Effects of food stress on survival and reproductive performance of seabirds

Project Number:	01479
Restoration Category:	Research
Proposed By:	USGS, University of Washington
Lead Trustee Agency:	DOI
Cooperating Agencies:	University of Washington
Duration:	3^{d} year, 4-year project
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. We will apply these techniques to seabirds breeding in Lower Cook Inlet and also use captive birds for controlled experiments. 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., 1999*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 captive seabirds provide a way to examine the mechanisms by which increased mortality and decreased reproduction are expressed.

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. We also propose to investigate the effects of 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 and EVOS-funded (Project 00479) studies show clearly (see below) 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.

Results of pilot work in 1997 showed that adult Black-legged Kittiwakes and Common Murres

had higher average baseline levels of corticosterone on Chisik (food-poor colony) and seasonal increase in corticosterone occurred earlier as body condition declines (Kitaysky et al. 1999a, and in prep.). Baseline levels of corticosterone were also measured in 1998. However, sample sizes and seasonal coverage were limited in 1997 and 1998, and planned measures of baseline corticosterone were carried out in 1999 only. These studies show, for example, that seasonal baseline stress levels in murres at Chisik and Gull were different in 1998 than in 1997; showing little seasonal variation at Chisik (very high throughout season with complete reproductive failure) and Gull (no seasonal increase in stress) and relatively high reproductive success. Summer of 1999 was different again, with very cold waters delayed breeding and lowered reproductive success of Common Murres at Gull I., but did not delay breeding of Common Murres at Chisik I. Baseline levels of corticosterone were also elevated in birds nesting at Gull I. at the pre-laying and early incubation stages, but then declined to normal at early chick-rearing. We did not find an elevation of baseline levels of corticosterone at early stages (pre-laying and early incubation) in murres at Chisik I. However, the dynamics of baseline corticosterone later in the season was similar between the colonies. Planned measures of baseline corticosterone need to be collected over at least two more years (2000-2001) to evaluate the annual variability in baseline stress before these methods can be used elsewhere with confidence.

The "acute stress response" to capture and restraint reveals, in a way that baseline measures cannot, how birds are likely to respond to future stress, and indicates whether birds are "chronically" stressed. During the pilot study of 1997, kittiwakes breeding at the food-poor colony had suppressed acute stress-responses compared to those at the food-rich colony, even early in the season when baseline hormone levels were similar. We measured the acute stress-response of small samples of kittiwakes and murres in the wild (Kitaysky et al. 1999a) and under experimental chick feeding regimes (Kitaysky et al. 1999b) in 1997. However, no acute stress-responses were measured in 1998 and only limited samples were collected on Chisik I. in 1999 owing to breeding failure and difficulties in capturing birds. Like baselines (above), acute stress-responses should be measured over two more years (2000-2001) to examine inter-annual variability.

One of the most important objectives of our study is to determine the relationship between circulating levels of corticosterone and post-breeding survival of parents and chicks at Gull and Chisik islands. Specifically, we propose to link stress with demographics; i.e., does food stress have an impact on populations? For example, even if murres on Chisik Island can fledge chicks (which they do most years), does the added physiological stress (compared to Gull Island) of doing this have some 'hidden' survival costs? This objective has three components:
1. Adult stress and subsequent survival. This study is linked with the survival study (Project 01338). The question is simple: Are physiological stress levels observed in one year correlated with levels of over-winter mortality observed in the subsequent year? Statistical power to answer this question depends on sample size and number of years of survival data. We estimated that it will take a minimum of four years (1998-2001) to address this objective.

An additional question here is whether stress and survival are linked to sex, especially if the sexes differentially allocate effort into reproduction. Other studies have shown that survival is sex-dependent in some species. Sex determination is relatively simple, and is being done at minimal cost as part of the survival study, so these data will also be used here to look for sex-dependent differences in physiological stress and body condition. Addressing this question is a matter of more thorough statistical analyses of data collected and collection of data during one more (2001) reproductive season at the both colonies, at no additional cost to the existing budget.

2. Adult stress and reproductive success. Experimental work in 1997 has already established a link between corticosteroid hormone levels, foraging effort, and feeding of chicks, which in turn must influence reproductive success in wild birds (in prep.). Pilot work in 1998 established a link between stress hormone levels and current breeding success (e.g., high baseline corticosterone levels found early in murres on Chisik with complete breeding failure later in summer). Additionally, high stress levels may cause abandonment of breeding and regression of reproductive systems. Both these questions can not be fully addressed with the data collected in 1998 and 1999 only. The relationship between current stress and reproductive success needs three years of study to establish predictive power in the relationship. It is possible that stress in one year may be correlated with reproductive failure (or skipping of breeding) in the subsequent year. Thus, it will take a minimum of two years (2000-2001) to address this question, especially as birds may skip years of breeding.

3. Juvenile stress and survival. With regard to juveniles, a critical question is: Does high stress levels prior to fledging (owing to food deprivation or poor quality food) have any impact on subsequent survival? Measuring survival of juveniles to breeding age was ruled out in APEX because of the long study times needed to address the question. In our project we address the question of whether juveniles are at risk of mortality immediately after fledging. Chronic elevation of corticosterone is known to cause neuronal cell death, suppress memory and immune systems, and promote wasting of muscle tissue. The results of pioneering EVOS-funded work in 1999 justified this prediction for Black-legged Kittiwake chicks. Chronic elevation of corticosterone in food-stressed Black-legged Kittiwake chicks causes impaired learning and memory, and consequently might decrease their chances of survival after fledging (Kitaysky et al. in prep). If Common Murre chicks respond to food stress in similar fashion to Black-legged Kittiwake chicks, which will be examined in summer of FY 2000, testing of learning and memory of Common Murre chicks exposed to a chronic elevation of corticosterone during their development will be conducted in summer of 2001.

All field work and experiments for this study will be completed by the end of FY 2001. Completion of laboratory analyses, summarizing results, preparation of the final manuscripts for publication in peer-review journals, preparation of the final report for EVOS, and developing a protocol for monitoring of seabird populations will be accomplished in 2002.

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 prevents 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

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, survival and the monitoring of foraging conditions in seabirds. A critical concurrent assessment of variation in survival of seabirds in Lower Cook Inlet will be provided by on-going project that is designed specifically for these purposes (Restoration Project #01338). 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.

B. Location

The proposed field studies 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 will be conducted at the University of Washington.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

None for this phase of the project.

PROJECT DESIGN

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 reproduction and survival of individual seabirds. 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 states 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 cause reproductive failure and an increase in the post-breeding mortality. The second set of hypotheses states that the observed population declines are due to a decrease in post-fledging survival of juvenile seabirds in the areas affected by the *Exxon Valdez* oil spill. In particular, seabirds chicks that were reared in the area affected by pollution complete the reproductive season in poorer physiological conditions and suffer greater post-fledging mortality compared with young reared under favorable environmental conditions. These hypotheses predict that the recovery of seabirds from pollution or food-related stress depends on: (a) age- and 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 main objective is to explore the relationships among endocrinological parameters, foraging conditions and survival of seabirds that breed in the areas affected by the *Exxon Valdez* oil spill

A. 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. Determine the relationship between circulating levels of corticosterone and post-breeding survival of parents and chicks at Gull and Chisik Islands. Monitor survival and reproduction of

the affected individuals during subsequent reproductive seasons.

C. Methods

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.

1. Correlations among corticosterone levels, reproductive stage and varying foraging conditions.

To assess whether seabirds from the 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. 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. Correlations among corticosterone levels, foraging conditions and postbreeding survival.

To determine the relationship between variation in circulating levels of corticosterone and post-breeding survival of parents at Gull and Chisik Islands we will monitor hormonal levels (as described above), survival and reproduction of the affected individuals during subsequent reproductive seasons. This component of the study will be coordinated with EVOS-funded project (Restoration Project #01338) that is specifically designed to address the issue of survival of adult murres and kittiwakes in relation to foraging condition. We anticipate that a sample size of 200 individuals of each species (as proposed in Restoration Project #01338), would allow us to make a conclusive statement about the relationships between stress and survival in parent Black-legged Kittiwakes and Common Murres in Lower Cook Inlet.

The proposed examination of the effects of chronic elevation of corticosterone on learning and memory of Common Murre chicks is contingent on the results of captive experiments, which will be carried out in summer FY 2000. If Common Murre chicks respond to food stress in similar fashion to Black-legged Kittiwake chicks, testing of learning and memory of Common Murre chicks exposed to a chronic elevation of corticosterone during their development will be conducted according to the established protocol (Kitaysky et al. in prep).

3. 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^{o}C. All plasma samples will be transported to the laboratory at the University of Washington and processed according to the radio-immuno assay techniques.

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 one field assistant. 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 01 (October 1, 2000 - September 30, 2001)

January-April:	preparation for field work, hiring personnel
February:	Annual Report on FY 00 results
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 University of Washington
FY02:	lab analyses, data analyses, reports, etc.

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 two reproductive seasons at the colonies in Lower Cook Inlet, laboratory analyses and sufficient time for analyses of results and preparation of manuscripts for publication.

PUBLICATIONS AND REPORTS

February 15, 2001:	Annual report on work accomplished in summer-fall period of 2000, and preliminary results.
February 15, 2002:	Annual report on work accomplished in summer-fall period of 2001, extensive analyses of results and preliminary conclusions.
September 30, 2002:	Final report on work accomplished and results obtained, 1998-2002.

We also plan to publish interim and final results of this study in conference proceedings and scientific journals. Note that results of our studies in 1996 and 1997 are already in press or submitted to peer-reviewed journals for publication.

NORMAL AGENCY MANAGEMENT

None of the proposed research described here would normally be conducted by the USGS.

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 be coordinated with on-going projects being supported by the Exxon Valdez Oil Spill Trustee Council and US Geological Survey.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The design of the proposed work has not changed, and the budget is the same as that originally proposed and accepted by the EVOSTC in FY98.

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-14, Alaska Biological Science 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 75 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. Prof. Wingfield is Chair of the Zoology Department at UW and an internationally recognized leader in the field of avian endocrinology.

LITERATURE CITED

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2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001						
Personnel	$12.4	$13.2						
Travel	$2.4	$2.4						
Contractual	$90.0	$93.2						
Commodities	$5.2	$5.3						
Equipment	$7.0	$7.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$117.0	$121.1			Estimated FY2002	Estimated FY2003		
General Administration	$8.2	$8.5						
Project Total	$125.2	$129.6			$75.0	$0.0		
Full-time Equivalents (FTE)		0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	
Name	Position Description					
Vacant	Biotech	GS-7	4.0	3.3		
	Subtotal		4.0	3.3	0.0	
					Personnel Total	

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	
Description					
Seattle-Anc	0.8	2			
Anc-Homer	0.2	4			
				Travel Total	

FY01

Prepared: 04/13/00

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2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	
Description	
University of Washington Research Work Order	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	
Commodities Costs:	
Description	
Food Fuel Misc. field supplies Fish for seabird growth expts	
Commodities Total	

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number	Unit	
Description	of Units	Price	
Misc Scientific field supplies Laboratory supplies for Radio-immunoassay			
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	

Existing Equipment Usage:	Number	
Description	of Units	
All boat, lodging, field laboratory, and logistic support provided by APEX project 98163M (Cook Inlet Seabirds). Equivalent value of about 25K.		
University of Washington, research laboratory of Dr. John Wingfield. Equivalent value of complete laboratory support including supplies for radio-immunoassy (above) is about 40K		

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$93.2
Travel		$0.0
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$93.2
Indirect		
Project Total	$0.0	$93.2
Full-time Equivalents (FTE)		1.7
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2002	Estimated FY 2003		
		$75.0			

Dollar amounts are shown in thousands of dollars.

Comments:

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		
	Name	Position Description	Budgeted	Costs	Overtime	
University of Washington Research Work Order						
	Post-doc Salary + Benefits + GA= 65K		12.0	5.5		
	Lab Assistant		8.0	3.4		
		Subtotal	20.0	8.9	0.0	
					Personnel Total	

Travel Costs:		Ticket	Round	Total	Daily	
	Description	Price	Trips	Days	Per Diem	
					Travel Total	

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	
Description	
Contractual Total	
Commodities Costs:	
Description	
Commodities Total	

FY01

Prepared: 04/13/00

Project Number: 01479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

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

Existing Equipment Usage:	Number of Units	
Description		

FY01

Prepared: 04/13/00

Project Number: 01479
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Agency: U.S. Geological Survey