graham Village Council.

The Port Graham Village Council will manage this project under a contract with ADF&G.

PROJECT DESIGN

A. Objectives

Provide a portion of the funding required to construct a new salmon hatchery at Port Graham to replace the one lost in the January 13, 1998 fire.

B. Methods

SUPPLEMENTATION CRITERIA. This is a supplementation project. The following is a brief discussion of how the project fits under each of the supplementation criteria presented in the *Invitation to Submit Restoration Projects for Federal Fiscal Year 1996 and Draft Restoration Program: FY 96 and Beyond*, March 1995, pages 34-35.

Benefits of Supplementation. This project will provide additional pink salmon, sockeye salmon and coho salmon for harvest in the subsistence and commercial fisheries in the Port Graham/ Nanwalek area. By shifting some of the subsistence and commercial harvest to hatchery salmon this project will help Port Graham and Nanwalek wild salmon stocks recover from their present low levels while providing a sufficient numbers of salmon to accommodate subsistence needs.

Genetic Risk. The Port Graham salmon hatchery program was reviewed by the ADF&G, CFMD Genetics Section who determined that the program meets all criteria of the state Genetics Policy for Salmon Enhancement. Only local salmon stocks are being utilized in the supplementation projects. The genetic policy on egg takes is being observed to ensure adequate representation in the gene pool. Each hatchery program (pink salmon, sockeye salmon, coho salmon) is reviewed by the state Fish Geneticist annually to ensure that they remain in compliance with the state genetics policy. The program has been awarded the necessary state and federal permits needed for salmon hatchery operations in Alaska.

Mixed-stock Fishery. The potential for the Port Graham pink salmon hatchery program creating or exacerbating a mixed stock fishery program is minimal. The harvest of each species of Port Graham hatchery salmon is spatially and/or temporally separated from other Kachemak Bay salmon stocks as well as other salmon species. There is very little overlap.

Monitoring and Evaluation. To determine how effective the hatchery programs are it will be necessary to mark hatchery fish for recovery upon their return from the sea. Of particular interest will be what percent of the local harvest is made up of hatchery fish and what percent of the escapement is comprised of hatchery fish. All fish released from the hatchery will have an otolith mark that will be laid down during incubation by rapidly changing the incubation water temperature over a 4 o C range. Random sampling in the subsistence and commercial fisheries or at recovery sites in the rivers will indicate the percentage of hatchery fish in the fisheries or escapement respectively.

Mark analysis of the pink salmon commercial harvest information will be especially useful to the ADF&G fisheries manager in adjusting fishing time and/or area so that the wild returns are given as much protection as possible. Mark analysis in the coho and sockeye fisheries and escapement coupled with an escapement enumeration program will provide crucial information on the success of the hatchery program in increasing wild stock survival.

Economic Criteria. Appendix B presents the Port Graham hatchery pro forma through the year 2020. The facility is designed to be a self-sustaining operation and is expected to achieve that status in 2005. The hatchery will make a significant contribution to the social and economic well being of the Nanwalek and Port Graham villages. In addition to rejuvenating the local subsistence fisheries the hatchery will produce a positive economic benefit. Using current exvessel prices the benefit/cost would be about 1.4:1 for the pink salmon program and 1.6:1 for the sockeye program.

The hatchery pink salmon program will underwrite virtually all hatchery operations. The sockeye will provide only a modest amount ($8,000 to $10,000 per year) to hatchery operations and the coho program will provide no revenue. The reason for this is that the hatchery pink salmon program is intended primarily as an economic enhancement program that will continue indefinitely. The hatchery sockeye and coho programs are primarily rehabilitation programs and, as such, will have an end point. Although both the coho and sockeye programs are likely to continue for most, if not all, of the hatchery's 20 year life span, the hatchery cannot become too revenue dependent on programs that will eventually end.

Procedural Criteria. All evaluations (Regional Salmon Planning Team, Coastal Project Certification) of the Port Graham hatchery program have been conducted and all necessary permits (hatchery permit, fish transport permits, COE, DNR, CZM) have been obtained. A NEPA Evaluation will be conducted immediately after the project is authorized.

C. Cooperating Agencies, Contracts and Other Agency Assistance

The ADF&G CFMD division has responsibility for managing the harvest of returning hatchery fish and will work closely with the Port Graham hatchery in the harvest of hatchery stocks to ensure adequate wild stock escapement.

SCHEDULE

A. Measurable Project Tasks for FY 99

October, 1998	Engineering and design firm selected.
December, 1998	Design approved, permits applied for, hatchery construction put out for bid(s).
March, 1999	Bid(s) awarded.
May, 1999	Contractor mobilization – site preparation
June – November	Hatchery construction
December, 1999	Contractor demobilization

B. Project Milestones and Endpoints

The project objective will be successfully met if hatchery construction is completed by December, 1999.

C. Completion Date

This project will end when hatchery construction is complete. This is expected to occur in December, 1999.

PUBLICATIONS AND REPORTS

No reports are required on capital improvement projects.

PROFESSIONAL CONFERENCES

No travel to professional conferences will be paid for out of this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

If funded, this project will be integrated into the overall salmon hatchery program in Port Graham.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

NA

PRINCIPAL INVESTIGATOR

Port Graham Village Council/ Hatchery Board
Elenore McMullen, Village Chief
P.O. Box 5510
Port Graham, AK 99603
phone (907) 284-2227
fax (907) 284-2222

The Port Graham Hatchery board, an arm of the village council, will select the design and engineering firm and oversee hatchery construction.

kumin associates, inc.
architects • planners • interior designers

808 E street, suite 200 anchorage, alaska 99501
telephone (907) 272-8833 fax (907) 272-7733
E mail: kumin@corecom.net

October 23, 1998

Chugach Regional Resources Commission
4201 Tudor Center Drive, Suite 300
Anchorage, Alaska 99508

Attention: Patty Brown-Schwalenberg, Executive Director

Re: Port Graham Cannery and Hatchery Re-Building
KAI Project No. 9848

Dear Patty:

You asked that we prepare a statement of probable replacement cost for the Port Graham hatchery building recently destroyed by fire. As you know, we are currently working from concept plans for the new hatchery and cannery, and have established only preliminary cost projections at this time. More refined cost analysis will be completed as the design development progresses.

Design development is focusing on the "Option 4" scheme presented in Port Graham earlier this month. This plan organizes the cannery opposite the existing warehouse, with the proposed hatchery building extending north onto new fill within the tideland parcel. Estimates for basic building and equipment components can be based on actual gross area. Others, such as costs for site fill and utilities have been based on a ratio of hatchery area to the total project. Using that logic, we estimate the hatchery replacement costs as follows:

Proposed Hatchery Building:	9,600 s.f. x $85/s.f.	$816,000
Sitework / Fill:	40% x $330,000	$132,000
Mechanical Systems / Equipment:	40% x $480,000	$192,000
Electrical Systems / Equipment:	40% x $344,000	$137,600
New Generators:	40% x $290,000	$116,000
Hatchery Equipment:		$500,000
10% Contingency:		$189,360
Subtotal:		$2,082,960
A/E Design Fees:	40% x $260,000	$104,000
Estimated Project Total Cost:		**$2,186,960**

I hope this information proves helpful to your planning process. We will keep you apprised of cost estimate refinements as they occur. Until then, please don't hesitate to call if you have any questions.

Sincerely,

Blase A. Burkhart, AIA
Associate - Kumin Associates, Inc.

cc: Pat Norman – President, Port Graham Corporation

Rec'd from D. Orsino 11-3-98

APPENDIX B

Port Graham Hatchery Return Estimates and Cc...ecovery Potential for Pink Salmon 1995 to 2021
Expansion Scenario

INCUBATION CAPACITY
1995 to 2000: 25 million green eggs
after 2000: 110 million green eggs

SURVIVAL ASSUMPTIONS
Green Egg to Released Fry: 83.00%
Fry to Adult (Marine):
1995 to 2000 2.25%
2001 to 2004 3.00%
after 2004 3.50%

HARVEST ASSUMPTIONS
Pink Salmon Average Weight: 3 lbs.
Cost Revovery & Common Property Fisheries Share Harvest 50/50 through 2009
95% of Harvestable Fish are Harvested
Cost to Harvest Cost Recovery Fish is 10% of Total Value

Year	Egg Take	Fry Released	Adult Return (#s)	Broodstock Needs (#s)	Cost Recovery Harvest (#s)	Common Property Harvest (#s)	Cost Recovery Price ($/lb)	Value of Cost Recovery
1998	7,000,000	0	0	all	0	0	$0.00	$0
1999	4,000,000	5,810,000	0	all	0	0	$0.14	$0
2000	25,000,000	3,320,000	130,725	55,000	35,969	35,969	$0.16	$15,539
2001	60,000,000	20,750,000	99,600	all	0	0	$0.16	$0
2002	110,000,000	49,800,000	622,500	170,000	214,938	214,938	$0.16	$92,853
2003	110,000,000	91,300,000	1,494,000	170,000	628,900	628,900	$0.16	$271,685
2004	110,000,000	91,300,000	2,739,000	170,000	1,220,275	1,220,275	$0.19	$626,001
2005	110,000,000	91,300,000	3,195,500	170,000	1,437,113	1,437,113	$0.19	$737,239
2006	110,000,000	91,300,000	3,195,500	170,000	1,437,113	1,437,113	$0.19	$737,239
2007	110,000,000	91,300,000	3,195,500	170,000	1,437,113	1,437,113	$0.19	$737,239
2008	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2009	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2010	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2011	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2012	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2013	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2014	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.21	$680,400
2015	110,000,000	91,300,000	3,195,500	170,000	1,200,000	1,665,725	$0.23	$745,200
2016	110,000,000	91,300,000	3,195,500	170,000	1,300,000	1,565,725	$0.23	$807,300
2017	110,000,000	91,300,000	3,195,500	170,000	1,300,000	1,565,725	$0.23	$807,300
2018	110,000,000	91,300,000	3,195,500	170,000	1,300,000	1,565,725	$0.23	$807,300
2019	110,000,000	91,300,000	3,195,500	170,000	1,400,000	1,465,725	$0.23	$869,400
2020	110,000,000	91,300,000	3,195,500	170,000	1,400,000	1,465,725	$0.23	$869,400

Rec'd from Daing 11-3-98
Appe x B

Port Graham Hatchery Annual Ope nal and Capital Budgets 1997-2006
Expansion Scenario

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Personnel									
Hatchery Manager	$31,280	$31,593	$31,909	$32,228	$32,550	$32,876	$33,204	$33,536	$33,872
Asst Hatchery Manager	$29,140	$29,431	$29,726	$30,023	$30,323	$30,626	$30,933	$31,242	$31,554
Maintenance Chief	$24,960	$25,210	$25,462	$25,716	$25,973	$26,233	$26,496	$26,760	$27,028
Fish Culturist	$21,466	$21,681	$21,897	$22,116	$22,338	$22,561	$22,787	$23,014	$23,245
Fish Culturist	$0	$0	$21,466	$21,681	$21,897	$22,116	$22,338	$22,561	$22,787
Fringe @ 28.6%	$30,558	$30,864	$37,311	$37,685	$38,061	$38,442	$38,826	$39,215	$39,607
Seasonals	$2,200	$8,859	$8,948	$9,037	$9,127	$9,219	$9,311	$9,404	$18,996
Seasonal Fringe @ 15%	$330	$1,329	$1,342	$1,356	$1,369	$1,383	$1,397	$1,411	$2,849
Total Personnnel	**$139,934**	**$148,966**	**$178,061**	**$179,841**	**$181,640**	**$183,456**	**$185,291**	**$187,144**	**$199,938**
Travel									
Total Travel	**$2,200**	**$2,200**	**$3,500**	**$3,500**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**
Contractual									
Utilities - heat, electricity, phone	$17,100	$17,442	$17,791	$18,147	$18,510	$18,880	$19,257	$19,643	$30,000
Broodstock collection vessel charter	$5,500	$0	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$10,000
Freight	$7,200	$7,344	$7,491	$7,641	$7,794	$7,949	$8,108	$8,271	$8,436
technical assistance	$15,000	$5,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
maintenance & repair	$2,200	$10,000	$10,000	$10,000	$16,500	$16,830	$17,167	$17,510	$17,860
air charter	$2,000	$2,000	$2,000						
building lease									
Total Contractual	**$49,000**	**$41,786**	**$54,782**	**$53,287**	**$60,303**	**$61,159**	**$62,032**	**$62,923**	**$76,296**
Supplies									
fish food	$0	$18,000	$10,000	$22,000	$45,000	$95,000	$96,900	$98,838	$100,815
fish culture	$2,300	$2,346	$2,393	$2,441	$2,490	$2,539	$2,590	$2,642	$2,695
building, electrical, plumbing	$5,850	$5,967	$6,086	$6,208	$6,332	$6,459	$6,588	$6,720	$5,200
boiler fuel	$1,200	$2,200	$2,244	$2,289	$2,335	$2,381	$2,429	$2,478	$2,527
skiff fuel/oil	$600	$612	$624	$637	$649	$662	$676	$689	$703
Total Supplies	**$9,950**	**$29,125**	**$21,348**	**$33,574**	**$56,806**	**$107,042**	**$109,183**	**$111,367**	**$111,940**
Equipment Replacement									
Total Equipment Replacement	**$4,000**	**$4,080**	**$4,162**	**$4,245**	**$4,330**	**$4,416**	**$4,505**	**$4,595**	**$4,687**
Other									
Debt Retirement						$27,200	$27,200	$27,200	$27,200
miscellaneous expenses	$5,000	$5,100	$5,202	$5,306	$5,412	$5,520	$5,631	$5,743	$5,858
administrative expenses	$25,200	$25,452	$25,707	$25,964	$26,223	$26,485	$26,750	$27,018	$27,288
Total Other	**$30,200**	**$30,552**	**$30,909**	**$31,270**	**$31,635**	**$59,206**	**$59,581**	**$59,961**	**$60,346**
Capital Improvments			**$500,000**	**$270,000**					
Grand Totals	**$235,284**	**$256,709**	**$792,760**	**$575,718**	**$338,714**	**$419,280**	**$424,592**	**$429,989**	**$457,206**

Port Graham Hatchery Annual Operational and Capital Budgets 2007–2016
Expansion Scenario

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Personnel										
Hatchery Manager	$34,553	$34,898	$35,247	$35,600	$35,956	$36,315	$36,678	$37,045	$37,415	$37,790
Asst Hatchery Manager	$32,189	$32,511	$32,836	$33,164	$33,496	$33,831	$34,169	$34,511	$34,856	$35,204
Maintenance Chief	$27,571	$27,847	$28,126	$28,407	$28,691	$28,978	$29,268	$29,560	$29,856	$30,154
Fish Culturist	$23,712	$23,949	$24,188	$24,430	$24,675	$24,921	$25,171	$25,422	$25,677	$25,933
Fish Culturist	$23,712	$23,949	$24,188	$24,430	$24,675	$24,921	$25,171	$25,422	$25,677	$25,933
Fringe @ 28.6%	$40,537	$40,942	$41,351	$41,765	$42,183	$42,604	$43,030	$43,461	$43,895	$44,334
Seasonals	$20,896	$21,105	$21,316	$21,529	$21,744	$21,962	$22,182	$22,403	$22,627	$22,854
Seasonal Fringe @ 15%	$3,134	$3,166	$3,197	$3,229	$3,262	$3,294	$3,327	$3,361	$3,394	$3,428
Total Personnnel	**$206,303**	**$208,366**	**$210,450**	**$212,554**	**$214,680**	**$216,827**	**$218,995**	**$221,185**	**$223,397**	**$225,631**
Travel										
Total Travel	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**
Contractual										
Utilities - heat, electricity, phone	$30,600	$31,212	$31,836	$32,473	$33,122	$33,785	$34,461	$35,150	$35,853	$36,570
Broodstock collection vessel charter	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Freight	$3,047	$3,108	$3,171	$3,234	$3,299	$3,365	$3,432	$3,501	$3,571	$3,642
technical assistance	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
maintenance & repair	$18,046	$18,207	$18,571	$18,942	$19,321	$19,708	$20,102	$20,504	$20,914	$21,332
land & water use fees			$51,030	$0	$0	$0	$0	$0	$55,890	$55,890
Total Contractual	**$71,693**	**$72,527**	**$124,608**	**$74,649**	**$75,742**	**$76,857**	**$77,994**	**$79,154**	**$136,227**	**$137,434**
Supplies										
fish food	$221,122	$225,544	$230,055	$234,656	$239,350	$244,137	$249,019	$254,000	$259,080	$264,261
fish culture	$3,047	$3,108	$3,171	$3,234	$3,299	$3,365	$3,432	$3,501	$3,571	$3,642
building, electrical, plumbing	$5,200	$5,304	$5,410	$5,518	$5,629	$5,741	$5,856	$5,973	$6,093	$6,214
skiff fuel/oil	$488	$497	$507	$517	$528	$538	$549	$560	$571	$583
Total Supplies	**$229,857**	**$234,454**	**$239,143**	**$243,926**	**$248,805**	**$253,781**	**$258,856**	**$264,034**	**$269,314**	**$274,700**
Equipment Replacement										
Total Equipment Replacement	**$4,876**	**$4,973**	**$5,073**	**$5,174**	**$5,278**	**$5,383**	**$5,491**	**$5,601**	**$5,713**	**$5,827**
Other										
Debt Retirement	$27,200	$54,300	$54,300	$54,300	$54,300	$54,300	$54,300	$54,300	$54,300	$54,300
miscellaneous expenses	$6,095	$6,217	$6,341	$6,468	$6,597	$6,729	$6,864	$7,001	$7,141	$7,284
administrative expenses	$32,811	$33,139	$33,471	$33,805	$34,143	$34,485	$34,830	$35,178	$35,530	$35,885
Total Other	**$66,106**	**$93,656**	**$94,112**	**$94,573**	**$95,041**	**$95,514**	**$95,993**	**$96,479**	**$96,971**	**$97,469**
Grand Totals	**$578,836**	**$613,977**	**$673,386**	**$630,878**	**$639,546**	**$648,362**	**$657,330**	**$666,453**	**$731,622**	**$741,062**

Port Graham Hatchery Annual Operational and Capital Budgets 2017–2020
Expansion Scenario

Travel				
Total Travel	**$4,000**	**$4,000**	**$4,000**	**$4,000**
Contractual				
Utilities - heat, electricity, phone	$37,301	$38,047	$38,808	$39,584
Broodstock collection vessel charter	$10,000	$10,000	$10,000	$10,000
Freight	$3,715	$3,789	$3,865	$3,942
technical assistance	$10,000	$10,000	$10,000	$10,000
maintenance & repair	$21,759	$21,994	$22,434	$22,883
land & water use fees	$60,548	$0	$0	$0
Total Contractual	**$143,322**	**$83,830**	**$85,107**	**$86,409**
Supplies				
fish food	$269,546	$274,937	$280,436	$286,044
fish culture	$3,715	$3,789	$3,865	$3,942
building	$6,214	$6,338	$6,465	$6,594
skiff fuel/oil	$594	$606	$618	$631
Total Supplies	**$280,069**	**$285,671**	**$291,384**	**$297,212**
Equipment Replacement				
Total Equipment Replacement	**$5,944**	**$6,063**	**$6,184**	**$6,308**
Other				
Debt Retirement	$130,800	$130,800	$130,800	$130,800
miscellaneous expenses	$7,430	$7,578	$7,730	$7,884
administrative expenses	$35,885	$36,244	$36,606	$36,972
Total Other	**$174,115**	**$174,622**	**$175,136**	**$175,657**
Grand Totals	**$603,450**	**$550,186**	**$557,811**	**$565,585**

Port Graham Hatchery C Flow Analysis 1997 - 2021
Expansion Scenario

	1998	1999	2000	2001	2002	2003	2004	2005	2006
INCOME									
Grants									
BIA Fisheries	$145,000	$210,600	$210,600	$210,600	$210,600	$210,600	$140,000		
EVOS Pink Salmon	$75,000	$75,000							
DCRA Pink Salmon			$75,000	$75,000	$75,000	$75,000			
ANA						$50,000			
HUD/EDA/BIA			$500,000						
Sockeye Incubation	$8,000	$8,000	$8,000	$8,500	$8,500	$8,500	$8,500	$8,500	$9,000
Hatchery Loan				$270,000					
Prior Year Cost Recovery	$0	$0	$0	$15,539	$0	$92,853	$271,685	$626,001	$737,239
Prior Year Cash Balance	$0	-$7,284	$29,607	$30,447	$34,368	-$10,246	$7,428	$3,021	$207,533
Total	$228,000	$286,316	$823,207	$610,086	$328,468	$426,707	$427,612	$637,522	$953,771
EXPENSES									
Hatchery Expenses as per attached sheets	$235,284	$256,709	$792,760	$575,718	$338,714	$419,280	$424,592	$429,989	$457,206
ENDING CASH BALANCE	-$7,284	$29,607	$30,447	$34,368	-$10,246	$7,428	$3,021	$207,533	$496,565

	2007	2008	2009	2010	2011	2012	2013	2014	2015
INCOME									
Grants									
BIA Fisheries									
Other									
Sockeye Incubation	$9,000	$9,000	$9,000	$9,500	$9,500	$9,500	$9,500	$9,500	$10,000
Prior Year Cost Recovery	$737,239	$737,239	$680,400	$680,400	$680,400	$680,400	$680,400	$680,400	$680,400
Prior Year Cash Balance	$496,565	$663,968	$796,229	$812,244	$820,236	$819,560	$810,068	$791,608	$764,025
Total	$1,242,804	$1,410,207	1,485,629	1,502,144	1,510,136	1,509,460	1,499,968	1,481,508	1,454,425
EXPENSES									
Hatchery Operations as per attached sheets	$578,836	$613,977	$673,386	$681,908	$690,576	$699,392	$708,360	$717,483	$731,622
ENDING CASH BALANCE	$663,968	$796,229	$812,244	$820,236	$819,560	$810,068	$791,608	$764,025	$722,803

Port Graham Hatchery C: Flow Analysis 1997 - 2021
Expansion Scenario

	2016	2017	2018	2019	2020
INCOME					
Grants					
BIA Fisheries					
Other					
Sockeye Incubation	$10,000	$10,000	$10,000	$10,000	$10,500
Prior Year Cost Recovery	$745,200	$807,300	$807,300	$807,300	$869,400
Prior Year Cash Balance	$722,803	$736,941	$722,904	$699,305	$665,779
Total	1,478,003	$1,554,241	$1,540,204	$1,516,605	$1,545,679
EXPENSES					
Hatchery Operations as per attached sheets	$741,062	$831,337	$840,899	$850,826	$860,925
ENDING CASH BALANCE	$736,941	$722,904	$699,305	$665,779	$684,755

Revision 12-98
approved TC 12/15/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI/USFWS	DOI/NPS
				$777.5	$0.0	$3.8	$0.0	$0.0
Personnel		$3.3						
Travel		$0.0						
Contractual		$750.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$753.3		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$28.0						
Project Total		$781.3		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)								
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY 99

1 of 1

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Lead Agency: ADFG

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$0.0	$0.0
Travel	$0.0	$0.0
Contractual	$0.0	$750.0
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$0.0	$750.0
General Administration	$0.0	$27.5
Project Total	$0.0	$777.5
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY2003
$0.0	$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
				Travel Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: ADFG

FORM 3B
Personnel
& Travel
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
4A Linkage: Port Graham Village Council	750.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$750.0

Commodities Costs:	Proposed
Description	FY 1999
Commodities Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: ADFG

FORM 3B
Contractual & Commodities
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	Inventory Agency

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: ADFG

FORM 3B
Equipment
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$0.0	$3.3
Travel	$0.0	$0.0
Contractual	$0.0	$0.0
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$0.0	$3.3
General Administration	$0.0	$0.5
Project Total	$0.0	$3.8
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY2003
$0.0	$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:
USFS funds on this project are for NEPA review.

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: USFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Ken Holbrook			0.5	6.5		3.3
	Subtotal		0.5	6.5	0.0	
					Personnel Total	$3.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
				Travel Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: USFS

FORM 3B
Personnel
& Travel
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: USFS

FORM 3B
Contractual & Commodities DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1999
			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	Inventory
Description	of Units	Agency

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: USFS

FORM 3B
Equipment
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$0.0	$0.0						
Travel	$0.0	$0.0						
Contractual	$0.0	$725.0						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0						
Subtotal	$0.0	$725.0	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003		
Indirect	$0.0	$25.0						
Project Total	$0.0	$750.0	$0.0	$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Hatchery Construction Budget Breakdown

Engineering & Design	175.0
Bidding & Legal	10.0
Construction Including Site Preparation	465.0
Contingencies	75.0
Total	725.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: Port Graham Village Council

FORM 4A
Non-Trustee
SUMMARY

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
						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	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: Port Graham Village Council

FORM 4B
Personnel
& Travel
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Hatchery Construction	725.0
Contractual Total	$725.0

Commodities Costs:	Proposed
Description	FY 1999
	0.0
Commodities Total	$0.0

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: Port Graham Village Council

FORM 4B
Contractual & Commodities DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units

FY 99

Project Number: 99405
Project Title: Port Graham Salmon Hatchery Reconstruction
Name: Port Graham Village Council

FORM 4B
Equipment
DETAIL

12/11/98

Revision 7-8-98
Approved 8-13-98

Project Title: Patterns and Processes of Population Change in Sea Otters

Project Number:	99423
Restoration Category:	Monitoring
Proposers:	Jim Bodkin and Tom Dean
Lead Trustee Agency:	DOI
Cooperating Agencies:	
Alaska Sea Life Center:	No
Project Duration:	1st year, 5-year project
Cost FY 99:	$60,000
Cost FY 00:	$63,000
Cost FY 01:	$50,000
Cost FY 02:	$53,000
Cost FY 03:	$55,000
Geographic Area:	Prince William Sound
Injured Resource/Service:	Sea otter

ABSTRACT

Our prior research has identified sensitive variables for assessing recovery of the nearshore ecosystem in western Prince William Sound through populations of sea otters and their invertebrate prey. Core data collection includes annual aerial surveys of sea otter distribution and abundance (1999-2003), and estimates of abundance and size classes of green sea urchins, a key sea otter prey (1999-2000). This project will monitor an injured population and an ecological process to address questions central to recovery of the nearshore ecosystem and will test new approaches to ecosystem monitoring. It may be advisable to resample invertebrates in out years as aerial surveys identify recovery.

INTRODUCTION

The nearshore environment of Prince William Sound (PWS) received about 40% of the oil spilled after the *Exxon Valdez* ran aground (Galt et al. 1991). Concerns about nearshore recovery and restoration have resulted in a suite of studies sponsored by the Exxon Valdez Oil Spill Trustee Council (EVOSTC), including the Nearshore Vertebrate Predator project (NVP). Principal findings include an apparent lack of recovery among sea otters and harlequin ducks, both invertebrate feeders in the nearshore ecosystem. Additionally, we identified a common pattern among several sea otter prey species consistent with reduced predation, through increased proportions of large individuals where sea otters populations were reduced. We are proposing to continue the sea otter components of previous research that were most effective and statistically powerful at identifying if, where, and how recovery may be constrained among EVOS affected sea otters populations in the nearshore. We address the need to refine and focus efforts on study components that provide the greatest resolution to ecosystem function.

We focus on sea otters (*Enhydra lutris*) through aerial surveys, and on ecological interactions between sea otters and green sea urchins, a preferred invertebrate prey. We selected sea otters because they were (1) injured by the oil spill and continue to show evidence for lack of a full recovery, (2) are presumably reflective of the health and recovery status of the nearshore system generally, and (3) are represented by abundant postspill information that can be utilized for long-term restoration monitoring. For sea otters we propose monitoring that tracks both the patterns of population demographics and the processes underlying change in the nearshore system.

Sea Otters

Studies conducted in 1996 and 1997 as part of the NVP program provided evidence that sea otters in western Prince William Sound (WPWS), in at least the area of northern Knight Island, had not fully recovered from oil spill injury (Holland-Bartels et al. 1997, Holland-Bartels et al. 1998). Shortly after the spill, in April 1989, a total of 33 sea otters were captured or recovered from Herring Bay, a heavily oiled embayment on northern Knight Island (Bodkin and Udevitz 1994). Fourteen aerial surveys conducted in 1996 found a maximum of 11 sea otters (mean = 3) in this same location. Constraints to recovery most likely are demographic, either through reduced survival among residents, or higher emigration from the oiled area.

This proposal builds on previous EVOS research to develop a statistically sensitive and cost-effective program that will continue to track the WPWS sea otter population and nearshore ecosystem recovery through two avenues. First, continued aerial surveys of sea otter abundance at appropriate intervals will allow population monitoring and testing of the predictions of a previously developed EVOSTC sea otter population model (Udevitz

et al. 1996). Second, monitoring abundance and size of a key invertebrate species will allow an independent assessment of sea otter recovery through predicted responses in a prey population.

Information obtained from the proposed research will be valuable for differentiating between demographic and health-related causes for the current lack of recovery in the WPWS sea otter population as well as aiding our understanding of processes involved in recovery of the nearshore system to major perturbations such as the EVOS.

NEED FOR THE PROJECT

A. Statement of Problem

Sea otters occupy an invertebrate consuming trophic level in the nearshore and are a conspicuous component of the nearshore ecosystem. In 1995, the NVP Project was initiated to examine the status or recovery of nearshore vertebrates (including sea otters, harlequin ducks, river otters and pigeon guillemots), and to examine possible causes for the apparent lack of recovery. Results of the NVP project, although not complete, clearly suggest that complete recovery may not have occurred, for at least the invertebrate-feeding sea otter and harlequin duck. This may reflect similarities in trophic dynamics or perhaps simply greater power to detect differences or change with these species. Additionally, we have observed an apparent response among several invertebrates to reduced sea otter densities. This finding represents a shift in the ecological processes structuring the nearshore community and provides a unique opportunity to test predictions related to sea otter recovery and their prey. We also have an opportunity to test the application of this novel approach as a tool for monitoring predators through prey that may have broader ecological applications.

Sea Otters

Sea otter populations in WPWS were injured as a result of the *Exxon Valdez* oil spill (EVOS). Estimates of sea otter mortality due to the spill range from 750 to 2,650 individuals (Garshelis 1997, Garrott et al. 1993). A population model (Udevitz et al. 1996) predicted recovery of the WPWS sea otter population in 10 to 23 years, projecting maximum annual growth rates from 0.10-0.14. Surveys to date (1993-1997) have not shown a significant increasing trend in the WPWS sea otter population, despite adequate power to detect relatively small changes (> 0.80 to detect a 1% annual change in 5 annual WPWS surveys). In particular, the northern Knight and Naked Island area numbers remain below pre-spill estimates, and do not show a significant increasing trend (Fig. 1; Holland-Bartels et al. 1998) though our power to detect change is lower for these surveys.

The status of sea otter recovery has been assessed, in part, by conducting aerial surveys of sea otter abundance in WPWS, comparing pre- and post-spill estimates of abundance, and comparing estimates of abundance in oiled and unoiled parts of the Sound. While these data provided a foundation for assessment of recovery status, there were few pre-spill data and there were known biases in pre-spill estimates that precluded using pre- vs. post-spill comparisons in making a definitive quantitative assessment of the extent of recovery. Furthermore, recovery status could not be based solely on post-spill comparisons of oiled and unoiled areas because there are known differences in habitat between these areas, and it is uncertain whether sea otters in oiled areas could ever achieve population levels observed in unoiled parts of the Sound. As a result, in the NVP study, we examined prey populations as an ancillary means of assessing recovery.

This approach was based on the knowledge that sea otters have a profound and predictable effect on the structure of prey populations (reviewed in Riedman and Estes 1990). Generally, as sea otters reoccupy an area, they first consume the largest members of the most energetically profitable prey, eventually switching to smaller sizes and different species, as preferred species and the larger size classes become rare (Estes and Palmisano 1974, Duggins 1980, Estes and Duggins 1995). Prey of the size preferred by sea otters generally are rare in areas where sea otters are abundant (Estes et al. 1978). There have been no prior studies of the impacts of reductions in the number of otters on the structure of prey populations. However, based on the work summarized above, we hypothesized that a reduction in otter abundance would be accompanied by an increase in the abundance and average size of prey. We concluded that the status of recovery of impacted populations of sea otters might therefore be assessed by examining the abundance and size-distributions of prey within impacted areas, and by comparing these with estimates from an unaffected area where otters and their prey were considered to be in equilibrium. Full recovery would be indicated by similar abundances and size distributions of prey in oiled and unoiled areas.

NVP comparisons of most invertebrate prey populations between Knight Island (oiled) and Montague Island (unoiled) identify differences in population structure consistent with lack of recovery of the sea otter population at the oiled site (Fig. 2; Holland Bartels et al. 1998). At the sites where sea otter populations were greatly reduced, we have found significantly greater proportions of large individuals among most species of clams, urchins and mussels. Size distributions of sea urchins (Fig. 2) and intertidal littleneck clams were strongly skewed toward smaller size classes at Montague Island, and there were substantially higher abundances of large urchins and clams per otter at Knight Island (15 to 50 times more urchins and 5 to 6 times more clams per otter at Knight than at Montague).

Continued prey assessment provides a unique opportunity to complete the testing of an innovative approach for estimating the status of a predator population. When sea otter

populations near complete recovery, we predict that differences in prey sizes between areas should diminish. We propose to continue to monitor the abundance of sea otters and the size and abundance of sea urchins in oiled and unoiled areas of PWS to assess the recovery status of sea otters.

In summary, continued monitoring of sea otter distribution and abundance and otter prey populations in WPWS will be valuable in (1) providing insight into potential demographic constraints to recovery which may improve future recovery models, (2) documenting actual recovery time for the nearshore system including sea otters, (3) providing long-term population trend data which may be used in assessing initial damage and subsequent recovery of sea otter populations in the event of future oil spills.

B. Rationale/Link to Restoration

Sea otter restoration requires assessment of population health and definition of impediments to recovery. This proposed work represents a comprehensive approach to understanding the factors that affect population dynamics and definition of critical bottlenecks to recovery. Without an understanding of the underlying processes that dictate population change, we can not prescribe specific activities to enhance recovery.

Population modeling is a powerful tool for describing population fluctuation and for identifying critical periods of the annual cycle (e.g., Lebreton and Clobert 1991, Schmutz et al. 1997). Previous work (Udevitz et al. 1996) has resulted in a population model for sea otters in PWS which may be tested with continued monitoring.

Sea Otters

Sea otter restoration requires an understanding of changes in population status and the processes affecting that change. Continued monitoring of sea otter distribution and abundance and otter prey populations in WPWS will be valuable in (1) providing insight into potential demographic constraints to recovery which may improve future recovery models, (2) documenting actual recovery time for the nearshore system including sea otters, (3) providing long-term population trend data which may be used in assessing initial damage and subsequent recovery of sea otter populations in the event of future oil spills.

C. Location

Studies will be conducted in PWS. Specific study sites for some components will be those used in previous and ongoing Trustee-sponsored research and monitoring programs to capitalize on previously collected data and populations of marked individuals.

Communities affected by the project include Chenega, Tatitlek, Whittier, Valdez, and Cordova.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The project will continue to inform and coordinate our community involvement activities, including the collection of indigenous knowledge with Dr. Henry Huntington, TEK specialist Chugach Regional Resources Commission and Hugh Short, Community Coordinator, EVOS Restoration Office. We will continue to solicit advice from the above parties and gather information on TEK through synthesis workshops, local community facilitators, and residents.

Efforts have and will continue to be made throughout the restoration process to participate in and provide public involvement in the design and implementation of this project. Information gathered from this project will be shared with local communities. Project staff has and will continue to present information to local communities or prepare articles or photographs for Trustee Council publications. Boat and air charter contracts, and other services will be contracted from local sources when possible.

PROJECT DESIGN

A. Objectives

Sea Otters

1. A. Compare estimates of sea otter abundance and population trends over time and between oiled and unoiled areas within WPWS.

   B. Estimate abundance and size class composition of green sea urchins in oiled and unoiled study sites.

B. Methods

Sea Otters

Sea otter population monitoring--We will continue to use previously developed aerial survey techniques which employ counts along systematic transects, and intensive search units (ISU's) to estimate a correction factor for each survey (Bodkin and Udevitz, in press). We will conduct a single survey of the entire WPWS every two years beginning

in 2000, and continue annual replicate surveys (5 or more replications per survey) of the smaller NVP study sites, beginning in 1999. In 1999, a Sound-wide survey will be conducted to provide a 5 year estimate of PWS sea otter abundance. Bi-annual WPWS surveys do not diminish our power to detect population changes in the greater WPWS area. However, increasing replicate survey intervals for the smaller NVP study areas greatly reduces our power to detect changes. It may require 8 years of annual replicate surveys (ie., 4 additional years beginning in 1999) to provide adequate power to detect a minimum of a 6% annual increase. The time required to detect this same change may extend to 12 years if the survey interval is increased to every two years (3 additional surveys). In years 2001 and 2003, additional replicates will be conducted to increase power to detect change within replicate survey areas.

Invertebrate prey population monitoring--In 1999-2003, we will focus on sampling intertidal populations of green sea urchins (*Strongylocentrotus drobachiensis*). We selected this species because they are a preferred sea otter prey and have populations that are centered in the intertidal zone and can therefore be sampled efficiently, providing adequate power to detect change.

Sampling will be conducted from within Herring Bay and Bay of Isles on Knight Island, and along the Stockdale Harbor and Port Chalmers portions of Montague Island. Density estimates will be obtained from systematically selected transects along the shorelines in each area. For sea urchins, size distribution data will be supplemented by sampling in preferred sea urchin habitats. The details of site selection and sampling methods are given in Holland-Bartels et al. (1998).

Recovery of sea otter populations will be assessed by comparing the size distributions and biomass of sea urchins at Knight Island vs. Montague Island. A lack of significant differences between oiled and reference (nonoiled) sites would be indicative of recovery. The data from 1999 will be combined with similar data from 1996-1998 to assess possible trends in recovery, as indicated by converging size distributions and abundances at the two sites.

A. Cooperating Agencies, Contracts, and Other Agency Assistance

USGS personnel, led by Jim Bodkin, will be responsible for aerial surveys and assist in invertebrate monitoring.

Contract with Coastal Resources (Dr. T. Dean) for sea otter invertebrate prey monitoring component.

SCHEDULE

A. Measurable Project Tasks for FY 99

Sea Otters

June - August	Sea otter aerial survey and prey monitoring

B. Project Milestones and Endpoints

Sea Otters

FY99 (and out years)

December-March:	Coordinate and plan surveys, community involvement, prepare equipment.
June-August:	Conduct aerial sea otter surveys and prey surveys
September-Nov:	Data analysis and report preparation. Coordinate with local communities.

This is a projected five-year monitoring program designed to assess the recovery of an injured species. Each project objective will be assessed annually for oiled and unoiled areas then compared with each other and with data collected in previous years. Year to year trends will first be compared in 2000 and then each year after. At the end of each year results will be compared with the restoration goals to assess whether recovery has occurred.

C. Completion Date

All project objectives will be met following FY03. The project may be terminated prior to FY03 if restoration guidelines for sea otters are met.

PUBLICATIONS AND REPORTS

Annual reports will be presented to the Chief Scientist by April 15. An annual report of FY99 activities will be submitted to the Restoration Office before 15 April 2000. A final report will be prepared at the end of the proposed monitoring schedule unless continued monitoring is warranted or when recovery objectives are met. Special reports (publications) will be prepared during the course of the study if warranted. Publications will be prepared for peer-review journals when sufficient data has been collected to warrant manuscript preparation. Because FY99 is the first year of this project, journal publications will not be generated until later years.

PROFESSIONAL CONFERENCES

None in FY99.

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described in the Introduction, this research relies on incorporation of data from other Trustee sponsored research, including project /025. Equipment purchased under this project will be used to conduct the proposed research and data collection and analysis will follow previously established protocols and standards.

PROPOSED PRINCIPAL INVESTIGATORS

James Bodkin
Alaska Biological Science Center
USGS-Biological Resources Division
1011 E. Tudor Rd.
Anchorage, Alaska 99503
PHONE: (907) 786-3550
FAX: (907) 786-3636
james_bodkin@usgs.gov

Tom Dean
Coastal Resources Associates, Inc.
1185 Park Center Drive, Suite A
Vista, CA 92083
PHONE: (760) 727-2004
FAX: (760) 727-2207
coastal_resources@compuserve.com

Revision 7-98
Approved 8-13-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$19,298.0
Travel		$3,820.0
Contractual		$30,808.3
Commodities		$800.0
Equipment		$200.0
Subtotal	$0.0	$54,926.3
General Administration		$5,051.3
Project Total	$0.0	$59,977.6
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY2000	Estimated FY2001	Estimated FY2002	Estimated FY2003
$63,000.0	$50,000.0	$53,000.0	$55,000.0

Dollar amounts are shown in thousands of dollars.

Comments:
Sea urchin sampling proposed for 2 years FY99 and 00
Aerial sea otter surveys proposed for 5 years

1998

Prepared: 1 of 8

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 3A
TRUSTEE
AGENCY
SUMMARY

7/8/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
J. Bodkin	Research wildlife Biologist	GS-13-1	0.5	6532.0		3,266.0
D. Monson	Research Wildlife Biologist	GS- 9-1	4.0	4008.0		16,032.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.5	10540.0	0.0	
					Personnel Total	$19,298.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Anch/Cord/Anch	250.0	2	20	141.0	3,320.0
Annual meeting	500.0	1			500.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3,820.0

1998

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 3B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:		Proposed
Description		FY 1998
Aircraft 80 hours at 200/hr		16,000.0
4A Linkage	Coastal Resources Assoc.	14,808.3
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$30,808.3

Commodities Costs:		Proposed
Description		FY 1998
Misc field/office supplies		800.0
	Commodities Total	$800.0

1998

Prepared: 3 of 8

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 3B
Contractual & Commodities DETAIL

7/8/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
Equipment maintenance and repair			200.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$200.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$7,267.3
Travel		$600.0
Contractual		$6,641.0
Commodities		$300.0
Equipment		$0.0
Subtotal	$0.0	$14,808.3
Indirect		
Project Total	$0.0	$14,808.3
Full-time Equivalents (FTE)		1.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 5 of 8

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 4A
Non-Trustee
SUMMARY

7/8/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
Thomas Dean			0.7	7904.0		5,532.8
Denis Jung			0.5	3469.0		1,734.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.2	11373.0	0.0	
					Personnel Total	$7,267.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 1998
San Diego/Anch		500.0	1	1	100.0	600.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$600.0

1998

Prepared: 6 of 8

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 4B
Personnel
& Travel
DETAIL

7/8/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Overhead	4,425.0
General Administrative costs	1,640.0
Fees	576.0
Contractual Total	$6,641.0

Commodities Costs:	Proposed
Description	FY 1998
Misc Field Supplies	300.0
Commodities Total	$300.0

1998

Prepared: 7 of 8

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Oters
Name: Bodkin and Dean

FORM 4B
Contractual & Commodities DETAIL

7/8/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			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: Description	Number of Units	

1998

Project Number: 99423
Project Title: Pattern and Process of Population Change in Sea Otters
Name: Bodkin and Dean

FORM 4B
Equipment
DETAIL

99424

Approved TC 8-13-9

Exxon Valdez Oil Spill Restoration Reserve

Project Number:	99424
Restoration Category:	Restoration Reserve
Proposer:	All Trustee agencies
Duration:	Ongoing
Cost FY 99:	$12,000,000
Cost FY 00:	$12,000,000
Cost FY 01:	$12,000,000
Cost FY 02:	$12,000,000
Geographic Area:	Oil spill area
Injured Resource/Service:	Multiple resources and services

ABSTRACT

In recognition of the fact that complete recovery from the oil spill may not occur for decades, the Trustee Council established the Restoration Reserve to hold funds to be used for restoration after the last annual payment is received from the Exxon Corporation in September 2001. The $12 million recommended for deposit in FY 99 would be the sixth deposit into the reserve account, and would bring the total in the account to $72 million. Annual deposits of $12 million in each of the next 3 years would provide a reserve of $108 million plus interest.

INTRODUCTION

Complete recovery from the *Exxon Valdez* oil spill may not occur for decades. In many cases, substantial research must precede effective restoration or improved management actions that will protect a resource or service, and long-term monitoring can be necessary to understand the effectiveness of specific restoration actions. Use of funds from the Restoration Reserve could potentially benefit any resource or service injured by the oil spill. No allocation of Restoration Reserve funds to specific activities has yet been made.

NEED FOR THE PROJECT

A. Statement of Problem

The Chief Scientist and other investigators working on the restoration program have identified a need to maintain restoration activities in the years following Exxon's last scheduled payment in the year 2001. The collection of long-term data sets is increasingly recognized as essential to understanding the results from any one year of work. In addition, there continues to be strong public interest in the Trustee Council's large and small parcel habitat protection efforts.

B. Rationale/Link to Restoration

To be effective, restoration activities may have to span more than one generation. For example, some salmon return in cycles of four to six years while other resources have lives that are much longer. In addition, oceanographic influences on the health and survival of numerous injured species under investigation are only just beginning to be understood. Work under the major ecosystem studies (SEA, NVP, APEX), while providing significant new insight into the status of recovery and health in the spill area, is also bringing attention to new questions that may require continuing efforts long into the future. This includes the identification of key areas or times of year (spatial or temporal refuges) and processes critical to the long-term recovery of injured resources and associated services.

C. Location

Oil spill area.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The Restoration Office has conducted a series of public meetings in communities in the spill area as well as Juneau, Anchorage and Fairbanks during FY 98 to obtain public comment on potential future uses of the Restoration Reserve. Substantial written as well as verbal comment has been generated and the Restoration Office staff continues to receive public comment. The staff has analyzed the comments and provided summary reports to both the Trustee Council and the PAG.

PROJECT DESIGN

A. Objectives

The essential objective of the Restoration Reserve is to ensure that funds are available to support restoration activities beyond the end of the settlement payment period.

B. Methods

This proposed $12 million would be the sixth payment to the Restoration Reserve. Based on previous Trustee Council action, the total principal after this deposit would be $72 million. Additional annual deposits of $12 million in each of the remaining three years would provide a reserve of $108 million plus interest earned by investment of these funds. This amount is expected to be sufficient to carry out long-term restoration activities after the last Exxon payment in the year 2001. Funds in the Restoration Reserve are currently invested in laddered securities within the Court Registry Investment System; accrued earnings remain with the Restoration Reserve. Other options for investment are currently being researched.

Any spending from the Restoration Reserve must be consistent with the Consent Decree and with the Memorandum of Understanding between the state and federal governments.

C. Cooperating Agencies, Contracts and Other Agency Assistance

Not applicable.

SCHEDULE

A. Measurable Project Tasks for FY 99

The $12 million proposed for FY 99 will be transferred from the Court Registry Investment System Liquidity Fund to the Restoration Reserve Fund by court order when such funds are available.

B. Project Milestones and End Points

This project will be complete when the funds are transferred from the Court Registry Investment System Liquidity Fund to the Restoration Reserve Fund by court order.

C. Completion Date

The project (i.e., the annual deposit of $12 million) will have been completed at the end of the fiscal year.

PUBLICATIONS AND REPORTS

Not applicable.

PROFESSIONAL CONFERENCES

Not applicable.

NORMAL AGENCY MANAGEMENT

Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Not applicable.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Not applicable.

PROPOSED PRINCIPAL INVESTIGATOR

Molly McCammon
Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska 99517
phone: 907/278-8012
fax: 907/276-7178

4-15-98 version
Approved 12-15-98

East Amatuli Island Remote Video Link

Project Number:	99434
Restoration Category:	General Restoration
Proposer:	M. O'Meara/Pratt Museum
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 1 yr. project
Cost FY 99:	$75.8
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	East Amatuli Island in the Barren Islands
Injured Resource/Service:	Seabirds, marine mammals

ABSTRACT

Under this project, a microwave link will transmit live images and audio from East Amatuli Island to the Pratt Museum in Homer. Two cameras on the island will be used to test remote collection of data on seabird breeding parameters (e.g., nest attendance) as a supplement to monitoring programs, provide a vehicle for student involvement in restoration monitoring, and allow members of the general public to view spill area resources and restoration research projects. Users at the Pratt Museum will pan, tilt, and zoom cameras to observe murres and kittiwakes. The cameras' computer control system will be programmed to store precise nest locations that can be revisited upon command, or automatically at specified intervals, to record images on video tape.

INTRODUCTION

The goal of this proposal is to install and test a remote video camera system in the Barren Islands in cooperation with U.S. Fish and Wildlife Service scientists. The project will provide an opportunity to evaluate the effectiveness of the system in collecting supplementary data on Common Murres (*Uria aalge*) and Black-legged Kittiwakes (*Rissa tridactyla*), two species being studied as part of the Alaska Predator Ecosystem Experiment (APEX) and as a tool to increase public access to EVOS-supported research programs. Cameras installed in the Barren Islands will be programmed to record images of birds at precise coordinates at selected times of day, unhampered by weather and sea conditions. Transmitting live video images from East Amatuli Island to the Pratt Museum presents tremendous potential for teaching a wide and diverse public about seabirds. Museum visitors, school groups and ultimately, via the Internet, researchers and audiences throughout the world will be informed by the project.

For many years Pratt Museum programs have enhanced formal and informal marine science education in Alaska. *Darkened Waters: Profile of an Oil Spill,* the exhibition documenting the *Exxon Valdez* oil spill and the *Sperm Whale Project*, an award-winning, five-year collaboration with Homer High School, are notable examples of projects that have successfully increased scientific and technological literacy and promoted ocean conservation. The new *Kachemak Bay Discovery* project focuses on educational programs outside the classroom, in the field and at the Museum. The Museum's Marine Gallery will be modified into a Discovery Lab starting in the fall of 1998. Installation of advanced technology such as an interactive remote video monitoring terminal will provide "hands-on" exhibitry which will help students and other Museum visitors learn about the marine environment, scientific methodology and the restoration effort.

In April 1998 a prototype remote video system began transmitting live images from Gull Island to the Pratt Museum, a distance of eight miles. Daniel Zatz, robotics designer and owner of Broadcast Services of Alaska (BSA) installed three cameras on the Island in Kachemak Bay. One camera transmits an overview perspective, another equipped with a 64-power telephoto lens provides extreme close-up views and a third camera is mounted underwater in the intertidal zone. Visitors in the Pratt Museum enjoy views of seabirds by using a joy stick and camera selection buttons to manipulate the direction of the cameras and the zoom lens. In this way people are able to observe and monitor the seabird rookery without disruption to the birds. Having a working prototype allows BSA and the Pratt Museum to field test and fine tune the equipment all summer. Based on the success of the Gull Island installation, BSA and the Museum are exploring the feasibility of installing a signal relay on Mt. Augustine in early summer so that by August we will be ready to field test a longer range transmission from McNeil River, via Mt. Augustine, to the Museum in Homer.

NEED FOR THE PROJECT

A. Statement of Problem

Development of remote video data collection techniques could enhance the capacity of field researchers to collect monitoring data at study sites that are difficult to access because of topography or weather and sea conditions. These techniques could also be used to collect valuable supplementary data at study sites in years when field teams are not present or at other, secondary sites that could be compared with primary monitoring sites (e.g., in the future, data on certain seabird parameters could be collected at Gull and Chisik Islands for comparison with data collected at the Barren Islands).

Developing the general public's awareness of spill area resources and promoting understanding and appreciation of the nature and value of long-term research at remote sites can be a daunting task. For the most part, access to remote areas is unavailable to people, and their presence in the field could be disruptive in any event. Yet public outreach and the ability to involve students in research projects have been identified as important parts of the restoration process.

The East Amatuli Island Remote Video Link project will provide researchers with an opportunity to test proven remote video technology as a cost effective method for collecting long-term data on seabirds and sea mammals at remote sites. Data collection via remote video link offers a practical way to supplement and optimize work done by field crews. The link will also provide unobtrusive public access to the study area and to the research process itself. Location of the control center in the Pratt Museum will provide an optimum environment for involving students in EVOS-supported restoration research and monitoring projects.

B. Rationale/Link to Restoration

Remote video cameras have the potential to supplement field observations in monitoring studies. To be useful, these systems must be reliable (able to send high quality data adequate distances on predictable schedules). Since 1999 is the last year of field data collection in the APEX project, it is a good time to test the reliability and cost effectiveness of this system for data collection on seabirds in the spill area. The Barren Islands provide a site where long-range transmission capabilities can be tested (to the Pratt Museum in Homer), where extreme weather conditions will test the system's durability and where ongoing APEX studies can be enhanced (e.g., the cameras could be used to increase sample sizes of parameters such as adult attendance at nest sites). If the system proves to be reliable and cost effective, it will be useful as a part of a proposed EVOS long-term monitoring program.

Although this pilot project will test the use of the video system at East Amatuli Island, it has potential applications throughout Lower Cook Inlet, the Northeast Gulf of Alaska and Prince William Sound. Experience gained from this project could be applied to supplement studies of Pigeon Guillemots, puffins and other seabirds and sea mammals throughout the spill area. Examples of EVOS-sponsored APEX projects that might ultimately benefit from testing the East Amatuli Island Remote Video Link include the Barren Islands seabird studies (Project 99163J), Black-legged Kittiwake studies in Prince William Sound (Project 99163E), Pigeon Guillemot studies in Prince William Sound (Project 99163F) and Cook Inlet seabird studies at Gull and Chisik Islands (Project 991673M). The system might also benefit studies of harbor seals in Prince William Sound (e.g., by providing remote viewing of pupping and haul-out areas).

One potential advantage of the remote video system is the ability to make observations at predetermined plots at optimum times of day, irrespective of sea or weather conditions. Video footage can be analyzed by research staff under controlled conditions and remain available as an archival record for future use by other investigators.

The EVOS Trustee Council has recognized the importance of disseminating information to the public about EVOS-sponsored research. They also believe that it is important for the general public and students to be involved in the research. With its control center located in the Pratt Museum, the East Amatuli Island Remote Video Link project will provide an outstanding vehicle for accomplishing these two goals. The Museum's marine science education programs associated with the *Darkened Waters* exhibit, the *Sperm Whale Project* and *Kachemak Bay Discovery* already tend to focus on issues of spill recovery and restoration. By incorporating the East Amatuli Island Remote Video Link into our *Kachemak Bay Discovery* program over 40,000 Pratt Museum visitors annually, students from all parts of Alaska, and in time, anyone viewing the Museum Web Site can be exposed to restoration research on seabirds.

There are strong incentives for starting the East Amatuli Island Remote Video Link project during the 1999 fiscal year:

> Proven technology will be available. By the end of September 1998, the Pratt Museum will have completed development and testing of the prototype remote video system on Gull Island in Kachemak Bay.
>
> The presence of experienced field crews on East Amatuli Island during FY99 will allow "ground-truthing" of the remote video system by comparison of data gathered by remote camera with data obtained by other methods.
>
> The major expense associated with remote video data collection is incurred during development and testing of its applications to research, public outreach and education. By completing this process during FY99, as much as a 60% reduction in costs can be realized by projects utilizing the system during subsequent years.

C. Location

Two cameras will be located at the East Amatuli Island, Light Rock Colony, in the Barren Islands.

COMMUNITY INVOLVEMENT

Over the last two years the Pratt Museum has been involved in a dialog with the local community and visitors from elsewhere regarding the nature of exhibits and programs they feel would best

suit their needs. This has included two visitor surveys (one focused on locals, one on tourists), a series of town meetings and ongoing input from the Museum's Community Advisory Council. A common theme is the desire to see more interpretation of the marine environment, greater use of interactive exhibits and more opportunities for students to become involved in some kind of scientific research. This input is helping shape the Museum's benchmark exhibit renovation program and the direction which the *Kachemak Bay Discovery* project will take. The East Amatuli Island Remote Video Link Project is a result of this planning which offers a multitude of possibilities for ongoing community involvement. Live footage taped for scientists can be used to demonstrate to students and the public how data is collected and interpreted. Museum visitors will be able to add their observations and thoughts to the video log. Student aids and interns can help visitors use the system. Local audiences and, ultimately, anyone viewing the Museum Web Site will be able to learn about EVOS Trustee Council-supported seabird research and view areas damaged by the spill that might otherwise be inaccessible.

PROJECT DESIGN

A. Objectives

1. Test the potential of remote video technology to supplement and support data collection by field crews for long-term monitoring of species injured by the spill.

2. Test the remote video system under some the harshest field conditions in Alaska and over long distances in preparation for other long-range monitoring projects.

3. Develop public programs and educational opportunities using remote video technology for real-time observations of wildlife and student research projects.

4. Provide interaction between students and researchers.

B. Methods

The East Amatuli Island Remote Video Link Project is composed of three interrelated elements: 1) remote video technology; 2) research applications of the technology; 3) public outreach and educational applications of the technology. The project is designed to test whether remote video technology is: 1) advanced enough to function dependably for long periods under harsh conditions; 2) a dependable and cost-effective way to augment the work of field crews in monitoring seabirds (and potentially sea mammals); 3) a powerful mechanism for educating the public and involving students in EVOS-supported research and monitoring projects. The following discussion of methodology is divided into three sections reflecting project structure.

Remote Video Technology

The remote video link will transmit live video and audio from East Amatuli Island to the Pratt Museum. Researchers and visitors at the Pratt will have full control of the camera via a PC

computer and digital transmission link. Operators will pan, tilt, zoom, clean dirty lenses and put the system to sleep from over 60 km away.

Cameras will be located to view some of the same seabird study plots observed by EVOS Trustee funded USFWS crews during FY99. Equipped with 100 X telephoto capability, two cameras will provide clear images of seabirds and nest sites. The system will offer preset positions allowing researchers to point the camera at pre-selected nest sites at the push of a button. Researchers may also instruct the computer to "visit" selected nests at desired intervals during all daylight hours and automatically record the video on a VCR for later analysis.

The system will consist of two video cameras enclosed in water-proof housings and mounted on motion control units. Digital command signals from the Pratt Museum will be decoded to move the selected camera and live pictures will be transmitted via a microwave transmitter. Power will be provided by an array of solar panels and a small wind generator. Camera lens and solar panels will be cleaned upon command by operators at the Pratt Museum control panel.

Because line-of-sight between East Amatuli Island and Homer is not possible, a relay station will be installed east of Port Graham. This relay will consist of a microwave receiver and transmitter capable of handling video and audio signals, and a digital data receiver and transmitter to handle control information.

The remote video link will be assembled between January and April 1999, and tested between April 15 and May 15, 1999 in Kachemak Bay. These tests will include installation and operation of the relay station. In late May 1999, the remote video system will be installed on East Amatuli Island. Installation will require several days, followed by testing. The system will be removed in mid-September as the USFWS crew departs the island.

Research Applications

Remote observations of seabirds on plots at the East Amatuli Island study site will be recorded on video tape at the Pratt Museum. Data will also be collected on the same plots by APEX Project 99163J researchers using standard Project 99163J protocols. After the field season is completed, data obtained by both methods will be compiled and compared and the effectiveness of the remote system as a research tool for use during long-term monitoring studies will be evaluated.

Public Outreach and Education

The Pratt Museum will incorporate the East Amatuli Island Remote Video Link as an exciting new part of the Museum's marine exhibits and science education curriculum. The remote video control station will be added to the Museum's marine gallery with appropriate explanatory signage. Museum staff, volunteers and student interns will be trained to interpret and assist visitors in operating the system during periods when it is not occupied with specific research functions. The project Outreach Coordinator will work with the project Educator and *Kachemak Bay Discovery* partner organizations to develop regular interpretive programs for the general

public. The project Educator will: 1) integrate use of the video system with visiting school groups; 2) work with the project Biologist to develop opportunities for student monitoring.

Science educators have long seen observation skills as the most basic to the study of science -- the very foundation for carrying out other scientific processes such as classifying and making inferences. Science educator and researcher Dorothy Gabel has stated that, "Teaching children to become discriminating observers is one of the major objectives of science education...". For many years, Pratt Museum educational activities have focused on developing observational skills. Each year over 4,300 students from all around Alaska are given an opportunity to participate in interactive lessons involving sea life in the aquariums, plants and animals in our gardens and on the forest trail and a wealth of artifacts throughout the Museum. The East Amatuli Island Remote Video Link is a natural extension of this already powerful learning experience.

Data needed to evaluate the effectiveness of remote video technology as a tool for informing and educating the public and students will be generated in a variety of ways. Museum staff will observe and track visitor attendance and response to the remote video exhibit. People attending the exhibit will be encouraged to enter their observations and reactions in the video log book at the control kiosk. Additional statements will be reviewed and compiled from Museum comment cards available to visitors throughout the galleries. Staff will periodically conduct informal interviews with visitors. The Pratt Museum Community Advisory Council will provide ongoing input. Teachers who bring their classes to the museum will provide feedback on whether or not their use of the remote video system engages students and enhances and supports the school curriculum and how its use might be improved.

Complicated statistical analysis of such data is not foreseen. Simple compilation, review and summary of responses and observations will make clear whether or not the video system is an effective tool for outreach and education. Outcomes will be summarized and presented at professional conferences and through publication of articles in selected informal and formal education journals.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Broadcast Services of Alaska will design, install and maintain technical equipment and licensed video control signals for the Pratt Museum. The system will be removed by a USFWS crew in mid-September. USFWS staff will assist the Pratt Museum with development of public outreach and education projects.

Pratt Museum's *Kachemak Bay Discovery* partners include Alaska Department of Fish and Game, Kenai Peninsula College, Alaska SeaLife Center, Nanwalek Elementary/High School, Center for Alaskan Coastal Studies, National Museum of Natural History, Chugachmiut, Port Graham School, Cook Inlet Keeper, Susan B. English Elementary/High School in Seldovia, *Exxon Valdez* Oil Spill Trustee Council, University of Alaska Fairbanks, Homer High School, Alaska Maritime National Wildlife Refuge, and Homer Junior High School.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 1, 1999)

June 15 - August 15, 1998:	Conduct initial surveys of East Amatuli and relay station site.
January 1 - April 15, 1999:	Customize and specialize system for Barren Islands use.
February 1 -April 15, 1999:	Modify Pratt Museum exhibits to accommodate receiver station.
April 15 - April 30, 1999:	Assemble transmitter and receiver station at Pratt. Begin testing transmitters, receivers and motion control systems.
May 1 - May 15, 1999:	Install relay station. Establish two-way link from relay station to Pratt. Transmit live pictures from relay station to Pratt. Transmit digital control signals to relay station.
May 15 - May 31, 1999:	Install cameras, transmitter and receiver at East Amatuli site. Transmit live pictures to relay station and Pratt. Receive control signals from Pratt.
May 28 - June 3, 1999:	Intensive testing of system. Installation crew remains on East Amatuli while control signals from Pratt move cameras through the initial test program.
June 10 - 15, 1999:	Travel to East Amatuli with USFW crew. Inspect and provide necessary maintenance for remote camera system.
June - August, 1999:	Education programs at the Pratt Museum.
June 25 - August 25, 1999:	Travel to East Amatuli as necessary to maintain system. Estimate two trips.
September 15, 1999:	Remove system from East Amatuli. Remove relay equipment from relay site.
October - December, 1999:	Evaluate project.
April 15, 2000:	Submit reports.

B. Project Milestones and Endpoints

April, 1999:	Install receiver station at the Pratt Museum and relay station.
May, 1999:	Install video system at Barren Islands.
October - December, 1999:	Analysis and evaluation of data.
April 15, 2000:	Submit report to chief scientist.

C. Completion Date

A final report documenting and evaluating use of the video system by the public and local schools and evaluating the systems capabilities for collecting seabird data will be submitted to the chief scientist on April 15, 2000.

PUBLICATIONS AND REPORTS

A short report will be produced by the USFWS that will evaluate the video system's capabilities for collecting data on seabirds. The Pratt Museum will prepare a similar report on findings which relate to public outreach and education.

Due to the uniqueness of the remote video project, the Pratt Museum plans to submit articles about the project for inclusion in Museum publications such as *Current: the Journal of Marine Education* (a publication of NMEA), *Curator* (a publication of AAM), *Informal Science Review* (a publication of Informal Science Inc. in Washington DC), and *Network* (a publication of Museums Alaska).

PROFESSIONAL CONFERENCES

Museums Alaska is a statewide museum association that will be meeting in Anchorage in September of 1998. They produce the publication *Network.* The Pratt Museum will help host this conference and will arrange to incorporate a presentation on the East Amatuli Island Video Link into the agenda.

As a part of this proposal, the Pratt Museum has requested funding for staff attendance and presentations at one of the following conferences (to be selected pending determination of conference agendas).

ASTC (Association of Science-Technology Centers) "is a non profit organization of science centers and museums that are dedicated to furthering the public understanding of science. ASTC encourages excellence and innovation in informal science learning by serving and linking its members worldwide and advancing their goals." They will be meeting in the spring of 1999.

NMEA (National Marine Educators Association) "brings together those interested in the study and enjoyment of the world of water." They produce the publication *Current: The Journal of Marine Science.* Their conference will take place in the fall of 1999.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project will be coordinated with the APEX Project 99163J and the Alaska Maritime National Wildlife Refuge.

PROPOSED PRINCIPAL INVESTIGATOR, IF KNOWN

Name:	Michael O'Meara
Affiliation:	Pratt Museum, *Kachemak Bay Discovery* Project Director
Mailing address:	3779 Bartlett Street, Homer, Alaska 99603

Revision 12-11-98
Approved TC 12-15-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$5.6
Travel		$0.0
Contractual		$64.9
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$70.5
General Administration		$5.3
Project Total	$0.0	$75.8
Full-time Equivalents (FTE)		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Agency: DOI-FWS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Dave Roseneau	Scientific Supervisor/Wildlife Biologist (range 11/5)		0.5	4.9		2.5
Arthur Kettle	BioTech (range 7/1)		1.0	3.1		3.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.5	8.0	0.0	
					Personnel Total	$5.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Agency: DOI-FWS

FORM 3B
Personnel
& Travel
DETAIL

12/11/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1998
Description	
4A Linkage (grant to Pratt Museum)	64.9
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$64.9

Commodities Costs:	Proposed FY 1998
Description	
Commodities Total	$0.0

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Agency: DOI-FWS

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			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: Description	Number of Units	Inventory Agency

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Agency: DOI-FWS

FORM 3B
Equipment
DETAIL

FY 99 Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$11.4
Travel		$1.7
Contractual		$45.0
Commodities		$3.0
Equipment		$0.0
Subtotal		$61.1
Indirect		$3.8
Project Total		$64.9
Full-time Equivalents (FTE)		
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003		
$0.0	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments: 1. Salaries under contractual costs are for system modification and specialization for Barren Island conditions.
2. Indirect costs are general administration, project accounting, facility overhead, phone, fax, repair, copying, clerical support, and contract **monitoring.**

3. The Pratt Museum has received a $175,000 grant from the Howard Hughes Medical Institute for the Kachemak Bay Discovery Program. The museum has also received a $10,000 grant from the Alaska Department of Environmental Conservation and the Environmental Protection Agency.

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Name: Pratt Museum

FORM 4A
Non-Trustee
SUMMARY

Prepared: 12/11/98

FY 99 Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to September 30, 1999

Personnel Costs: Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
						0.0
Michael O'Meara	PI		0.8	3.6		2.9
Carol Harding	Outreach Coordinator		1.0	3.6		3.6
Gail Parsons	Educator		1.0	3.3		3.3
(as appropriate)	Staff Technician		0.5	3.2		1.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.3	13.7	0.0	
					Personnel Total	$11.4

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Homer-Anchorage for EVOS workshop (1 person)	0.2	1	4	0.1	0.6
Homer-Washington, D.C. for ASTC (1 person)	0.6	1	5	0.1	1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.7

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Name: Pratt Museum

FORM 4B
Personnel & Travel DETAIL

Prepared: 12/11/98

FY 99 Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to September 30, 1999

Contractual Costs:			Proposed FY 1998
Description			
Broadcast Services of Alaska for:			
Lease of equipment, licenses for video and control signals (equipment includes video, audio, motion control, transmit and receive equipment)			15.0
Salary - Daniel Zatz and assistant engineer (January-May 1999)			22.5
Installation including transportation of personnel and equipment	via boat	3.7	
	via helicopter	1.3	5.0
Maintenance June through September 1999			2.5
		Contractual Total	$45.0

Commodities Costs:	Proposed FY 1998
Description	
Computer and video supplies and miscellaneous cables. Supplies and services to modify exhibit space to accommodate control system and video monitor.	3.0
Commodities Total	$3.0

FY 99

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Name: Pratt Museum

FORM 4B
Contractual & Commodities DETAIL

Prepared: 12/11/98

FY 99 Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to September 30, 1999

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1998
			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	
Description	of Units	

FY 99

4 of 4

Project Number: 99434
Project Title: East Amatuli Island Remote Video Link
Name: Pratt Museum

FORM 4B
Equipment
DETAIL

Prepared: 12/11/98

Revised 7-7-98
Approved TC 8-13-98

Harbor Seal Recovery: Effects of Diet on Lipid Metabolism and Health

Project Number:	99441
Restoration Category:	Research
Proposer:	R. Davis/Texas A&M Univ.
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	Yes
New or Continued:	New
Duration:	1st yr. 2 yr. project
Cost FY 99:	$140.9
Cost FY 2000:	$131.6
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound, Seward
Injured Resource/Service:	Harbor seals

ABSTRACT

To better understand the results from field studies of harbor seal health, body condition, and feeding ecology, data are needed on diets that vary in nutritional composition. Working with the Alaska SeaLife Center, this project will determine how fatty acid profiles in the blubber of captive harbor seals change over time during controlled diets of pollock and herring. In addition, it will assess the aerobic capacity and lipid metabolism of skeletal muscle in harbor seals fed controlled diets and in wild harbor seals in Prince William Sound. The results will augment already funded investigations of diet and health to provide a more in-depth understanding of the nutritional role and assessment of dietary fat for harbor seals.

INTRODUCTION

Understanding the feeding ecology and nutritional status of harbor seals (*Phoca vitulina richardsi*) is an essential component of ecosystem-based research on the recovery of species impacted by the Exxon Valdez oil spill in Prince William Sound. Until recently, determinations of prey preferences for pinnipeds have been based on stomach content and fecal analyses, both of which can only yield information on the most recent meals and may be biased due to differential rates of passage of food items. A new technique using fatty acid profiles of blubber can provide details on recent meals as well as past diet history. It can also, in some cases, be used to determine foraging habitat. In pinnipeds, as with other carnivores and monogastric animals, dietary fatty acids generally remain intact through the digestion process and are deposited in adipose tissue with little or no modification (1). As a result, differences in the fatty acid composition of carnivore blubber can be used to infer dietary differences between individuals or populations and perhaps even species composition of the diet.

Previous research has shown that fatty acid signatures are significantly affected by spatial or temporal heterogeneity in habitat and food webs (1). In a study of harbor seal foraging ecology (Project 117-BAA; Harbor seal blubber and lipids) supported by the Restoration Program, Iverson, et al (2) were able to distinguish individual species of fish using fatty acid signatures. They also found fatty acid composition of these prey items to be correlated with body size as well as location within a study area. Hence, analysis of fatty acids in pinnipeds and their prey should provide details on the spatial scales of foraging and habitat use of both individuals and populations. Evaluating how harbor seal blubber fatty acids change with diet during controlled feeding studies where species composition of diet is known will improve the spatial and temporal interpretation of fatty acid profiles of wild seals whose diet composition is unknown.

Muscle condition and metabolic function can be used as indicators of the health status of marine mammals. Important indices of muscle function and health are aerobic capacity, the ability to store oxygen in the form of oxy-myoglobin and the size of lipid stores. In a preliminary study conducted by our laboratory (3), we observed that the volume density of mitochondria, myoglobin concentration and citrate synthase activity in the swimming muscles of harbor seals were elevated relative to terrestrial mammals and appeared to be an adaptation for aerobic metabolism during diving. One objective of this study is to study the effect of diet on the aerobic capacity, myoglobin concentration and lipid stores of skeletal muscles in harbor seals. In addition, we will measure the activities of citrate synthase and *B*-hydroxyacyl CoA dehydrogenase (an enzyme important for lipid metabolism) as indicators of aerobic capacity and the *B*-oxidation of fatty acids, respectively.

The Restoration Program has supported the population monitoring component of health assessment, diving behavior and food preferences of harbor seals in Prince William Sound. Now, with controlled feeding studies of harbor seals to begin at the Alaska SeaLife Center, we are in a position to study the effects of diet on fatty acid signatures in blubber and the metabolic function of muscle, especially with regards to lipid. The results will improve our understanding of harbor seal feeding ecology and the effects of diet on health and metabolism.

NEED FOR THE PROJECT

A. Statement of Problem

The Restoration Program has supported three harbor seal studies in Prince William Sound (Project 001- Harbor seal condition and health status; Project 064- Monitoring habitat use and trophic interactions of harbor seals; Project 117-BAA- Harbor seal blubber and lipids). One objective of these studies has been to measure health and body condition indices related to metabolic alterations that might occur in animals that were food deprived. Although these studies collected much useful information, some researchers realized that controlled dietary studies were needed to more completely interpret field data. In 1997, the Restoration Program funded a captive study (Harbor Seal Recovery. Phase II: Controlled Studies of Health and Diet) at the Alaska SeaLife Center that will quantify the nutritional value of several key Alaskan fish species for harbor seals and will follow health indices over time in both healthy and rehabilitation animals. That project will feed controlled diets of fish to harbor seals to examine changes in body condition, health, assimilation efficiency and blood chemistry biomarkers. Of particular interest will be the health and body condition effects of diets containing nutritionally poor (compared to herring) fish such as pollock, the so-called "junk food" hypothesis for explaining the decline of certain pinniped stocks. In the proposed research, we will take advantage of the controlled feeding studies at the Alaska SeaLife Center to examine the effects of diet on: 1) fatty acid markers in the blubber, 2) muscle condition and 3) lipid metabolism. In addition, we will use samples of blubber and muscle obtained by the BIOSAMPLING Program in Prince William Sound for comparison with captive seals fed known diets. This important work will augment already funded investigations of diet and health to provide a more in depth understanding of the nutritional role and assessment of dietary fat for harbor seals.

B. Rationale

The harbor seal population in Prince William Sound has not recovered and may continue to decline. An underlying hypothesis is that ecosystem wide changes in food availability could be affecting harbor seal population recovery. To better understand the behavioral and physiological results obtained from field studies of harbor seal health, body condition and feeding ecology supported by the Restoration Program, we need comparable data for seals on diets that vary in nutritional composition. In 1998, a captive study will begin at the Alaska SeaLife Center that will quantify the health effects of feeding several key Alaskan fish species to harbor seals. We propose to augment this study by examining changes in fatty acid profiles in seal blubber and muscle lipid content during controlled feeding studies where fish species composition is known. In addition, we will quantify the aerobic capacity and activities of enzymes that are crucial for muscle lipid metabolism and which may be affected by nutritional stress.

C. Location

The experiments for this project will be conducted at the Alaska SeaLife Center in Seward. We will collaborate with existing projects that will examine the detailed metabolic alternations in stable isotope ratios (Schell/Project 170) and changes in body condition and health indices

(Castellini/Project 341) in harbor seals that occur under different feeding regimes.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Field studies of harbor seals have been assisted by Native communities in conjunction with the BIOSAMPLING program (Project 96244). We will continue that collaboration by analyzing samples of muscle, blubber and other tissues taken as part of subsistence hunting

PROJECT DESIGN

A. Objectives

1. Determine how fatty acids in the blubber of captive harbor seals change over time during controlled diets of herring and pollock.

2. Measure the content and composition of lipid in muscle of captive harbor seals fed controlled diets and for wild harbor seals in Prince William Sound.

3. Assess the aerobic capacity and lipid metabolism of skeletal muscle in harbor seals fed controlled diets and for wild harbor seals in Prince William Sound.

B. Methods

1. Hypotheses to be Tested.

1. Null hypothesis: Fatty acid profiles in the blubber of harbor seals are not affected by the fatty acid composition of the diet.

   Alternative hypothesis: Fatty acid profiles in the blubber of harbor seals will be directly affected by the fatty acid composition of the diet and will change as the diet is altered.

   Methodology: Feed controlled diets of different fish species to captive harbor seals. Assess temporal changes in the fatty acid composition of the blubber by taking serial biopsies. Compare with samples obtained from the BIOSAMPLING program of wild harbor seals in Prince William Sound.

2. Null hypothesis: Mitochondrial volume density, myoglobin concentration, lipid content, and the enzymatic activities of citrate synthase and *B*-hydroxyacyl CoA dehydrogenase are not affected by diet.

   Alternative hypothesis: These variables of muscle condition and function are affected by changes in diet.

Methodology: Feed controlled diets of different fish species to captive harbor seals. Assess temporal changes in the these variables by taking serial muscle biopsies. Compare with samples obtained from the BIOSAMPLING program of wild harbor seals in Prince William Sound.

2. Harbor Seal Feeding Trials Conducted at the Alaska SeaLife Center (ASLC).

Animals. Eight harbor seals have been acquired by the ASLC for the feeding trials. Dietary protocols have been developed by Dr. Michael Castellini (Research Director at ASLC) for EVOS Project 99341. In the event that our proposed study is funded, Dr. Castellini has already agreed to obtain blubber and muscle biopsies from the seals during the controlled phase (herring only) of the dietary studies during the summer 1998. Beginning in FY99, we would begin direct participation in the feeding studies. During the staggered feeding trials, the diet will be changed every four months. During these dietary manipulations, we will obtain serial blubber and muscle biopsies of not less than once per month from two sites on each animal.

Design for Feeding Trials. A detailed matrix of the feeding schedule has been developed by Dr. Castellini and is shown below. The procedure will use a cross-over repeated measures approach and will allow statistical comparisons within any one group of seals between diet and season. Statistical software (SYSTAT) will be used to analyze the cross-over method. However, there are several considerations that must be addressed using this matrix.

CROSS-OVER REPEATED MEASURES ANOVA FEEDING TRIALS
FOR HARBOR SEALS

Period	Herring	Pollock	Condition
Sept-Dec 1998	Seals A,B,C	Seals D,E,F	Molting
Jan-April 1999	D,E,F	A,B,C	Spring
May-Aug 1999	A,B,C	D,E,F	Breeding
Sept-Dec 1999	D,E,F	A,B,C	Molting
Jan-April 2000	A,B,C	D,E,F	Spring
May-Aug 2000	D,E,F	A,B,C	Breeding

Two seals (G,H) will be in a separate feeding trial. They will follow alternating four month periods of herring and pollock, but for these animals feeding frequency and total mass fed will be varied every two weeks. For these two animals, blubber biopsy samples will be obtained at the end of each two week feeding period. Since the biopsies are small (see below), this should not affect the animals' health.

This feeding matrix allows each group of seals to experience a different diet at similar physiologically relevant times of the year. Group A,B,C for example, will receive a herring diet during the molting season in Year 1 and a high pollock diet in Year 2. We will work during the

summer of 1998 to establish the highest amount of pollock in a diet that will be accepted by the animals. We expect this to be at least 75-80% pollock.

A problem with cross-over ANOVA designs is that residual or carry-over effects from previous treatments can complicate the analysis. We correct for this with long test periods and phased cross-overs. That is, since each feeding trial will last for four months, several weeks of diet switching will be allowed. This provides the additional advantage of allowing us to study the impact of the phased switch on blubber and muscle lipid content and composition, and on muscle lipid metabolism.

Blubber Biopsies. Blubber samples will be obtained through the full depth of blubber layer with a 6-mm punch biopsy inserted through a small incision in the skin. Samples will be immediately transferred to liquid nitrogen and stored at -80° C until analysis. Total lipids will be extracted in chloroform according to Folch et al. (4) as modified by Iverson (5). Fatty acid methyl esters (FAME) will be prepared from the purified lipid extracts using the Hilditch reagent (0.5 N H_2SO_4 in methanol). FAME for fish in the controlled diets will be obtained similarly from homogenates of individual food items. The methyl esters will be analyzed by temperature-programmed capillary gas-liquid chromatography. FAME will be identified and quantified using a combination of standard mixtures, including those identified using chromatography and an ion-trap mass detector. Individual fatty acids, expressed as weight percent of the total fatty acids, will be analyzed using classification and regression trees (CART) in S-plus (StatSci, Seattle), a non-parametric multivariate technique for classifying data. CART uses a series of algorithms to split data into groups as differently as possible, based on measures of deviance; the splitting continues in a tree-like form until a classification is made at a terminal node. The analysis of blubber fatty acids is already being conducted in our laboratory in collaboration with Dr. Sara Iverson (University of Halifax) as part of a feeding ecology study of Steller sea lions. This collaboration will continue during the proposed harbor seal study.

Muscle Biopsies. Two muscle samples of approximately 50 mg each will be collected with a 6 mm biopsy cannula (Depuy, Warsaw, Indiana) from both the swimming (*M. longissimus dorsi*) and non-swimming (*M. pectoralis*) muscles. Control samples will be collected from the *M. soleus*, a predominantly slow oxidative muscle, of laboratory rats (*Sprague Dawley*) euthanized by cervical dislocation after 2-3 min of carbon dioxide anesthesia. Muscle samples will be placed either into 2% glutaraldehyde fixative or frozen in liquid nitrogen immediately upon collection. Samples will remain in the fixative for a minimum of 48 hours but no longer then 14 days before being transferred and stored in 0.1 M cacodylate buffer pH 7.4. Frozen samples will be stored at -70 ° C until analysis for citrate synthase activity, *B*-hydroxyacyl CoA dehydrogenase activity and myoglobin concentration.

Electron Microscopy of Muscle Samples. Fixed muscle samples will be rinsed in cacodylate buffer and post-fixed for 2 hours in a 1% solution of osmium tetra oxide. They will be stained 'en bloc' with 2% uranyl acetate overnight in a refrigerator. After dehydration with increasing concentrations of ethanol (50-100%), they will be passed through propylene oxide and increasing concentrations of epoxy (50-100%). The samples are finally embedded in fresh epoxy and allowed to polymerize overnight at 60 ° C. Thick sections (1 mm) will be cut with a Leica Ultratome and stained with toulidine blue to determine fiber orientation. Ultrathin (50-70 nm), transverse sections will be cut and contrasted with

lead citrate from 4 randomly chosen blocks per muscle. Micrographs will be taken with a Phillips 201 transmission electron microscope. The number of micrographs per muscle analyzed will range from 25 and 40, yielding relative standard errors of less than 10% in all muscles. Determination of the volume density of mitochondria, myofibrils and lipid droplets will be performed at a final magnification of x19,250 using standard point counting procedures (6, 7). The electron microscopy will be conducted under the supervision of Dr. Odile Mathieu-Costello at the University of California at San Diego (see attached letter).

Citrate Synthase, B-hydroxyacyl CoA dehydrogenase and Myoglobin Assays of Muscle Samples. Frozen muscle samples will be weighed and then homogenized at 0° C in 1 ml of buffer containing 1 mmol L^{-1} EDTA, 2 mmol L^{-1} $MgCl_2$, and 75 mmol L^{-1} Tris-HCl, pH 7.6 at 25 ° C (8). The homogenates will be spun at 2,900 g for 30 minutes at 4° C. 500 ml from each supernatant will be prepared for myoglobin assay and the rest will be used for the analysis of citrate synthase. Citrate synthase and *B*-hydroxyacyl CoA dehydrogenase will be assayed on a Beckman DU series 64 spectrophotometer according to the method of Reed et al. (1994). Assay temperature will be maintained at 37 ° C using a constant temperature water bath and a water-jacketed cuvette holder. The assay conditions for citrate synthase (CS; EC 4.1.3.7) will be 50 mmol L^{-1} imidazole, 0.25 mmol L^{-1} 5,5-dithiobis (nitrobenzoic acid, DTNB), 0.4 mmol L^{-1} acetyl CoA, and 0.5 mmol L^{-1} oxaloacetate, at pH 7.5; DA_{412}, e_{412} = 13.6 (8). For *B*-hydroxyacyl CoA dehydrogenase (HAD; EC 1.1.1.35), the assay conditions will be 50 mmol L^{-1} imidazole, 1 mmol L^{-1} EDTA, 0.1 mmol L^{-1} acetoacetyl CoA, and 0.15 mmol L^{-1} NADH, pH 7.0 at 37° C; DA_{340}, e_{340} = 6.22 (9). Enzyme activities (mmol min^{-1} g^{-1} wet mass muscle) will be calculated from the rate of change in absorbance at the maximum linear slope. Myoglobin will be assayed according to the method of Reynarfarje (1963) with the following modifications. A portion (500 ml) of the supernatant is further diluted with 1 ml of phosphate buffer (0.04 M, pH 6.6). The resulting mixture is centrifuged for 50 min at 28,000 g at 4°C. The supernatant is bubbled with carbon monoxide for three min. Spectrophotometric absorbance will be measured at 538 and 568 nm, and the concentration of myoglobin in milligrams g^{-1} wet mass of muscle will be calculated as:

$$(Abs_{538} - Abs_{568}) \times 5.865 [(1.5/0.5) \times (\text{mass of sample})]$$

Statistical Analysis. Results will be expressed as the mean ± one standard error. We will use a cross-over repeated measures approach that will allow statistical comparisons within any one group of seals between diet and season. Statistical software (SYSTAT) will be used to analyze the cross-over method. The relative proportions of fatty acids from blubber samples of seals in the controlled feeding study will be used as a basis for generating tree-based models (using S-Plus; StatSci, Seattle) of groups or classes of samples such that new samples (obtained via BIOSAMPLING) can be compared with the modeled classes to decide their membership, i.e. obtain a classification of their "diet". Similarly, classification and regression trees will be used to screen the set of prey fatty acids and choose a subset of those fatty acids which can be used to classify the "diets" of seals based the patterns of fatty acid proportions in their blubber.

3. Blubber and Muscle Samples Obtained from the BIOSAMPLING Program in Prince William Sound.

The main swimming muscle of 10 harbor seals will be obtained during BIOSAMPLING Program. The entire muscle will be removed and weighed, and three transverse subsamples will be taken along the muscle bundle. Each subsample of the swimming muscle will be precisely labeled for its orientation and location within the animal. These will then be further subsampled along points on a circular grid using a stainless steel borer, averaging 35 samples per muscle section. Cores of tissues weighing 200 and 300 mg will be removed for assay. A spectrophotometric technique will be used to determine myoglobin, citrate synthase, and *B*-hydroxyacyl CoA dehydrogenase concentration (see above for details). Detailed contour maps and statistical tests for all concentrations will be made using a PC based program S-Plus (Stat-Sci, Seattle). Blubber samples will also be obtained from the same approximate anatomical location as on animals used in the captive studies and stored frozen in airtight plastic bags . Blubber samples will be analyzed according to the protocols described in Section 2 of this proposal.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

Each feeding trial will take four months beginning in September, 1998.

September	Set up fatty acid analysis and muscle lipid and enzyme analysis
September-December	Trial 1 of staggered feeding protocol at ASLC. Obtain and analyze blubber and muscle biopsies.
January-April	Trial 2 of staggered feeding protocol. Obtain and analyze blubber and muscle samples.
May-August	Trial 3 of staggered feeding protocol. Obtain and analyze blubber and muscle samples. Obtain blubber and muscle samples from wild harbor seals in Prince William Sound in conjunction with BIOSAMPLING Program.

B. Project Milestones

FY 99:	Establish protocols for feeding studies; obtain and analyze blubber and muscle samples during feeding studies at ASLC.
FY 00:	Continue to obtain and analyze blubber and muscle samples during feeding studies at ASLC; obtain and analyze blubber and muscle samples from seals in Prince William Sound in conjunction with BIOSAMPLING Program; analyze all data and prepare reports and manuscripts

C. Completion Date

This project will finish on September 30, 2000.

PUBLICATIONS AND REPORTS

Since this is a new project, there are no current publications from the proposed research. However, the results from a preliminary study of the aerobic capacity and lipid content of muscles from harbor seals in Prince William Sound has been submitted to the Journal of Applied Physiology. We do not anticipate any referred articles in FY 99. However, by FY 2000 most of the data will be analyzed and manuscripts in preparation. We anticipate several publications by 2001 on the affects of diet on fatty acids in blubber and the aerobic capacity and lipid metabolism in harbor seal muscle.

PROFESSIONAL CONFERENCES

The PI requests funds to attend the annual EVOS workshops each year.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

We will be working in close coordination with Dr. Michael Castellini (PI on Harbor Seal Recovery. Phase II: Controlled Studies of Health and Diet) and staff at the Alaska SeaLife Center (see attached letter). Dr. Castellini will be supervising the controlled diet studies. We will coordinate our blubber and muscle samples with the veterinary staff at ASLC. Samples obtained from the BIOSAMPLING program will be coordinated with Mr. Short, who is the Spill Area-wide Coordinator for the Trustee Council.

PROPOSED PRINCIPAL INVESTIGATOR

Dr. Randall Davis
Dept. Marine Biology
Texas A&M University at Galveston
Galveston, TX 77553
Phone: 409-740-4712
Fax: 409-740-5002
email: davisr@tamug.tamu.edu

Approved TC 8-__-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999						
Personnel		$0.0						
Travel		$0.0						
Contractual		$123.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$123.0		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$8.6						
Project Total		$131.6		$131.6				
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

NOTE: FY 2000 estimate includes GA ($123.0 + GA).

TOTAL PROJECT COST: $131.6
+ 9.3 ASLC Bench Fees
$140.9

FY 99

Project Number: 99441
Project Title: Effects of Diet on Harbor Seal Lipid Metabolism and Health
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$47,535.0
Travel		$21,200.0
Contractual		$5,300.0
Commodities		$10,800.0
Equipment		$0.0
Subtotal	$0.0	$84,835.0
Indirect @ 45% ($84,835)		$38,176.0
Project Total	$0.0	$123,011.0
Full-time Equivalents (FTE)		12.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$123,011.0		

Dollar amounts are shown in thousands of dollars.

Comments:

Indirect Costs @ 45% of Modified Total Direct Cost. The indirect cost rate is a predetermined rate established by the the Department of Health and Human Services dated 9/9/97.

Fringes are calculated @ 15.5% of Salaries and Wages for Principal Investigator and Research Assistant. 8.25% is the calculation for the Graduate Research Assistant. Included in the fringe category is a fixed rate for medical insurnace. The rate is a calculation based on the percentage of effort. The Principal Investigator is calculated @ $370/mo. The Research Assistant and Graduate Research Assistant is calculated @ $298/mo.

FY 99

Prepared: 4/9/98

Project Number: 99441-BAA
Project Title: Harbor Seal Recovery Phase III: Effects of Diet on Lipid Metabolism and Health
Name: Texas A&M Research Foundation

FORM 4A
Non-Trustee
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1999
						0.0
R. Davis	Principal Investigator		3.0	8412.3		25,236.9
Vacant	Research Assistant		6.0	2183.0		13,098.0
Vacant	Graduate Research Assistant		3.0	3066.7		9,200.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		12.0	13662.0	0.0	
					Personnel Total	$47,535.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
To Seaward, Alaska for research at Alaska SeaLife Center (4 people)	1200.0	4	120	100.0	16,800.0
Car Rental in Seaward, Alaska	40.0	30	0	0.0	1,200.0
To Anchorage, Alaska for EVOS workshop	1200.0	1	5	100.0	1,700.0
To Halifax, Canada for gas chromatograph analysis	1000.0	1	5	100.0	1,500.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$21,200.0

FY 99

Prepared:4/9/98

Project Number:

Project Title: Harbor Seal Recovery Phase III: Effects of Diet on Lipid Metabolism and Health

Name: Texas A&M Research Foundation

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Gas Chromatograph analysis (To Be Named)	2,500.0
Electron Microscope analysis (University of California, San Diego)	2,500.0
Communications-Long distance telephone charges	300.0
Contractual Total	$5,300.0

Commodities Costs:	Proposed
Description	FY 1999
Expendable supplies and chemicals	10,000.0
Shipping of blood for analysis	300.0
Publication and Page Charges	500.0
Commodities Total	$10,800.0

FY 99

Prepared:4/9/98

Project Number:
Project Title: Harbor Seal Recovery Phase III: Effects of Diet on Lipid Metabolism and Health
Name: Texas A&M Research Foundation

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	

FY 99

Prepared:4/9/98

Project Number:

Project Title: Harbor Seal Recovery Phase III: Effects of Diet on Lipid Metabolism and Health

Name: Texas A&M Research Foundation

FORM 4B Equipment DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$8.7
Commodities		$0.0
Equipment		$0.0
Subtotal		$8.7
General Administration		$0.6
Project Total		$9.3
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

FY 99

Project Number: 99441
Project Title: Bench Fees: Effects of Diet on Harbor Seal Lipid Metabolism and Health
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Revised 7-8-98
Approved TC 12-15-98

Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska

Project Number:	99459
Restoration Category:	Monitoring
Proposer:	G. Irvine/USGS-BRD, D. Mann/UAF, J. Short/NOAA
Lead Trustee Agency:	DOI
Cooperating Agencies:	NOAA
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 2 yr. project
Cost FY 99:	$124.9
Cost FY 2000:	$40.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Kodiak, Alaska Peninsula, Kenai Peninsula
Injured Resource/Service:	Designated wilderness areas, mussels, intertidal communities

ABSTRACT

For at least five years after the spill, oil mousse persisted on the exposed rocky shores of the Alaska and Kenai peninsulas in a remarkably unweathered state. This project will resample these boulder-armored beach sites that were last studied in 1994. In addition, several oiled mussel beds in the Gulf of Alaska that had relatively high levels of oiling in 1993 will be resampled, to compare residual oiling of these with oiled mussel beds in Prince William Sound. A mixture of qualitative and semi-quantitative approaches will be used.

INTRODUCTION

This proposal is focused on shoreline oiling in the Gulf of Alaska, the continued presence of subsurface oiling, and the situations that promote oil persistence and retard weathering of stranded oil. The continued contamination of shorelines and biotic communities by residual *Exxon Valdez* oil, especially slowly weathering oil, is a concern of direct relevance to the recovery status of injured resources and services. The *Exxon Valdez* oil spill directly affected the scientific and recreational values including wilderness characteristics of shorelines in Kenai Fjords National Park and Katmai National Park and Preserve. The injury to these values and characteristics is continued by the persistence of oil that degrades the "naturalness" of the coasts. These values and characteristics are clearly stated in both ANILCA (1980) and the Wilderness Act (1964). Additionally, the retention of oil by mussel beds in the Gulf of Alaska and its retarded weathering is of some concern, as the mussel beds are reservoirs of oil that could be released into the environment or contaminate foragers of the mussels.

The exposed Gulf of Alaska habitats where oil has persisted and mussel beds share some common features. They have complicated three-dimensional spatial structures, which allow stranding oil to penetrate into more protected sediments beneath an "armor" of boulders or mussels. Oil thus sequestered is slower to weather (Babcock et al. 1994, 1996, 1997; Irvine and Cusick 1995; Irvine et al. 1997, 1998; Short and Heinz 1997). In fact, oil sampled five years post-spill at sites along national park coasts distant from the spill point was negligibly different from 11-day old *Exxon Valdez* oil (Irvine et al. 1997, 1998). The oil contaminating these coasts was mousse, a water-in-oil emulsion that weathers more slowly internally (Payne and Phillips 1985) and can serve to transport less weathered oil over long distances (Irvine et al. 1997, 1998).

In general, the shorelines impacted by *Exxon Valdez* oil in the Gulf of Alaska region experience higher wave energy than those inside Prince William Sound (Hayes et al. 1977; Hayes and Ruby, 1979; Domeracki et al. 1981; Hayes 1986). Gravel beaches, those composed of mixtures of sand, pebbles, cobbles and boulders, are the most common type of non-bedrock shorelines in the Gulf of Alaska region (Hayes et al. 1976). Gravel beaches exposed to moderate and high wave energies characteristically develop a lag of boulders (stones > 25 cm in diameter) after smaller stones are winnowed away by waves. This boulder lag forms an "armor" that shields the gravel substrate from wave disturbance. Unaffected by all but the largest storm waves, the gravel substrate under a boulder armor can remain undisturbed for years. Observations in the study plots we have established to monitor the persistence of surface oil in Kenai Fjords and Katmai National Parks suggest that on 5 of 6 boulder-armored beaches, no shifting of the boulder armor occurred for 6 years post-spill (Mann et al. 1995).

The length of time that spilled oil remains on a shoreline is thought to depend on the vigor of wave action (Vandermuelen 1977; Gundlach 1983). Frequent large waves breaking on a beach cause vigorous natural cleaning and consequently a short residence time for stranded oil. However, the *Exxon Valdez* spill affected numerous gravel beaches, many possessing the boulder armoring just described. While high wave energy does seem to limit the persistence of surficial

oil on gravel beaches, it may have little effect on the persistence of subsurface oil. Subsurface oil can persist even within high wave-energy gravel beaches because the boulder armor prevents waves from stirring the beach substrate.

Results of our several-year study of oil fate and persistence on beaches in Kenai Fjords and Katmai National Parks indicate sizable reductions in the amount of surficial oiling there. However, observations made in 1994 indicate that significant amounts of subsurface oil remain within gravel beaches along the Katmai coast of Shelikof Strait, even after these beaches were cleaned at the surface. Similar inferences emerge from the studies of Michel and Hayes (1993a, 1993b, 1994, 1996) and Neff et al. (1995) on the fate of shore-stranded oil on Prince William Sound shorelines. This study will continue our monitoring of persistent oil in the Gulf of Alaska region on previously established sites along national park coastlines.

Study History:
Both the stranded oil persistence study and the oiled mussel bed study were previously funded by the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). The oil persistence study (R103B, 93090, 94266) was funded for field work in 1992 and 1994. Six moderately to heavily oiled sites along the Gulf of Alaska coasts of Kenai Fjords National Park and Katmai National Park and Preserve were studied for both surficial and subsurface oiling changes, and oil samples were analyzed to examine the degree of weathering of the oil. Although five of these sites were very high energy beaches, oil mousse persisted in a remarkably unweathered state on these boulder-armored beaches. Mousse sampled in 1989, 1992, and 1994 showed negligible changes in polynuclear aromatic hydrocarbons compared to 11-day old *Exxon Valdez* crude (Irvine et al. 1997, 1998). Our findings also suggest that the low ecological sensitivity ratings previously applied to exposed, rocky shorelines need to be modified when boulder-armored beaches are present. Because the weathering of the oil was so slight, we feel that a resampling of these beaches 10 years post-spill is desirable.

The study of oiled mussel beds in the Gulf of Alaska (R103B, 93090, 95090), was a companion to studies of oiled mussel beds in Prince William Sound being spearheaded by NOAA. The objectives of the previous study were to establish the geographical extent and intensity of the oiling of mussel beds, and to determine the rate of recovery of those beds that were oiled. We are proposing to resample the 3 sites sampled in 1995 that had the highest levels of oiling.

NEED FOR THE PROJECT

A. Statement of Problem

Oil from the wrecked T/V*Exxon Valdez* spread from Prince William Sound out into the Gulf of Alaska, stranding on coastlines of the Kenai and Alaska Peninsulas and the Kodiak Archipelago. As recently as 1993 and 1994, oil remained in particular types of locations in the Gulf of Alaska. These included boulder-armored intertidal beaches and mussel beds. As stated on page 19 of the

Invitation to Submit Restoration Proposals, "The oil that remains in the environment and the extent and significance of any biological exposure to that oil continues to be an important concern of direct relevance to the recovery status of injured resources and services."

The persistence of oil on national park coastlines (sites are located on Kenai Fjords and Katmai National Parks) constitutes injury to the scientific, recreational, and wilderness values of the parks. While we assess the significance of the oiling, we will also be assessing the recovery of oiled sediments through natural processes of physical and chemical weathering of the oil.

The three-dimensional topography of mussel beds creates a situation similar to that of boulder-armored beaches, where oil has penetrated finer sediments beneath the mussels but is protected to some extent from disturbance and weathering processes. The same questions regarding the retention and weathering can be asked for mussel beds as for the boulder-armored beaches. Additionally, since predators feed on the mussels, there is the potential for exposure of the predators to hydrocarbons. In the Nearshore Vertebrate Predator project in PWS, invertebrate-feeding predators (sea otters and Barrow's goldeneye ducks) have shown elevated levels of biomarkers that may indicate increased exposure of the animals to hydrocarbons, though the linkages to sources and the significance of the results are not known.

B. Rationale/Link to Restoration

This project has a very basic link to oil spill effects: we are studying the persistence and degradation of stranded oil. The project is primarily a monitoring project. The monitoring elements are straightforward reassessments of the persistence and degradation of oil on boulder-armored beach sites and in oiled mussel beds. On the oiled shorelines, we will continue to monitor surface-oil weathering at six sites already established in the Gulf of Alaska, as well as subsurface oiling. Both physical and chemical weathering of the oil will be assessed. The re-assessment of these previously sampled sites is the essential core of our proposal. Oiled mussel beds will be resampled at three locations using previously established techniques to determine the chemical weathering of hydrocarbons in both mussel tissue and sediments underlying the mussels. The results obtained will help describe the progress of recovery of oiled sediments and biota. Results will guide decisions about whether future restoration efforts are desirable and how they might be implemented.

Our results will also help predict the effects of future oil spills in this region and guide future oil-spill response efforts. In particular, our results suggest that a revision to the Ecological Sensitivity Indices (ESI's) for boulder-armored exposed rocky shores may be necessary, and that instead of being rapidly cleansed by wave action, these sites are locations where oil may persist for decades with minimal weathering. This revision could lead to changes in how these habitats are dealt with following spills.

C. Location

Sites that will be resampled are located in the Gulf of Alaska along Kenai Fjords and Katmai National Park coasts, and the outer Kenai Peninsula.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

At present, there are no communities in the vicinity of the study areas. We will be happy to present information to the nearest local communities and/or prepare lay abstracts of our work.

PROJECT DESIGN

A. Objectives

1. Monitor (a) surface and (b) subsurface oil at 6 previously established sites along the Gulf of Alaska coast. Determine the physical extent and chemical weathering of the oil.

2. Monitor recovery of a select subset (3) of previously sampled Gulf of Alaska oiled mussel beds.

B. Methods

Sampling methods at the boulder-armored beaches will include: relocation and resampling of permanently marked quadrats, gas chromatography/ mass spectroscopy (GC/MS) analysis of oiled sediment samples from each site, and analysis of sub-surface oiling by sampling "dip stones". At the oiled mussel sites, 3 pooled samples each of mussels and sediments will be taken relative to a transect laid along the zone of heaviest oiling of the mussel bed.

The following section details the hypotheses and methods associated with each of the Objectives listed above.

1. a. *Monitor <u>surface</u> oil at 6 previously established sites.*
Continued monitoring of the fate of stranded surface oil on Gulf of Alaska shorelines indicates gradual disappearance of this oil. We hypothesize that surficial oil will have disappeared entirely by 1999 (5 years since the last sampling and 10 years post-spill).

Methods established in 1994 will be used to reassess the surficial oiling at the 6 sites previously established along the coasts of Kenai Fjords and Katmai National Parks. Oil percent cover will be estimated visually in the field within 10-25 quadrats per site previously set up and marked by rock bolts. Independent estimates by observers will be compared and estimates modified until all observers agree on oil coverage within 5% (Dethier et al. 1993).

1. b. *Monitor subsurface oil at the 6 previously established Gulf of Alaska sites.*
We hypothesize that oil trapped in the subsurface of boulder-armored gravel beaches will remain there for lengthy intervals and will weather slowly since it is shielded from both physical abrasion and evaporation. We intend to monitor the persistence and chemical weathering of the buried oil by systematically examining "dip stones" within the oiled area and by analyzing 2 samples of oiled sediments taken at each site via GC/MS. Both of these methods were used in 1994. The extent of subsurface oiling will be assessed via dip stones, which are elongate rocks protruding out of the surface but extending down into the subsurface oil layer. The ideal dip stone extends vertically below the lowest subsurface oil, illustrating the maximum depth of oiling at that spot. GC/MS analyses of oil samples will provide an indication of oil weathering in addition to identifying the oil as *Exxon Valdez* oil. The Auke Bay Laboratory has offered to conduct, gratis, GC/MS analyses of 6 oil samples from these sites. We have proposed analysis of an additional 6 samples in order to replicate our previous sampling effort.

2. *Monitor recovery of 3 Gulf of Alaska mussel beds previously sampled in 1993.*
Previous sampling of oiled mussel beds along the Gulf of Alaska coast suggested that levels of hydrocarbons in mussels and in the sediments underlying the mussels were declining (Irvine and Cusick 1995; Babcock et al 1996, 1997). However, several mussel beds sampled in 1995 had levels of hydrocarbons above baseline levels (50 μg/g total petroleum hydrocarbons [TPH] wet weight in sediments and 0.09 μg/g total polynuclear aromatic hydrocarbons [TPAH] dry weight in mussels). These baseline levels are determined from the minimum detection limits of the analytical instruments and historical data from unoiled sites in Prince William Sound. We propose to examine three beds on the outer Kenai Peninsula (Tonsina Bay, Port Dick and Morning Cove) in order to assess the recovery of these assemblages. We predict that levels should have declined further, perhaps to background levels. We will use the same methods as in previous years, and will take 3 pooled samples each of mussels and underlying sediments. Samples will be analyzed by GC/MS at the Auke Bay Fisheries Laboratory. NOAA is proposing a resampling of beds in PWS, and combination of PWS and GOA sampling should provide a broad picture of the recovery status of these oiled beds. The resampling of these beds can be done very efficiently in conjuntion with the sampling of the boulder-armored beaches.

Statistical Analyses

Shoreline Oil Persistence and Weathering:
Surficial Oil: Surface oiling is reassessed in marked quadrats by estimates of oil percent cover. Percent cover data for individual quadrats will be compared through time (1994 and 1999 data) via pair-wise tests. As for all tests discussed, the data will be tested for normality and the appropriate parametric or non-parametric test chosen. The power to detect change is usually increased when fixed quadrats are used as a sampling method, although the resulting inference is

limited to changes within that particular quadrat. Since we have only one year of data, we cannot project the anticipated variability within quadrats over time.

Subsurface Oiling: Subsurface oiling will be assessed through sampling of dip stones at each site. Means and ranges of the depth of oiling for each site will be compared through time.

Oil Weathering: The presence and relative abundance of polynuclear aromatic hydrocarbons (PAH) within samples will be compared, and a weathering index based on a first-order kinetic loss rate model of Short and Heinz (1997) will be used to compare the degree of weathering of different samples at the same and different sites.

Oiled Mussels:
The parameters described above to be used in comparing the oiled sediment samples (relative abundances of PAHs and an EVO weathering index) will be used to compare the oil in samples of mussel tissue and underlying sediment. The change in the percent phenanthrenes of samples in samples analyzed by GC/MS will also be compared (Babcock et al. in prep). Additionally, uv-fluorescence (Krahn et al. 1991) will be used initially to analyze sediments associated with the mussel beds. Data from individual sites will be compared through time using paired tests. The data from these outer Kenai Peninsula sites will also be compared to data from PWS. Power analyses from another mussel hydrocarbon monitoring study (Kinnetics 1993) suggests that triplicate sampling such as we propose could have the statistical power of 80% to detect a change or difference of 60% (alpha = 0.05) at two sites or two sampling times at the same station.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

NOAA is a cooperating agency, as one of our Principal Investigators, Dr. Jeff Short, is allied with the NOAA's Auke Bay Fisheries Laboratory. We also expect to cooperate with the NOAA's Principal Investigators on the PWS Oiled Mussel project, although we are submitting separate proposals.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

February 1 to April 1:	Arrange charter boat contract, recruit field personnel
March 23-27:	Attend the 10th Anniversary Symposium
April 1 to May 1:	Assemble field gear and supplies.
May 1 to August 31:	Field work
Sept.1 to Oct.31:	Analysis of field data.
Jan. 15, 2000:	Receive results of hydrocarbon analyses.
April 15, 2000:	Submit annual report (FY99 findings).

B. Project Milestones and Endpoints

Objective 1: *Monitor surface and subsurface oil at 6 previously established sites along the Gulf of Alaska coast. Determine the physical extent and chemical weathering of the oil.*
Field monitoring should be completed during summer 1999. Analysis of data will be accomplished in the fall, but results of the hydrocarbon analyses are not expected until Jan. 2000.

Objective 2: *Monitor recovery of 3 Gulf of Alaska mussel beds previously sampled in 1993.*
The mussel beds will be sampled during the summer of 1999. Results of the hydrocarbon analyses are expected in Jan. 2000.

As stated in greater detail above, the field work for the project is expected to be completed in FY99, with data analysis the following fall, hydrocarbon analyses in the fall and winter, an annual report in April 2000, and manuscript preparation in FY 2000.

C. Completion Date

All of the projects objectives should have been met by the end of FY 2000.

PUBLICATIONS AND REPORTS

We do not anticipate submitting any publications in FY99. We have a paper covering our previous results in press at Marine Pollution Bulletin, and would anticipate submitting a manuscript on the FY99 field work in FY2000.

We will prepare an annual report by April 15, 2000 and final report in FY 2000.

PROFESSIONAL CONFERENCES

We do not anticipate presenting the results of this project at conferences until FY2000.

NORMAL AGENCY MANAGEMENT

This project is not at all part of any normal agency management. It is being proposed solely because the *Exxon Valdez* oil spill occurred and contaminated coastlines and biota.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is built on the framework of two previously funded EVOSTC projects that the

Prinicpal Investigators have been involved with. One of our PI's is with NOAA's Auke Bay Laboratory, and we expect to coordinate data analysis and results of the oiled mussel samples with the NOAA PI's examining oiled mussels in Prince William Sound. Due to some mismatch of timing in the preparation of our respective proposals, we are not listed as cooperators on NOAA's oiled mussel proposal, even though we expect to coordinate.

PRINCIPAL INVESTIGATORS

Dr. Gail V. Irvine
DOI, USGS-BRD
Alaska Biological Science Center
1011 E. Tudor Rd.
Anchorage, AK 99503
907-786-3653
907-786-3636 (fax)
gail_irvine@usgs.gov

Dr. Dan H. Mann
Institute of Arctic Biology
907 Yukon Drive
University of Alaska
Fairbanks, AK 99775
907-474-7161
907-4746967 (fax)
dmann@mosquitonet.com

Dr. Jeffrey W. Short
NOAA, NMFS
Auke Bay Fisheries Laboratory
11305 Glacier Highway
Juneau, AK 99801
907-789-6065
907-789-6094
jeff.short@noaa.gov

Revi . 7-10-98
Approved TC 12-15-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999	PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
								$24.2
Personnel	$0.0	$35.0						
Travel	$0.0	$2.2						
Contractual	$0.0	$75.8						
Commodities	$0.0	$1.3						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$114.3		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration	$0.0	$10.6						
Project Total	$0.0	$124.9		$40.0	$0.0	$0.0		
Full-time Equivalents (FTE)	0.0	0.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0		

Comments:

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Lead Agency: DOI-BRD

FORM 2A
MULTI-TRUSTEE AGENCY SUMMARY

7/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$35.0
Travel		$2.2
Contractual		$66.1
Commodities		$1.3
Equipment		$0.0
Subtotal	$0.0	$104.6
General Administration		$9.9
Project Total	$0.0	$114.5
Full-time Equivalents (FTE)		0.6
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
		-			

Dollar amounts are shown in thousands of dollars.

Comments:

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: DOI-BRD

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Dr. Gail Irvine	Marine Ecologist	GS-12	4.0	6.5		26.0
Vacant	Technician	GS-7	3.0	3.0		9.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.0	9.5	0.0	
					Personnel Total	$35.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Anchorage - Homer, RT	0.2	2	4	0.1	0.8
Anchorage- Kodiak, RT	0.5	2	4	0.1	1.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.2

1999

Prepared: 3 of 13

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: DOI-BRD

FORM 3B
Personnel
& Travel
DETAIL

7/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1999
Boat charter (estimated 20 days @ $1500/day)	30.0
Research Work Order with University of Alaska, Fairbanks	35.1
Film processing, duplication	0.4
Excess baggage, freight	0.4
Sample shipment	0.2
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$66.1

Commodities Costs:	Proposed
Description	FY 1999
Miscellaneous field gear, supplies	0.8
Sample jars	0.2
Rain gear/boots	0.3
Commodities Total	$1.3

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: DOI-BRD

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4 of 13

7/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	Inventory Agency
GPS unit		
Cameras		
Surveying equipment		
Binoculars		

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: DOI-BRD

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$9.7
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$9.7
General Administration		$0.7
Project Total	$0.0	$10.4
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Comments:

1999

Prepared: 6 of 13

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

7/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
						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	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1999

Prepared: 7 of 13

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

7/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed FY 1999
Description	
Hydrocarbon analyses	
Shoreline component	
GC/MS analysis of 6 samples, @ $500/sample	3.0
Mussel Bed component	
GC/MS analysis of 12 samples (9 tissue, 3 sediment), @$500/sample	6.0
uvf screening of 9 sediment samples, @$75/sample	0.7
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$9.7

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 1999
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
			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		

1999

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Agency: NOAA

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999						
Personnel		$25.6						
Travel		$4.4						
Contractual		$0.8						
Commodities		$1.1						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$31.9		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
Indirect		$3.2						
Project Total	$0.0	$35.1						
Full-time Equivalents (FTE)		5.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

See attached form 4B's for detail

UAF: University of Alaska, Fairbanks Research Work Order (RWO)

FY 99

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Name: University of Alaska, Fairbanks (UAF)
Agency: DOI-BRD

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1999
Dr. Dan Mann	Geomorphologist		3.0	5.4		16.2
benefits						1.2
Vacant	Technician		2.0	3.0		6.0
benefits						2.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.0	8.4	0.0	
					Personnel Total	$25.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Fairbanks-Anchorage, RT	0.2	2	6	0.2	1.6
(includes travel to EVOS 10th Anniversary Symposium)					0.0
Fairbanks - Homer, RT	0.4	2	4	0.1	1.2
Fairbanks - Kodiak, RT	0.6	2	4	0.1	1.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$4.4

FY 99

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1999
Duplication	0.1
Excess baggage/freight	0.5
Film processing	0.2
Contractual Total	$0.8

Commodities Costs:	Proposed
Description	FY 1999
Misc. field supplies (shovels, boots, etc.)	1.1
Commodities Total	$1.1

FY 99

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Name: University of Alaska, Fairbanks (UAF)/ Agency: DOI-BRD

FORM 4B
Contractual & Commodities DETAIL

7/10/98

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	

FY 99

Project Number: 99459
Project Title: Residual Oiling of Armored Beaches and Mussel Beds in the Gulf of Alaska
Name: University of Alaska, Fairbanks (UAF) / Agency: DOI-BRD

FORM 4B
Equipment
DETAIL

Approved TC 8-13-98

Effect of Disease on Pacific Herring Population Recovery in Prince William Sound

Project Number:	99462
Restoration Category:	Research and Monitoring
Proposer:	University of California, Davis
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	no
Duration:	3 years
Cost FY99:	$75,100
Cost FY00:	$78,500
Cost FY01:	$84,000
Cost FY02:	none
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific herring, commercial fishing, subsistence

ABSTRACT

The Pacific herring population of Prince William Sound has not recovered from severe population decline in 1993. Viral hemorrhagic septicemia virus and the fungus *Ichthyophonus hoferi* were identified as the two main diseases during a multiyear research project that is in its final year (98162). Prevalence of *Ichthyophonus* decreased after 1995, but an unexpected increase in the prevalence of viral hemorrhagic septicemia virus in 1997 might delay recovery. To determine if disease continues to impair recovery, and to document recovery when it occurs, we propose to monitor prevalence of the two major diseases in Pacific herring in Prince William Sound twice annually, from October 1998 through April 2001.

INTRODUCTION

The population of Pacific herring (*Clupea pallasi*) in Prince William Sound (PWS), Alaska has not recovered since the estimated spawning biomass decreased precipitously from over 100,000 tons in 1992 to less than 20,000 tons in 1994 (Figure 1). Study of the population since 1993 has revealed that viral hemorrhagic septicemia virus (VHSV) and the fungus *Ichthyophonus hoferi* are the two major diseases in Pacific herring, and that VHSV probably contributed most to population decline in 1993 (Meyers et al. 1994; Marty et al. 1998). Prince William Sound Pacific herring fisheries were severely curtailed in 1993, and were never opened in 1994 or 1995. The population began to recover in 1996, and a small bait fishery was opened in November of 1996. All fisheries were opened in 1997, but an unexpected increase in prevalence of VHSV in spring samples (15% in 1997 vs. 0% in 1996) was associated with abnormal spawning activity.

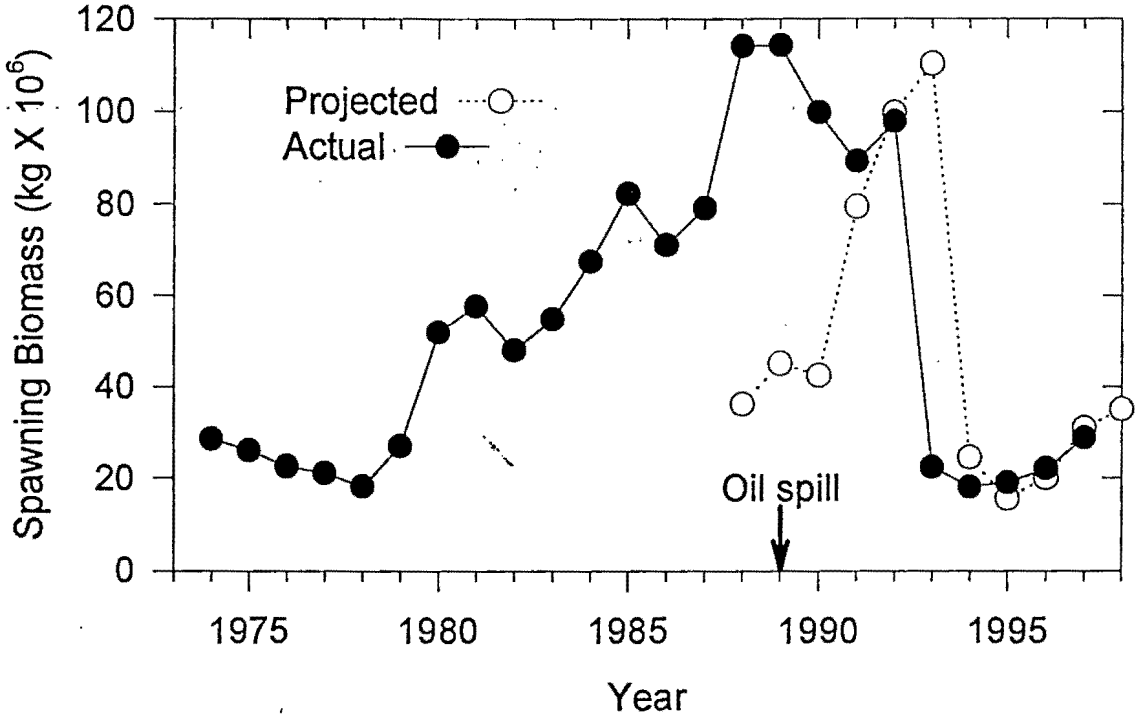


Figure 1. Biomass estimates of mature Pacific herring in Prince William Sound, Alaska. Unexploited spawning biomass is estimated using an age-structured assessment model.

After the major crash of 1993, the Pacific herring population continued to decline in 1994 and project 94320-S was initiated under emergency conditions to determine causes of herring morbidity (sickness), with particular emphasis on the role of VHSV. Beginning in 1995, a 4-year multidisciplinary project was initiated to explore the role of VHSV, *Ichthyophonus hoferi*, and other parasites on population change (95320-S, 96162, 97162, and 98162). Study in 1995 and 1996 included examination of fish from a reference site, Sitka Sound, in which the herring fishery was strong and there was no history of a large oil spill.

It soon became obvious that the results from this study had broad significance beyond the two populations being studied. We were beginning to answer basic questions about how disease contributes to mortality of free-ranging, pelagic, schooling fish. To more fully answer these basic questions, a proposal was submitted to the National Science Foundation (Biological Oceanography) to continue disease research in PWS for three more years; the proposal was submitted on 2-15-98, with a goal of starting research 10-1-98. Although the NSF proposal has a good chance of being funded, competition for unsolicited proposals to NSF is very intense, and funds for new projects are very limited. Therefore, this proposal is being submitted to share costs with NSF to continue this research. This proposal asks the Trustee Council to fund fish necropsy, tissue sampling, and virus analysis, and NSF will pay for blood analysis, histopathology, and population modeling on the same samples. Both organizations benefit from high quality, multiyear research, but at a fraction of the cost of supporting the entire project. Specifically, the Trustee Council will have access to the same types of data generated from 1994-1998, with the addition of a modeling component to determine the role of disease in stock assessment. We propose to continue monitoring the health of the Pacific herring population in PWS through spring of 2001.

Preliminary surveys suggested that the 1994 year-class was the most likely to recruit at numbers large enough for population recovery by 1999. Unfortunately, the prevalence of VHSV increased to 15% among all Pacific herring sampled in spring 1997 (Figure 2), and 23% of the 71 fish that were from 1994 year-class had VHSV. The effect of the VHSV outbreak on population biomass does not appear to be as severe as in 1993, but the viral outbreak may limit the contribution of the 1994 year-class to population recovery. This project is most closely linked to other Pacific herring projects, and details are given in the dedicated section below.

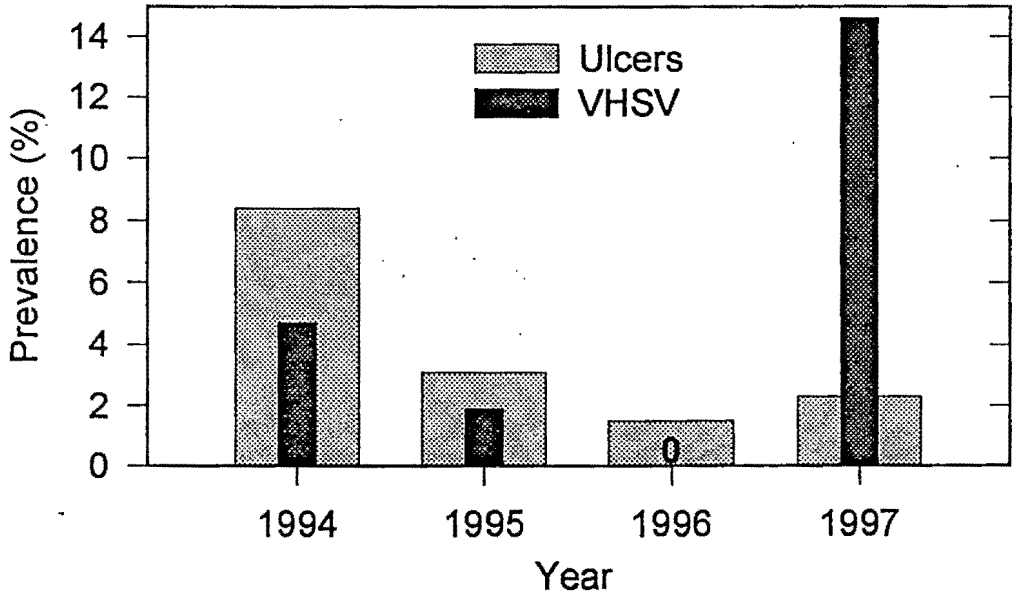


Figure 2. Prevalence of severe focal skin reddening (ulcers) and VHSV in adult Pacific herring sampled from Prince William Sound, Alaska.

NEED FOR THE PROJECT

A. Statement of Problem

Pacific herring are an injured biological resource in Prince William Sound (PWS) classified as not recovering. Indeed, the spawning population in 1994 was lower than ever recorded in 20 years of reliable estimates. Because of small population size, commercial fishing for herring was severely curtailed in 1993, and closed entirely in 1994, 1995, resulting in lost services. Also, several thousand pounds of herring and herring spawn on kelp are harvested annually for subsistence purposes and form an important part of the local native culture of Chenega and Tatitlek. Decline in herring populations resulted in lost resources for subsistence use. Although all fisheries were re-established in November, 1996, the recovery objective has not yet been reached; i.e., "Pacific herring will have recovered when the next highly successful year class is recruited into the fishery and when other indicators of population health are sustained within normal bounds in PWS." Even if the 1994 year class proves to be the next highly successful year class, they will not fully recruit into the fishery until 1999, one year after current disease research (98162) in completed. Therefore, continued study is needed to determine if disease prevalence is limiting recovery and to document when recovery has occurred.

B. Rationale/Link to Restoration

This project should be done because it will provide information on what might be limiting population recovery and it will monitor when fish are healthy and recovery has occurred. Continued sampling fish twice a year is needed to determine the dynamics of disease in the population. During the five-year research project previously funded by the Trustee Council (98162), we established that VHSV and *Ichthyophonus hoferi* caused the most significant diseases. Prevalence of VHSV can be determined by virus isolation and prevalence of *Ichthyophonus hoferi* can now be estimated fairly closely by gross examination. Therefore, proposal for an additional three years of disease research eliminates blood analysis and histopathology from the design of previous study, at considerable savings to the overall project.

C. Location

Study will be done in Prince William Sound, Alaska. Information will benefit fisheries managers as they consider alternatives for managing Pacific herring fisheries. As the resource is enhanced, users throughout PWS could potentially benefit.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Dr. Marty has a solid record of local contact and dissemination of information, and continued collaboration with local users is proposed for FY 99. For example, Dr. Marty worked closely with the Cordova District Fishermen United (and Torie Baker) and ADFG to propose supplemental study of spawn-on-kelp pound fisheries in PWS in 1997 and 1998. This contact occurred through participation in conference calls, personal contact while in Anchorage and Cordova, and via e-mail. Area residents and subsistence users have shown interest in the unique

use of veterinary pathology in the field component of previous study, and information was distributed through participation in Jody Seitz' radio program and by submission of information on the spawn-on-kelp pound fishery to the Restoration Science Newsletter.

To aid in dissemination of information, project personnel are available by phone for interviews and will respond quickly to requests from the Restoration Office for general information and articles for newsletters. The project's principal investigator is based in California, but Dr. Kathy Burek of Alaska Veterinary Pathology Services (one of only two board-certified veterinary pathologists residing in Alaska) has been contracted as a necropsy pathologist in 1995 and 1996, and has indicated her interest to serve as the second pathologist in April 1999. Alaska residents will be hired by ADFG for sampling logistics and recording data, and ADFG will charter vessels from local residents for collecting and processing fish.

PROJECT DESIGN

A. Objectives

The restoration objective states that "Pacific herring will have recovered when the next highly successful year class is recruited into the fishery and when other indicators of population health are sustained within normal bounds in PWS." The population cannot be classified as healthy until individuals within that population are healthy. Increased prevalence of VHSV in spring 1997 samples was consistent with a population at risk. Field sampling to determine the ongoing disease status is a high priority of this project. Objectives include:

1. Determine the prevalence of major diseases in Pacific herring.

2. Determine the interaction of gender, age, and season on disease prevalence.

3. Determine if disease prevalence correlates with population trends.

B. Methods

Pacific herring will be randomly sampled from PWS in October (at the end of the feeding season, n = 100) and in April (near the time of spawning, n = 300). Each fish will be examined for abnormalities (e.g., *Ichthyophonus hoferi*), and tissues from each fish will be assayed for VHSV.

This proposal has two specific hypotheses to test:

1. Prevalence of external lesions, VHSV, or *Ichthyophonus hoferi* is different from previous years.
2. Gross lesions, VHSV, or *Ichthyophonus hoferi* are related season, age, or gender.

To test the hypothesis that reproductive stage affects the development of disease, sampling is needed during the spawning season (spring) and during the period of gonadal development and peak condition (fall). Nearly 80% of the PWS Pacific herring biomass schools in the waters on

the northern and western edge of Montague Island during October, and the fish remain in this area until after they spawn in April. All fish will be sampled from this region. During the summer, fish disperse throughout the Sound. The other 20% of the PWS Pacific herring biomass overwinters and spawns in the Northeast region of PWS; these fish have sampled for disease study on as part of the spawn-on-kelp investigations, and preliminary genetic evidence indicates that they may be a different population (J. Seeb, ADFG, unpublished data). To provide a minimum number of fish from which at least the dominant year class can be analyzed in detail, we propose sampling 300 fish in April. Fish are easier to capture in the spring, and the age distribution in the spring is most consistent with data used in the historical age-structured assessment model. With a sample size of 300, diseases with a prevalence as low as 1% can be detected with 95% confidence, and a 6% difference in sample prevalence (e.g., 10 vs. 16%) can be detected with a statistical power of 0.80 (Becker and Grieb 1987). To test hypotheses of age differences, the dominant year class--often >40% of the sampled population--will be compared with combined groups of smaller year classes. To detect seasonal differences, and minimize costs, 100 fish will be sampled in the fall. A sample size of 100 is sufficient to have 95% confidence that disease with a prevalence of 3% will be detected in at least one fish sampled (Becker and Grieb 1987).

Proposed study is designed to minimize bias associated with gear type, capture, and holding (Holst 1996). All fish will be sampled using commercial purse seines. In the event that large numbers of fish begin to spawn in areas too shallow for commercial seines, fish will be captured using cast nets. All necropsies will be completed < 4 hours after the seine is pursed around the fish.

To best characterize the condition of herring in Prince William Sound, herring will be subjected to complete necropsy using the following sampling schedule (as field conditions allow) during the three years of proposed study:

Dates	Reproductive Stage	Number of Fish
FY99: Oct./Nov., 1998 (2 nights)	peak condition/ gonadal development	100
mid-late April, 1999 (4 days)	spawning/post-spawning	300
	Total Fish, FY99:	400
FY00: Oct./Nov., 1999 (2 nights)	peak condition/ gonadal development	100
mid-late April, 2000 (4 days)	spawning/post-spawning	300
	Total Fish, FY00:	400
FY01: Oct./Nov., 2000 (2 nights)	peak condition/ gonadal development	100
mid-late April, 2001 (4 days)	spawning/post-spawning	300
	Total Fish, FY01:	400

Pacific herring will be sampled randomly by a commercial purse seine or cast net. Necropsies will be done on a vessel chartered by ADFG. To minimize chances for VHSV to spread from one fish to others during holding, fish will be held no longer than four hours before necropsy. Fish for necropsy will be anesthetized in tricaine methane sulfonate (Finquel®) and visually screened for external lesions (Marty et al. 1998), which are ranked as none (0), mild (1), moderate (2), or severe (3). Prevalence of *Ichthyophonus* will be estimated by gross examination of internal organs, especially the heart. Gross examination is not as sensitive as histopathology for diagnosis of *Ichthyophonus*, but in spring 1997 samples, Dr. Marty correctly diagnosed 67% of the *Ichthyophonus*-positive cases by gross examination alone. Unfortunately, inexperience with histological examination of *Ichthyophonus* makes gross examination less efficient. For example, in spring 1997 samples, the second pathologists correctly diagnosed only 20% of the *Ichthyophonus*-positive cases by gross examination alone. In future sampling events, a high priority will be placed on training the second pathologist to recognize gross features of mild *Ichthyophonus* infection.

Measurements on each fish include body weight, standard length, age (from scales), liver weight, and gonad weight. Otoliths are archived for later use if information on annual growth rates is desired. This study is designed to diagnose gross lesions and the two major diseases: VHSV and *Ichthyophonus hoferi*. Results will be compared with previous years of study. Several samples will be collected, but only selected samples will be analyzed:

a. Virus isolation - To assay fish for virus, anterior kidney, spleen, and any severe skin lesions will be put into individually labeled plastic bags and stored on ice (for each fish, one bag will hold kidney and spleen, and a separate bag will be used for skin lesions). Samples will be shipped by air to the ADFG fish pathology laboratory in Juneau (under the direction of Dr. Ted Meyers) for analysis every 48 to 72 hours. Isolation using EPC cell lines will be as previously described (Meyers et al. 1994). The application of polymerase chain reaction (PCR) techniques for primary diagnosis of VHSV is being explored (R.M. Kocan and J.R. Winton, personal communication); if these techniques prove more useful than virus isolation, PCR may be used in place of virus isolation for detection of VHSV.

b. Bacteriology - for each fish with severe gross lesions, a sterile loop is stabbed into the anterior kidney and then streaked on Trypticase Soy Agar (TSA) and Marine agar for bacterial isolation. Ulcers will be preserved for histopathology or virology, but they will not be cultured for bacteria (superficial bacteria can be diagnosed on histopathology).

Other samples will be collected and archived, but analysis will require funding through NSF (a proposal for this work was submitted to NSF on 2-17-98):

a. Histopathology (fix in 10% neutral buffered formalin) - gill, spleen, liver, gonad, heart, stomach, intestinal tract, exocrine pancreas, trunk kidney, skeletal muscle, skin, brain, and other gross lesions. Also, a touch prep of kidney from each fish is made on a glass slide.

b. Hematology - blood will be drawn from the caudal vein into a Lithium-heparinized syringe and stored on ice. Packed cell volume (PCV) is determined on site. A smear is made on a glass slide, dried, and archived. Plasma is separated by centrifugation (3,000 *g* for 7 min) and

frozen within 3 h of collection. Plasma will be archived at -80°C for at least two years or until funding for analysis is secured.

c. Immunology - plasma for IgM determination and a blood smear for leukocyte differential counts will be collected and archived.

In previous study, spring samples from PWS had several other parasites, but these did not seem to be significant on the population level. Gross lesions and other observations will be scored as in previous years. Although all lesions are described in a "comments" section, only the most common lesions are scored for statistical analysis: caudal fin fraying, caudal fin reddening, fin base reddening, focal skin reddening, diffuse skin reddening, iris reddening, branchial copepods, number of 0.5-mm-diameter white foci on gills, number of peritoneal Anisakidae, and gonadal fullness. Parasites requiring histopathology for diagnosis will not be scored unless NSF funds are secured.

The ADFG fisheries laboratory in Cordova, Alaska, will handle logistics for sampling fish for necropsy, collecting age and length data, preparing formalin and containers for tissue fixation, providing data recorders for one pathologist on site, and ship all samples. Results from virus isolation will be reported as a VHSV titer.

Quality control and quality assurance are part of all examinations. For necropsy examination, the senior pathologist (Dr. Marty) is on site at all times; when questionable or difficult lesions are encountered, the second pathologist can consult with Dr. Marty. In the event that Dr. Marty is unavailable for necropsy, five other pathologists have experience on the herring necropsy team, and services of these pathologists would be secured.

Statistical analysis in this study will focus on determining changes in disease prevalence over time. The association of selected categorical variables (e.g., VHSV status versus external lesion scores) will be evaluated using chi-square methods for categorical data analysis; comparisons will be considered valid only if individual expected cell frequencies are >1 and no more than 20% of the cells have expected cell frequency <5. Odds ratios will be calculated only for standard (2x2) two-way contingency tables. Significance of changes in disease prevalence will be tested using chi-square or Fisher's Exact test. For all analyses, comparisons will be considered significant when $P<0.05$ and highly significant when $P<0.01$.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal includes significant contributions from ADFG as the lead agency. The project is being run through ADFG because Dr. Marty has worked closely with ADFG on several Trustee Council-funded projects during this decade. ADFG has unique local knowledge on Pacific herring in PWS, and Greg Carpenter has the necessary experience and expertise to secure all necessary charters and ship hazardous materials from Cordova to Davis. Close collaboration with ADFG allows for seamless transfer of disease information to fishery managers, and rapid transfer of disease information to commercial and subsistence fishers. No other agencies are requesting funds for this section of the project, and no other agencies or universities will be contracted for this work. Note, however, that Dr. Richard Kocan, University of Washington, is submitting a

proposal to study disease in juvenile Pacific herring and determine if other forage fishes in PWS carry VHSV. Dr. Marty and Dr. Kocan worked closely on the initial multiyear herring disease project (98162 et al.), and they will continue to share information on these new projects. A letter of collaboration from Dr. Kocan is attached.

SCHEDULE

A. Measurable Project Tasks for FY99

DATES (results due on final date)	ACTIVITY
Fall Samples:	
Oct. 1 - Nov. 30, 1998:	Collect samples; Person in charge: Gary D. Marty, UC Davis
Nov. 1 - Dec. 31, 1998:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
Nov. 1, 1998 – Feb. 28, 1999:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
March 1- Aug. 1, 1999:	Statistical analysis; Person in charge: Gary D. Marty
March 23-27, 1999 (5 days):	Attend 10th anniversary symposium (Gary D. Marty)
Spring Samples	
April 1 - April 30, 1999:	Collect samples; Person in charge: Gary D. Marty
April - July 31, 1999:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
April - Sept. 30, 1999:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
Oct. 1999 - Feb. 1, 2000:	Statistical analysis; Person in charge: Gary D. Marty
Jan. 11, 1999 –April 15, 2000:	Annual report writing; Person in charge: Gary D. Marty
open:	Opportunities for public comment

B. Project Milestones and Endpoints

Review of Objectives:

1. Determine the prevalence of major diseases in Pacific herring.
2. Determine the interaction of gender, age, and season on disease prevalence.
3. Determine the effect of disease on population trends.

Objectives will be met when each year of results is reported in the annual report, but the most complete information will be available when the multi-year study is completed and the final

synthesis report is submitted April 15, 2002.

C. Completion Date

We anticipate that biannual sampling in PWS through the spring of 2001 (FY01) will be sufficient to document that all project objectives have been met. Prevalence of VHSV decreased from 1994 to 1996, but then increased in 1997. Prevalence of the second major pathogen, *Ichthyophonus*, was high in 1994 and 1995, and it has continued to decrease since 1996. If the prevalence of *Ichthyophonus* continues to decrease, and the prevalence of VHSV decreases, we should be able to document recovery by the year 2001.

PUBLICATIONS AND REPORTS

No publications are anticipated from this work in FY99. Because the study is primarily monitoring, and proposed for three years, publication will be most beneficial to the scientific community after all three years of data are collected and analyzed. Results from fall 1998 samples may be incorporated into manuscripts being prepared as part of the final report for the field component of project 98162, but funds needed for that work have already been appropriated.

PROFESSIONAL CONFERENCES - No funds are requested.

NORMAL AGENCY MANAGEMENT - Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Continuation of proposed disease research in PWS is critical for obtaining other funding. On Feb. 17, 1998, Dr. Marty submitted an unsolicited proposal to continue this research through the National Science Foundation's Division of Biological Oceanography. The three-year $522.3K proposal exactly matches the sampling schedule outlined in this proposal, and the proposal includes collaboration with ADFG (through John Wilcock) and the University of Alaska, Fairbanks (Dr. Terrance J. Quinn). The major difference is that the NSF proposal includes funds for complete analysis of all samples (e.g., histopathology and blood analysis) not included in this proposal but part of the first 5 years of disease research. Using Dr. Quinn's expertise, the NSF proposal includes a modeling component to mathematically determine the relation of disease and changes in population biomass. Trustee Council-funded studies of herring disease since 1994 were highlighted in the NSF proposal as a significant source of matching funds (about $2.1 million over the life of the project). NSF normally does not fund unsolicited proposals for more than $150K per year. If the Trustee Council funds this proposal, it would represent savings of $207.7K to NSF. At the same time, the Trustee Council would benefit from $522.3K worth of research for only $207.7K.

This project is designed to provide the same types of data that were generated during detailed disease study since 1994 (94320S, 95320S, 96162, 97162, and 98162). Each year of research produces some new findings, but with each year the significance of the project becomes greater than its individual parts. Indeed, the knowledge gained from the 5-year data set is already unprecedented among studies of disease in feral fish species. The addition of three more years of data on the most important diseases will only add to the significance of this work. Proposed study has two specific interactions: 1) fish captured at the same time as disease samples will be available for, but not replace, age-weight-length studies conducted under normal ADFG management or research studies; 2) Dr. Marty will continue to share information with Dr. Kocan as he proposes separate but related research on VHSV in PWS.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS - not applicable

PROPOSED PRINCIPAL INVESTIGATOR (Field Component)

Gary D. Marty
Department of Anatomy, Physiology, and Cell Biology
School of Veterinary Medicine
University of California
1 Shields Ave.
Davis, CA 95616
phone: 530-754-8062
FAX: 530-752-7690

Approved TC 8-13-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FFY 1998	Proposed FFY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$0.0	$16.1						
Travel	$0.0	$0.0						
Contractual	$0.0	$44.5						
Commodities	$0.0	$9.0						
Equipment	$0.0	$0.0						
Subtotal	$0.0	$69.6	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002			
General Administration	$0.0	$5.5						
Project Total	$0.0	$75.1	$78.5	$84.8	$0.0			
Full-time Equivalents (FTE)	0.0	0.4						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

This project proposal includes two components:

1. University of California, Davis: Fish necrospsy
   a. Funds for writing the annual report in FY00 are included in the FY99 request.

2. Alaska Department of Fish and Game: Logistical and analytical support

FY99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Agency: ADFG

FORM 3A
AGENCY
PROJECT
DETAIL

4/14/98

Prepared: 4/2/98
Revised: 4/98, JRS

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:			GS/Range/	Months	Monthly		Proposed
PM	Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
	G. Carpenter	Fishery Biologist II	16C	1.5	5.1		7.7
	Vacant	Fish & Wildlife Technician II	9A	0.5	3.2	2.6	4.2
	Vacant	Fish & Wildlife Technician II	9A	0.5	3.2	2.6	4.2
			Subtotal	2.5	11.5	5.2	
						Personnel Total	$16.1

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FFY 1996
					Travel Total	$0.0

FY99

Prepared: 4/2/98
Revised: 4/14/98, JRS

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:		Proposed FFY 1997
Description		
PWS Fall Sampling	Vessel Charter (R/V Montague, 3d @ 1100/d)	3.3
	Vessel Charter (seiner to locate fish, 3d @ 1200/d)	3.6
	Shipping	0.2
PWS Spring Sampling	Vessel Charter (R/V Montague, 6d @ 1100/d)	6.6
	Vessel Charter (seiner to locate fish, 6d @ 1200/d)	7.2
	Shipping	0.4
	Air Charter (2RT to Montague Is. @ 250/hr, 4 hr total)	1.0
Contract with the University of California, Davis		23.3
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$45.6

Commodities Costs:	Proposed FFY 1997
Description	
Misc. sampling supplies (tubes, jars, preservative, coolers, totes etc.) (approximately $500/sample event - 2 events)	1.0
Pathology Laboratory - Virology/Bacteriology Supplies (400 samples @ $20/sample)	8.0
Commodities Total	$9.0

FY99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Agency: ADFG

FORM 3B
Contractual & Commodities DETAIL
4/14/98

Prepare 2/98
Revised 4/14/98, JRS

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases:	Number of Units	Unit Price	Proposed FFY 1997
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		

FY99

Prepared: 4/2/98
Revised: 4/14/98, JRS

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Agency: ADFG

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$9.7
Travel		$5.6
Contractual		$2.3
Commodities		$2.2
Equipment		$0.0
Subtotal	$0.0	$19.8
Indirect		$3.5
Project Total	$0.0	$23.3
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$23.0	$26.5			
Dollar amounts are shown in thousands of dollars.					

Comments: **Indirect Costs** include the standard overhead rates and applications for the Institute of Toxicology and Environmental Health (ITEH) at the University of California, Davis (18.9%).

Other funds - A 3-year $522.3K proposal was submitted to the National Science Foundation (NSF) on 2-15-98 (Dr. Gary D. Marty as principal investigator). The proposal to NSF includes all of this proposal except for travel to the 10th Anniversary meeting. The NSF proposal is more expensive because it includes complete blood analysis, histopathology, and population modeling not included in this proposal. This proposal can stand on its own, but it is designed to leverage NSF funds. If both proposals are funded, this proposal will not change, but Trustee Council funds will be used to decrease the cost of the NSF proposal. This will increase the chance of securing NSF funding because NSF will get all of the research described in the NSF proposal at a savings of $238K to NSF. The Trustee Council benefits by getting complete analysis of all samples collected, including population modeling, at no additional cost (otherwise, the Trustee Council would have to pay about $300K for this research over the life of the project).

Proposal includes funds (here, direct costs) for report writing (0.5 month time for G. Marty, $400 of the supply budget), community involvement (0.2 month time for G. Marty, $50 for long distance phone calls), and the 10th anniversary meeting (travel and per diem, $1175). The proposal does not include funds for NEPA compliance, review session attendance, publications, or professional conferences.

FY 99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4A
Non-Trustee
SUMMARY

Prepared: 2/98
Revised: 4/98, JRS

4/14/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
	Marty, G.	Assistant Researcher III	1.5	5.4	0.0	8.1
	Teh, C.	Laboratory Assistant III	0.5	3.1	0.0	1.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.0	8.5	0.0	
					Personnel Total	$9.7

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
	airfare to Cordova for sample collection (1 fall, 3 spring)*	0.6	4	11	0.1	3.5
	airfare to Anchorage for 10th Anniversary meeting	0.5	1	5	0.1	1.0
						0.0
	*There are actually 22 days per diem rather than 11 on these trip, but the field rate is $45/day which these formulas will not accommodate. Thus the number of days were halved and the rate doubled.					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$4.5

FY 99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Personnel
& Travel
DETAIL

Prepared: 4/2/98
Revised: 4/14/98, JRS

4/14/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
150 fish necropsies @ $15/fish (professional services of consulting pathologist)	2.3
Contractual Total	$2.3

Commodities Costs:	Proposed
Description	FY 1999
Materials and supplies (for sampling supplies, report writing, long distance phone, film, computer disks)	1.6
statistical analysis	0.4
ITEH supplies	0.2
Commodities Total	$2.2

FY 99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Contractual & Commodities DETAIL

Prepared: 4/2/98
Revised: 4/98, JRS

4/14/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
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: Description	Number of Units
IEC clinical centrifuge equipped with rotors for on site plasma separation and packed cell volume determination	1
Revco -80° freezer for archiving plasma	1
YSI Model 55 hand-held dissolved oxygen meter for checking fish holding conditions before necropsy	1
For report writing and correspondence:	
Pentium 90 IBM-PC desktop computer with 64Mb RAM, Ethernet card, and internal 14,400 baud modem	1
486-100 IBM-PC color notebook computer with 16MB RAM and internal 14,400 baud modem	1
HP4L LaserJet printer	1
Codonics NP-1600 Color Photographic Network Printer, for publication grade printing of digital images	1

FY 99

Project Number: 99462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Equipment
DETAIL

Prepared: 4/2/98
Revised: 4/14/98, JRS

4/14/98

99466

Submitted 4-15-98
Approved TC 12-15-98

Recovery Status of Barrow's Goldeneyes

Project Number:	99466
Restoration Category:	Research
Proposer:	D. Esler/USGS-BRD
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 2 yr. project
Cost FY 99:	$12.2
Cost FY 2000:	$14.2
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Barrow's goldeneye

ABSTRACT

Although Barrow's goldeneyes are not on the list of resources injured by the oil spill, some recently collected evidence suggests that goldeneyes may have been injured and populations may not be fully recovered. Due to these concerns, this proposal will critically assess the status of recovery of Barrow's goldeneye populations from the oil spill through assemblage and analysis of all existent, relevant data. This will be accomplished through analyses of data collected for other objectives within the Nearshore Vertebrate Predator project (/025) and compilation of existing information from other sources. This work will lead to the definition of recovery status, identification of any data gaps limiting our understanding of recovery status or impediments to recovery, and, if warranted, proposal of directed research to fill those gaps during FY 2000 and beyond.

INTRODUCTION

Barrow's goldeneyes (*Bucephala islandica*) occur in nearshore habitats of Prince William Sound (PWS), the environment that received about 40% of the oil spilled after the *Exxon Valdez* ran aground (Galt et al. 1991). PWS is almost exclusively a wintering area for Barrow's goldeneyes. Estimates of sound-wide goldeneye numbers (which include a small proportion of common goldeneyes [*B. clangula*]) during 1996 were approximately 36,000 in winter and 400 in summer (Agler and Kendall 1997). Although concerns about nearshore recovery and restoration have resulted in a suite of studies sponsored by the Exxon Valdez Oil Spill Trustee Council (EVOSTC), assessments of Barrow's goldeneye recovery status and constraints to recovery have not been conducted.

Barrow's goldeneyes may be particularly susceptible to injury and constraints to recovery from the oil spill. Because of their close affiliation with intertidal habitats, which still contain oil in some areas (e.g., in Sleepy Bay, based on clean up efforts in summer 1997), Barrow's goldeneyes may continue to be exposed. Further, winter diets of Barrow's goldeneyes consist almost entirely of mussels (*Mytilus trossulus*; Koehl et al. 1982, Vermeer 1982), which have been demonstrated to contain hydrocarbon residues as recently as 1995 (Babcock et al. 1997). In fact, a growing body of evidence suggests that Barrow's goldeneyes suffered, and may continue to suffer, from effects of the oil spill (see Statement of Problem below). Also, Barrow's goldeneyes, like other sea ducks, are long-lived with relatively low annual productivity. Population dynamics of species with these life history characteristics have relatively low rates of potential population growth (Goudie et al. 1994, Schmutz et al. 1997). Thus, recovery of Barrow's goldeneye populations (if injured by the oil spill) would be expected to take many years, even in the absence of long-term, chronic effects.

This species warrants concern not only for population recovery, but also because Barrow's goldeneyes are an important subsistence resource for local residents. For example, in Chenega goldeneyes were harvested by over 25% of households and constituted the majority of harvested waterfowl (Scott et al. 1996). PWS residents have expressed concern over recovery of populations of harvested waterfowl species, including Barrow's goldeneyes (Dan Rosenberg, ADFG, pers. comm.).

Despite proclivity and some evidence for oil spill injury to Barrow's goldeneyes, this species is not on the list of injured resources developed by the EVOSTC. Some recently available data (see Statement of Problem below) suggest that Barrow's goldeneyes warrant consideration for listing as an injured species, and research addressing their recovery may be an appropriate restoration objective. This proposal addresses the need to fully evaluate recovery status of the species via analysis and compilation of existing data.

This project will capitalize on data collected during NVP studies on the primary study sites of northern Knight Island (oiled) and Montague Island (unoiled). These data were collected during efforts addressing sea otter (*Enhydra lutris*) and harlequin duck (*Histrionicus histrionicus*)

recovery. However, they also can be used to critically assess Barrow's goldeneye recovery. This project does not propose work that is already funded under NVP, but rather proposes to either (1) reanalyze data used to assess sea otter or harlequin duck recovery to address questions specific to goldeneyes or (2) analyze data specific to Barrow's goldeneyes that were collected as an aside when conducting NVP field studies. Data collected during NVP that will be used to assess goldeneye recovery include: mussel size class and abundance (collected to assess sea otter recovery), goldeneye abundance and distribution (collected during harlequin duck surveys), goldeneye body condition and diet (from birds collected for NVP copredator studies), and cytochrome P4501A induction of goldeneyes (from collected birds).

Other data that will be assessed with regard to Barrow's goldeneye recovery status include survey data from USFWS, Migratory Bird Management, mussel contaminant level data from NOAA, Auke Bay Lab; and immediate post-spill data collected during ADFG harlequin duck studies. All analyzed and compiled data will be incorporated into the NVP recovery assessment framework as described in Methods.

Based on results from analyses and compilation of available data, the proposed work will lead to conclusions regarding the status of recovery and will generate recommendations for specific research to fill any remaining data gaps. If necessary, additional research would be recommended following the logic and organization of the NVP project, which addressed potential demographic, trophic, and health constraints to recovery of nearshore vertebrate predators, and the nearshore environment generally. Along with addressing questions specific to Barrow's goldeneye recovery, the work conducted under this proposal, as well as any additional research, will serve as another window into recovery of the nearshore system (Holland-Bartels 1995).

NEED FOR THE PROJECT

A. Statement of Problem

Several pieces of evidence suggest that Barrow's goldeneyes suffered injury from the oil spill and that recovery has not occurred. Sound-wide population surveys have found differences in population trends between oiled and unoiled areas (Agler and Kendall 1997), as of March 1996. Further, comparisons of pre- and post-spill data suggest population reductions in oiled versus unoiled areas at several geographic scales of analysis (David Irons, USFWS, pers. comm.). Also, levels of P4501A expression in goldeneyes were significantly higher on oiled Knight Island than unoiled Montague Island (Esler, unpubl. data). These data, along with the life history characteristics that indicate susceptibility of Barrow's goldeneyes to oil spill effects, strongly suggest that a more complete evaluation of the status of recovery, and potential impediments to recovery, is an important restoration objective.

B. Rationale/Link to Restoration

Barrow's goldeneye restoration requires assessment of recovery status and definition of impediments to recovery (demographic, trophic, or health/oil exposure). This proposed work represents a comprehensive approach to understanding the factors that affect population dynamics and definition of critical bottlenecks to recovery. Without an understanding of the underlying processes that dictate population change, we can not prescribe specific activities to enhance recovery.

C. Location

Data to be compiled will come from throughout Prince William Sound. NVP data that will be used to assess Barrow's goldeneye recovery were collected on northern Knight Island (Bay of Isles and Herring Bay) and Montague Island. There is no field component for proposed work.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

All efforts will be made throughout the restoration process to participate in and provide public involvement in the implementation of this project. Project staff will be available to present information to local communities or prepare articles or photographs for Trustee Council publications.

PROJECT DESIGN

A. Objectives

1. Analyze data collected during NVP studies and report on results regarding:

    a. Foraging ecology of Barrow's goldeneyes, including body composition, diet composition, and mussel size class selection.

    b. Factors influencing distribution and abundance of Barrow's goldeneyes, including mussel abundance, habitat characteristics, and oiling history.

2. Summarize data from other sources relevant to assessment of Barrow's goldeneye recovery status and impediments to recovery.

3. Generate conclusions regarding recovery status, identify impediments to recovery (if any), and recommend research needed to fill in data gaps to fully evaluate recovery status or impediments to recovery (if necessary).

B. Methods

Following the NVP framework, the proposed work will ask the questions: "Is there evidence for lack of recovery or continued injury from the oil spill?" and "If so, is recovery limited by trophic, demographic, or health constraints?".

Trophic Interactions

Data collected during NVP studies will prove valuable for understanding potential limiting effects of prey availability. Mussel availability and abundance data for NVP study sites will be used to assess food limitation. Lower biomass of mussels (in size classes consumed by goldeneyes) per goldeneye on the oiled study area would be consistent with a hypothesis of potential food limitation of recovery.

Waterfowl body mass and condition have been shown to be related to both contaminant exposure (see below) and food availability. Further, body mass and condition have been shown to affect subsequent survival (Conroy et al. 1989, Longcore et al. 1991, Bergan and Smith 1993) and productivity (Esler and Grand 1994). Lab analyses of lipid and protein levels were conducted for each Barrow's goldeneye collected for NVP copredator studies. Under this proposal, these data will be analyzed to assess variation in body condition related to sex, age, and oiling history (i.e., study area). Poorer body condition in oiled areas than unoiled areas, in conjunction with lower food availability, would be consistent with a hypothesis of food limitation of recovery.

Demography

Data regarding goldeneye distribution and abundance were collected during NVP harlequin duck surveys. These data will be analyzed to assess variation in goldeneye density related to mussel abundance, habitat characteristics, and oiling history. This will assess recovery status by determining whether densities of goldeneyes on oiled study areas are comparable to those on unoiled areas after accounting for intrinsic differences in habitat and food.

Migratory Bird Management, USFWS, has conducted surveys throughout Prince William Sound following the spill. This project proposes interpretation of data through the most recent (March 1998) survey, in light of other data regarding Barrow's goldeneye population health.

Indices to Health/Oil Exposure

Oil exposure of collected Barrow's goldeneyes was evaluated by measurements of cytochrome P4501A, an enzyme that is a specific indicator of exposure to aromatic hydrocarbons. For many nearshore predators, including Barrow's goldeneyes, elevated cytochrome P4501A was expressed in oiled sites, raising concern of continued exposure to *Exxon Valdez* oil. These data will be interpreted in light of other results.

Because Barrow's goldeneye diets consist almost exclusively of mussels during winter, mussel hydrocarbon contamination data from NOAA, Auke Bay Lab, will be reviewed to determine whether foraging represents a potential pathway of continued oil exposure.

Waterfowl body mass has been demonstrated to be related to contaminants (Hohman et al. 1990). Body mass and condition data will be interpreted in light of measures of oil exposure. Lowered body mass, in conjunction with differences in P450 induction, would be consistent with a hypothesis of health related constraints to recovery.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal relies on data collected by a number of researchers funded by the EVOSTC, including the proposed principal investigator, Chuck O'Clair (NOAA), Malin Babcock (NOAA), David Irons (USFWS), and Dan Rosenberg (ADFG).

SCHEDULE

A. Measurable Project Tasks for FY 99

Throughout: Analyze and summarize data regarding Barrow's goldeneye recovery status and impediments to recovery.

April: Prepare preliminary findings and recommendations and submit proposal for directed research in FY2000 and beyond, if necessary.

B. Project Milestones and Endpoints

FY2000

April: Submit final report.

C. Completion Date

All project objectives will be met during FY2000.

PUBLICATIONS AND REPORTS

A final report of activities will be submitted to the Restoration Office before 15 April 2000. The report will consist of 3 documents:

1. A report on status and constraints to recovery of Barrow's goldeneyes based on all available

data.

2. A draft manuscript regarding foraging ecology of Barrow's goldeneyes, including diet and body composition variation within and between oiled and unoiled study areas.

3. A draft manuscript addressing factors related to density of Barrow's goldeneyes, including habitat variables, mussel biomass, and oiling history.

PROFESSIONAL CONFERENCES

None in FY 99.

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described above, this research relies on incorporation of data from other Trustee sponsored research. The major objectives of this work require interaction with other investigators and integration of all available data that are relevant to the question of Barrow's goldeneye recovery status. Also, this proposal relies on data collected during NVP studies by the principal investigator.

PROPOSED PRINCIPAL INVESTIGATOR

Dan Esler
Alaska Science Center
USGS-Biological Resources Division
1011 E. Tudor Rd.
Anchorage, AK 99503
(907) 786-3485
FAX: (907) 786-3636
daniel_esler@nbs.gov

4/15 ...
approved 12/15/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$10.6
Travel		$0.0
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$10.6
General Administration		$1.6
Project Total	$0.0	$12.2
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$14.2				

Dollar amounts are shown in thousands of dollars.

Comments:

FY 99

Project Number: 99466
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-BRD

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: April 15, 1998

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
D. Esler	Wildlife Research Biologist	GS12/01	2.0	5.3		10.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	5.3	0.0	
					Personnel Total	$10.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 99

Project Number:
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-BRD

FORM 3B
Personnel
& Travel
DETAIL

Prepared: April 15, 1998

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

FY 99

Prepared: April 15, 1998

Project Number:
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-BRD

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	Inventory Agency

FY 99

Project Number:
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-BRD

FORM 3B
Equipment
DETAIL

Prepared: April 15, 1998

Revised 7-20-98
Approved 8-13-98

FEATS: Fundamental Estimations of Acoustic Target Strength

Project Number:	99468-BAA
Restoration Category:	Research
Proposer:	J. Kirsch, G. Thomas/PWSSC
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	2nd yr. 2 yr. project
Cost FY 99:	$146.6
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific herring

ABSTRACT

To scale acoustic survey data from relative units (dB) to absolute units (kg/m3), knowledge of the individual fish's target strength (TS) by size is required. This project will conduct experiments to measure the TS of Pacific herring and sand lance in Prince William Sound. FY 99 will concentrate on the development of experimental apparatus, experimental logistics and the application of these to measure Pacific herring TS and sand lance TS. TS-to-length regressions will be calculated and applied to past surveys in Prince William Sound to obtain more accurate density and biomass estimates, and will serve future acoustic survey efforts of these species in coastal Alaska.

INTRODUCTION

Acoustical estimates of fish abundance are used for stock assessment and fisheries management, and for ecological and life history studies (Thorne 1983a; Thorne 1983b; Thomas 1992; MacLennan and Simmonds 1991; Gunderson 1993; Misund 1997). Acoustic surveys estimating Pacific herring fishing stocks have been conducted from Alaska to California, (Thorne 1977a; Thorne 1977b; Trumble et al. 1982; Thorne et al. 1983; Thorne and Thomas 1990) and have been conducted in Prince William Sound since 1993. Acoustic surveys are used to determine densities and distributions of the zooplankton and ichthyofauna in both the Sound Ecosystem Assessment (SEA) and the Alaska Predator Ecosystem Experiment (APEX) programs.

To convert acoustic survey data into population estimates it is essential to have precise and accurate estimates of fish target strength. Experiments with live active animals are more likely to produce results relevant to acoustic surveys (MacLennan and Simmonds 1993). Two approaches to measure live fish target strength are by directly ensonifying single or numbers of live fish in a cage (Edwards and Armstrong 1983) or by *in-situ* measurement of the target strength of wild fish with dual-beam or split beam techniques (Traynor and Ehrenberg 1981). In both cases, mean dorsal aspect TS is required. We propose measurements of PWS herring by these two methods. This proposal describes experiments to estimate target strength on live, caged herring, *in-situ* wild herring, and live, caged sandlance. The experiments were designed to investigate the nature of target strength and the way in which it varies with fish length, weight, and depth, while monitoring orientation (fish tilt) with video.

Previous SEA and APEX surveys provided herring estimates based on either Thorne's relationship, which predicts a 3 to 4 dB higher TS than Foote's relationship, or relative estimates of fish density. Relative densities may have high precision if the survey is replicated, but the accuracy of the density estimates is affected by the chosen TS to length regression. In addition, relative density estimates from different surveys can only be compared to one another if similar sampling protocols are used (Kjelson and Johnson 1978; Pennington 1985). Absolute density estimates, the actual number of organisms per unit area, are required to calculate population dynamic statistics such as reproductive rate, energy flow, and nutrient cycling (Kjelson 1977; Krebs 1989). Rose and several other reviewers have clearly stated that trying to estimate absolute density is impossible without determining the proper target strengths for the acoustic data. Therefore, absolute densities are required to describe food web interactions, density-dependent growth and mortality, and health of these fish populations, all of which are critical to the ecosystem models being developed by SEA and to harvest management.

Absolute density of scatterers in number of targets per m^3 can be determined by the equation:

$$D = \frac{\overline{v^2}}{k\bar{\sigma}}$$

Where...

$\bar{\sigma} = 10^{\overline{TS}/10}$	*average backscattering cross section, arithmetic equivalent of target strength per fish*
k	*electro-acoustic calibration coefficient*
v	*sonar output voltage at echo integrator*

This can be re-written in terms of absolute biomass density in kg/m^3 by multiplying the numerical density by average fish weight in kg, and separating the terms.

$$\bar{B} = \bar{D}\,\bar{w} \qquad \bar{B} = \left(\frac{\overline{v^2}}{k}\right)\left(\frac{\overline{w}}{\sigma}\right)$$

Where...

$\left(\frac{\overline{w}}{\sigma}\right) = 10^{-\overline{TS}/10}$	*arithmetic equivalent of target strength per weight*

Ideally, one would measure target strength (TS) in the field (*in-situ*), then determine the average backscattering cross section σ. However, for dense schools (typical of herring, young-of-year pollock, capelin, and sandlance), target coincidence makes *in-situ* TS measurement difficult, as multiple targets can be measured as one. See figure 1.

NEED FOR THE PROJECT

A. Statement of Problem

Many physical and biological variables affect target strength including: size of the fish; depth of the fish; tilt angle distribution of the fish; frequency of the transducer; physiology and morphology of the fish (Thorne 1983b; Foote 1987; Rose and Leggett 1988; Thorne and Thomas 1990; MacLennan and Simmonds 1991; Misund et al. 1995; Misund 1997).

TS typically increases with surface area of the fish, which is square to the length. Thorne

(1983) predicts that weight divided by backscattering cross-section increases linearly with length. Most length to TS relationships follow the formula TS = $20\text{Log}_{10}(\text{FL}) + b$, where b is species dependent (MacLennan and Simmonds 1992). For Atlantic herring b has been determined to be -72.1 (Foote, 1987), -73.2 (Halldorsson and Reynisson, 1983), -69.9 (Rudstam et al, 1988), and -73.2 (Misund and Ovredal, 1988).

Boyle's law predicts that the volume of a sphere will decrease with depth, so that in a fish, the bladder volume is inversely proportional to pressure (Mukai and Iida, 1996). Since backscattering cross-section is linearly related to surface area of the scatterer, this predicts that $\Delta\text{TS} = (-20/3)\ \text{Log}_{10}(1+\text{depth}/10)$ (Fig 3). Deviation from this theory may occur because the swimbladder is not a perfect sphere, there may be some time for the swimbladder to adapt to the new pressure, and fish may control the swimbladder size for buoyancy control. See figure 4.

The dependence of TS on fish tilt is non-linear, and is due to the non-spherical shape of the swimbladder and the fish. See figure 5. The maximum TS is not necessarily at level orientation, and mean tilt is usually not level (Huse and Ona 1996) either. TS regressions and models should include tilt effects, as fish behavior (diving, swimming, etc.) could change the TS and therefore the acoustic density estimations.

Classical scattering physics predicts a slight decrease of TS (Figure 6) with transducer frequency (Love, 1977). However, this does not include resonance effects, which could be important in that typical wavelengths of scientific sonar systems are close to typically swim-bladder sizes.

Ona (1990) observed that swimbladder volume of cod was reduced to about 60% of its original volume when they were ready to spawn, due to compression by the gonads. If the swimbladder were spherical, this would yield a surface area reduction of 29%, resulting in a theoretical TS reduction of 1.5 dB. The egg sack in Pacific herring is adjacent to the swimbladder, but the actual compression of the swim bladder is unknown. Also, herring are physostomes (open swimbladder) while cod are physoclists (closed swimbladder), so the compression amount with depth should differ. Since herring surveys are done year round, TS measures in both summer (regular gonads) and late winter (pre-spawning with ripe gonads) are required.

B. Rationale/Link to Restoration

Acoustic surveys of Pacific herring by SEA, APEX and the Alaska Department of Fish and Game (ADF&G) presently use a length dependent scaling constant to convert the reflected acoustic energy into a biomass density estimate TS re: $W = -5.982 * \text{Log}_{10}(\text{FL}) - 24.234$ (where FL is the mean fork length (cm) of the fish caught in the area (Thorne 1977b; Thorne 1983a; Thorne 1983b; Thorne and Thomas 1990). However, this regression is based on only a few data points from trawl catches.

This equation differs from the more standard regression equation (TS= 20 logFL -71.9 dB) calculated for Atlantic herring *Clupea harengus* (Foote 1987; MacLennan and Simmonds 1991) as it derives the target strength as a proportion of biomass. The use of Foote's equation instead of Thorne's would increase the density estimates of these fish species by a factor of two (Fig. 2). Atlantic herring differ physiologically from Pacific herring in characteristics including meristic counts, length at age, maximum length, egg size and fecundity, growth rate, age at maturity and longevity (Blaxter and Hunter, 1982). Atlantic herring also differ in behavior such as spawning place and season, and typical depth distributions. Because of these differences, it is necessary to generate a separate TS to length regression for Pacific herring.

C. Location

Samples will be collected from Prince William Sound, and the experimentation will be conducted in Cordova. Data analysis will be performed mostly in Cordova, with some assistance from researchers in Fairbanks.

COMMUNITY INVOLVEMENT

Local fishing vessels will be chartered, which will facilitate the finding and catching of live fish. Results from acoustic surveys have been and will continue to be presented to the public in Cordova.

PROJECT DESIGN

A. Objectives

We will conduct two cage experiments, and conduct analysis of *in-situ* measurements from acoustic-purse seine surveys of herring in Prince William Sound. The cage apparatus will be used to measure the TS of three sizes of both Pacific herring and sandlance at the depths they are commonly found during night and daytime periods. Analysis of *in-situ* measurements of TS herring on surveys in Prince William Sound will be made to evaluate the effects of density on coincidence.

The caged measurements will be made in the fall-winter of 1998 in protected areas of Prince William Sound, Alaska when all sizes of fish are available, the water is unstratified and underwater visibility is at its seasonal high. The *in-situ* measurements were made with dual-beam procedures and will include retrospective analysis of surveys conducted between 1993 and 1998. This proposal includes a description of the methods of capture, transport and handling of fish, and the experimental apparatus and procedures used to determine the target strength. The TS equations developed in this research will be applied to past and future acoustic surveys in Alaska.

B. Methods

The project has been broken into two components: 1) measurements of caged herring in fall and spring and measurements of caged or tethered sandlance in summer, and 2) *in-situ* herring TS analysis, which uses previously collected survey data.

An apparatus will be fabricated that is capable of mounting a transducer, a standard target, a cage or a tethered fish, and a video camera. Figure 7 is a preliminary design of a support structure, adapted from Edwards and Armstrong (1983). This apparatus may also be usable in the future for calibration, density ground-truthing, and possibly forward scatter experiments.

The targets of interest will be acoustically sampled using a 101-120 kHz BioSonics dual-beam transducer. The acoustic signal will be processed in real-time using target discriminator software (BioSonics ESP 281), which outputs TS estimates that will be analyzed. After sufficient acoustic data have been collected, the fish will be measured for fork length, weight, age, sexual maturity, and stomach fullness.

Four field trips are planned: a short trial experiment to refine apparatus design and procedures, a fall herring cruise, a spring herring cruise, and a summer sandlance cruise. Each experiment will be conducted in a deep, protected area of PWS (e.g. Parshas Bay) and continue for several days. Nets for catching and holding samples may be borrowed from ADF&G Cordova, including a large anchovy net (250.0 x 34.0 m and 20.0 m, 25.0 mm stretch mesh) and, for shallow water sampling, a small salmon fry seine (50.0 x 8.0 m, 3.0 mm).

I. Field experiments

Caged fish TS measurements

The experimental technique is modified from Edwards and Armstrong (1983). Modifications to these designs will be made to include new, more acoustically transparent but stronger material. The fish will be contained in an experimental cage, which will be surrounded by a guard cage. Care will be taken to ensure that all measurements are made outside of the transducer near field and that the beam fully ensonifies the cage. The guard cage will be hung from a transducer platform, which will be suspended from an anchored vessel moored in a protected bay. The electronics will be housed on the vessel. Holding tanks and a boom and winch with 60 meters capacity will be used to raise and lower the target strength apparatus.

Detailed descriptions of the electronic systems are found in Thomas et al. (1997). A standard target will be used as a reference target. After each experiment the fish will be weighed and measured, since handling prior to the experiment induces stress. TS will be regressed to both length and weight.

Two experiments with the cage will be conducted during each of three cruises: (1) evaluation of fish size on target strength, (2) evaluation of fish depth on target strength.

Cruise 1. Fall herring (120 kHz dual-beam)

a. The goal is to measure twelve fish, four each of three size ranges (corresponding to ages 1, 2 and 3+) at one depth (10 m), with orientation monitored.
b. The goal is to measure four (acclimation time will determine actual sample size) fish of one size of herring (3+) at three depths (10, 30, 60 m), with orientation monitored.
c. If time permits, we will repeat 1b with another size of herring.

Cruise 2. Spring herring (120 kHz dual-beam)

a. The goal is to measure four fish of one size range (corresponding to age 3+) at one depth (10 m), with orientation monitored.
b. The goal is to measure four fish of one size range (age 3+) at three depths (10, 30, and 60 m), with orientation monitored.
c. If time permits, 2b will be repeated for another size herring.

Cruise 3. Summer sandlance (120 kHz dual-beam)

a. The goal is to measure twelve sandlance over a wide range of lengths at one depth (10 m) with orientation monitored.
b. The goal is to measure six sandlance each at two depths (10, 60 m) with orientation monitored.

Since sandlance do not possess swimbladders, their TS should be less susceptible to stress. Therefore, no depth acclimation is required. Also, if sandlance will not swim in the cage, they will be tethered.

Behavioral monitoring

The caged fish will be continuously monitored with an underwater video system and a red strobe light, which will be mounted on the bottom of the cage. Video signals will be transmitted to the ship via an electronic cable, where they will be both viewed on a TV monitor and recorded to tape. The behavior of the fish will be monitored during experiments so that unusual behavior (e.g. presence of predators, death, escape) can be eliminated from the records. After the experiments, in the office, tapes will be played back into a frame grabber and the images stored to hard disk, where they will be analyzed for orientation of the fish within the experimental cage.

Fish Capture and Transport

Only fish in prime condition will be used in these experiments. All herring will be captured with either a commercial purse seiner or a fry seine. The fish will be segregated by size and stored in floating net enclosures for the duration of the experiment, and will be replenished when necessary. Live tanks with aeration systems will be used on deck to hold fish during

experiments. Condition and mortality will be recorded for all experimental fish after the TS measurements are conducted.

Environmental Conditions

Throughout the experiments the temperature and salinity will be measured by depth with a CTD, so that accurate absorption coefficients and sound speeds can be applied to the acoustic signals.

II. *In-situ* data analysis

Since 1995 the SEA project has conducted surveys for juvenile herring, where *in-situ* dual-beam target strength data was collected along with echo-square integration data. This phase of the project is the simplest to implement as the data already exist (no additional field time or equipment is required); however, the data are the most problematic in that coincident targets can yield overestimates of TS, and catches often have multiple age-classes and species.

We will first identify net sets with single-species single-age catch, then determine the acoustic transects from previous surveys that temporally and spatially overlap these net sets. From this acoustic data, we will identify any valid single targets (via a target-tracking algorithm and off-axis angle distributions). The TS from the acoustics will then be regressed with lengths and weights from the catch. These TS data will also be compared with TS measurements from the caged experiments.

A relationship between the ability to detect a valid single target and the volume backscatter may also be established, which may indicate a density threshold at which target coincidence becomes a problem.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

ADF&G will assist with some field logistics, and personnel from UAF will assist with field operations and statistics.

SCHEDULE

A. Measurable Project Tasks

FY 98:

Sep 99	Cage apparatus designed and constructed

FY 99:

Oct 98	Field experiments (non-spawning herring)
Dec 98	Preliminary results/equation available
Jan 99	In-situ data aligned
Mar 99	Field experiments (pre-spawning herring)
Jul 99	Field experiments (sandlance)
Sep 99	Results available, final report written

B. Project Milestones and Endpoints

Target strength equations for the dorsal aspect of Pacific herring by size and depth. These will be used to transform future acoustic survey information to density and biomass and correct past estimates if this is needed. TS equations will be developed from these data for length and weight per dB. The first preliminary length to target strength regression will be available one month after the first experiment.

C. Completion

The work will be completed and a final report written by September 1999.

PUBLICATIONS AND REPORTS

The result of this research will be a series of target strength regressions specifically for Pacific herring and sandlance in Prince William Sound, Alaska, and an understanding of changes in TS due to physics, behavior, and physiology. With these equations it will be possible to correct the density estimates of previous surveys to accurate absolute densities. It will then be possible to incorporate these data into the ecosystem models presently being developed for Prince William Sound. Furthermore, these equations will improve acoustic estimates of biomass, thereby aiding in the management of fisheries resources.

PROFESSIONAL CONFERENCES

Preliminary results of the FEATS project will be available for researchers making presentations at the EVOSTC Restoration workshop in March 1999. Final results will be presented at a seminar at University of Alaska Fairbanks in August 1999, and at a

professional meeting in September 1999.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The FEATS project will cooperate with other EVOSTC-sponsored programs. Results of these experiments will be given to SEA and APEX fisheries researchers.

ENVIRONMENTAL COMPLIANCE

The FEATS project will operate under strict environmental compliance.

PROPOSED PRINCIPAL INVESTIGATORS

Jay Kirsch and Gary Thomas
Prince William Sound Science Center
P.O. 705 Cordova, AK 99574
Phone: (907) 424-5800
Fax: (907) 424-5820
E-mail: kirsch@grizzly.pwssc.gen.ak.us

PRINCIPAL INVESTIGATOR QUALIFICATIONS

Qualifications of the principal investigators are attached.

OTHER KEY PERSONNEL

Kevin Stokesbury, UAF
John Wilcock, ADF&G
Mark Willette, ADF&G

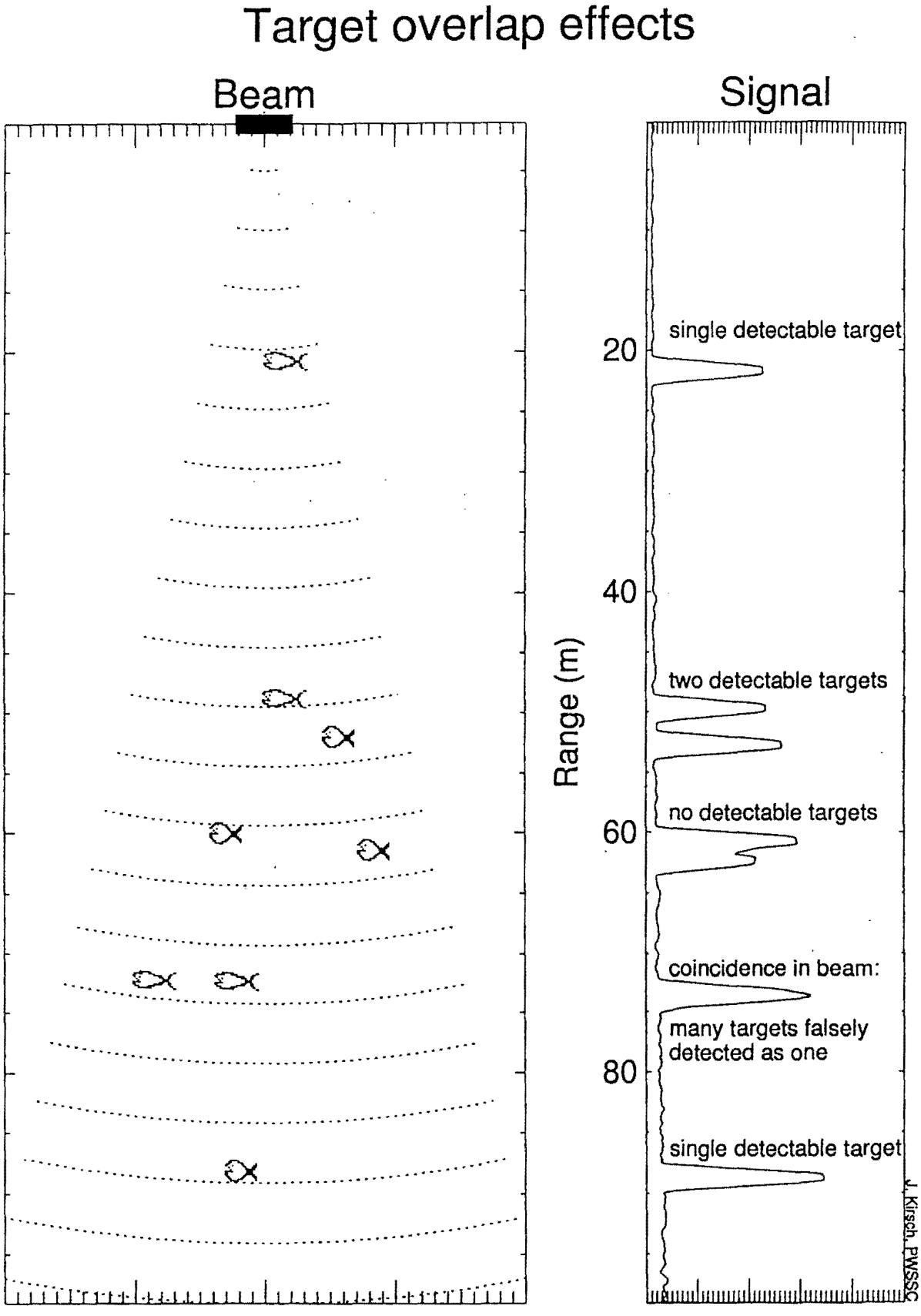


Figure 1. Effects of target overlap

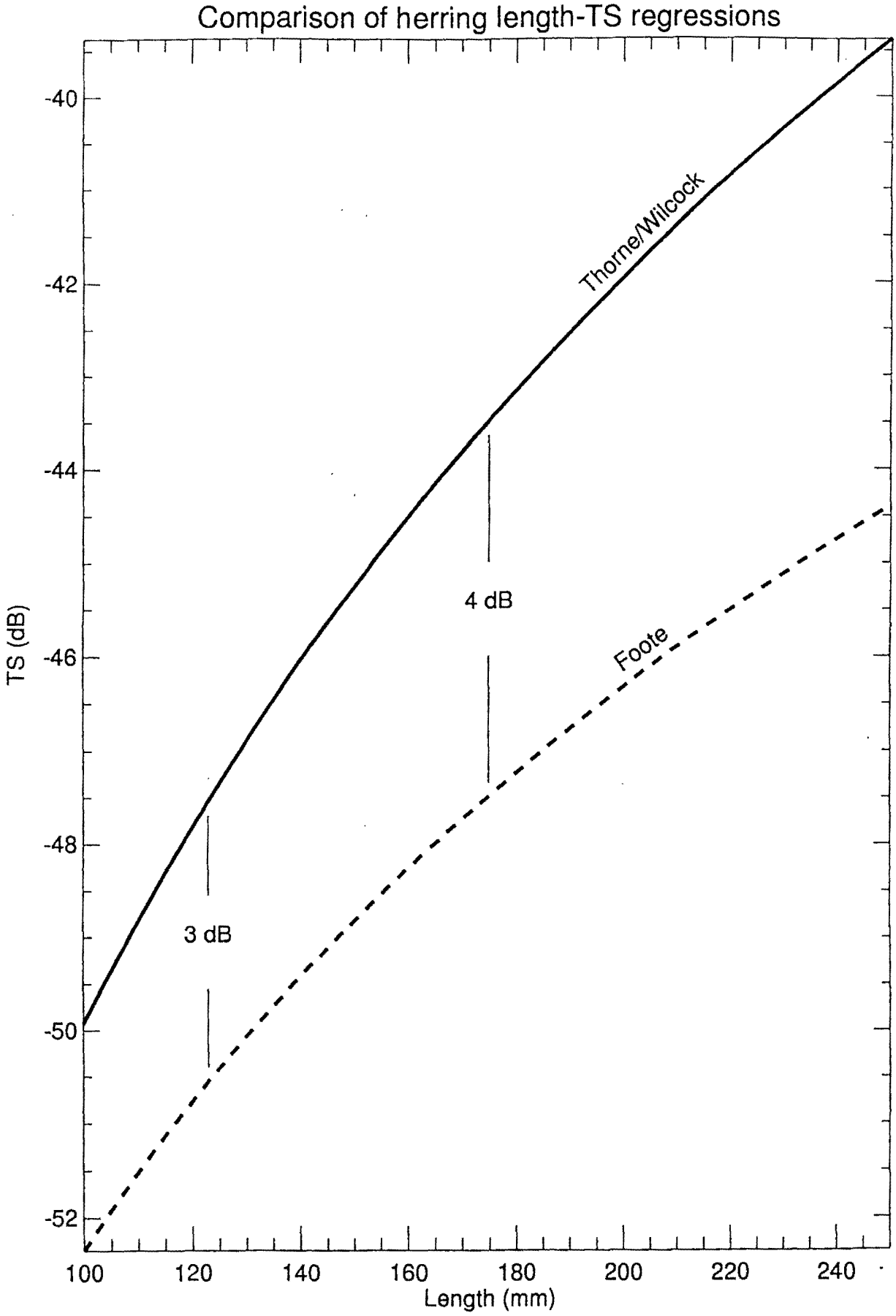


Figure 2. TS models compared: Thorne vs. Foote

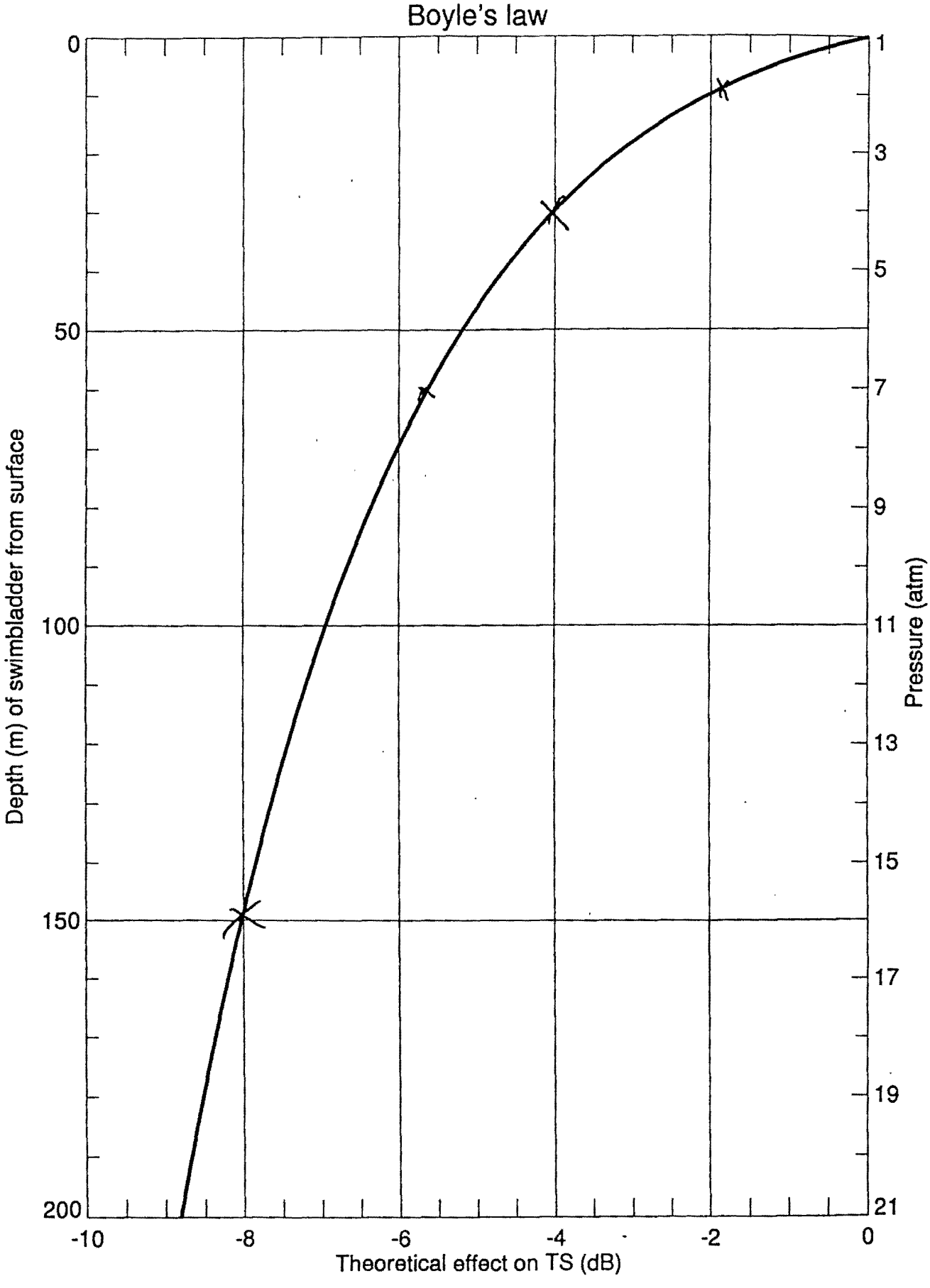


Figure 3. Effect of depth on TS

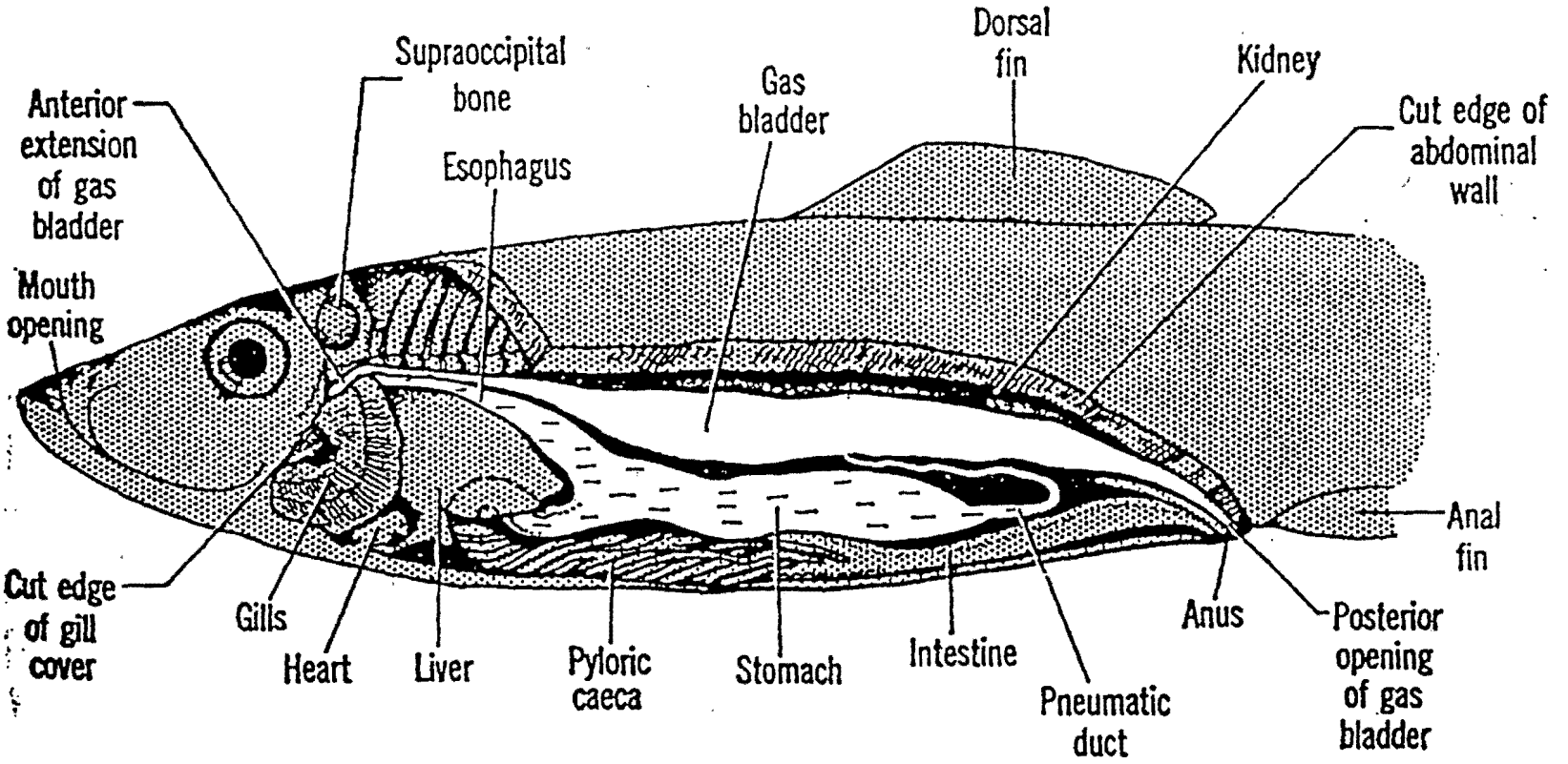


Figure 4. Herring anatomy, including swimbladder

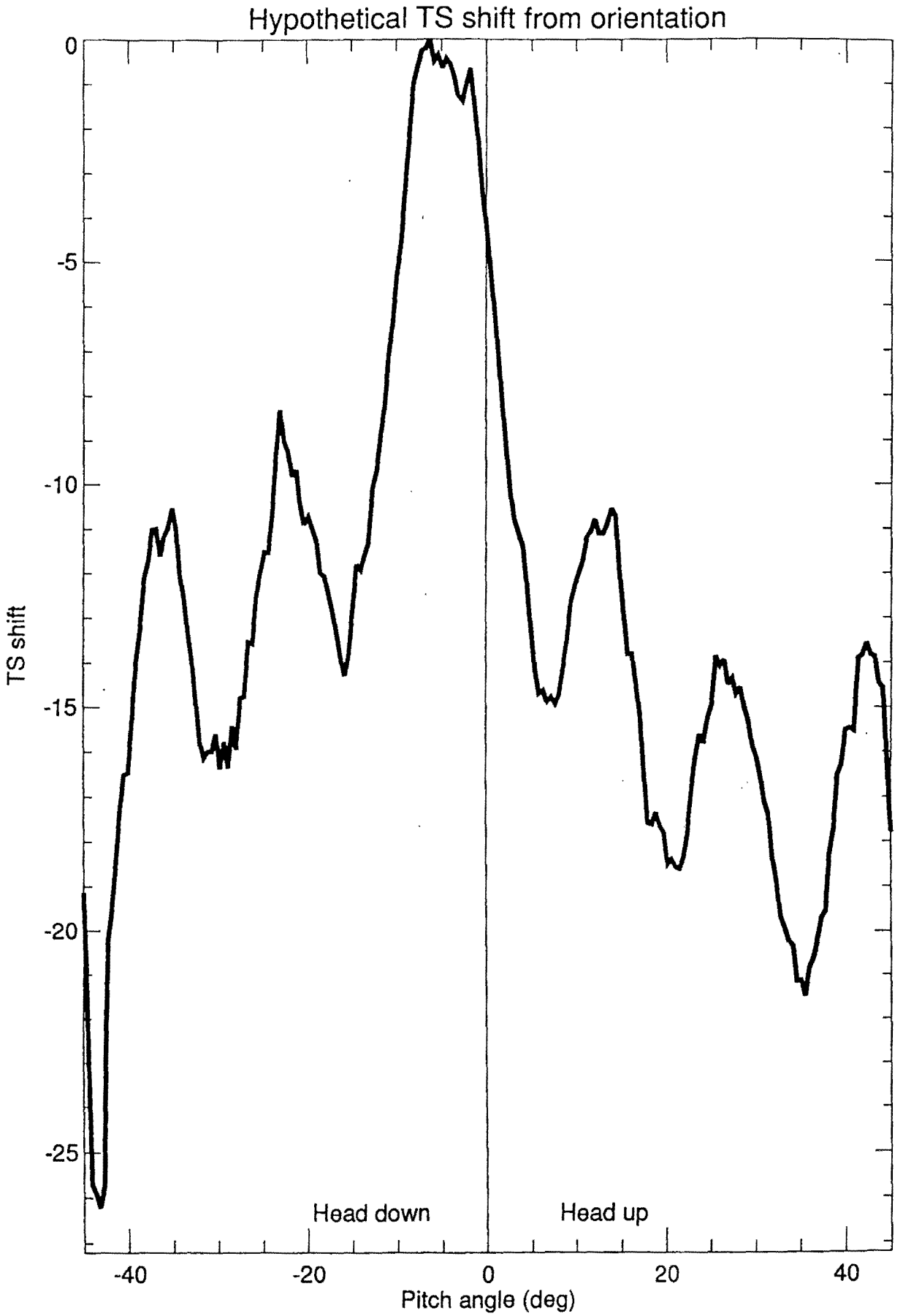


Figure 5. Effects of orientation on TS

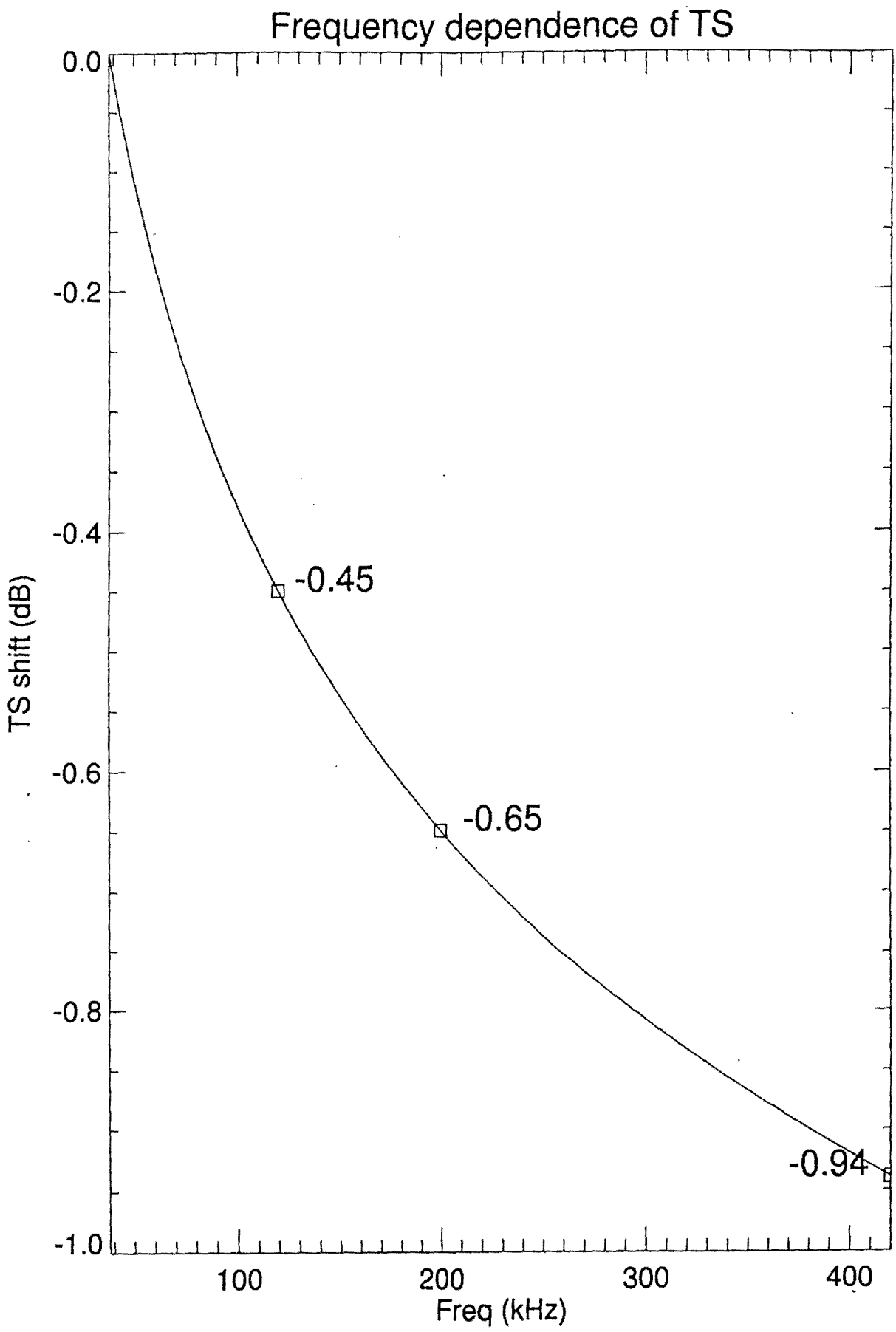


Figure 6. Simplified frequency response

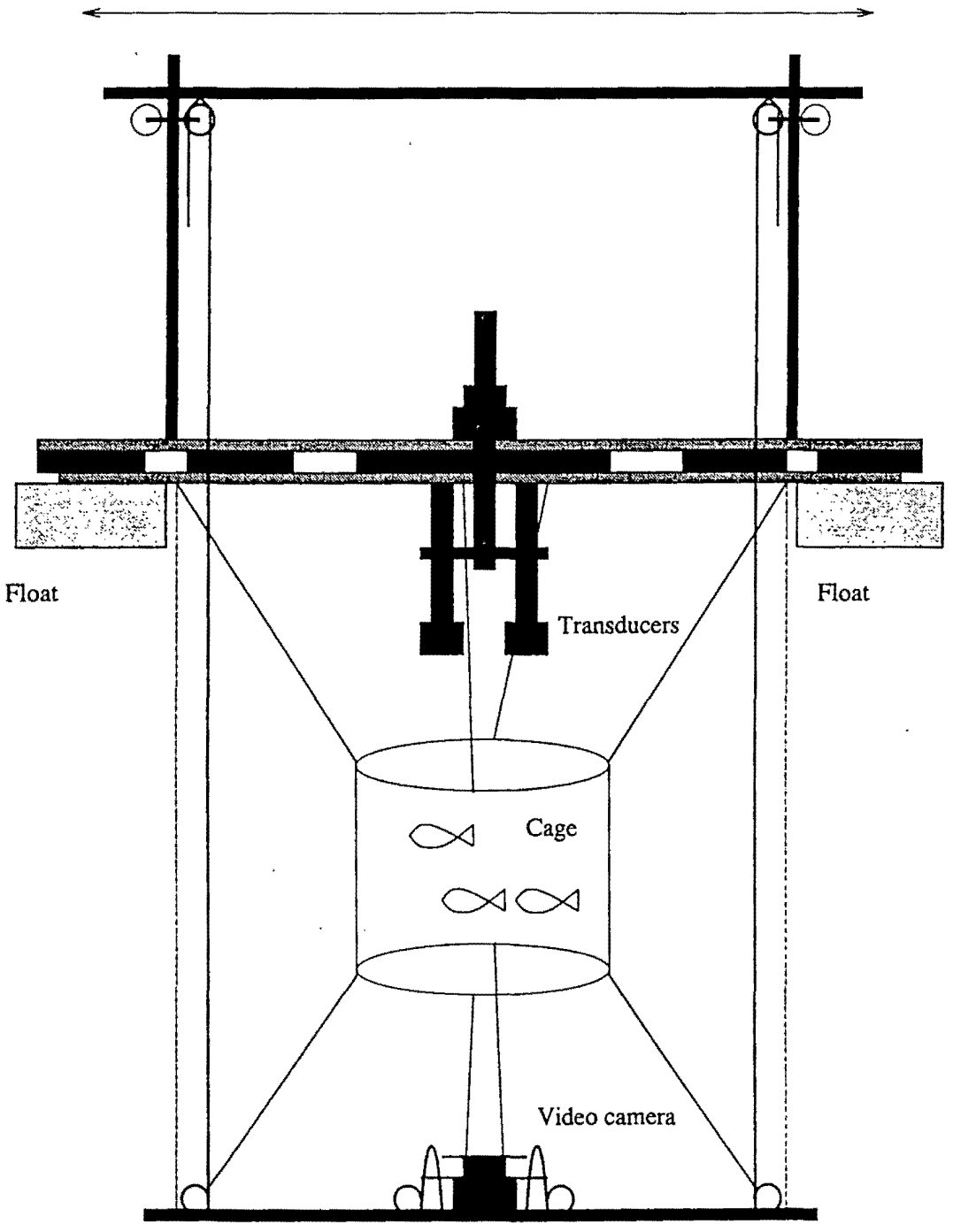


Figure 7. Preliminary design of fish support apparatus

Revision 6-98
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$0.0						
Travel		$0.0						
Contractual		$137.0						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$0.0	$137.0		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$9.6						
Project Total	$0.0	$146.6		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)		6.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY 99

Prepared:

Project Number: 99468
Project Title: Project Title: Target Strength Studies in PWS
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999						
Personnel		$44.2						
Travel		$8.6						
Contractual		$49.2						
Commodities		$2.0						
Equipment		$5.6	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$109.6		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
Indirect		$27.4						
Project Total	$0.0	$137.0						
Full-time Equivalents (FTE)		6.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY 99

Project Number:
Project Title: Target Strength Studies in PWS
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4A
Non-Trustee
SUMMARY

Prepared:

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
	G.L. Thomas	co-Principal Investigator	1.0	13.6		13.6
	J. Kirsch	co-Principal Investigator	3.0	7.1		21.3
	TBA	Mathmatician	0.15	6.2		0.9
	TBA	technicians	1.2	4.0		4.8
		technicians	0.9	4.0		3.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	6.3	34.9	0.0	
					Personnel Total	$44.2

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
	EVOS Annual meeting	0.2	2	10	0.2	2.4
	CDV-Fairbanks	0.4	4	8	0.2	3.2
	ASA Conference (Berlin)	1.2	1	6	0.3	3.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$8.6

FY 99

Prepared:

Project Number:
Project Title: Target Strength Studies in PWS
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Description	FY 1999
vessel charter, purse seiner for 5 days @1275/day	6.5
vessel charter, acoustic vessel for 28 days @ 800/day	22.4
vessel fuel/Orca Challenger	3.0
additional fabrication services: net & cage	1.5
misc. services	0.2
telecommunication, facsimile	0.6
Subcontract - Fisheries biologist, (ADF&G or UAF)	15.0
Contractual Total	$49.2

Commodities Costs:	Proposed
Description	FY 1999
field supplies	1.0
office supplies	0.5
video and acoustic storage	0.5
Commodities Total	$2.0

FY 99

Prepared:

Project Number:
Project Title: Target Strength Studies in PWS
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1999
video recording system & accessories	1	2.4	2.4
transmit cable	1	3.2	3.2
			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**	$5.6

Existing Equipment Usage:	Number	
Description	of Units	
digital and analog echosounding systems		
Research Vessel: Orca Challenger		
Sun computers		

FY 99

Prepared:

Project Number:
Project Title: Target Strength Studies in PWS
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Equipment
DETAIL

Approved TC 12-15-98

Exxon Valdez Oil Spill Trustee Council

645 G Street, Suite 401, Anchorage, AK 99501-3451 907/278-8012 fax:907/276-7178

MEMORANDUM

To: Trustee Council Date: December 7, 1998

Thru: Molly McCammon Subj: Amendment to 99470

From: Joe Hunt

This memo provides the background for a request to amend *99470 (10-Year Symposium and Related Events/Materials)* to fund an educational component for the 10th anniversary.

Oil Pollution Prevention Education Program

After two months of discussion involving several spill-area resource groups, a coalition has formed to promote education about the *Exxon Valdez* spill, restoration activities, and spill prevention/response. The Oil Pollution Prevention Education Program is a partnership between the Prince William Sound Regional Citizens' Advisory Council, the U.S. Forest Service, Prince William Sound Science Center, and Chugachmiut. The EVOS Restoration Office, Oil Spill Recovery Institute, Alaska SeaLife Center, Pratt Museum, Valdez Museum and others have participated in the planning efforts of this group.

OPPEP has submitted an education proposal to the Trustee Council and to OSRI to request funding for 1) 10th anniversary activities for spill region schools and 2) a long-term education program for school districts statewide. The proposal was submitted December 1, with Restoration Office encouragement so that we could consider requests concerning 10th anniversary education activities. OPPEP has been informed that any proposal to fund a long-term education program would have to go through the normal Trustee Council funding cycle.

Due to the late date, any 10th anniversary education project must be limited to what can reasonably be accomplished before the March 24, 1999 anniversary. Proposed activities include:

1) Informational Newspaper

Creation of a four-page newspaper to be distributed through the school districts within the spill region. This newspaper would answer key questions in very simple terms.

- Is there still oil on the beaches? If so, where?
- Are the fish and wildlife injured by the spill recovering?
- Was the EVOS event the largest spill ever?
- Could it happen again?
- If it happened again, would the response be improved?

The newspaper would also contain a broad resource list for teachers and others to obtain more information. The OPPEP proposal asks for $3,700 to create the newspaper and print 10,000 copies. Prince William Sound Science Center would provide $1,200 in in-kind staffing to organize this effort.

The newspaper would be available to any agency or group that would want to reprint it for distribution. The Restoration Office could reprint 30,000 copies for distribution with the 30-minute video (see video information below) and for distribution at the Alaska SeaLife Center as part of the EVOS exhibit. If this is done at the time of the original printing, it will cost about $3,000 or 10 cents each.

2) Art & Essay Contest

Organization of an Art & Essay Contest for school children in the spill region. This contest would be open to high school students who would have been four- to eight-years-old at the time of the spill. It would ask for impressions about how the spill impacted their families and communities. The art contest would be open to all grade levels.

The art and essay contest would be one way to get students to reflect on the 10th anniversary and all of the spill-related events of the previous 10 years. A series of prizes would be made available to the top finishers in each category.

The Art and Essay contest could benefit 10th anniversary activities in several ways.

- Submissions to the art contest could be exhibited at the symposium.
- The winner(s) of the essay contest could present the paper(s) at the symposium.
- A calendar could be created as an educational tool about the EVOS and spill prevention/response. This would be modeled after the Goose Calendar Contest conducted by the USFWS to promote conservation in western Alaska.
- Artwork and essays could be collected into an exhibit that would tour Alaska schools and libraries.
- The Anchorage Daily News has expressed an interest in printing essays and artwork in We Alaskans.

The OPPEP proposal asks for $9,700 for the Art & Essay Contest to cover the costs of:

Promotion	$700
Prizes	$2,000
Travel scholarships to attend symposium	$2,000
Calendar printing (2,500 @ $2)	$5,000

This contest would be managed by the U.S. Forest Service, which would staff time and graphic design for the calendar. The USFS in-kind contribution is estimated to be worth $11,400.

EVOS Video Distribution

In addition to the OPPEP proposal, the Trustee Council's 30-minute video should be disseminated to school districts statewide. This video will focus on specific EVOS research projects as well as the Habitat Protection Programs and is due to be finished by December 31, 1998. Distributing the video to high school science teachers and school libraries throughout the state will require up to 600 copies at a cost of $1,800 plus mailing.

- Video copies (600 @ $3) $1,800
- Postage (video and supporting materials) $2,000

Recommendations

Newspaper Flyer. The newspaper is a practical item that would serve the Trustee Council's public information efforts well during this 10th anniversary year. Since a considerable portion of the newspaper would be dedicated to spill prevention and response, the Restoration Office should fund a portion of the requested amount. I recommend paying the printing costs of $1,500 for 10,000 copies. This would be contingent on the remainder of the costs being picked up by an appropriate spill prevention/response organization. In addition, the Restoration Office should fund an extra 30,000 copies of the newspaper for distribution with the 30-minute video and for other uses.

Art & Essay Contest. The benefits of the Art and Essay Contest are numerous. The Restoration Office should fund the entire package, providing input on contest rules, prizes, judging, and creation of the calendar.

Video Distribution. The video and supporting material, such as the newspaper and the annual report, will be instrumental in encouraging teachers to dedicate classroom time to the oil spill and its ramifications. This statewide distribution effort should be funded.

Newspaper Flyer printing	$ 1,500
Reprints (30,000 copies)	$ 3,000
Art & Essay Contest	$ 9,700
Video Distribution	$ 3,800
G.A. – ADF&G	$ 400
G.A. – USFS	$ 400
TOTAL	$18,800

Revised 6-24-98
Approved TC 8-13-98

10-Year Symposium and Related Events and Materials

Project Number:	99470
Restoration Category:	General restoration
Proposer:	Restoration Office, *Exxon Valdez* Oil Spill Trustee Council
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	All Trustee agencies
Alaska SeaLife Center:	No
Duration:	1st year of a one-year project
Cost FY 99:	$152.0
Geographic area:	Entire oil-spill region
Injured Resource/Service:	All injured resources and services

ABSTRACT

In March 1999, the 10th anniversary of the oil spill, the Trustee Council will sponsor a five-day symposium in Anchorage; the Alaska Sea Grant Program and the Prince William Sound Regional Citizens' Advisory Council will be cosponsors. This public symposium will open with an overview session on the oil spill and the Restoration Program, followed by more technical sessions. The symposium will be the centerpiece of several anniversary-related efforts, including a traveling exhibit in spill-region communities and a special anniversary edition of the annual status report.

INTRODUCTION

Since the *Exxon Valdez* oil spill on March 24, 1999, the *Exxon Valdez* Oil Spill Trustee Council has spent hundreds of millions of dollars and sponsored hundreds of projects as part of the Natural Resources Damage Assessment and the subsequent Restoration Program. Projects have included studies on such topics as the fate and effects of oil, injury to and recovery of fish and wildlife resources, loss of services provided by injured natural resources, and ecological and other factors that limit or influence recovery, productivity, and long-term population trends. The Trustee Council also has sponsored a major habitat protection program and many general restoration projects, including local fisheries enhancements, removal of residual oil from mussel beds and shorelines, and protection of vandalized archaeological sites. Although not part of the Trustee Council's Restoration Program, during this same time there has been increased attention to the prevention of and response to oil spills, as well as to cleanup techniques appropriate in cold marine waters.

In March 1994, five years after the oil spill, the Trustee Council sponsored a public symposium to review what had been learned about injury and recovery and to update the public on what the Trustee Council had done to aid restoration. In Fiscal Year 1999, the Trustee Council proposes to hold a five-day public symposium, "Legacy of an Oil Spill - 10 Years After *Exxon Valdez*," to once again update the public, resource managers, industry, the news media, and researchers on what has been learned since the oil spill and what has been done to aid recovery from the effects of the spill. Additional topics will include socioeconomic effects of the spill and oil-spill response and prevention.

The symposium will be part of a larger effort to report to the public on the Trustee Council's activities 10 years after the oil spill. Additional efforts will include a traveling exhibit that will tour oil-spill communities and a special 10th-anniversary edition of the annual status report.

NEED FOR THE PROJECT

A. Statement of the Problem

The Trustee Council's Restoration Program produces dozens of annual and final project reports each year, as well as an annual status report, several workplan documents, newsletters, and other materials that are used to involve and inform the public. In addition, the Trustee Council conducts public meetings, such as those on possible uses of the Restoration Reserve, and has sponsored videos, exhibits, radio programs, and newspaper columns. Although these products and outreach efforts are effective, it still can be difficult--particularly for persons who have not followed the Restoration Program closely over the last decade--to understand the larger picture of what has been learned since the spill and what has been done to restore and enhance the injured marine ecosystem. The need to pull together this information will be especially great during the

10th year after the spill, when the eyes of the nation, if not the world, will once again focus on the aftermath of the largest marine oil spill in United States history.

B. Rationale/Link to Restoration

During the year of the 10th anniversary year most people, including those in the news media, will turn to the Trustee Council as the primary source of information about EVOS and the Restoration Program. There is, however, no single means of effectively providing this information, and a suite of approaches, including a symposium, exhibits, and a publication, will be most effective. Public involvement is a requirement of the settlement between the state and federal governments and the Exxon Company USA, and disseminating information about the spill is fundamental to the Trustee Council's mission. In addition, helping the public take stock of what has been learned about injury and recovery and what has been done in the Restoration Program is, in itself, an important part of the restoration process. The anniversary should help bring a measure of closure to the EVOS experience for some affected persons, and the "availability to the public of the latest scientific information" plays an important role in the restoration of passive uses, which was a lost or reduced service as a result of the oil spill (Exxon Valdez *Oil Spill Restoration Plan*, p. 49).

C. Location

The symposium will be held at the Egan Convention Center in Anchorage, Alaska, March 23-27, 1999. Persons attending the symposium are expected to come from spill-area communities and from throughout Alaska, the United States, and other countries.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The Community Involvement Coordinator (Project \052) participated in early discussions about the content of the symposium's first day, which is intended to provide an overview on spill effects and the Restoration Program. An Alaskan Native will be invited to give a presentation during the first-day (March 23) plenary session. Subsequent technical sessions (March 24-27) will afford an opportunity for persons who have conducted post-spill research on the effects of the spill in communities and villages to present the results of their work. The Executive Director has already sent a letter to representatives of local municipal and tribal governments in the spill area, informing them about the plans for the symposium.

PROJECT DESIGN

A. Objectives

The overarching goal of this project is to inform the interested public, including residents of spill-area communities and the news media, about the status of injured resources and lost or reduced services, what has been learned about the marine and coastal ecosystem in the northern Gulf of Alaska, what the Trustee Council has done to aid restoration, and advances in oil-spill response and prevention since the *Exxon Valdez* oil spill on March 24, 1989. Specific objectives are to:

1. Hold a symposium, *Legacy of an Oil Spill - 10 Years After the* Exxon Valdez, from March 23-27, 1999, in Anchorage, Alaska;

2. Circulate a traveling EVOS exhibit (prepared in FY 98) to 10 or more oil-spill communities;

3. Move the EVOS exhibit now at the Alaska SeaLife Center (through at least January 1, 1999) to Anchorage for display at the 10th anniversary symposium and explore a possible permanent venue for this exhibit; and

4. Issue a special, expanded 10th-anniversary edition of the Trustee Council's annual status report.

B. Methods

The methods described below are organized by project objective.

1. Symposium. In cooperation with the Alaska Sea Grant College Program at the University of Alaska Fairbanks, a program committee developed general plans for the symposium. In addition, several subcommittees have been formed to address specific areas of responsibility, such as planning for the overview session on day one, review of technical abstracts, and planning for field trips and the news media.

Appropriate space has been reserved in the Egan Conference Center for March 23-27, 1999. The symposium has been and will be publicized in various EVOS materials, such as in the newsletter (*Restoration Update*), as well as through the news media. Twice in FY 1998, a "Call for Abstracts" was mailed to the EVOS mailing list, and announcements have been circulated for publication in newsletters of professional societies and other organizations. In addition, the Executive Director sent letters to local municipal and tribal governments, informing them about the planned symposium.

The Sea Grant office designed the Call for Abstracts and is compiling the abstracts, which are due May 15, 1998. In FY 1999, after the abstracts have been screened by the scientific program subcommittee, the Sea Grant office will prepare (e.g., edit, format) the abstract book, which will be available for distribution at the symposium. The Sea Grant office also will design the brochure containing "Program and Registration Information, " which will be mailed by the Restoration Office to the EVOS mailing list and to anyone who inquires about the symposium. This brochure will be mailed once near the end of FY 1998 and at least once in FY 1999. The Restoration Office will handle incoming registrations, while Sea Grant will design and prepare the formal program for distribution at the symposium. The Restoration Office will prepare and distribute information packets to news media contacts in advance of the symposium.

Putting on the symposium will require participation by many persons, including staff from Trustee agencies, the Trustees themselves, Restoration Office staff, Sea Grant staff, and various investigators. For example, tasks include: emceeing various functions, chairing technical and poster sessions, operating the registration table, etc. These responsibilities will be assigned early in FY 99, after the initial review of abstracts is completed and the number and subjects of the oral and poster presentations are known.

Some travel support will be required for invited speakers (e.g., Dr. Jane Lubchenco, the luncheon speaker on March 23) and for principal investigators who previously conducted studies for the Trustee Council, but who no longer have Trustee Council funding.

2. Traveling Exhibit. The traveling exhibit consists of four pieces that are self-contained for shipping and easy assembly. The exhibit will be shipped to various spill region communities where it will be displayed at such locations as community centers, city halls, schools and museums for 2-3 weeks at a location. Specific arrangements have not yet been made, though the exhibit will be displayed in Valdez in the 1998 summer, except for late August, at which time it will be at the Alaska State Fair.

3. ASLC Exhibit. The comprehensive EVOS exhibit now on display at the Alaska SeaLife Center is large and requires special handling. Contractors will be hired to remove the exhibit prior to the 10th anniversary symposium, convert it from a wall-based exhibit to a self-standing exhibit, install it at the Egan Convention Center, and remove it at the conclusion of the 10th anniversary symposium. In FY 1999, we also will seek a permanent venue for the exhibit, but funds for any related modifications and move are not included in this (99470) budget.

4. Status Report. The special 10th anniversary edition of the annual status report will be similar to the regular annual report, though longer (about 60 pp.) and in full color. It will be printed in lieu of a regular status report, and it will not contain the detailed auditor's report. The report will be both informative and visually appealing to a general audience. It will contain many color photographs with descriptive captions that explain restoration activities. Some informative graphics, including a map of the spill region, will be used to illustrate and better explain habitat

protection and ecosystem dynamics in the spill area.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The program committee includes staff members representing four of the six Trustee agencies (ADFG, NOAA, DOI, USFS), plus the Restoration Office, EVOS Public Advisory Group, University of Alaska Sea Grant College Program, the Prince William Sound Regional Citizens' Advisory Council, and the University of Alaska. A Reimbursable Services Agreement will be developed to transfer the necessary funds to the Sea Grant program at the University of Alaska Fairbanks.

There is a contract in place with the Egan Conference Center for space, services, and food for the symposium. There will be need for a contract with a graphic artist to produce the special edition of the status report. Another contract is needed to remove the exhibit from the ASLC and modify, install, and remove it from the Egan Center for the symposium.

The Prince William Sound Regional Citizens' Advisory Committee previously contributed $5,000 to construction of the exhibit at the ASLC and have been invited to contribute $9,500 toward completion of the expanded video documentary. The Alaska Sea Grant College Program has donated substantial time and expertise to the symposium planning effort; additional resources will be donated in FY 99.

SCHEDULE

A. Measurable Project Tasks for FY 99

October 1998:	-Final assignments of symposium responsibilities
	-Develop schedule of venues for traveling exhibit
	-Contract with graphic artist for status report layout and artwork
November:	-Publish advertisements and announcements for symposium
December:	-Second mailing of Program and Registration Information brochure
	-Send symposium abstract book to be printed
January 1999:	-Finalize text, photos, and layout for status report
February:	-Send status report to be printed
	-Print symposium program
March:	-Remove exhibit from ASLC and install at Egan Center
	-Hold symposium at Egan Center
	-Distribute symposium program, abstract book, and other materials
April:	-Follow up as required

B. Project Milestones and Endpoints

Project objectives will be completed according to the schedule above; there are no objectives beyond FY 99.

C. Completion Date

Nearly all work will be completed at the conclusion of the symposium, March 27, 1999. Any follow up tasks and work not directly related to the symposium itself will be completed by the end of FY 1999.

PUBLICATIONS AND REPORTS

While there will not be an annual or final report in the conventional sense, there will be an abstract book and program from the symposium and the special anniversary edition of the status report. Also, persons presenting research results at the symposium will be encouraged to publish their findings in open, peer reviewed journals.

PROFESSIONAL CONFERENCES

There is need for limited travel support to enable participation by invited speakers and some former investigators who no longer have projects funded by the Trustee Council. Costs for the participation of current PIs will be borne through their own project budgets; the FY 1999 *Invitation to Submit Proposals* instructs applicants to request such funds. We also can expect requests for presentations by Restoration Office staff on EVOS and the restoration program at other professional conferences; support for travel to two such meetings is requested.

NORMAL AGENCY MANAGEMENT

Public information and participation is an explicit requirement of the October 1991 settlement. Thus, this project is something that is appropriately carried out by the Restoration Office on behalf of the Trustee Council.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be fully coordinated with and among Trustee agencies, scientific peer reviewers, the Public Advisory Group, and others. The March 1999 symposium will be held in lieu of an annual restoration workshop (normally held in January). Preparation for the symposium and the

symposium itself will be a valuable exercise in integration and synthesis of what has been learned since the oil spill. This should be valuable for the public, but it also will be valuable for the Trustees, Restoration Office staff, and others in terms of shaping the future of the Restoration Program.

PROPOSED PRINCIPAL INVESTIGATOR

Molly McCammon, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501
907-278-8012
907-276-7178 (fax)
<mollym@oilspill.state.ak.us>

Stanley E. Senner, Science Coordinator
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501
907-278-8012
907-276-7178 (fax)
<stans@oilspill.state.ak.us>

Joe Hunt, Communications Coordinator
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501
907-278-8012
907-276-7178 (fax)
<joeh@oilspill.state.ak.us>

PRINCIPAL INVESTIGATOR

Ms. McCammon has 25 years of experience in recreation and tourism, journalism, communications, and public policy, emphasizing natural resource issues. She has been Executive Director of the Trustee Council since 1994.

Mr. Senner has 25 years of experience as biologist and in positions involving science, public policy and conservation. He has been Science Coordinator for the Trustee Council since 1995.

Mr. Hunt has 16 years of experience in journalism and public affairs, including two years as the lead reporter in the Anchorage Times' coverage of the *Exxon Valdez* oil spill. He has been Communications Coordinator for the Trustee Council since 1996.

OTHER KEY PERSONNEL

Ms. Brenda Baxter, Coordinator
Alaska Sea Grant College Program
University of Alaska Fairbanks
P.O. Box 755040
Fairbanks, Alaska 99775-5040
(907) 474-6701
(907) 474-6285 (fax)
<FNBRB@uaf.edu>

Bruce Wright, Chief
Office of Oil Spill Damage Assessment and Restoration
National Marine Fisheries Service
11305 Glacier Highway
Juneau, Alaska 99801
(907) 789-6601
(907) 789-6608 (fax)
<bruce.wright@noaa.gov>

TC approved 1 15-98
Adds to funding
approved 8-13-98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI/USFWS	DOI/NPS
				$8.7	$0.0	$10.1	$0.0	$0.0
Personnel		$0.0						
Travel		$2.0						
Contractual		$12.0						
Commodities		$4.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$18.0		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$0.8						
Project Total		$18.8		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)								
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: This amendment to 99470 ($152,000 was approved in August 1998) will fund 10th anniversary activities not anticipated at the time the original budget was approved.

TOTAL PROJECT COST:

approved 8-13-98	152.0
approved 12-15-98	18.8
	$ 170.8

1999

1 of 1

Project Number: 99470 (am)
Project Title: 10 Year Symposium and Related Events & Materials
Lead Agency: ADFG (Restoration Office)

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

12/10/98

TC approved 1: 5-98 (amendment)

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$6.3
Commodities		$2.0
Equipment		$0.0
Subtotal	$0.0	$8.3
General Administration		$0.4
Project Total	$0.0	$8.7
Full-time Equivalents (FTE)		0.0

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Project Total	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

These funds will support printing and distribution of an informational newsletter to schools in the spill area and at the Alaska SeaLife Center, and reproduction and distribution of the Trustee Council's video on its restoration efforts to school districts statewide. The newsletter will be prepared by the Prince William Sound Science Center (in-kind contribution $1,200).

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: ADFG (Restoration Office)

FORM 3A
TRUSTEE
AGENCY
SUMMARY

12/10/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
						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	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: ADFG (Restoration Office)

FORM 3B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1998
Description	
Print newspaper (5,000 copies) for distribution to school districts in spill area; additional 5,000 copies will be printed with other funds	1.5
Print newspaper (30,000 copies) for distribution at Alaska SeaLife Center and for other uses	3.0
Reproduce Trustee Council video (600 copies @ $3)	1.8
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$6.3

Commodities Costs:	Proposed FY 1998
Description	
Postage (distribute Trustee Council video to highschool teachers and school libraries statewide)	2.0
Commodities Total	$2.0

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: ADFG (Restoration Office)

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 1998
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		

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: ADFG (Restoration Office)

FORM 3B
Equipment
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$2.0
Contractual		$5.7
Commodities		$2.0
Equipment		$0.0
Subtotal	$0.0	$9.7
General Administration		$0.4
Project Total	$0.0	$10.1
Full-time Equivalents (FTE)		0.0

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$0.0	$0.0	$0.0	

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

These funds will support an art and essay contest for school children in the spill area. The USFS will provide the following in-kind contribution: 1 mo. Interpretive specialist ($4.4), volunteer judges ($2.0), and other organizational costs ($5.0).

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: USFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

12/10/98

FY 99 EXXON VALDEZ TRUS[illegible] COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
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	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Description						
Travel for contest winners to 10 Year Symposium						2.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.0

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

12/10/98

FY 99 EXXON VALDEZ TRUS[illegible] COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1998
Print calendar (2,500 @.$2)	5.0
Radio advertising	0.7
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$5.7

Commodities Costs:	Proposed
Description	FY 1998
Awards for contest winners	2.0
Commodities Total	$2.0

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: USFS

FORM 3B
Contractual & Commodities DETAIL

12/10/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			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
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY 99

Project Number: 99470 (am.)
Project Title: 10 Year Symposium and Related Events & Materials
Agency: USFS

FORM 3B
Equipment
DETAIL

12/10/98

Approved TC 8-13-98

Updating the Status of Services Reduced or Lost Due to the Oil Spill

Project Number:	99471
Restoration Category:	General restoration
Proposer:	Alaska Department of Fish & Game (subsistence component) and Restoration Office (commercial fishing, recreation/tourism, and passive use components)
Lead Trustee Agency:	Alaska Department of Fish & Game
Alaska SeaLife Center:	No
Duration:	1st year, 1 year project
Cost FY 99:	$184,300 (subsistence component) $ 10,700 (commercial fishing component) $0 (recreation/tourism component) $0 (passive use component)
Geographic Area:	Oil spill area
Injured Resource/Service:	Subsistence, commercial fishing, recreation/tourism, passive use

ABSTRACT

The *Restoration Plan* (1994) identifies four services (human uses) as lost or reduced by the oil spill -- subsistence, commercial fishing, recreation/tourism, and passive use -- and a recovery objective for each. Although the status of these services was discussed briefly in the *Update on Injured Resources and Services* (1996), no formal studies have been funded by the Trustee Council to evaluate their recovery. With an eye to the 10th anniversary of the spill, this project will review the status of each service. Methods include reviewing existing information provided through ongoing EVOS research as well as gathering additional information.

INTRODUCTION

In the years immediately following the oil spill, several studies were conducted to evaluate the effects of the spill on human uses, in particular on subsistence, commercial fishing, recreation/tourism, and passive use. The Alaska Department of Fish and Game Subsistence Division conducted household surveys which collected subsistence harvest and other information in 15 communities in the spill area. The surveys found that subsistence harvests declined substantially in several communities in the year after the spill and rebounded but remained below pre-spill norms in several communities three years after the spill. A study based on ex-vessel revenues valued the loss to the commercial fishing industry at $6.4 million to $41.8 million. Studies of sportfishing activity, vacation planning, visitor spending, and canceled bookings all indicated decreases in recreation/tourism activity. A contingent valuation study estimated the lost passive use value at $2.8 billion.

The Exxon Valdez *Oil Spill Restoration Plan* (1994) identifies these human uses -- subsistence, commercial fishing, recreation/tourism, and passive use -- as services reduced or lost due to the oil spill. For each, the plan provides a recovery objective and describes the status of injury and recovery. Although the status of these services was discussed briefly in the *Update on Injured Resources and Services* (1996), no formal studies have been funded by the Trustee Council to evaluate their recovery since the initial studies described above were conducted. With an eye to the 10th anniversary of the spill (March 1999), this project will review the status of each service. Methods will include reviewing existing information provided through ongoing Council research as well as gathering additional information.

NEED FOR THE PROJECT

A. Statement of Problem

Since its establishment in 1992, the Trustee Council has spent millions of dollars and sponsored hundreds of projects to examine the injury to and recovery of fish and wildlife resources injured by the oil spill. In preparation for the upcoming 10th-year symposium (March 1999), Council staff will be using information from these studies to update the status of the injured resources. The Council's Restoration Plan also identifies services (human uses) that were lost or reduced by the spill. To date, the Council has not sponsored any studies to evaluate the status of the services. Now, ten years after the spill, it is appropriate to examine the recovery of these lost or reduced services.

B. Rationale/Link to Restoration

During the 10th anniversary year, it is anticipated that the public, including the news media, will turn to the Trustee Council for information about the oil spill and the progress of restoration. To enable the Council to report to the public on the status of the services lost or

reduced by the spill, this project will evaluate the recovery of the four services identified in the Restoration Plan: subsistence, commercial fishing, recreation/tourism, and passive use. Public information and participation is an explicit requirement of the October 1991 settlement.

C. Location

The subsistence evaluation will take place in the following communities, which were selected to represent the three main subregions of the spill area and a range of community sizes: Chenega Bay, Tatitlek, and Cordova in Prince William Sound; Nanwalek and Port Graham in lower Cook Inlet; and Ouzinkie, Larsen Bay, and Old Harbor in the Kodiak Island Borough.

The commercial fishing, recreation/tourism and passive use evaluations will be conducted by Trustee Council staff based in Anchorage, using the expertise of a fisheries economist and various agency personnel. The evaluation will look at the status of these services throughout the spill area.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The subsistence evaluation will be a collaborative effort among the Division of Subsistence of the Alaska Department of Fish and Game, the Chugach Regional Resources Commission (CRRC), and the proposed study communities. Training local researchers in survey administration and data review and analysis will be a key project goal. The study communities will be involved in each phase of the research, from planning to fieldwork, data review, and report preparation. The recreation/tourism evaluation will include interviews with several key informants from throughout the spill area.

PROJECT DESIGN

A. Objectives

The objectives for each component of this project are derived from the recovery objectives contained in the Restoration Plan (as updated in September 1996).

Subsistence

1. Evaluate the status of subsistence uses by collecting, analyzing, and reporting information about current subsistence uses in a subset of oil spill area communities that is comparable with previous research results.

2. Conduct the evaluation as a collaborative effort in which the study communities are partners with the Division of Subsistence in each phase of the study.

3. Update the status of injured subsistence resources (primarily harbor seals, salmon, herring, clams, and harlequin ducks) based on the results of Trustee Council research projects, and compare these scientific results to the results of the subsistence use survey.

Commercial Fishing

1. Evaluate the status of commercial fishing based on the status of commercially important fish species injured by the oil spill (pink salmon, sockeye salmon, Pacific herring, and rockfish) and the presence or absence of fishery closures.

2. Summarize changes that have taken place in the commercial fishing industry in Alaska since 1989, in order to provide context and background for discussing the status of commercial fishing.

Recreation/Tourism

Evaluate the status of recreation/tourism based on the status of important fish and wildlife species (primarily salmon, cutthroat trout, killer whale, sea otter, harbor seal, bald eagle, various seabirds, and harlequin ducks), the presence of oil on beaches, and the presence of recreational facilities.

Passive Use

Update the injury information that was provided participants in the passive use/contingent valuation study conducted immediately following the oil spill so that people have current information with which to form their perceptions.

B. Methods

Subsistence

Four basic ethical principles will guide the research. These are: (1) review and approval of the research plans by community governments prior to fieldwork; (2) informed consent by household members selected for interviewing (participation in the research will be voluntary), (3) individual and household-level responses will be anonymous, and (4) study results will be reviewed by and shared with the study communities.

1. Objective regarding research collaboration (ADFG & CRRC):
   a. Collaboratively develop a final set of research objectives as part of a study planning workshop that involves representatives of each study community. Funding for this workshop ($8,700), which was held July 16-17, 1998, was approved by the Trustee Council on June 8, 1998. The workshop was the primary opportunity for representatives of other Trustee agencies to participate in the study design. Following the workshop, a small committee was designated to finalize the survey instrument based upon the workshop recommendation
   b. Through a subcontract with the Chugach Regional Resources Commission, hire and train local residents to conduct interviews using the survey instrument

c. Collaboratively review the study results and develop study findings and conclusions during a post-fieldwork workshop

2. Objective regarding subsistence use survey (ADFG & CRRC):
The survey instrument will be modeled after those administered by the Division of Subsistence during previous rounds of research in the study communities. Key sections on demography and resource harvests and uses will not be modified significantly in order to maintain comparability with previous research. Additional questions will be formulated to address study objectives identified at the planning workshop that are not covered in the standard instrument. The survey instrument is not designed for self-administration. Rather, a researcher (either a Division of Subsistence Resource Specialist or a local resident) will administer the survey in face-to-face interviews in the study communities.

The following list of information to be collected was developed during a planning workshop in Anchorage on July 16 and 17. A drafting committee was appointed to develop the final survey instrument.

a. Percentage of households using, attempting to harvest, harvesting, receiving, and giving away each wild resource
b. Harvest quantities in numbers of animals, buckets, gallons, or other appropriate units
c. Households' assessments of uses and harvests in 1997/98 compared to pre-spill years
d. Relative harvest effort
e. Changes in harvest location
f. Individual involvement in subsistence activities, including the involvement of children
g. Evaluations of food safety and resource availability
h. Demographic information, including, for each household member, age, sex, ethnicity, birthplace, length of residency in the community
I. Gross household income
j. Information about qualitative aspects of subsistence uses that illustrate how well subsistence is being integrated back into community life, including the role of elders in the community, sharing, children's participation in subsistence, and ideas about what can be done to help restore subsistence
k. Evaluations of the status of selected subsistence resources
l. Comments on selected restoration projects which had goals to enhance natural resources available for subsistence harvest
m. Household's comments and concerns: open-ended responses

In all but the two largest communities, the goal will be to interview a knowledgeable representative of every resident household. In Old Harbor, the goal will be to interview a randomly-selected sample of 50 percent of the households. The goal in Cordova will be a stratified random sample of about 50 Alaska Native households and 100 other households. It is

estimated that approximately 450 interviews will be conducted in total.

Chugach Regional Resources Commission, with assistance from ADFG Subsistence Division, will be responsible for obtaining approvals for the research from community governing bodies. Fieldwork will take place in October 1998. One or two Division of Subsistence personnel will travel to each community. They will then conduct a training session with the local researcher or researchers hired by Chugach Regional Resources Commission. A detailed training manual, developed during previous rounds of surveys in these communities, will guide the training. In every community except Cordova, the researchers will develop a list of all community households. The Division of Subsistence Resource Specialist will then conduct one or more interviews with the local researcher present to demonstrate the procedures. Next, the local researcher will conduct a few interviews on their own. These completed forms will be reviewed by the Subsistence Resource Specialist, who will then review any corrections with the local researcher. Then the remaining interviews will be completed. It is anticipated that local assistants will conduct up to about two-thirds of the interviews.

In Cordova, a Division of Subsistence Resource Specialist will consult with city officials prior to the field work to update maps of the community. A random sample will be drawn from lists of dwellings keyed to these maps. Eyak tribal enrollment lists will be used to select the random sample of Alaska Native households. Because of the large number of interviews to be conducted in Cordova, Subsistence Resource Specialists and local researchers will work as a team to accomplish the work.

All data will be coded for data entry by Division of Subsistence staff in Anchorage and Kodiak. Double data entry will occur to minimize entry errors. Preliminary tables and figures will be produced with the Statistical Package for the Social Sciences (SPSS) program. Sets of preliminary results will be provided to each local researcher for review. Following the initial round of data review and cleaning, project personnel, including local researchers, will participate in a two-day workshop in Anchorage in January 1999 to review the study findings and develop a set of preliminary conclusions. These will guide the content and organization of the final report.

3. Objective regarding status of subsistence resources (Trustee Council staff):
Trustee Council staff will update the status of injured subsistence resources (primarily harbor seals, fish, shellfish, and seaducks) based on the results of Council-funded research projects, other information, and the results of the subsistence use survey. A description of the Council's efforts to aid recovery will also be prepared (e.g., projects to enhance or replace subsistence resources and to test for food safety).

The information compiled on subsistence will be used to revise the Council's *Update on Injured Resources and Services*. This document was prepared in 1996 to update the recovery objectives and the injury/recovery description contained in the Restoration Plan, and will be updated again in 1999 in advance of the 10th-year symposium. The information compiled on

subsistence will also become part of the Administrative Record.

Commercial Fishing

1. Objective regarding evaluation of status:

Existing information on (A) the status of commercially important fish species (pink salmon, sockeye salmon, Pacific herring, and rockfish) and (B) the presence or absence of fishery closures will be compiled by Trustee Council staff. This information is available through the Council's ongoing research projects (part A) and the Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development (part B). A description of the Council's efforts to aid recovery will also be prepared (e.g., projects to restore, enhance, or replace commercial species, including development of improved management techniques, and habitat acquisitions to protect fish from further degradation).

2. Objective regarding other changes in the commercial fishing industry:

A fisheries economist or similar professional will be contracted through a competitive Request for Proposals (RFP). In order to provide context and background for evaluating the status of commercial fishing, the contractor's report will summarize changes that have occurred in the commercial fishing industry in Alaska since 1989. The contractor will be asked to discuss issues such as worldwide market changes, natural variability in resource abundance (including catch data), and the changing political influence of commercial fishing in the state. The contractor's report will also include a synopsis of how the commercial fishermen's unresolved private claims against Exxon are addressing the economic impacts of the spill. In addition, the status information compiled under (1) above will be provided to the contractor for incorporation into the contractor's report. The RFP will be administered by Trustee Council (Restoration Office) staff.

The information compiled on commercial fishing will be used to revise the Trustee Council's *Update on Injured Resources and Services*. This document was prepared in 1996 to update the recovery objectives and the injury/recovery description contained in the Restoration Plan. It will be updated again in 1998/99 in advance of the 10th-year symposium. The information compiled on commercial fishing will also become part of the Administrative Record.

Recreation/Tourism

Existing information on (A) the status of important fish and wildlife species (primarily salmon, rockfish, Dolly Varden, cutthroat trout, killer whale, sea otter, harbor seal, bald eagle, seabirds, and harlequin ducks), (B) the presence of oil on beaches, and (C) the availability of recreational facilities will be compiled by Trustee Council staff. This information is available through the Council's ongoing research projects and the State Division of Parks, the National Park Service, the U.S. Forest Service, the State Department of Environmental Conservation, and others. In addition, Council staff will conduct telephone interviews with several key informants in order to obtain a sense of recreational users' perceptions of the spill area pre- and post-spill. A description of the Council's efforts to aid recovery of recreation/tourism will also be prepared (e.g., description of projects to restore important species and to clean

beaches).

A list of possible key informants will be circulated to the Restoration Work Force and others, such as members of the Public Advisory Group, for review and input prior to interviews taking place. Interview questions will be open-ended, such as:

Do your recreational experiences in ___(Prince William Sound)___ today differ from your experiences pre-spill? If so, how?

Are your recreational activities today affected by lingering spill effects (e.g., oil on beaches) or possible lingering spill effects (e.g., diminished wildlife viewing)?

The information compiled on recreation/tourism will be used to revise the Trustee Council's *Update on Injured Resources and Services*. This document was prepared in 1996 to update the recovery objectives and the injury/recovery description contained in the Restoration Plan. It will be updated again in 1999 in advance of the 10th-year symposium. The information compiled on recreation/tourism will also become part of the Administrative Record.

Passive Use

Passive use values encompass nonuse values, such as aesthetic and intrinsic values. Immediately following the oil spill, the state used a contingent valuation approach to measure lost passive use. This involved surveying a sample of U.S. households to elicit what people would be willing to pay in additional taxes to fund a program designed to prevent future spills. This approach emphasizes economic value, which is probably not directly relevant to the Trustee Council's ongoing mission of restoration, and is costly and time consuming. Furthermore, it would not directly address the Council's recovery objective for passive use, which looks to people's perceptions of recovery. An alternative approach of declaring passive use recovered when all of the injured resources are recovered is also problematic. Even if all of the injured resources are determined to be recovered, there could still be a perception that the spill area remains diminished by the spill.

The approach this project will take in regard to passive use is to update the injury information that was provided respondents in the contingent valuation study. People may then use this information, along with information provided through the Trustee Council's other public information efforts, to form new perceptions of the passive use values associated with the spill area. This information will be compiled by Trustee Council staff. A description of the Council's efforts to provide the public with the latest information on the status of restoration also will be prepared (e.g., newsletter, radio show, annual report).

The information compiled on passive use will be used to revise the Trustee Council's *Update on Injured Resources and Services*. This document was prepared in 1996 to update the recovery objectives and the injury/recovery description contained in the Restoration Plan. It will be updated again in 1999 in advance of the 10th-year symposium. The information compiled on passive use will also become part of the Administrative Record.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Subsistence

An existing cooperative agreement with the Chugach Regional Resources Commission will support the community involvement goals of the project. CRRC responsibilities will include participating in the research planning workshop, hiring local researchers, and participating in the study findings review workshop. CRRC will seek concurrence from the Kodiak Area Native Association and endorsement from the affected village councils (Ouzinkie, Old Harbor, and Larsen Bay) to perform these responsibilities on behalf of the Kodiak study communities.

Commercial Fishing

A fisheries economist or similar professional will be contracted through a competitive process, consistent with state procurement requirements. The contract will be administered by Trustee Council (Restoration Office) staff through the Alaska Department of Fish and Game.

Recreation/Tourism and Passive Use

Work will be performed by Trustee Council staff, in cooperation with resource agency personnel. All work will be performed using existing funds.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

Subsistence

July 1998:	Project planning workshop, Anchorage
Aug/Sept 1998:	Finalize survey instrument
	Finalize cooperative agreement with CRRC
	Obtain community approvals
Oct/Nov 15, 1998:	Conduct fieldwork
Nov/Dec 1998:	Complete data coding and data entry
January 1999:	Data review workshop, Anchorage
	Complete description of Trustee Council's efforts to aid recovery
February 1999:	Complete final report
	Complete evaluation of status of injured subsistence resources
March 23-27, 1999:	Present results, 10th-year symposium, Anchorage

Commercial Fishing

October 1998:	Prepare RFP for fisheries economist (or the like)
December 1998:	Contractor complete summary of changes to the industry
January 1999:	Complete compilation of existing information
	Complete description of Trustee Council's efforts to aid recovery
February 1999:	Complete evaluation of status

Recreation/Tourism

Nov/Dec 1998:	Conduct telephone interviews with key informants
January 1999:	Complete compilation of existing information
	Complete description of Trustee Council's efforts to aid recovery
February 1999:	Complete evaluation of status

Passive Use

January 1999:	Complete description of Trustee Council's efforts to inform the public
February 1999:	Complete update of injury information

B. Project Milestones and Endpoints

Subsistence
Objective 1: Research collaboration will continue throughout the life of the project.
Objective 2: Data collection will be completed by November 15, 1998. Data analysis and draft final report will be completed by February 1999.
Objective 3: Assessment of injured resources will be completed by February 1999.

Commercial Fishing
Objective 1: Evaluation of status will be completed by February 1999.
Objective 2: Summary of other changes in the industry will be completed by February 1999.

Recreation/Tourism
Evaluation of status will be completed by February 1999.

Passive Use
Update of injury information will be completed by February 1999.

C. Completion Date

Nearly all work will be completed by the conclusion of the 10th-year symposium (March 1999). Any follow up tasks will be completed by the end of FY 99.

PUBLICATIONS AND REPORTS

The information compiled under this project will be used to revise the Trustee Council's *Update on Injured Resources and Services*. This document was prepared in 1996 to update the recovery objectives and the injury/recovery description contained in the Restoration Plan. It will be updated again in 1999 in advance of the 10th-year symposium. Information compiled under this project will also become part of the Administrative Record.

In addition, the contractor's brief report on changes in the commercial fishing industry will be

prepared by late December 1998. A final report on the subsistence component will be prepared by late February 1999. A draft of the report will be reviewed by each participating community and by peer reviewers for the Trustee Council. Following approval of the report, a short (four page) overview of the study findings will be prepared for distribution to all households in each study community. Each study community will receive a full set of the study findings in formats suitable to their further use. The study findings will also become part of the Division of Subsistence Community Profile Database and will be used in additional reports and analyses as needed.

PROFESSIONAL CONFERENCES

Study findings will be presented in one or more presentations during the 10th-year symposium (March 1999). The tentative agenda for the public overview symposium (Day 1) includes a talk on human dimensions of the spill. In addition, the topics for the scientific symposium (Days 2-5) include socioeconomic aspects of injury and recovery, and it is anticipated that some of the research conducted under this project will be the subject of presentations at the scientific symposium.

NORMAL AGENCY MANAGEMENT

Although the various resource agencies have regulatory authority over and management responsibility for aspects of the services this project will study, the Trustee Council is responsible for tracking and reporting on recovery from the oil spill. Public information and participation is an explicit requirement of the October 1991 settlement. This project will be performed primarily by Council staff, with the exception of the subsistence component which will be performed primarily by the Alaska Department of Fish and Game (working in collaboration with Chugach Regional Resources Commission) and the commercial fishing component which will be performed by an outside contractor. Council staff will rely in part on information gathered by the agencies through their routine management activities. The Alaska Department of Fish and Game routinely monitors some subsistence activity in some communities; however, this project will conduct a comprehensive overview of all subsistence uses in these communities, as well as collect additional demographic, economic, and perception information. The majority of the new funds being requested are for the Alaska Department of Fish and Game for the subsistence component ($184,300). A small amount of funds ($10,700) is requested for a contract with a fisheries economist for the commercial fishing component. The work performed by Council staff under this project will be done as part of their regular duties; no new funds are requested for Council staff.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will rely extensively on the results of other Trustee Council funded projects.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

New project; not applicable.

PROPOSED PRINCIPAL INVESTIGATOR

Subsistence

James A. Fall, Regional Program Manager
Division of Subsistence
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99518
Phone: 267-2353
Fax: 267-2450

Commercial Fishing, Recreation/Tourism, Passive Use

Molly McCammon, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501
Phone: 278-8012
Fax: 276-7178

Subsistence

James Fall, ADFG Subsistence Division regional program manager in Anchorage, will be the overall project manager. Charles Utermohle, head of the division's data management section, will be responsible for data management and quality control. Subsistence Resource Specialists who will train local researchers, conduct interviews, and assist with data analysis will include Ronald Stanek, Rita Miraglia, Craig Mishler, William Simeone, and Vicki Vanek. All of these personnel have substantial research experience in the proposed study communities. An existing cooperative agreement with the Chugach Regional Resources Commission will support the community involvement goals of the project. Patty Brown-Schwalenberg, CRRC Executive Director, is responsible for overall administration of this agreement.

Revision 30/98
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$107.7						
Travel		$14.2						
Contractual		$51.9						
Commodities		$1.4						
Equipment		$0.0						
Subtotal	$0.0	$175.2		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$19.8						
Project Total	$0.0	$195.0		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)		1.7						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY 99

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 7/22/98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
James A. Fall	Regional Program Manager	22J	1.5	7.8		11.7
Charles Utermohle	Research Analsyst III	18J	0.6	6.4		3.8
Louis Brown	Analyst Programer III	17L	3.1	6.0		18.6
Jessie Mallery	Administrative Clerk II	8B	4.5	2.9		13.1
Subsistence Resource Specialists			11.0	5.5		60.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		20.7	28.6	0.0	
					Personnel Total	$107.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Anchorage - Chenega Bay	0.7	1	3	0.1	1.0
Anchorage - Nanwalek	0.3	1	7	0.1	1.0
Anchorage - Port Graham	0.2	1	9	0.1	1.1
Anchorage - Tatitlek	0.7	1	4	0.1	1.1
Anchorage - Larsen Bay	0.4	1	7	0.1	1.1
Anchorage - Old Harbor	0.4	1	10	0.1	1.4
Anchorage - Ouzinkie	0.3	2	14	0.1	2.0
Anchorage - Cordova	0.2	4	30	0.1	3.8
Juneau - Anchorage	0.5	2	7	0.1	1.7
					0.0
					0.0
					0.0
				Travel Total	$14.2

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
4A Linkage	37.6
Data Management: network charges	0.8
Xerox copying: survey instruments and reports	1.0
Vehicle rentals	2.0
Phones	0.5
Contract with fisheries economist or similar professional for summary of changes to commercial fishing industry since 1989; contract to be administered by Restoration Office	10.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$51.9

Commodities Costs:	Proposed FY 1999
Description	
Data management supplies: software, media	0.9
Paper, notebooks, and maps	0.5
Commodities Total	$1.4

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	Inventory Agency

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$27.9
Travel		$6.3
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$34.2
Indirect		$3.4
Project Total	$0.0	$37.6
Full-time Equivalents (FTE)		6.8
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months Budgeted	Monthly Costs	Overtime	Proposed FY 1999
Name	Position Description					
Patty Brown-Schwalenberg	Executive Director		0.8	6.0		4.8
Local research assistants (field componant)			6.0	3.2		19.2
Local research assistants (data review workshop)						3.9
						0.0
						0.0
Data review workshop = $3,840						0.0
(8 people, 3 days each, @ 20/hour)						0.0
						0.0
Field componant = $20/hour, 40 hrs/week, 4 wks/month						0.0
= 3.2/month						0.0
						0.0
						0.0
	Subtotal		6.8	9.2	0.0	
					Personnel Total	$27.9

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1999
Description					
Chenega Bay to Anchorage	0.7	1	3	0.1	1.0
Tatitlek to Anchorage	0.7	1	3	0.1	1.0
Cordova to Anchorage	0.3	1	3	0.1	0.6
Port Graham to Anchorage	0.3	1	3	0.1	0.6
Nanwalek to Anchorage	0.3	1	3	0.1	0.6
Ouzinkie to Anchorage	0.3	1	3	0.1	0.6
Larsen Bay to Anchorage	0.4	1	3	0.1	0.7
Old Harbor to Anchorage	0.4	1	3	0.1	0.7
					0.0
Reimbursement to local researchers for use of personal vehicles for interveiwing					0.5
(about 5 miles/survey x 300 surveys x $0.3/mile)					0.0
					0.0
				Travel Total	$6.3

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Name: Chugach Regional Resources Commission

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	

FY 99

Prepared: 7/22/98

Project Number: 99471
Project Title: Evaluation of Subsistence Uses
Name: Chugach Regional Resources Commission

FORM 4B
Equipment
DETAIL

Revision 7-8-98
Approved TC 8-13-98

Project Title: **Effects of Oiled Incubation Substrate on Pink Salmon Reproduction**

Project Number:	99476
Restoration Category:	Research
Proposer:	Ron Heintz NMFS Auke Bay Laboratory
Lead Trustee Agency:	NOAA
Cooperating Agencies:	ADF&G
Alaska SeaLife Center:	No
Duration:	3 years
Cost FY99:	$74.1K
Cost FY00:	$75K
Cost FY01:	$36K
Geographic Area:	Little Port Walter, Baranof Island, Southeast Alaska
Injured Resource:	Pink salmon

ABSTRACT

This project examines the effects of oil exposure during embryonic development on the gamete viability of pink salmon that survive to spawn. The objective is to determine if exposure to oil during incubation could explain the reduced gamete viability reported for pink salmon in Prince William Sound under Restoration Study 191A. In that study gametes taken from pink salmon returning to oiled streams had higher mortality rates than gametes taken from salmon in unoiled streams. These data suggest a dramatic effect of oil on vertebrate reproduction that has not previously been described. The plausibility of reduced gamete viability is indicated the by effects demonstrated by 191B which include reduced marine survival and growth of returning adults, however this effect still requires unequivocal demonstration. This study is designed to make the demonstration and complete a model of life cycle impacts from incubating eggs in oiled gravel.

INTRODUCTION

This experiment tests the hypothesis that incubation in oiled gravel produces adult pink salmon with reduced reproductive capacity. After the Exxon Valdez oil spill (EVOS), pink salmon embryos developing in oiled streams experienced increased mortality (Bue et al. 1995). Further experiments reported by Bue et al. (In press) indicated that adult fish returning to oil contaminated streams had reduced gamete viability. In these experiments, gametes were collected from adults returning to oil contaminated and uncontaminated streams before they could be they could be exposed to oil and incubated in a hatchery. Despite the identical uncontaminated incubating environments, the gametes derived from oil contaminated streams consistently produced fewer viable embryos than gametes derived from uncontaminated streams. This difference was thought to result from differences in the incubating environments experienced by the adults contributing the gametes and therefore suggested a previously undescribed long term effect of oil on reproductive ability.

Demonstrating a long term effect of oil on pink salmon reproduction has important implications for managers in PWS as well as managers seeking to restore wildlife populations in other locations. The effects observed in pink salmon after the EVOS were a direct result of their dependence on the intertidal environment for early development. This implies that other species with similar dependencies were also at risk. Furthermore, the exposure levels shown to be capable of causing long term impacts on growth and marine survival in pink salmon are less than or equal to the Alaska State water quality standards which are among the most rigorous in the United States. This suggests that water quality standards in locations outside Alaska may limit the potential for restoring salmon populations in streams located near hydrocarbon sources such as those exposed to urban runoff.

The intent of this experiment is to examine the effects of oil exposure on pink salmon reproduction under controlled laboratory conditions. Environmental exposures will be mimicked by incubating embryos in gravel with a known concentration of oil from fertilization to emergence in a simulated inter-tidal environment. Surviving fish will be marked and released. Upon maturity, returning adults will be recovered and the viability of their gametes will be compared to those taken from unexposed, but similarly handled, fish.

The procedure proposed here repeats the experiments performed under Restoration 191B, but with the sole purpose of testing the hypothesis that incubating in oiled gravel impairs the reproductive ability of salmon that survive to maturity. Consequently, we propose limiting the exposure to a single dose, releasing sufficient numbers of fish to guarantee an adequate number of returning adults and marking the fish externally so that exposure levels can be readily observed prior to spawning the fish. These procedures significantly reduce the cost of the study to the extent that NOAA/NMFS can contribute labor without impairing normal agency objectives.

The earlier project was successful in measuring oil impacts to marine survival and straying, but the coded-wire tags required to identify the treatment groups in that study had to be recovered and decoded before adult pairs could be matched for mating. The delays encountered while decoding hundreds of tags that were not useful for mating led to reduced gamete viability for all the treatments which may have masked any oil related effects. This follow-up study uses external marks to alleviate that problem and is designed specifically to test for oil effects on gamete viability.

NEED FOR THE PROJECT

A. Statement of the Problem

Field and laboratory work conducted after the EVOS by Restoration Study 191A suggested that pink salmon in contaminated streams had reduced fitness when they were exposed to extremely low concentrations of polynuclear aromatic hydrocarbons (PAH). Field evidence for reduced fitness included observations of increased embryo mortality in contaminated streams (Bue et al. 1995) and reduced viability in gametes taken from adults returning to contaminated streams (Bue et al. In press). These data have been supported by laboratory studies (Heintz et al. 1995 and Wertheimer et al. 1996) that have shown the susceptibility of pink salmon embryos to water contaminated with very low concentrations of oil.

The laboratory studies provided a basis for estimating the total reduction in fitness for pink salmon exposed to water contaminated with oil at concentrations near the Alaska State water quality standard. The reductions in embryo survival, growth, and marine survival can be integrated to calculate a total reduction in the average fitness for exposed populations of nearly 50%. However, reduced gamete viability among individuals as reported by Bue et al. (In Press) has not been adequately demonstrated among the survivors of the laboratory exposures. In 1995, gametes taken from fish exposed as embryos in the 1993 experiments appeared to have reduced viability, but inadequate numbers of fish prevented statistical verification of this observation. In 1997 we recovered sufficient numbers of fish that had been exposed as embryos in 1995 experiments, however high mortality rates were observed in all the treatment groups including the controls, possibly masking elevated mortality rates in the exposed groups. The source of these high mortality rates is unknown, but is probably related to the time required to hold the gametes prior to spawning in order to find sufficient numbers of mates among all the returning fish.

The effects already described for pink salmon that incubate in oil gravel indicate the plausibility of reduced gamete viability. The long term effects that have been described for those individuals that survive incubating in oiled gravel include effects on fitness related characters such as growth and marine survival. In addition, histopathological examination of fry emerging from oiled gravel demonstrated an effect on gonad development (Marty et al. 1997). Previous attempts at demonstrating gamete viability have provided results that are highly suggestive of oil related effects, and have generally included a number of doses so that dose response curves could be generated. In the study proposed here, the design is solely aimed at demonstrating an effect on gamete viability. Thus, we have limited the number of treatments so that we can maximize the number of fish that survive to adult, and we will mark fish externally to identify exposure level which will minimize the holding time for gametes prior to mixing them.

B. Rationale/Link to Restoration

Pink salmon are an ideal species for identifying prolonged population effects resulting from embryonic oil exposure. Pink salmon have been widely studied because of their commercial value and relatively simple life history, and their dependence on the intertidal for incubating in PWS made them a premier sentinel species for detecting oil damage after EVOS. Consequently, a large amount of effort and money was expended towards understanding how oil effected pink

salmon populations. This work has led to important advances in our understanding of the scope and mechanisms of oil toxicity and has led to developing a model describing the average reduction in reproductive fitness of exposed populations. Laboratory confirmation of Bue et al.'s claim of an oil effect on gamete viability is the last piece of data required to construct a new paradigm for oil toxicity.

Confirmation of the field observations of reduced gamete viability (Bue et al. 1995) will provide managers with a more comprehensive model for the long-term effects of oil on pink salmon. This information is important to managers working to restore salmon populations in PWS as well as locations in less pristine locations. Concentrations found to be effective at reducing average fitness (Heintz 1995) are significantly lower than the Alaska State water quality standard and typical of concentrations in urban locations (Maltby et al. 1995). Of additional value is the demonstration that oil has life long effects for organisms exposed during sensitive life stages. Both the exposure mechanism and scope of the effects described in this work represent significant advances in the understanding of oil toxicity.

C. Location

This project will take place at Little Port Walter (LPW), a research hatchery operated by NMFS in southeastern Alaska. This location is appropriate because it has been the site of these studies since their inception. The facility provides easy access to the intertidally spawning pink salmon stock that has been the subject of previous experiments. In addition, the exposure apparatus requires a simulated intertidal environment and such a system is in operation at LPW.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project will take place in southeastern Alaska, but depends on contract labor for marking fish for a period of 6 weeks in the spring of 1999. All efforts will be made to advertise our labor requirements from the spill zone. We will continue to provide information to interested public (primarily fishermen) who visit the station; we will be displaying at the facility the posters developed for the Restoration Workshop for 97191B and 97076 as interpretative tools.

PROJECT DESIGN

A. Objectives

1. Determine the effect of incubating in oiled gravel on reproductive capacity of pink salmon.

2. Complete the model of life cycle impacts from incubation in oiled gravel.

We propose testing the hypothesis that incubating in gravel contaminated with oil leads to reduced gamete viability. This test will provide information for completing a life-history model for oil toxicity which allows us to quantify the effect of oil on each of the major life-history

stages of pink salmon in terms of reduced survival. Thus far, we have demonstrated that embryos developing in oil contaminated gravel have reduced survival, and fry that survive incubation have reduced growth and reduced survival to maturity. These observations account for a 50% reduction in the average survival of a population of pink salmon exposed to PAH concentrations equal to the Alaska State water quality standard. The proposed study will refine the model by providing an estimate for the specific loss in reproductive ability in exposed individuals. To our knowledge this type of analysis does not exist for any vertebrate and these effects occur at concentrations that are commonly seen in urban locations.

B. Methods

The exposure mechanism and fish culture procedures will follow those described in previous proposals for Restoration Study 191B. Gametes will be taken from an intertidally spawning pink salmon stock, transferred to our hatchery at Little Port Walter where they will be incubated beginning in FY98. The eggs will be exposed to effluent from either oil-coated or untreated gravel. In FY99 approximately 75,000 surviving fry from each exposure group will be marked by excising the adipose fin and one pelvic fin depending on exposure regime. Marked fish will be held for a short period while they recover from the marking procedure and then released. Exposures will begin in September of 1998 and between 50 and 500 mature fish representing each treatment will return two years later in September 2000.

All pink salmon returning to the Sashin Creek weir will be inspected for marks during the 2000 escapement period (FY00). Marked fish will be sorted by treatment groups into holding pens since the external marks will provide for immediate identification of exposure level. On a given spawning date, sufficient numbers of fish will be removed from each pen and spawned, ensuring minimal holding times for gametes prior to spawning. Spawning will be directed by a contracted expert in fish reproduction to ensure maximal survival. Previously, we have released fish representing multiple treatments which has necessitated the use of coded-wire tags for identifying them when they return. This approach has allowed us to quantify oil effects on growth and marine survival, and homing fidelity but not gamete viability because of the long time periods associated with recovering and decoding the tags on a given spawning date.

Gamete viability will be determined for the oil treatment and the control groups. Three experiments will be performed to evaluate the reproductive viability of the parents. The objective of the first experiment will be to determine the average offspring survival of parents exposed to oil during incubation and the objective of the second experiment will be to estimate how much of the variability in offspring survival is due to individual variation. The objective of the third experiment is to identify the genetic component to variability or heritability of offspring survival. The benefit of the first experiment is that all the possible crosses within an exposure group can be made and the overall average survival measured, however the primary source of variation will be measurement error and no information will be available on individual variation. The benefit of the second experiment is determine individual variability and thus provide control for the interpretation of the results of the first experiment. The benefit of the third experiment besides demonstrating a genetic effect of oil, is that calculation of the genetic heritability of the damage provides a basis for calculating how long the effect will persist in the exposed population. In all experiments survival will be measured to fertilization, eyeing, and emergent fry stages. The numbers of defective or dead progeny will be compared between treatment

groups. Because these gametes will not be incubated in an oiled environment, any observed increases in mortality or defective individuals can be attributed to oiling effects upon the first generation.

First Experiment

Average offspring survival will be estimated in the first experiment by measuring the survival in pools of gametes comprising all the possible pairwise crosses. On each day of spawning, 2 embryo pools will be formed per treatment. Upon formation of an embryo pool, 6 subsamples, each of approximately 150 embryos, will be randomly selected and incubated in an individual cell within a Heath tray. On a given day, pools will be formed by randomly assigning half the males and females from a treatment group to one of two subgroups. Each female in a subgroup will contribute approximately 900 eggs to a common pool, the pool will be mixed and the mixture divided into a number of aliquots equal to the number of males in the subgroup. Each male in the subgroup will fertilize one aliquot, and the fertilized eggs will be recombined in a common container, mixed and divided into six aliquots that will be incubated in randomly assigned locations. Thus, the average survival of a treatment group on a given day will be the mean of the average survivals in each of the two subgroups.

The estimates of mean survival of the treatment groups will be compare with *t* tests after assuming that variability between groups of like-treated incubators is negligible. A *t* test between, for example, treatment 1 and 2, when there are *d* spawning days, *q* treatments, *p* subgroups per treatment, and *r* cells per subgroup will have the following form:

$$t_{((p-1)*q*d)df} = \frac{\frac{1}{d}[\overline{sv_{11}}+\ldots\overline{sv_{1d}}-\overline{sv_{21}}\ldots-\overline{sv_{2d}}]}{\sqrt{\frac{1}{d^2}*\frac{s_c^2}{p*r}*2*d}}$$

where,

$\overline{sv_{ij}}$ = Survival rate for treatment *I* on day *j*

s^2_c = Combined Between-Pools Mean Square obtained by ANOVA.

Comparisons will be made between each of the doses and the control and the overall α will be maintained at 0.05.

Second Experiment

For the second experiment, fish from the oil and control doses will be mated using a fully-crossed half-sib design (Falconer 1981). In this design, the remaining eggs from an exposed female and a control female are each split into two aliquots. One aliquot from each female is fertilized with aliquots of sperm from the same oil-exposed male, and one aliquot from each female is fertilized with aliquots of sperm from the same control male. This 2 x 2 breeding matrix will be replicated so that every female is represented in a breeding matrix or until there are 30 breeding matrices for each treatment, whichever is greater. Each half-sib family will be incubated in an individual container.

Third Experiment

The third experiment will be performed under contract by the University of Alaska using gametes collected at the same time as those used in the previous experiments. The fish will be used to produce ten 2 x 3 mating sets: 'oiled' females crossed with oiled males and ten 2 x 3 mating sets: 'unoiled' females crossed with unoiled males. Within each set, eggs from each female will be separately fertilized using semen from 3 males. Therefore, each set will produce 6 families, resulting in a total of 60 oiled families and 60 unoiled families (oiled and unoiled F1). Each family will be divided in 2 parts, each of which will be randomly placed in an incubator compartment. Data to be collected for each of the 240 incubator compartments includes: mortality rate at eye, hatch, and emergence, and developmental rate to eye, hatch, and emergence.

Additive genetic, maternal, non-additive genetic, and phenotypic variances will be estimated and heritabilities, and ratios of maternal and nonadditive genetic variances to phenotypic variances will be calculated using an animal model solved by applying a derivative free technique for estimating variance components employing restricted maximum likelihood (Graser et al., 1987). The derivative-free restricted maximum likelihood (DFREML) analysis procedure of Meyer (1988) will be utilized. The technique has been utilized to analyze data from breeding experiments of fish (Crandell and Gall, 1993). Heritability estimates may be used to predict expected genetic change due to natural selection for a range of selection intensities (Van Vleck, 1987).

C. Cooperating Agencies, Contracts and Other Agency Assistance

Fish spawning and handling of gametes in FY 00 will be directed by a contracted expert in the field of fish reproduction. The statistical analysis of the results for experiment 1 have been designed by the Alaska Department of Fish and Game (ADF&G). The design and execution of experiment 3 will be contracted to University of Alaska through ADF&G.

SCHEDULE

A. Measurable Tasks for FY 99 (October 1, 1998 - September 30, 1999)

Sept. 1998: Set-up exposure apparatus and take eggs.

Fall 1998: Evaluate effects of oil incubation on survival to eyed embryo stage. Collect samples for quantifying exposure levels.

Spring 1999: Mark and release surviving fry from the control and exposed groups.

B. Project Milestones

Sept. 1998: Set-up exposure apparatus, collect gametes begin exposures.

May 1999: Release marked fry

Sept. 2000: Examine oil effect on gamete viability by recovering and spawning marked adults when they return to weir.

Aug 2001: Complete analysis of gamete viability.

C Completion Date

Final Report will be submitted on August 15, 2001 in FY 2001.

PUBLICATIONS AND REPORTS

FY 99: Annual Report describing the doses, exposure apparatus and effects on early incubation.

FY 00: Final Report
Other manuscripts planned:
Heintz, R. 2000. Effect of incubating in oil on pink salmon reproductive capacity. Journal Unknown.

Heintz, R. 2000. Incubating in oiled gravel damages the entire life-history of pink salmon. Journal Unknown.

PROFESSIONAL CONFERENCES

No conferences planned in FY 99, travel to 1999 Oil Spill Symposium is covered in other Proposed Project Plans.

NORMAL AGENCY MANAGEMENT

This project will complete the work begun under Restoration 191B which has been performed cooperatively between the Trustees and NMFS from the outset. However, NMFS proposes

providing most labor requirements for this project and seeks funding for primarily contractual labor and commodities. There is no charge for project support costs which include management of the LPW facility and project budget, production of reports or hydrocarbon chemistry to verify dosing. There is no charge for setting up the experiment in FY98 and early FY99, NMFS will cover costs associated with setting up the exposure apparatus, spawning pink salmon, and maintaining the incubation for 9 months. In outlying years, NMFS will cover costs associated with spawning the returning fish, and evaluating their gamete viability.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be coordinated with continuation of ADF&G research and monitoring efforts regarding pink salmon embryo survival under Restoration 191A. This study also coordinates the results of Restoration 191B and 076 by completing a life-history model for oil effects on pink salmon. Investigators and agencies will coordinate by sharing data. NOAA/NMFS will coordinate with the Trustees by providing labor requirements and laboratory overhead.

PROPOSED PRINCIPAL INVESTIGATOR

Name	Ron Heintz
Affiliation	NMFS
Address	Auke Bay Laboratory
	11305 Glacier Hwy.
	Juneau, AK 99801
Phone	907-789-6058
Fax	907-789-6094
E-mail	ron.heintz@noaa.gov

Revision 5-98
Approved 7-13-98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Proposed FFY 1998	Authorized FFY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$19.8						
Travel		$6.0						
Contractual		$33.0						
Commodities		$10.0						
Equipment		$0.0						
Subtotal	$0.0	$68.8	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005	
General Administration	$0.0	$5.3						
Project Total	$0.0	$74.1	$75.0	$36.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources		$58.0	$50.0	$10.0				

Comments:

NOAA Contribution:
Principle Investigator R. Heintz, 3 mo = $19.8k
Fishery Research Biologist, R. Bradshaw 4.0 mo = $19.3K
Fishery Research Biologist, J. Maselko 2 mo. = $8.9k
Additional Operating Costs of Little Port Walter Field Station = $10.0k

Total NOAA/NMFS Contribution = $58.0k

1999

Project Number: 99000
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared:7/7/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1999
R Heintz	Co-PI: Fishery Research Biologist	12/3	3.0	6.6		19.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	6.6	0.0	
					Personnel Total	$19.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1999
Little Port Walter Filed Station -- 4 staff, 6 crew, multiple trips					0.0
Beaver Charters	1.0	6			6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.0

1999

Project Number: 99000
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

Prepared:7/7/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FFY 1999
NOAA Contract Labor (marking crew)	6.6
1 x 16.50 x 400h	26.4
6x$16.00x300h	0.0
	0.0
	0.0
	0.0
	0.0
	0.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$33.0

Commodities Costs:	Proposed
Description	FFY 1999
groceries	5.0
gloves, anaesthetic, fish food, buckets,spawning supplies	5.0
Commodities Total	$10.0

1999

Project Number: 99000
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

Prepared:7/7/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1999
			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: Description	Number of Units	Inventory Agency
tagging tables	1	NOAA
nets	4	NOAA

1999

Project Number: 99000
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

Prepared:7/7/98

Revision 8-5-98
Approved TC 8-13-98

Effects of Food Stress on Survival and Reproductive Performance of Seabirds

Project Number:	99479
Restoration Category:	Research (new)
Proposed By:	USGS, University of Washington
Lead Trustee Agency:	DOI
Cooperating Agencies:	N/A
Duration:	1st year, 4-year project
Cost FY 99:	$84,700
Cost FY 00:	$125,200
Cost FY 01:	$129,600
Cost FY 02:	$75,000
Geographic area:	Cook Inlet, Gulf of Alaska
Injured resource:	Common Murre, Black-Legged Kittiwake

ABSTRACT

Traditional field methods of assessing effects of fluctuations in food supply on the survival and reproductive performance of seabirds may give equivocal results. Here we propose to apply an additional tool: The measure of stress hormones in free-ranging seabirds. Food stress can be quantified by measuring base levels of stress hormones such as corticosterone in the blood of seabirds, or the rise in blood levels of corticosterone in response to a standardized stressor: capture, handling and restraint. This well-known response (found throughout vertebrates from fish to mammals) provides a strong assessment of whether or not a free-living population is chronically stressed or, if baseline levels of corticosterone appear normal, the stress-induced increase in corticosterone indicates potential for stress. This "field endocrinology" approach provides exact information on current stress status and the potential for stress in relation to quality and abundance of food. We will apply these techniques to seabirds breeding in Lower Cook Inlet and also use captive birds for controlled experiments. The hormone assay techniques and collection methods in the field are well established in the laboratories of a cooperator, who is the internationally recognized leader of the "field endocrinology" approach. Pilot studies conducted in 1996 and 1997 in the proposed study area have already validated the techniques, provided conclusive results, and underscore the need for more extensive investigations proposed here. This study provides a unique opportunity for a concurrent field and captive study of the behavioral and physiological consequences of stress in seabirds. Moreover, it will provide the basis for management of seabird populations in the areas affected by the *Exxon Valdez* oil spill, and it will have broader applications for seabird monitoring programs.

INTRODUCTION

During the last decade, reduced productivity, increased mortality and subsequent population declines occurred among some seabirds and marine mammal species in the Gulf of Alaska. It has been suggested that declines in food availability resulted in food-related stress (Merrick *et al.* 1987, Piatt & Anderson 1996). Oil pollution from the Exxon Valdez oil spill may have exacerbated these stress-related effects. In this context, nutritional stress can be defined as changes in the physiological conditions of individuals that experience a long-term shortage of food or rely on low quality and/or contaminated food resources that impair their ability to reproduce successfully. Alternatively, less severe food shortages may allow reproduction to proceed, but additional stress such as from anthropogenic sources may precipitate reproductive failure. It is frequently difficult, or impossible, to detect these possible types of perturbations by using traditional field methods (Piatt & Anderson 1996).

An approach using well characterized responses of hormones to stress can provide a sensitive indicator of chronic stress in the environment, or the potential impact of future stressors (Wingfield et al. 1997). Food-related stress is associated with elevated levels of corticosteroids (also known as "stress hormones") in the peripheral system of affected animals (Axelrod & Reisine 1984; Wingfield, 1994). In seabirds, corticosterone levels were elevated in free-living Magellanic penguins exposed to oil pollution (Fowler et al. 1995), and in Black-legged Kittiwakes breeding under poor foraging conditions (Kitaysky et al., submitted *a*). Chronically elevated corticosteroid levels are known to result in regression of the reproductive system, suppression of memory and immune systems, lead to muscle wasting and cause neuronal cell death (e.g. Sapolsky 1987; Wingfield 1994). Exposure to oil pollution and decreased food availability can have similar debilitative effects on foraging and reproductive behaviors in seabirds. The effects of the stress can be detected and monitored through measurements of baseline plasma levels of corticosterone in the peripheral system of potentially affected seabirds. The pattern and extent of a corticosterone increase following application of a standardized stressor such as capture, handling and restraint then indicate potential for stress effects. Furthermore, experimental manipulations with corticosterone levels in wild and captive seabirds provide a way to examine the mechanisms by which increased mortality and decreased reproduction are expressed.

The factors regulating seabird populations are poorly understood. Variations in mortality of adult birds and reproductive success due to natural fluctuations in the availability of food and anthropogenic impacts are probably among the most important factors (Cairns 1992). Life-history theory predicts that in long-lived animals, an increase in parental investment in current reproduction may impair post-breeding survival of parents and the probability of their successful reproduction in the future (Williams 1966, Charnov & Krebs 1974, Stearns 1992). Being long-lived animals, with an estimated life span of about 25-30 years (e.g., Ydenberg 1989), seabirds might buffer the cyclic variability of food resources by pursuing long-term reproductive strategies

(Ricklefs 1990). For example, some seabirds can maintain their investment in reproduction at a constant level despite a large variation in foraging conditions (Pugesek 1981, Bolton 1995, Kitaysky 1996). This parental strategy can result in large fluctuations in reproductive success but relatively small variations in the post-breeding survival of parent seabirds. Other seabirds are known to adjust their effort in current reproduction in relation to foraging conditions during a particular breeding season (Burger & Piatt 1990, Shea & Ricklefs 1985, Shea & Ricklefs 1996, Kitaysky 1996, Kitaysky et al. submitted *b*). For example, if feeding conditions are poor, adults should increase foraging effort to raise young. This parental strategy results in relatively low variation in bird reproductive success, but large variation in post-breeding survival of parent seabirds. In both scenarios, a trade-off between reproduction and survival must be balanced to maintain populations.

In contrast to regular, natural fluctuations in food availability, anthropogenic impacts such as oil pollution or commercial fisheries are unpredictable. These may also shift the balance between the processes of reproduction and survival in seabird populations. We hypothesize that the shift in the balance between reproduction and survival is responsible for the marked decline of some seabird populations in the Gulf of Alaska. It is also well known that unpredictable events in the environment have the potential to be severely stressful in terms of increased secretion of corticosteroids. Thus circulating levels of corticosterone in seabirds indicate not only current stress state, but the pattern of secretion in response to capture and handling also provides a simple test of vulnerability of the population to stress as well. We predict that the patterns in reproduction and survival of the affected population of seabirds can be altered in two possible ways. First, low reproductive rates can result from the decreased post-fledging survival of juvenile seabirds that have experienced long-term food shortages or were fed poor quality food during their development. Second, the post-breeding survival of parent seabirds that reproduced during food shortages may be decreased.

In this study we propose to examine the possible consequences of food-related stress by measuring circulating levels of plasma corticosterone as an indicator of current and potential stress. Although the impacts of stress on behavior and physiology of individuals are potentially very important to the processes of reproduction and mortality in seabird populations, the physiological mechanisms underlying these relationships are not known. We also propose to investigate the influence of the foraging and parental behaviors altered by stress on survival and reproduction of several species of seabirds that breed in the Gulf of Alaska and have been affected by the *Exxon Valdez* oil spill. The results of our pilot studies of 1996 and 1997 show clearly that the hormone aspects of the proposed study are effective and will be powerful indicators of current stress state and equally important, may point to populations that are vulnerable to future stress.

NEED FOR THE PROJECT

A. Statement of the Problem

Immediate and potential long-term effects of food-related stress on foraging and reproductive behavior in seabirds are not completely known. Recent declines of seabird populations in the Gulf of Alaska may be a result of a decrease in reproductive success due to an elevated mortality of food-stressed chicks after fledging, and/or the increased mortality of parents that rear their young under poor feeding conditions. Traditional field methods of assessing potential pollution-related stress on the survival and reproductive performance of seabirds may give equivocal results. Lack of knowledge of the long-term effects of pollution-related stress on physiology and behavior prevent us from developing a successful rehabilitation program for seabird populations in the areas affected by the *Exxon Valdez* oil spill. The basic problem is that we do not know the mechanisms of how and at what stage of a bird's life the effects of stress might most strongly affect survival and reproductive performance. Furthermore, we know even less about the recovery of populations from stressful episodes in their life cycles. The latter is critical if we are to implement future programs to successfully manage seabird populations.

B. Rationale/Link to Restoration

Long-term effects of pollution and stress on seabird reproductive biology are poorly known mostly because, to date, there have been no possibilities for a concurrent study of stress and the monitoring of foraging conditions in seabirds; and no facilities available where relationships between physiological conditions and behavior can be studied under controlled semi-natural conditions. A critical concurrent assessment of variation in foraging conditions in Lower Cook Inlet will be provided by Dr. Piatt and co-workers through the on-going project that is designed specifically for this purpose (APEX project 98163M). An ideal natural experiment to study effects of food stress can be conducted in Cook Inlet because seabirds at one study colony (Chisik Island) are chronically deprived of food, while seabirds at another study colony (Gull Island) have a surplus of food. From these studies, we will develop a protocol to monitor populations of seabirds at other colonies for possible effects of both natural and human-induced environmental perturbations.

C. Summary of Major Hypotheses and Objectives

We propose to investigate whether profiles of corticosterone in free-living seabirds reflect stress status and vulnerability to environmental stress, and how increased corticosterone levels affect parental care, reproductive success and survival of individual seabirds. The specific questions to be addressed in the field experiments include:

1. Are the baseline levels of corticosterone high in populations under nutritional stress? Both chicks and adults will be sampled and contrasted between food-deprived (Chisik Island)

and food-rich (Gull Island) colonies.

2. When artificially stressed, do circulating levels of corticosterone of seabirds increase more rapidly in populations under low level stress? In other words, are the populations under nutritional stress more vulnerable to future potential stresses? Again, both chicks and adults will be sampled at food-poor and food-rich colonies.
3. Do the amount and extent of parental care change when parents or their chicks are treated with hormonal implants imitating the effects of stress? Both chicks and adults will be manipulated.
4. How does the induced change of parental reproductive behavior affect reproductive success and survival of individual parents? Reproductive success and post-breeding survival of manipulated adults will be monitored (already being done by Restoration Project 98163M).
5. Do seabirds which possess different parental provisioning strategies show different patterns of reproductive success and survival in response to the experimental treatment? Adults of several species will be manipulated.
6. Do patterns of corticosterone release and baseline levels indicate degree of recovery and how quickly they recover from episodes of stress?

To address these questions we will investigate hypotheses and predictions on the relationships among stress physiology, behavior and reproduction in seabirds that breed in the areas affected by the *Exxon Valdez* oil spill. The first set of hypotheses state that the observed population declines are due to a decrease in post-breeding survival or reduced reproductive performances of adult seabirds that reproduce in the areas affected by the *Exxon Valdez* oil spill. In particular, parent seabirds that rear their chicks in the area affected by pollution complete the reproductive season in poorer physiological conditions and suffer greater post-breeding mortality compared with birds that rear young under favorable environmental conditions. These hypotheses predict that: (a) pollution-related stress results in chronically elevated concentrations of corticosterone in the peripheral system of parent seabirds; (b) prolonged increases in concentration of corticosterone affect provisioning behavior of parent seabirds, causes reproductive failure, an increase in the post-breeding mortality, and a decrease in the future reproductive performance of the affected birds; (c) increased levels of corticosterone in stressed chicks cause an increase in parental effort in chick-provisioning which results in the elevated post-breeding mortality of parents.

The second set of hypotheses state that the recovery of seabirds from pollution or food-related stress depends on: (a) species-specific responses to stress in general; (b) the degree to which individuals are stressed and how debilitated they may become by exposure to chronically high corticosterone levels; and (c) foraging conditions after exposure to stress.

Thus, our overall objectives are to explore the relationship between foraging conditions and endocrinological parameters of seabirds that breed in the areas affected by the *Exxon Valdez* oil spill; model the physiological and behavioral responses of individual seabirds to food-related stress through the experimental manipulations of corticosterone concentrations in wild and captive seabirds; and assess recovery from stress— particularly high circulating levels of corticosterone.

D. Location

The proposed field experiments will be based out of Homer, Alaska. Studies will be conducted at the colonies in Kachemak Bay, and in western Cook Inlet. Captive-rearing, learning, and foraging efficiency trials, and observations of sexual maturity and reproductive performances of the captive birds will be carried out at Kasitsna Bay Laboratories.

COMMUNITY INVOLVEMENT

The unique opportunity of the concurrent experimental studies of seabird foraging and reproductive behaviors in captivity at the SeaLife Center (possibly to be conducted in FY00) and at the colonies in Lower Cook Inlet will allow local high-school, undergraduate and graduate students to carry out research projects under guidance of seabird researchers from the University of Washington and U.S. Geological Survey.

PROJECT DESIGN

A. Background and Results of Pilot Studies

Decreases in the availability of food can account for the increased mortality of seabird chicks in nests. Nevertheless, a high tolerance of juvenile seabirds to intermittent or low rates of food provisioning by their parents can buffer against an immediate loss in reproductive success (Kitaysky 1996). Juvenile seabirds possess an ability to retard growth processes in response to the dietary restrictions and might fledge successfully despite severe food shortages during their development (Θyan & Anker-Nilssen 1996). Controlled experiments have shown that food-related growth retardation can account for the lower body mass and smaller body size of the young at fledging when compared to the young raised on *ad libitum* nutritional regimes (Kitaysky 1996). However, low body mass of young seabirds at fledging is not a reliable predictor of post-fledging survival (Lloyd 1979, Hedrgren 1981, Harris & Rothery, Harris et al. 1992). Potential deleterious effects of retardation in morphological development (other than effects of low body mass at fledging) on post-fledging survival and reproductive performances of food-stressed individuals have never been studied in seabirds. Chronic stress in mammals affects hippocampal regions of the brain (Sapolsky et al. 1986) which can result in less efficient learning of new behavioral methods, e.g. foraging techniques, by stressed young. Long-term effects of food-related stress during early development in Zebra finches (*Poephila guttata*) include reduced body size and possibly lower reproductive success during the adult stage of their life (Boag 1987, Boag & Grant 1981, Zink 1983). Thus, there is a possibility that food-stress in young seabirds results in: (1) increased post-fledging mortality due to a low ability of the retarded young to learn foraging techniques and/or a reduction in their foraging efficiency; (2) low reproductive performances during the adult stage of their life (e.g., delayed maturity and low reproductive

success).

Results of EVOS-funded studies in 1996 and 1997 revealed that the types and quantities of different forage fish available to seabird parents can affect the physiological condition of their young at fledging. Black-legged Kittiwake chicks that were raised on restricted amounts of food, or poor-quality diets (APEX Project 98163N), had significantly elevated levels of corticosterone compared to the control chicks (Fig. 1). These results allowed us to establish an empirical relationship between daily energy intake and corticosterone levels in Black-legged Kittiwake chicks. We used this relationship to estimate daily energy intake of wild Black-legged Kittiwake at the Gull Island colony in 1997 (Fig. 1). The estimated values of daily energy intake were very similar to those obtained from conventional methods (growth rates, asymptotic mass), giving us confidence that secretion of corticosterone reflects the nutritional status of Black-legged Kittiwake chicks.

Corticosterone appears to be involved in the regulation of begging behavior by young Black-legged Kittiwakes (Kitaysky et al., submitted *c*). An increase in begging intensity among the stressed chicks (Fig. 2 a) influences food-provisioning behavior of their parents (Fig. 2 b) and might result in an increase in the parents' investment in foraging for the young. An increase in parental investment in current reproduction can potentially decrease post-breeding survival of parent birds and the probability of their successful reproduction in the future (e.g., Jacobsen et al. 1995, Pugesek & Diem 1990, Golet et al., in press).

Studies of the effects of food shortages on parental behavior of seabirds have shown that the duration of the chick-rearing period may be extended if food conditions are poor (e.g., Harris & Rothery 1985, reviewed in Ydenberg 1989). Changes in food availability, for instance food shortages that follow El Niño events, did not affect growth of young seabirds suggesting that parents were able to compensate for a decrease in food availability by adjusting their efforts in chick-provisioning for the changed feeding conditions or pursuing brood reduction strategy (Shea & Ricklefs 1996). An increase in the duration of parental care and a possibility of additional investment of parent seabirds in reproduction during food shortages might lead to an increase in post-breeding mortality. For example, results of field experiments indicated that parent Atlantic puffins that were experimentally exposed to a prolonged chick-rearing period were in poor physiological condition at the end of breeding season compared to control birds (Erikstad et al. 1997). This raises a possibility that seabirds which reproduce during seasons of food shortages would suffer a greater post-breeding mortality compared to the birds that reproduce under conditions that are favorable for reproduction.

Results of our pilot studies have shown that parent Black-legged Kittiwakes and Common Murres respond to a standardized stressor such as capture, handling and restraint, by increasing plasma levels of corticosterone. These results indicated that the hormonal response of adult seabirds can be used to assess susceptibility to stress as might be expected during food shortages. Specifically, in 1997, when Black-legged Kittiwakes nesting on Chisik Island showed the first signs of food shortages at the egg-laying stage they also modulated their stress response compared with those

of birds in the egg-laying on Gull Island colony (Fig. 3 a). Continued food shortages resulted in a further significant elevation of circulating levels of corticosterone (Fig. 4) and a suppression of stress response in kittiwakes breeding on Chisik Island (Fig. 3 b). Black-legged Kittiwakes failed to produce any chicks on Chisik Island in 1997 (Piatt et al., unpublished). Using endocrinological parameters alone, we could predict this failure at the egg-laying stage of their reproductive season (Kitaysky et al., submitted *a*).

On the other hand, chick-rearing under favorable foraging conditions does not alter the physiological condition of parent Black-legged Kittiwakes. In particular, exposure to the standardized stressor did not indicate a significant difference in the hormonal response of birds raising young compared to those with experimentally removed chicks (Fig. 5). This raises a possibility that not chick-rearing *per se*, but an additional effort in foraging for the young during food shortages can alter the physiological conditions of parent Black-legged Kittiwakes and result in decreased post-breeding survival of adults. Moreover, the pattern and extent of a corticosterone increase following application of the standardized stressor allows us to assess changes in physiology of a parent in relation to its normal effort in reproduction as opposed to changes associated with food-stress (Kitaysky et al. submitted *a*).

In 1997, we did not find an increase in circulating levels or a suppression of stress levels of corticosterone in breeding Common Murres at early stages of reproduction on Chisik Island compared to Gull Island (Fig. 6). However, we observed a rapid increase in circulating levels of corticosterone during the chick-rearing stage, and this increase occurred earlier in the season among murres breeding on Chisik Island than on Gull Island (Fig. 6). The phenology of reproduction was similar between the colonies suggesting that, in addition to the species-specific seasonal increase of corticosterone secretion, food shortages affected the physiological condition of parent murres on Chisik Island. The experimental manipulation revealed that parent murres respond to elevation of corticosterone by fledging their young (Table 1). To verify this result, we compared the age of fledglings between Chisik and Gull Islands and found that parent murres fledged their young at earlier age at Chisik Island, where feeding conditions are poor (Fig. 7). We also manipulated the corticosterone levels in murre chicks but did not find an effect of the experimentally elevated corticosterone levels on the age of chicks at fledging (Fig. 8). Thus, parent Common Murres can avoid food-related stress during reproduction by fledging their young at an early age. Therefore, it is less likely that a population decrease of Common Murres on Chisik Island is related to high mortality of adult birds breeding under poor foraging conditions. It can, however, result from a low recruitment of young at this colony because of either low survival of chicks that left nests at an early age or a delay in reproductive maturation of young birds that experienced nurtitional stress during early development. However, the effects of stress on physiological condition, future survival, foraging behavior and reproduction of food-stressed murre chicks have yet to be investigated.

Overall, the results of our pilot studies in 1996 and 1997 provide a strong background for the proposed research on the effects of food-related stress on foraging and reproductive behaviors of seabirds. Our findings fully justify the general assumption of the proposed research that

experimental manipulations with hormones will allow us to simulate the effects of the stress on reproductive biology of seabirds in areas affected by the *Exxon Valdez* oil spill.

B. Objectives

1. Establish whether populations at Gull and Chisik Islands are chronically stressed. Determine baseline levels of corticosterone in relation to varying foraging conditions.

2. Investigate the potential for future stress in populations at Gull and Chisik Islands. Measure circulating levels of corticosterone in response to a standardized stressor: capture, handling and restraint.

3. Examine the effects of variation in daily energy intake on baseline levels of corticosterone in Common Murre and Pigeon Guillemot chicks. Determine the effects of food-related stress on morphological development and rate of corticosterone secretion of juveniles in captivity.

4. Examine the effects of stress levels of corticosterone on the begging behavior of young and the chick-provisioning behavior of parents at Gull Island. Model the effects of stress with corticosterone implants.

5. Determine the effects of stress levels of corticosterone on the post-breeding survival and future reproductive performance of parents at Gull Island. Monitor survival and reproduction of the manipulated individuals during subsequent reproductive seasons.

C. Methods

The proposed research utilizes a unique combination of field and captive experiments, and laboratory analyses. We will focus on the comparison of the endocrinological characteristics of seabirds breeding at Gull Island, where foraging conditions were continually good during the last few years with those nesting under poor feeding conditions at Chisik Island. In this study we plan to use Black-legged Kittiwakes and Common Murres as the study organisms. Baseline levels and stress-induced increases of corticosterone will be also be determined in Horned Puffins, Tufted Puffins and Pigeon Guillemots breeding elsewhere in Lower Cook Inlet. Multi-species comparison of the physiological and behavioral aspects of stress will ultimately allow us to predict responses of seabird communities to variability in food supplies or to oil-spills, and to develop efficient programs for their rehabilitation.

1. Correlations among corticosterone levels, reproductive stage and varying foraging conditions.

To assess whether seabirds from different populations are chronically stressed or not, we will determine baseline levels of corticosterone in relation to the reproductive stages, pre-incubation, incubation and chick-rearing. Adult birds will be captured at the breeding colonies by using a

noose pole. We will collect a blood sample (approximately 100-150 μL) from the brachial vein of the wing immediately after capture. To determine the potential for stress in different populations we will measure circulating levels of corticosterone in response to a standardized stressor, capture, handling and restraint. For that, additional samples of blood (15-30 μL) will be collected from the same birds over a period of 1 h after capture (at 5, 10, 30 and 60 min intervals). To collect blood samples from chicks we will use similar methods as for adult birds, except that the first sample will be smaller (30-50 μL).

The results of our pilot study indicate that a sample size of N>7 (per each group of birds) was sufficient to detect significant inter- and intra-specific differences in baseline concentrations of corticosterone in adult birds and juveniles (Figures 1-6). Therefore, approximately 7-10 adult birds and chicks will be sampled at each colony at every stage of the reproductive period (total 25-30 birds of each species per colony/year). After sampling, adult birds will be released at the colony and chicks returned to their nests. Previous field and captive studies indicate that taking blood does not affect the long-term physiological condition or behavior of birds (J. Wingfield, personal observations). In 1996, 1997 and 1998, Black-legged Kittiwakes and Common Murres released after bleeding at Gull Island and Chisik Island were sighted at their nests within 1-10 min period. Similarly, bleeding captive seabird chicks does not appear to affect their behavior or development (A. Kitaysky and M. Romano, personal observations).

2. Field manipulations with stress levels of corticosterone.

To test whether corticosterone affects begging by chicks and provisioning of food by parent seabirds we will experimentally manipulate the concentration of this hormone in plasma of birds at Gull Island. We plan to use two experimental treatments (10 nests each) where either the chicks or their parents will be given subcutaneous implants of corticosterone (sealed plastic tubes filled with the crystallized hormone, for details see Wingfield & Silverin 1986) during the first week after hatching. The control birds will be given empty implants. The following parameters will be measured to record a change in the behavior of birds due to the hormonal treatment: chick-feeding rate (assessed as #feedings/day per chick) and nest attendance by the parents (in minutes per day). Recording of behavior will be accomplished by direct observation from blinds established at the colony. Blood samples will be taken on a weekly basis from all young and parent birds to monitor concentrations of corticosterone in plasma of manipulated and unmanipulated birds.

Results of the experiment in 1997 at Gull Island show in six experimental and six control nests of Black-legged Kittiwakes on Gull Island (Kitaysky et al., submitted *c*), that chicks with subcutaneous corticosterone implants beg more frequently than controls with empty implants (Fig. 2 a). Parent kittiwakes then respond to the change in begging by the chicks by providing more food (Fig. 2 b). Thus, parents provide more or less food in response to the physiological condition of their offspring as indicated directly by chick begging behavior. However, feeding conditions were exceptionally good for kittiwakes breeding on Gull Island in 1997 (Piatt et al. Unpublished), and the observed behavioral response of parent kittiwakes can change if parent

kittiwakes experience food shortages. Therefore, the experiment will be repeated during breeding season of 1999 and 2000, when potential food shortages related to the El Niño of 1997/98 are expected.

All experimental birds will be individually marked with a unique combination of color bands and standard aluminum USFWS rings. Individual markings will allow us to identify the birds during the experiments and to monitor their survival after breeding and future reproductive performances during the following breeding seasons. Both Black-legged Kittiwakes and Common Murres have strong nest site and mate fidelity and their breeding performance and survival are relatively easy to monitor over a period of several years (Coulson & Thomas 1983). Golet and co-authors (Golet et al., in press) showed that the difference in post-breeding survival between Black-legged Kittiwakes raising their young with those with experimentally removed chicks was possible to detect with sample sizes of about 100 nests per treatment. As indicated by the pilot studies, chick-rearing per se does not cause stress to a parent under favorable environmental conditions. However, poor foraging conditions as an additional stressor would impair parents' physiological condition. Thus we expect a considerable difference in survival due to the manipulations with stress levels of corticosterone. We anticipate that a sample size of 30 nests (60 birds per experimental treatment) would allow us to make a conclusive statement about the relationships among survival, reproduction and stress in Black-legged Kittiwakes and Common Murres in Lower Cook Inlet. This component of the study will complement, and be coordinated with, a larger study of adult survival at Gull and Chisik Islands (Restoration Project 98338).

3. Captive study of food-related stress.

To test whether the food/pollution-related stress affects morphological development and physiological condition of young seabirds, we will raise Common Murre and Pigeon Guillemot chicks on three different nutritional regimes in captivity during 1999. For the experimental treatments (15 chicks per each treatment) we will use the methods described by Romano and co-authors (Romano et al., unpublished) where either quantity and quality of the chick diets will be altered or a supply of mineral oil will be given to chicks with food. In particular, one group of young will be raised on reduced quantities of the high quality food (sandlance, *Ammodytes hexapterus*, and capelin, *Mallotus villosus,* or herring, *Clupea harengus*). Chicks from the second experimental treatment will be raised on sufficient amounts of food of poor quality (juvenile pollock, *Theragra chalcograma*). Chicks from the control group will be raised on the food of high and poor quality given *ad libitum*.

4. Study of recovery from stress.

To investigate recovery from stress in birds of different species we will model the stress by manipulation with concentrations of corticosterone in the peripheral system of wild birds. In particular, we will monitor survival/return rates of parent birds following stressful incident (as

described above) at Gull Island.

5. Laboratory analyses.

In parallel to the field and captive research we will conduct the laboratory analyses of blood samples taken from the birds during the experimental manipulations. All blood samples will be taken from the brachial vein of the wing, blood plasma will be separated from blood cells and then frozen at -10°C. All plasma samples will be transported to the laboratory at the University of Washington and processed according to the radio-immuno assay techniques (see Wingfield et al. 1991 for the details).

D. Contracts and Other Agency Assistance

The field and captive experiments, and laboratory analyses will be carried out by Dr. Alexander Kitaysky, a research associate in the Zoology Department at University of Washington, Seattle, with the aid of one full-time assistant and two field volunteer-assistants. Dr. John Piatt of the US Geological Survey will serve as field supervisor, providing logistical support and hiring the assistant and volunteers. Radio-immuno assay analyses of blood samples collected during the proposed research will be conducted in Dr. Wingfield's laboratory at UW. Dr. Wingfield will provide the supervision of laboratory analyses, and provide logistical support.

SCHEDULE

A. Project Tasks for FY 99 (October 1, 1999 - September 30, 1999)

January-April: preparation for field work, hiring personnel

May-June:	blood sampling during pre-incubation stage, setting study plots for the experimental work
July:	blood sampling during incubation stage, study plot monitoring
August:	blood sampling during chick-rearing stage, colony work: implanting birds with the hormonal implants, monitoring parental feeding rates and chick survival
July-October:	chick-rearing in captivity at the Kasitsna Bay Laboratories
October-April:	laboratory analyses of blood samples, data analysis
February:	Annual Report on FY 99 results
March-April:	preparation for FY00 research
May:	begin field work for FY00

B. Project Milestones and Endpoints

The ultimate goals of this study are (*i*) to assess whether or not populations of seabirds breeding in Lower Cook Inlet are chronically stressed; (*ii*) to quantify potential for stress at different stages of a bird's life-cycle under varying foraging conditions; (*iii*) to develop a "field endocrinology" protocol to monitor populations of seabirds in different habitats for possible effects of environmental disturbance both natural and human-induced. Objectives ***i*** and ***ii*** will require at least three years of field and laboratory work to quantify the relationships between baseline levels of corticosteroids and foraging conditions before final conclusions can be made. Objective ***iii*** will be accomplished after all field and laboratory tasks are completed.

If the objectives are achieved, it should be possible by year 2002 to evaluate current status and potential for stress at the colonies in Lower Cook Inlet. Moreover, it will reveal how effects of stress on reproduction and survival are expressed in seabird populations. This will provide the basis for management of seabird populations in the areas affected by the oil spill.

C. Completion Date

The study will be completed in December of 2002, after three reproductive seasons at the colonies in Lower Cook Inlet, laboratory analyses and sufficient time for analyses of results and preparation of manuscripts for publication.

Originally we proposed three years of captive trials on post-fledging foraging efficiency and recovery from stress at Alaska SeaLife Center (see previous version of the proposal). We will further explore the possibility of using the facilities of Alaska SeaLife Center for a study of recovery from stress. We believe that this is a critical part of research on food-related stress in seabirds.

PUBLICATIONS AND REPORTS

February 15, 2000:	Annual report on work accomplished in summer-fall period of 1999, and preliminary results.
February 15, 2001:	Interim report on work accomplished in summer-fall period of 1999, extensive analyses of results and preliminary conclusions.
February 15, 2002:	Annual report on work accomplished in summer-fall period of 2001, and preliminary results.
February 15, 2003:	Draft Final report on work accomplished and results obtained, 1999-2002.

We also plan to publish interim and final results of this study in conference proceedings and scientific journals. Note that some results of pilot studies in 1996 and 1997 have already submitted to peer-reviewed journals for publication.

NORMAL AGENCY MANAGEMENT

None of the proposed research described here would normally be conducted by the USGS, or any other government agency.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This study addresses a number of questions related to conservation and management of Alaskan seabirds. The proposed research will allow to create captive populations of several species of seabirds that breed in the Gulf Of Alaska and affected by the *Exxon Valdez* oil spill. The proposed research will be coordinated with on-going projects being supported by the Exxon Valdez Oil Spill Trustees and US Geological Survey.

PRINCIPAL INVESTIGATORS

Principal Investigator and Project Leader - Dr. Alexander S. Kitaysky, Research Associate with the University of Washington, Seattle. Obtained a Ph.D. in Ecology and Evolutionary Biology from University of California in 1996 (dissertation on behavioral, physiological and reproductive responses of seabirds to environmental variability). Since 1986, studied seabird behavior and physiology at colonies in Okhotsk Sea and on the Aleutian Islands, and foraging behavior of seabirds at sea in Bering Sea, Aleutian Islands and in Gulf of Alaska.

Dr. John F. Piatt (Research Biologist GS-13, Alaska Biological Sciences Center, USGS, Anchorage, AK) obtained a Ph.D. in Marine Biology from Memorial University of Newfoundland in 1987. His dissertation involved seabird-forage fish interactions. Since 1987, he has studied seabirds both at colonies and at sea in the Gulf of Alaska, Aleutian Islands, and Bering and Chukchi seas. His is an author on over 50 peer-reviewed scientific publications about seabirds, fish, marine mammals, and effects of oil pollution on marine birds.

OTHER KEY PERSONNEL

Professor John Wingfield (University of Washington, Seattle). Financial and logistic support for laboratory analyses in his lab at UW. He is an author on over 250 scientific publications (see attached CV).

Research assistants:

-Biotech (12 month, vacant)

Table 1. Behavioral response of parent Common murres to the experimental increase in curculating levels of corticosterone. At the experimental nests (n=6, chick age = 13.5 (SD=2.51) days after hatching) parents were implanted subcutaneously with two 25 mm silicon tubes filled with the cristallized cotricosterone, parents at the control nests (n=6, mean chick age = 13.0 (SD=2.45) days after hatching) were implanted with empty tubes. Direct observations (during two days between 7 a.m. and 21 p.m.) were carried out 24 hours after the implantation. By that time, implanted parents fledged their chicks, whereas most of controls stayed with their chicks at the colony (difference between the treatments is statistically sugnificant: $\chi^2 = 8.57$, p=0.003).

Experimental treatment	Behavioral response of parents	
	Fledged their chicks	Stayed at the nest with chicks
Controls	1*	5
Implanted	6	0

* - number of nests where parents were manipulated.

Figure 1. Black-legged Kittiwake chicks that were raised on restricted diets (low lipids to proteins ratio, Romano M., unpublished data), had significantly elevated baseline levels of corticosterone (open circles, mean ± SE). Analysis of covariance with the diet composition as a factor and the energy intake as a covariate has shown significant effects of both, diet composition ($F_{2,39}$=3.38, p=0.04, not shown) and energy intake ($F_{1,39}$=28.77, p<0.001). Solid circle shows baseline plasma concetrations of corticosterone of wild Black-legged Kittiwake chicks at Gull Island in 1997. According to the observed levels of corticosterone, daily energy intake of wild chicks were ca. ~530 kJ day^{-1}, which were similar to actually recorded values (Piatt J.F., unpublished data).

Figure 2. Behavioral responses of Black-legged Kittiwake chicks (**a**) and parents (**b**) to the experimentally increased circulating levels of corticosterone in chicks (mean ± SE; n=6 nests per treatment). (**a**) Chicks increase begging in response to the increased levels of corticosterone (Kruskal-Wallis ANOVA: H=8.49, P<0.01); (**b**) parents increase feeding of their young in response to the corticosterone-increased begging rate of chicks (independent samples t-test: t=3.969, P<0.01, n=12). At experimental nests chicks were implanted with a single 25 mm silicon tube filled with crystallized corticosterone. Behavioral observations were conducted over a two day period beginning 24 hours after implant placement

Figure 3. Comparison of stress response to handling between Black-legged Kittiwakes breeding under poor foraging conditions at Chisik Island (solid circles and bars represent mean ± SE, sample sizes are 7 and 7 individuals in the egg-laying and chick-rearing stages, respectively) and under favorable conditions at Gull Island (open circles, n=10 and n=8 in the egg-laying and chick-rearing stages, respectively). At Chisik Island, breeding kittiwakes modulated their response to a standardized acute stressor compared to those of birds at Gull Island (repeated measures ANOVA, time after capture x colony effect: $F_{4,112}$=6.64, p<0.001).

Figure 4. In 1997, baseline levels of corticosterone were significantly elevated in birds breeding at Chisik Island (poor foraging conditions) compared to those of birds breeding at Gull Island (favorable foraging conditions) (colony effect: $F_{1,55}$=13.24, p=0.001).

Figure 5. Stress response to handling of Black-legged Kittiwakes rearing their chicks and those with experimentally removed chicks (J.C. Wingfield and G. Golet, unpublished data). This comparison suggests that, chick-rearing under favorable foraging conditions is not a stressfull event in the Black-legged Kittiwake.

Figure 6. In 1997, increase in baseline levels of corticosterone occurred earlier in Common murres breeding at Chisik Island that in those at Gull Island (mean ± SE).

Figure 7. In 1997, Common murre chicks were fledging at a younger age at the food-poor colony on Chisik Island compared to food-rich colony on Gull Island (mean ± SE).

Figure 8. The experimental increase in circulating levels of corticosterone does not change a

Fig. 1

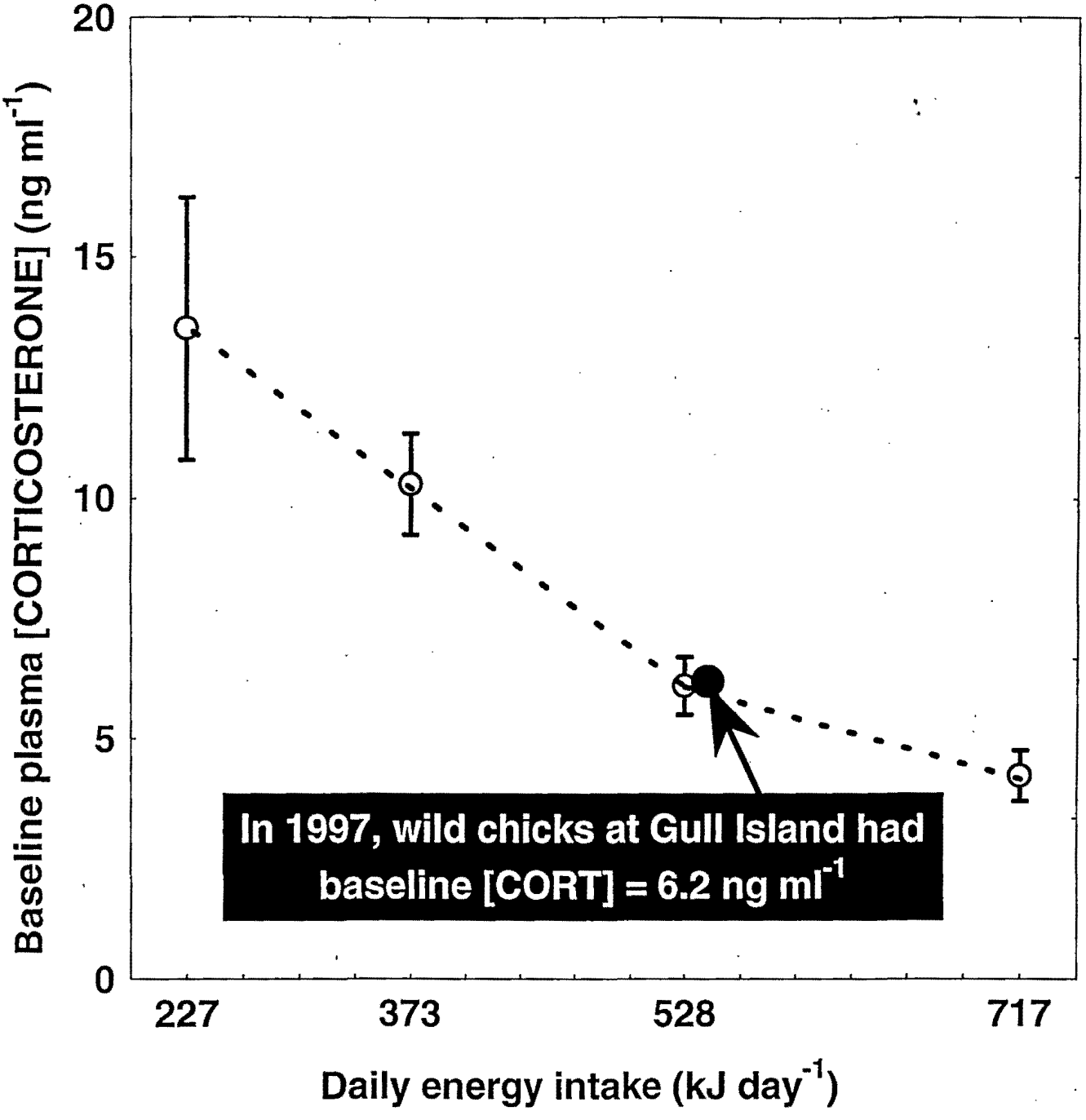
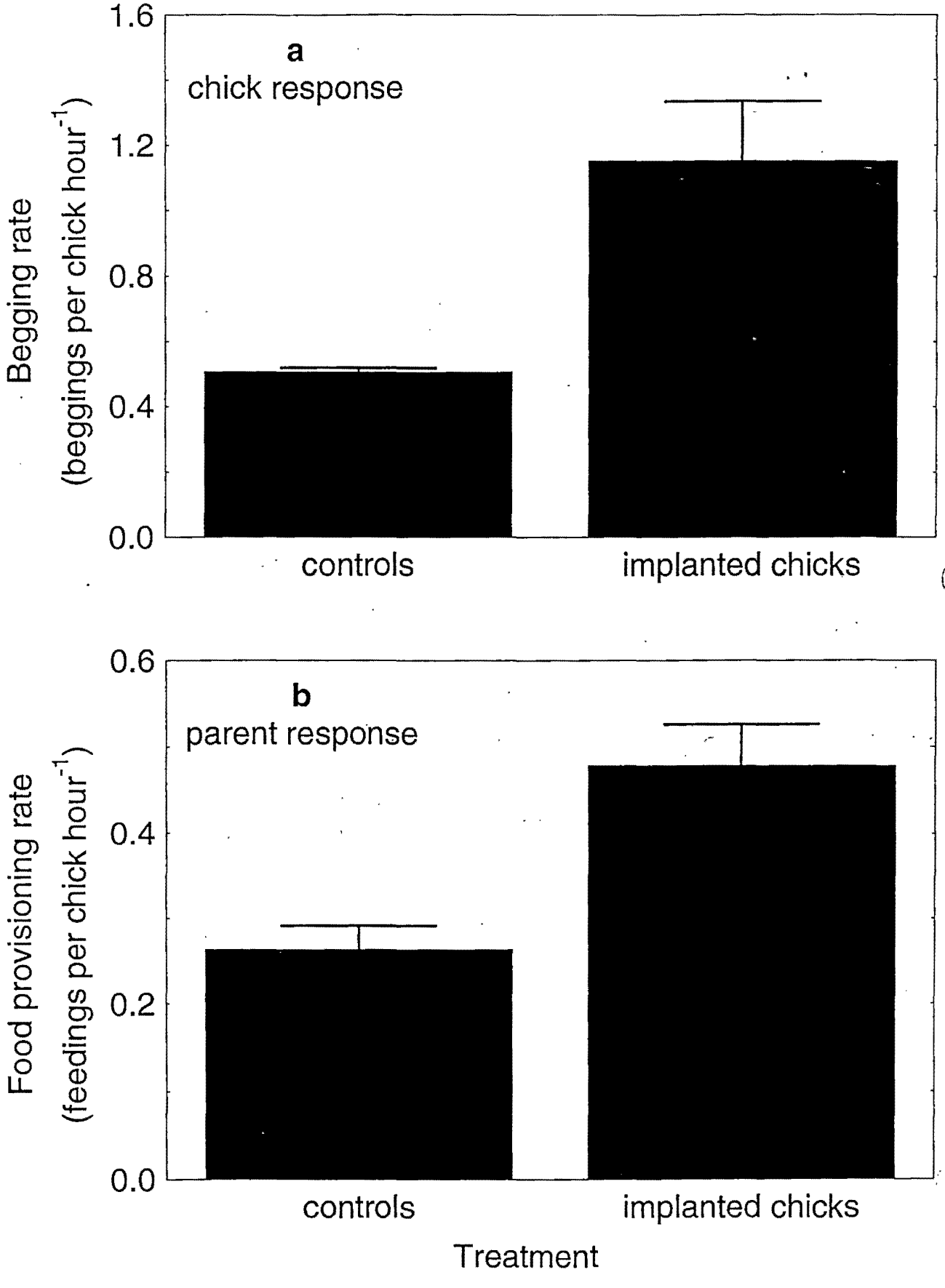

20
15
10
5
0
Baseline plasma [CORTICOSTERONE] (ng ml-1)
227
373
528
717
Daily energy intake (kJ day-1)
In 1997, wild chicks at Gull Island had baseline [CORT] = 6.2 ng ml-1

Fig. 2 a&b


a
chick response
Begging rate
(beggings per chick hour^{-1})
1.6
1.2
0.8
0.4
0.0
controls
implanted chicks
b
parent response
Food provisioning rate
(feedings per chick hour^{-1})
0.6
0.4
0.2
0.0
controls
implanted chicks
Treatment

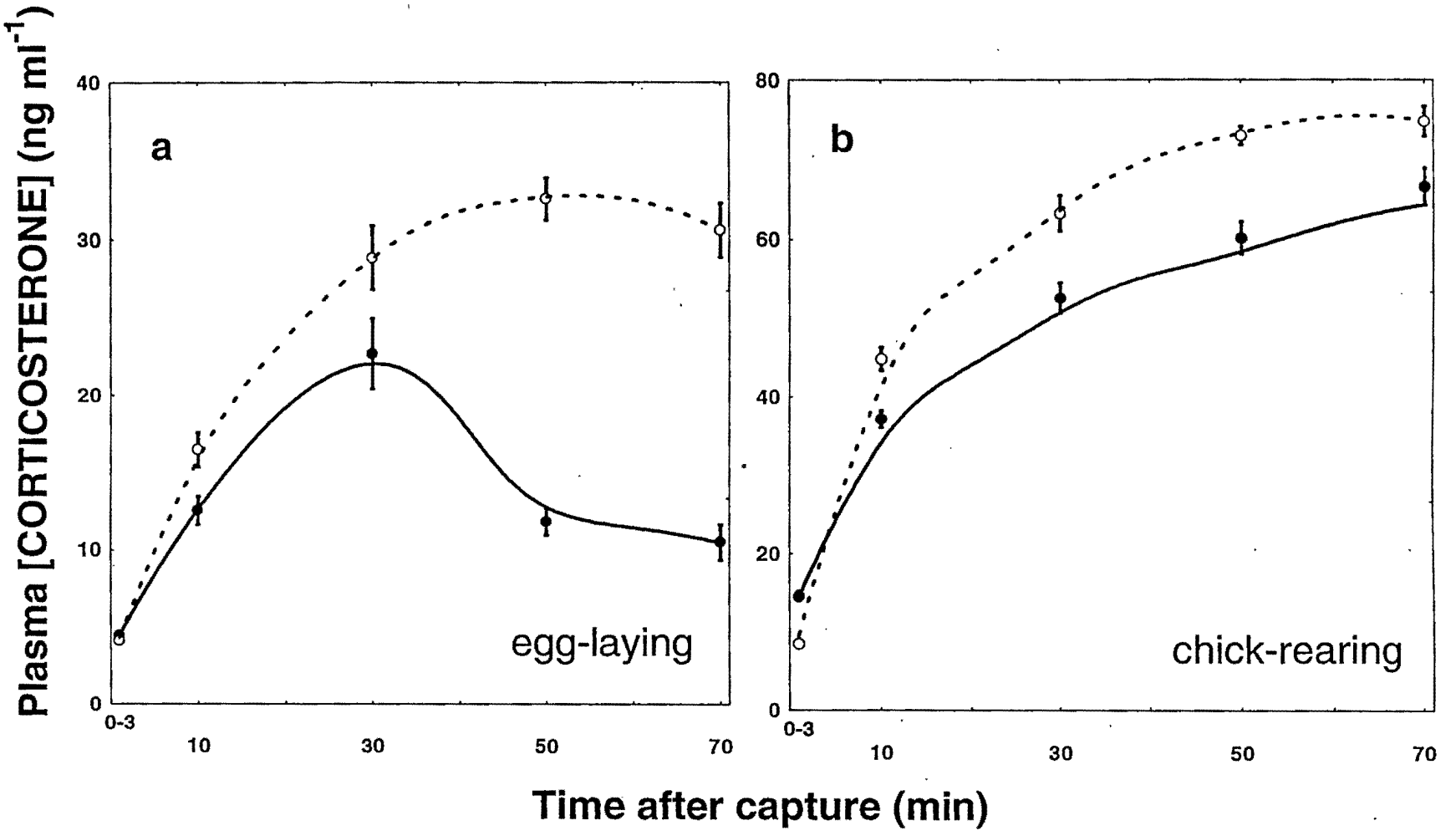
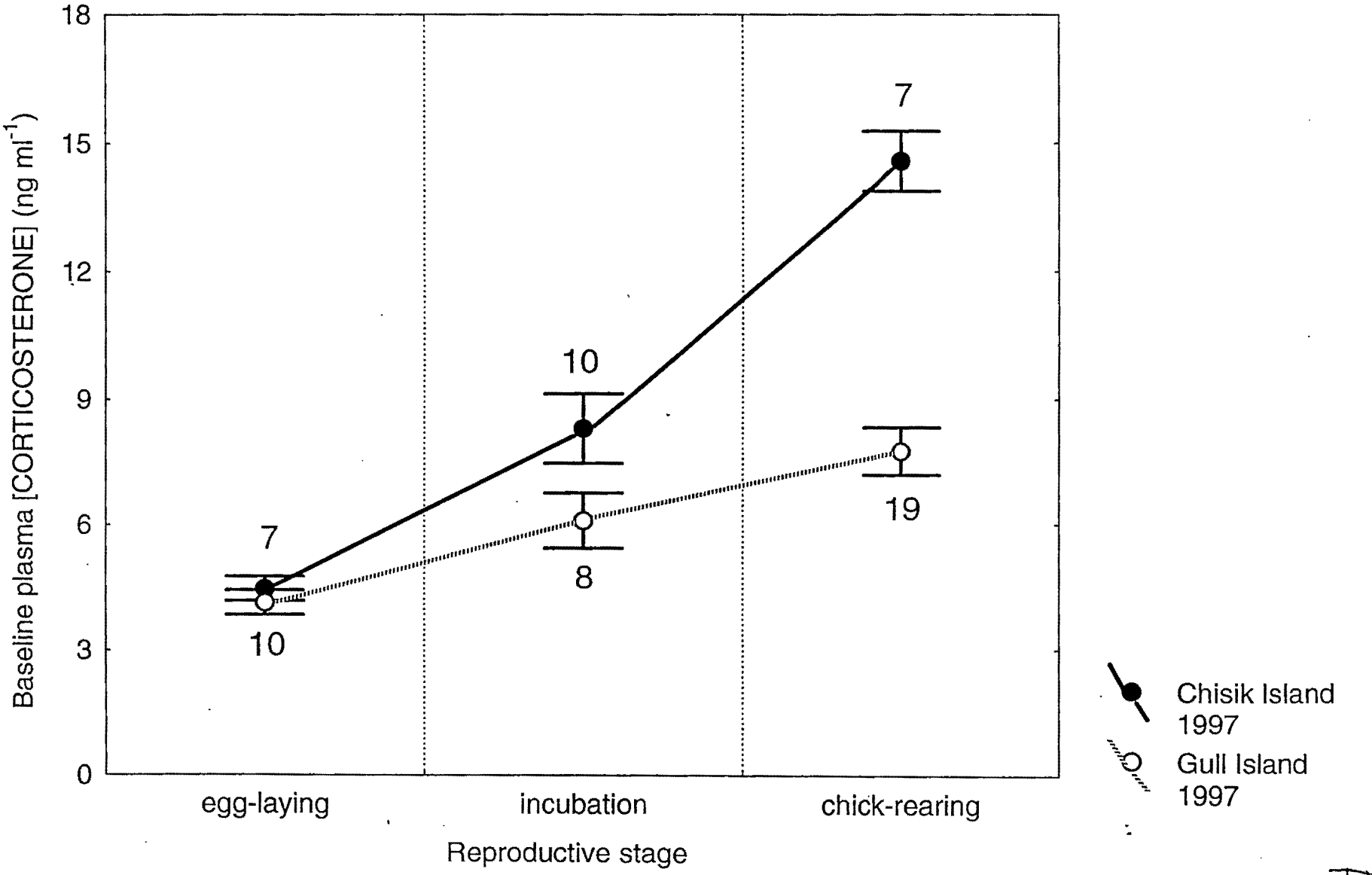

Plasma [CORTICOSTERONE] (ng ml-1)
a
b
egg-laying
chick-rearing
0
10
20
30
40
60
80
0-3
10
30
50
70
Time after capture (min)

Fig. 3


Baseline plasma [CORTICOSTERONE] (ng ml-1)
18
15
12
9
6
3
0
7
10
7
10
8
19
egg-laying
incubation
chick-rearing
Reproductive stage
Chisik Island 1997
Gull Island 1997

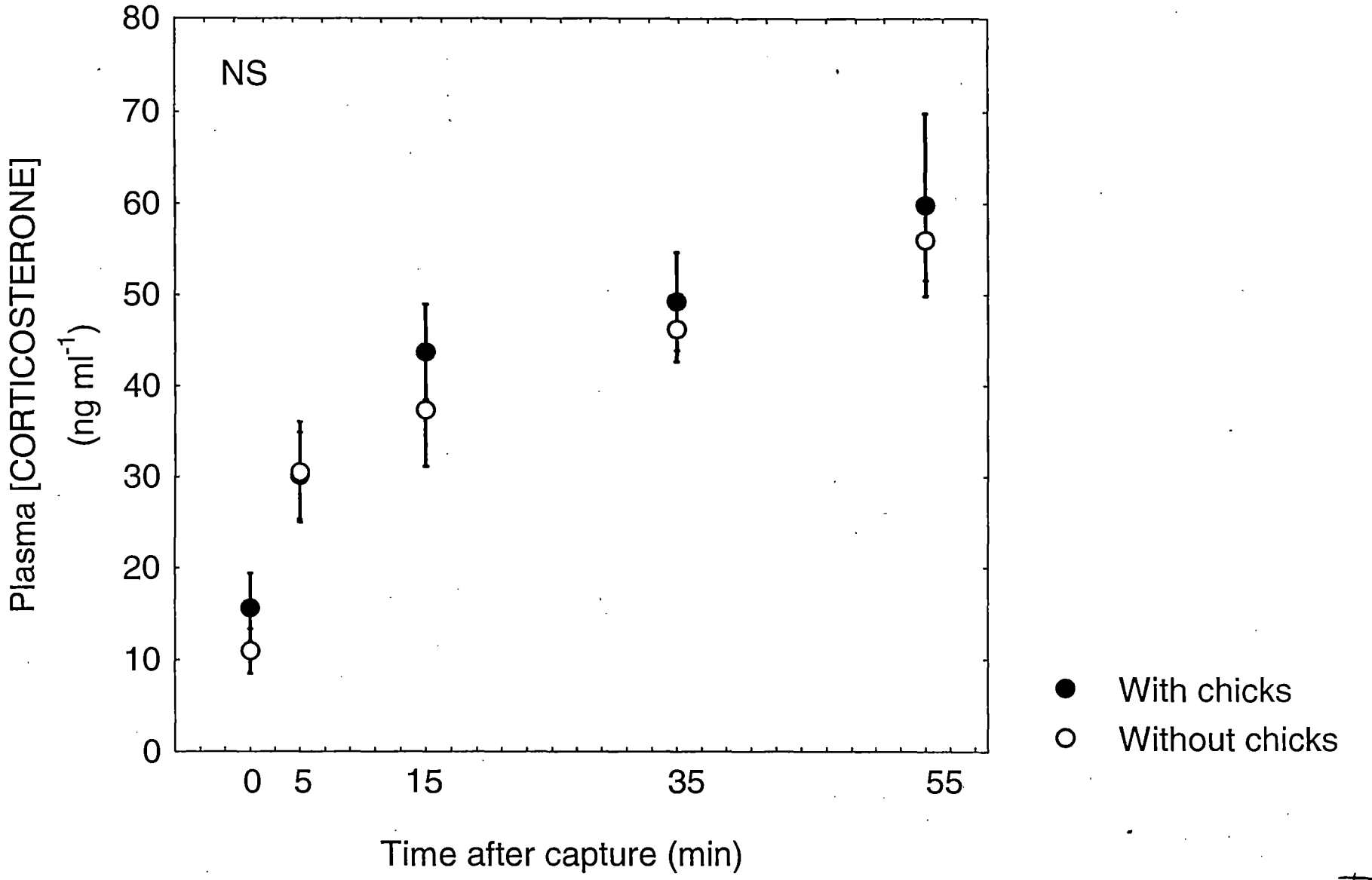

NS
Plasma [CORTICOSTERONE]
(ng ml-1)
80
70
60
50
40
30
20
10
0
0
5
15
35
55
Time after capture (min)
With chicks
Without chicks

Fig. 5

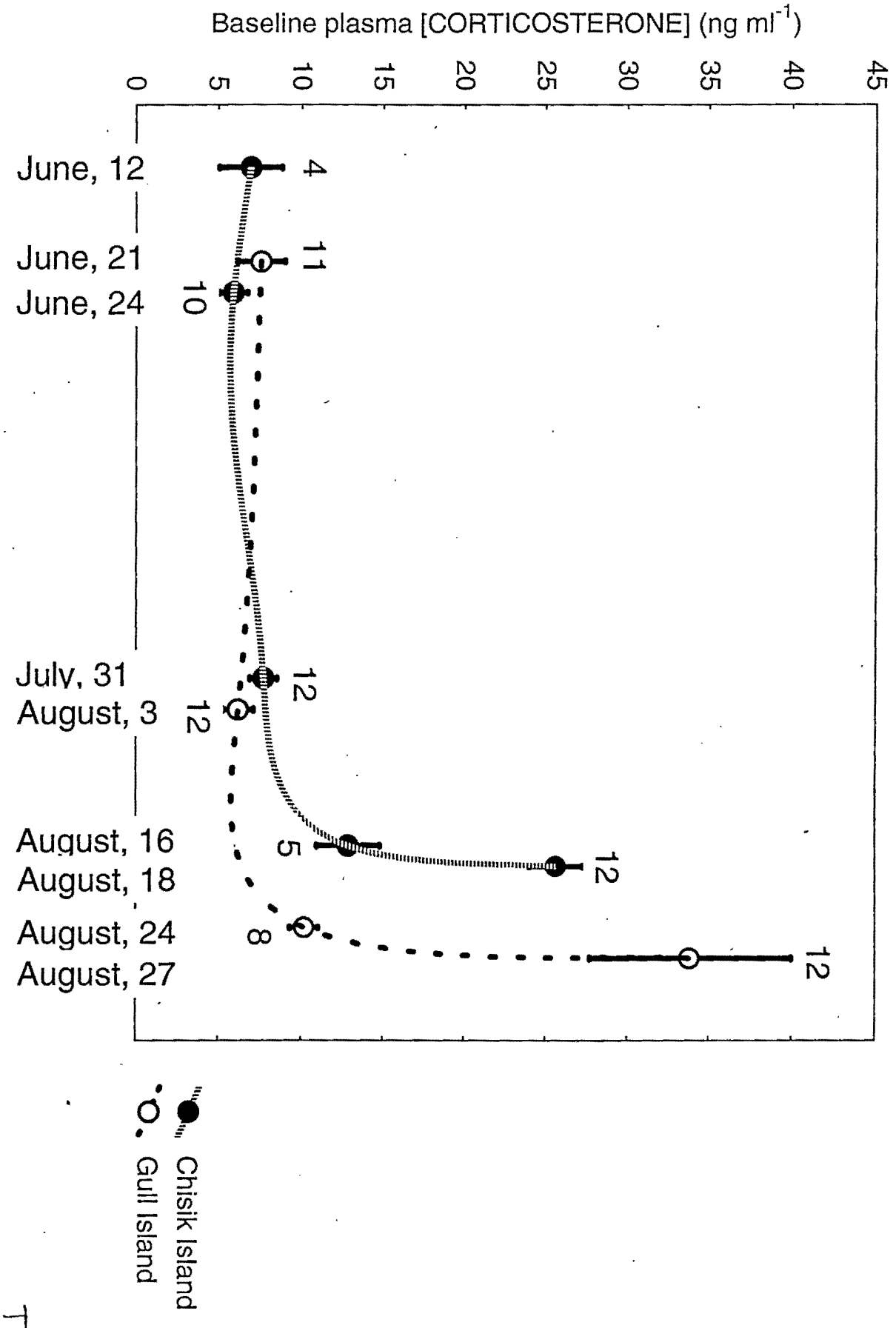

Baseline plasma [CORTICOSTERONE] (ng ml^{-1})
0
5
10
15
20
25
30
35
40
45
June, 12
June, 21
June, 24
July, 31
August, 3
August, 16
August, 18
August, 24
August, 27
4
11
10
12
12
5
12
8
12
Chisik Island
Gull Island

Fig. 6

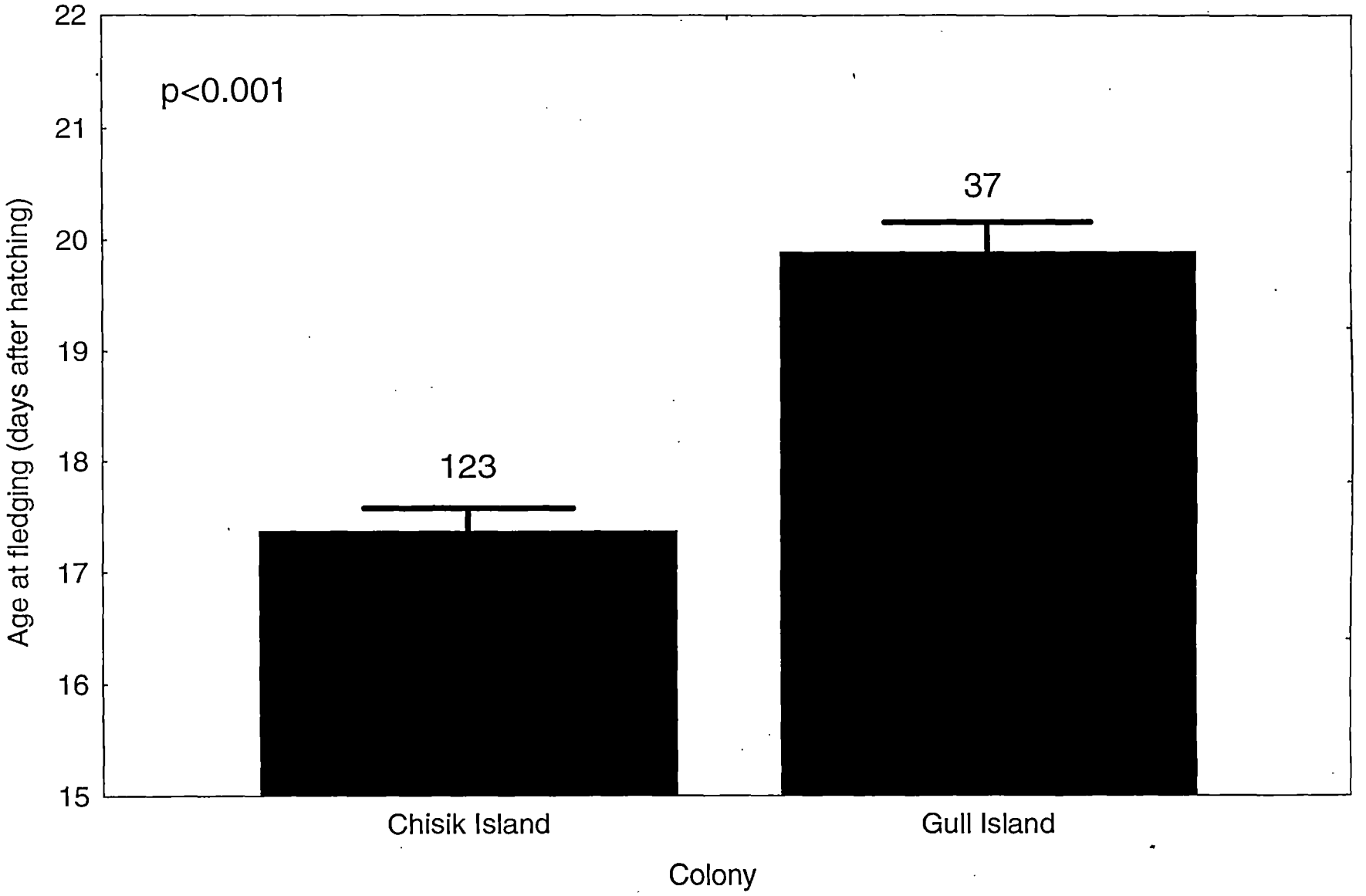

p<0.001
22
21
20
19
18
17
16
15
Age at fledging (days after hatching)
123
37
Chisik Island
Gull Island
Colony

Fig. 7

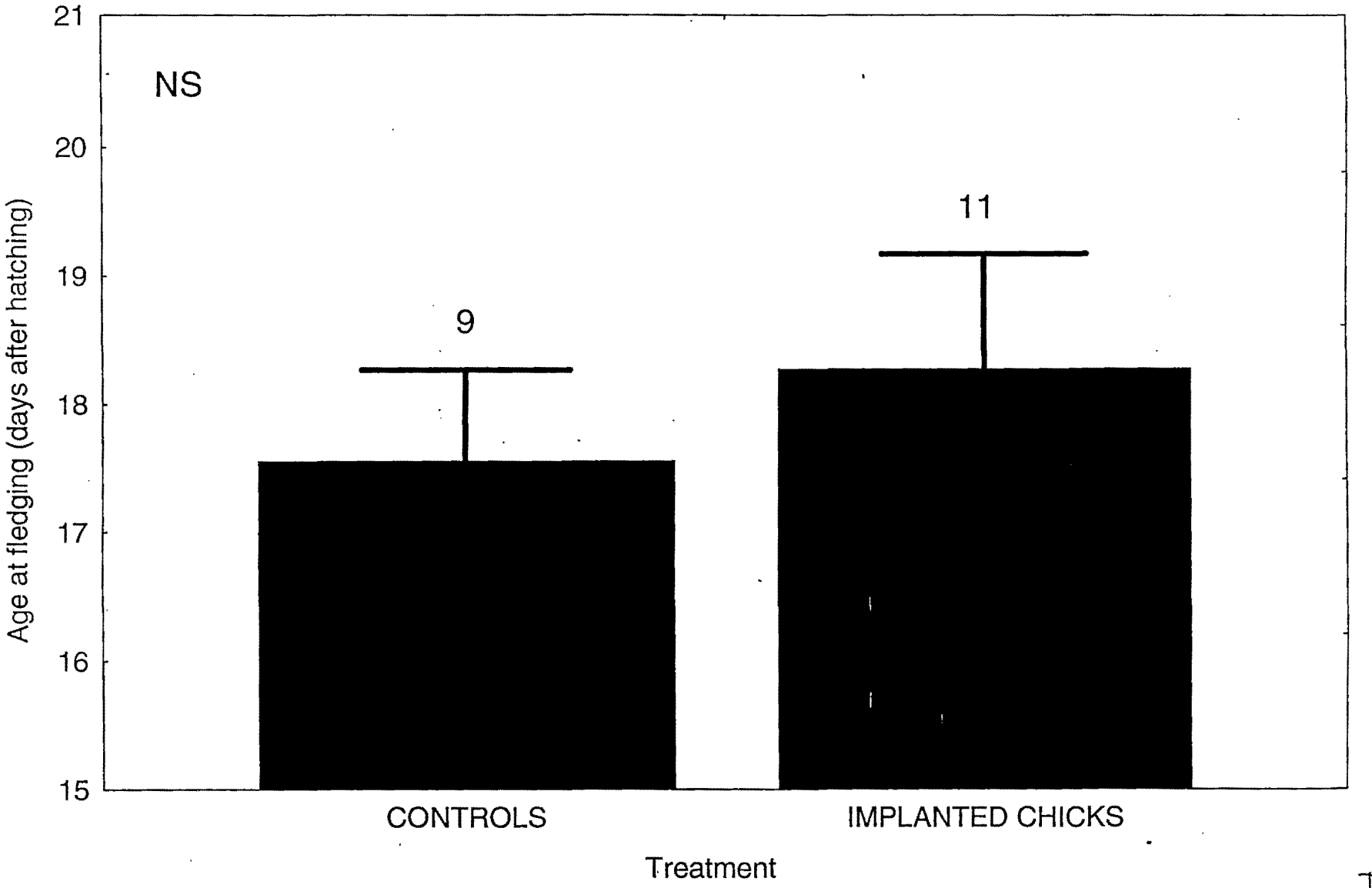

NS
21
20
19
18
17
16
15
Age at fledging (days after hatching)
9
11
CONTROLS
IMPLANTED CHICKS
Treatment

Fig. 8

Revision 7 1-98
Approved TC 8-13-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$9.6
Travel		$1.2
Contractual		$47.0
Commodities		$3.7
Equipment		$18.5
Subtotal	$0.0	$80.0
General Administration		$4.7
Project Total	$0.0	$84.7
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003
$125.2	$129.6	$75.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments: Originally proposed research to be conducted at the Alaska SeaLife Center was cut from the FY99 proposal, but remains in the out year budgets pending review of the project following field work in 1999.

1999

Prepared: 1 of 4

Project Number: 99479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3A
TRUSTEE
AGENCY
SUMMARY

7/31/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1999
Name	Position Description					
Vacant	Biotech	GS-5	4.8	1992.0		9.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.8	1992.0	0.0	
					Personnel Total	$9.6

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Description					
Seattle-Anc	600.0	2			1.2
				Travel Total	$1.2

1999

Prepared: 2 of 4

Project Number: 99479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Personnel & Travel DETAIL

7/31/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed FY 1999
Description	
University of Washington Research Work Order	47.0
Post-doc Salary - 35K	
Benefits and fees - 12K	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$47.0

Commodities Costs:	Proposed FY 1998
Description	
Food	2.7
Fuel	1.0
Commodities Total	$3.7

1999

Prepared:

Project Number: 99479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Contractual & Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1999
Field Centrifuge			2.0
Mobile freezer			1.5
Misc Scientific field supplies			2.0
Laboratory supplies for Radio-immunoassay			13.0
			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.			$18.5

Existing Equipment Usage:	**New Equipment Total**	Inventory
Description	Number	Agency
All boat, lodging, field laboratory, and logistic support provided by APEX project 98163M (Cook Inlet Seabirds). Equivalent value of about 25K.	of Units	
University of Washington, research laboratory of Dr. John Wingfield. Equivalent value of complete laboratory support beyond supplies for radio-immunoassy (above) is about 100K		

1999

Project Number: 99479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Equipment
DETAIL

Revision 7-9-98
Approved TC 8-13-98

Lower Cook Inlet Waste Management Plan

Project Number:	99514
Restoration Category:	General Restoration
Proposer:	A. Viteri/ADEC
Lead Trustee Agency:	ADEC
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 1 yr. project
Cost FY 99:	$54.5
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Lower Cook Inlet
Injured Resource/Service:	Intertidal communities, subsistence, recreation

ABSTRACT

This project will assess the pollutants reaching the marine environment in proximity to the communities of Port Graham, Nanwalek, and Seldovia and draft recommendations to address each of the identified problems. Following the model of the Sound Waste Management Plan (Project /115) and the Kodiak Island Waste Management Plan (Project /304), this project is designed to address marine pollution from land-based sources and identify methods to help restore injured resources in these coastal communities.

INTRODUCTION

In varying amounts, a wide range of waste streams are generated from the communities of Seldovia, Port Graham, and Nanwalek that may be entering, degrading, and preventing recovery of the Exxon Valdez spill area. This includes oil generated from vehicles and vessels, hazardous wastes generated by households, and solid wastes. This pollution constitutes a major and chronic source of marine pollution.

Port Graham, Seldovia, and Nanwalek currently face varied problems with managing these wastes, including inadequate facilities to properly manage used oil, landfills located in areas of potential groundwater and surface water contamination, lead, acid batteries, and hazardous household wastes disposed of in community landfills where they may leach into surrounding land and water. As a result of these problems, pollution from these sources is entering Kachemak Bay and the Gulf of Alaska on an on-going basis.

The oil spill region has seen an excellent effort by the Trustee Council to reduce marine pollution, especially in the Prince William Sound and Kodiak Island. The lower Cook Inlet region has experienced chronic marine pollution problems as well, threatening recovering species injured by the Exxon Valdez oil spill. As a result, waste generated within the communities represent a chronic source of pollution that not only hinders full recovery of the marine environment, but also has a negative impact on services and general quality of life. The efforts put forth in Prince William Sound and Kodiak Island communities provided a forum for local governments to discuss region-wide pollutant problems; it is anticipated that this project will provide a similar forum for those concerned governing bodies within this region to address current pollution problems.

In an effort to use the model produced by the Sound Waste Management Plan and also decrease planning costs, the Alaska Department of Environmental Conservation proposes that these three objectives be implemented for the region: 1) To assemble a planning team consisting of representatives from the three governing bodies within the communities of Seldovia, Port Graham, and Nanwalek. 2) Release a Request For Proposals (RFP) in an effort to contract with an environmental engineering firm to assess pollution problems within the three communities, identify cost effective solutions to each of those problems, and identify environmentally sensitive marine areas impacted by the pollution problems. 3) Begin process to alleviate on-going pollutants reaching the marine environment in Port Graham Bay and Kachemak Bay.

NEED FOR THE PROJECT

A. Statement of Problem

This project addresses pollution entering the Kachemak Bay from a wide variety of sources, including households, businesses, boats, and automobiles. These sources generate used oil, oily bilge water, hazardous wastes, and solid wastes on an on-going basis. These communities are struggling to contain the pollution problem, but do not have adequate equipment, facilities, and training necessary to ensure prevention of spills, illegal dumping/discharges of solid and oily wastes, and of on-going contamination of ground and surface water from current disposal practices. As a result, pollution is entering the waters around the villages that maybe entering, degrading, and preventing the recovery of the Exxon Valdez oil spill.

Marine pollution in this region affects the following injured resources: intertidal and subtidal organisms, harlequin ducks, black oystercatchers, sea otters, harbor seals, herring, and other sea birds, shore birds, and marine mammals. Subsistence services, as well as recreation are affected additionally.

B. Rationale/Link to Restoration

The wastes entering the waters generated from the communities on an on-going basis are affecting fish, wildlife, and human uses injured by the oil spill. A decrease of land based pollution would have the effect of decreasing the stress on injured fish and wildlife that rely on clean water. The fish and wildlife likely to benefit the most are those that feed in the intertidal or near-shore waters in the vicinity of community waterfronts. Subsistence will be the major beneficiary, along with recreational uses.

Chronic pollution from community sources is believed to have significant adverse effects on the marine environment:

- refined petroleum products tend to be even more toxic to fish and wildlife than crude oil
- the cumulative effects of chronic marine pollution can substantially increase the stress on fish and wildlife
- with regard to seabirds, chronic marine pollution is believed to be at least as important as large-scale spills

C. Location
This project will take place in Seldovia, Port Graham, and Nanwalek.

COMMUNITY INVOLVEMENT

Port Graham, Nanwalek, and Seldovia fully support this project. The governing body of each community will be an integral part of the whole process. The planning team will consist of community representatives, DEC representatives, and Trustee Council representatives. Each phase of this project will depend on the involvement of the local affected communities.

PROJECT DESIGN

A. Objectives

1. To assess pollution that is entering Kachemak Bay from solid waste sites, mishandling of wastes, and illegal dumping of solid, hazardous, and oily wastes.

2. To assess the flow of used oil into Kachemak Bay from vessels, boats, vehicles, and other land based sources due to lack of sufficient management equipment.

B. Methods
The Alaska Department of Environmental Conservation will release a RFP with the approval of an evaluation team consisting of community representatives from Port Graham, Seldovia, and Nanwalek, DEC representatives, and a Trustee Council representative. Once all proposals have been received, the evaluation team will determine which proposer merits the award based on a scoring system.

Once the environmental engineer has been selected to conduct the work described in the RFP, an initial planning meeting will take place with all involved parties. Priorities and a schedule will be drawn out and site visits, community meetings, and planning meetings will be planned. With the close direction of the involved communities, the environmental engineer will conduct the assessment and identify cost effective solutions for pollution problems in conjunction with the DEC and community representatives, review previous assessments that have taken place within the region, and develop a cooperative relationship with the Kenai Peninsula Borough.

The whole of the work produced between the environmental engineer, DEC, and community

representatives will be put into a final report to be produced by the environmental engineer and released by ADEC titled the Lower Cook Inlet Waste Management Plan. All problems and solutions will be addressed in this manuscript and it will be presented to the Trustee Council in accordance with "Procedures for the Preparation of Final Reports." Any recommendations to construct environmental facilities will take into consideration proper siting and planning of operation and maintenance.

C. Cooperating Agencies, Contracts, and Other Agency Assistance
The Alaska Department of Environmental Conservation

SCHEDULE

A. Measurable Project Tasks for FY 99

October 1 - October 20	Formulate team and approve RFP. Publish RFP.
November 20	Select environmental engineer to carry out work put forth in the RFP
November 20 - January 15	Site visits, community meetings, and environmental assessments take place.
February 1	Lower Cook Inlet Waste Management Plan is complete
February 28	Draft Final Project report Submitted to Trustee Council Chief Scientist for review.

B. Project Milestones and Endpoints

November 20	Contract environmental engineer
February 1	Lower Cook Inlet Waste Management Plan complete
February 28	Final report to Trustee Council Chief Scientist

C. Completion Date
September 30, 1999

PUBLICATIONS AND REPORTS, PROFESSIONAL CONFERENCES
None.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT
None.

PROPOSED PRINCIPAL INVESTIGATOR
Alex Viteri, P.E., EVOS Liaison
Alaska Department of Environmental Conservation
410 Willoughby Ave., Rm. 105
Juneau, AK 99801
(907) 465-5324 phone
(907) 465-5362 fax

Revision -98
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$1.0
Contractual		$50.0
Commodities		$0.0
Equipment		$0.0
Subtotal		$51.0
General Administration		$3.5
Project Total		$54.5
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

FY 99

Project Number: 99514
Project Title: Lower Cook Inlet Waste Management Plan
Agency: ADEC

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
						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	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
One trip to Seldovia, Port Graham, and Nanwalek for ADEC P.I.	0.6	1	4	0.1	1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.0

FY 99

Prepared: 7-8-98

Project Number: 99514
Project Title: Lower Cook Inlet Waste Management Plan
Agency: ADEC

FORM 3B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Contractual costs for environmental engineer to prepare plan	50.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$50.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

FY 99

Prepared: 7-8-98

Project Number: 99514
Project Title: Lower Cook Inlet Waste Management Plan
Agency: ADEC

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			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: Description	Number of Units	Inventory Agency

FY 99

Prepared: 7-8-98

Project Number: 99514
Project Title: Lower Cook Inlet Waste Management Plan
Agency: ADEC

FORM 3B
Equipment
DETAIL