August 24, 2016

Elise Hsieh, Executive Director
Exxon Valdez Oil Spill Trustee Council
4210 University Drive
Anchorage, AK 99508-4626

Dear Elise:

Final FY 2017-2021 Proposal Submittal for Long-term Monitoring

17120114-E. Long-term Monitoring of Marine Birds during Fall and Winter in Prince William Sound

Gulf Watch Alaska, the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC), has finalized our program and project proposals for fiscal years 2017-2021 funding based on comments received from EVOSTC's Science Panel on May 19, 2016. Below is the final budget summary and response to Science Panel comments for the marine birds during fall and winter project.

EVOSTC Funding Requested *(including 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$90,100	$92,700	$95,700	$98,600	$101,300	$478,500

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$53,000	$53,000	$53,000	$53,000	$53,000	$265,000

Science Panel comment: *The Panel noted that the proposal was difficult to review as a majority of the text was copied from the other Predator-Prey Survey proposal. It was challenging to find information within the text specific to this project. The Panel requests a revised proposal that focuses on the details of this specific project and how its data will be integrated into a wider cross-project set of analyses of interacting forage "fish", and piscivorous seabirds, and whales (humpback whales explicitly).*

PI Response:

- Revised and clarified text throughout the proposal to be specific to the marine bird project while referencing the integrated predator-prey surveys
- Clarified marine bird data collection and analysis methods in conjunction with the forage fish and humpback whale surveys (see pages 7-9)

Sincerely,

Mandy Lindeberg
Gulf Watch Alaska Program Lead designate

Attachment: Gulf Watch Alaska: Pelagic Component Project Proposal: 17120114-E—Long-term Monitoring of Marine Bird Abundance and Habitat Associations during Fall and Winter in Prince William Sound

EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
PROGRAM PROJECT PROPOSAL SUMMARY PAGE

Project Title

Gulf Watch Alaska: Pelagic Component Project:

17120114-E—Long-term Monitoring of Marine Bird Abundance and Habitat Associations during Fall and Winter in Prince William Sound

Primary Investigator(s) and Affiliation(s)

Mary Anne Bishop, Ph.D., Prince William Sound Science Center

Date Proposal Submitted

24 August 2016

Project Abstract

The fall-winter marine bird surveys will continue to build upon the previous years of monitoring marine bird abundance and habitat associations (2007-2016), but will be upgraded by means of further integration with companion studies of humpback monitoring and forage fish assessments of prey availability. All three components will share logistics, sample timing, and location of sampling and monitoring. Of the marine birds that overwinter in Prince William Sound (PWS), nine species were initially injured by the *Exxon Valdez* oil spill, including three species that have not yet recovered or their recovery is unknown (pigeon guillemot, marbled murrelet, and Kittlitz's murrelet). Fall through winter are critical periods for survival as food tends to be relatively scarce or inaccessible, the climate more extreme, light levels and day length reduced, and water temperatures colder. By monitoring marine birds during fall and winter we will improve our predictive models of species abundance and distribution across PWS in relation to biological and physical environmental factors. Furthermore, continued monitoring will help determine marine bird vulnerability to future perturbations and environmental change, including oil spills. Our long-term monitoring has shown that the nonbreeding season cannot be characterized as a single time period when describing marine bird distribution and suggests that multiple surveys are required to quantify wintering populations and understand changes in marine bird distribution. The project utilizes established U.S. Fish and Wildlife Service survey protocols adapted for GPS-integrated data entry. Surveys are conducted onboard research vessels already conducting oceanographic, fisheries, or marine mammal surveys, thereby increasing opportunities for cross-project collaboration and reducing project costs. For 2017-2021 we have identified four cruises a year for marine bird surveys: Gulf Watch Alaska Pelagic Integrated Predator Prey Surveys (September/October, March- funding dependent), Alaska Department of Fish and Game spot shrimp survey (October), and PWS Science Center Ocean Tracking Network maintenance cruise (February). Our participation in the Gulf Watch Alaska Pelagic Integrated Predator Prey Surveys will allow us to identify and estimate the forage biomass at the same locations in which marine birds and humpback whales are feeding, which will provide comparable information on both predator density and prey availability.

EVOSTC Funding Requested (must include 9% GA)

FY17	FY18	FY19	FY20	FY21	TOTAL
$90.1	$92.7	$95.7	$98.6	$101.3	$478.5

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$53.0 in-kind	$53.0 in-kind	$53.0 in-kind	$53.0 in-kind	$53.0 in-kind	$265.0 in-kind

1. Executive Summary

Background & History

Of the marine birds that overwinter in Prince William Sound (PWS), nine species were initially injured by the *Exxon Valdez* oil spill (EVOS). As of 2014, two species that overwinter in PWS have not yet recovered (marbled murrelet and pigeon guillemot) and a third species, Kittlitz's murrelet, has an unknown recovery status. The vast majority of marine bird monitoring in areas affected by EVOS has taken place around breeding colonies during the reproductive season, a time when food is generally at its most plentiful. Long-term monitoring of marine birds in PWS during fall and winter is needed to understand how post-spill ecosystem recovery and changing physical and biological factors are affecting marine bird abundance and species composition, as well as marine bird distribution and habitat use.

Systematic fall and winter marine bird surveys began in 2007 under the direction of co-principal investigators (PI) Bishop and Kuletz. In 2012 this research project became part of the Gulf Watch Alaska (GWA) Pelagic Component under the direction of PI Bishop. Over the past nine winters (2007-2008 through 2015-2016) a total of 36 marine bird surveys, typically 6-9 d in duration, have been conducted across PWS. Observers are placed on "ships of opportunity" that include research vessels already conducting oceanographic, fisheries, or marine mammal surveys, thereby enabling integration of data across projects. Collaborators have included the EVOS funded GWA Pelagic- Humpback Whale Project and the Herring and Research Monitoring-Juvenile Herring Hydroacoustic Surveys, as well as Alaska Department of Fish and Game (ADF&G) spot shrimp surveys, and the PWS Science Center Ocean Tracking Network maintenance cruises.

We have documented consistent temporal patterns in density and distribution from fall through winter for the most abundant marine bird species, including common murre, marbled murrelet, black-legged kittiwake, and large gulls (primarily glaucous-winged gull) (Zuur et al. 2012, Dawson et al. 2015, Bishop and Kuletz, unpubl. data). Common murres and marbled murrelets both tend to increase in density from early to midwinter, with murrelets decreasing as winter progresses. Black-legged kittiwakes decrease to extremely low numbers during midwinter surveys and increase again in late-winter. Our surveys have established that marine bird communities in the bays and fjords show significant differences in species composition between early (November) and late (March) winter, driven primarily by higher common murres and lower marbled murrelet densities in late winter compared to early winter (Bishop and Kuletz in prep).

Our surveys have also identified patterns in the spatial distribution of marine birds in the Sound. Habitat association modeling has indicated that winter climate conditions may drive distribution patterns in PWS (Dawson et al. 2015). Our models revealed that common murre favor relatively protected waters while marbled murrelet favor inside bays and passages (which make up 45% of semi-protected waters) and areas of higher sea surface temperatures (Dawson et al. 2015).

Most recently, our surveys detected changes in common murre densities and distribution in the months leading up to a prolonged die-off event occurring along the Gulf of Alaska. During our February 2015 surveys, which immediately preceded the onset of the die-off (March 2015), we recorded a dramatic increase in the number of common murres using the southwest passages of PWS. Immediately prior to the peak of the die-off in December 2015, we again recorded significantly higher murre densities in PWS (November 2015 surveys; Bishop unpubl. data).

Based on surveys conducted between November 2007 and March 2016 (nine winters) we have identified areas of persistent, high marine bird concentrations including northeast PWS, Montague Strait, and the southwest passages. These are also areas in which humpback whales concentrate. Similarly, Montague Strait is a known hotspot for killer whales. This suggests that in these areas environmental drivers such as currents and nutrients are creating dependable, favorable foraging conditions for marine birds and marine mammals.

Finally, we developed a bioenergetics model for marine birds in winter. Our model results highlight the importance of herring to marine birds in PWS during winter and suggest that predation by marine birds may have an important top-down effect on the PWS herring population. Our model shows that in winters with relatively high numbers of marine birds or with relatively low adult herring biomass, as much as 10% (1864 t) of the adult biomass can be removed by avian predators (Bishop et al. 2015).

2017-2021 Project Summary

Over the next five-year cycle, our project will: a) continue to conduct systematic, marine bird surveys to document the abundance and distribution in PWS using regularly-scheduled vessels of opportunity; and, b) investigate the trophic linkages in areas with high marine bird concentrations by expanding and integrating our efforts with two other components in the Pelagic Program -the forage fish and humpback whale projects. Predator-prey surveys that combine the marine bird, humpback whale, and forage fish (including euphausiids) projects will be conducted each fall (September/October) and late winter (March, funding-dependent). Using the same vessel platforms in time and space, concurrent surveys will provide quantitative measures of the density and distribution of marine bird and humpback whale predators relative to forage fish availability and will facilitate an integrated analysis of how predator communities respond to changes in prey availability (quantity and quality).

2017-2021 Hypotheses

There are two primary research questions for the overall GWA Pelagic Component of which this proposal is a component:

1) What are the population trends of key upper trophic level pelagic species groups in PWS (marine birds, humpback whale, killer whale)?
2) How do predator-prey interactions, including interannual changes in prey availability, contribute to underlying changes in the populations of pelagic predators in PWS and Middleton Island?

The pelagic component research team is proposing to continue monitoring key pelagic species groups in PWS using the same five projects focused on 1) killer whales, 2) humpback whales, 3) forage fish, and 4) marine birds (this proposal). However, modifications have been made to the forage fish, humpback whale, and fall/winter marine bird (this proposal) projects for greater integration, increased precision of information, and achievement of new goals. Ultimately this will provide more information to the EVOS Trustee Council, agency resource managers, non-governmental organizations, and the public.

Our marine bird study will gather data to improve our ability to monitor status and trends of marine bird populations during fall and winter. Additionally, this research will address the following hypotheses:

1) *Marine bird distribution and abundance varies with physical and biological habitat characteristics within the fall/winter season.*
2) *Marine bird distribution and abundance varies with prey availability (quantity and/or quality).*
    a. *Marine bird forage flocks signal the presence of prey aggregation to humpback whales.*

To address the first hypothesis, our project will continue to conduct marine bird surveys in collaboration with three to four marine research cruises every winter, including the ADF&G spot shrimp survey, the PWS Science Center Ocean Tracking Network maintenance cruise, and the Pelagic Component's Integrated Predator-Prey Surveys. The second hypothesis will be addressed during marine bird surveys conducted as part of the Pelagic Component's Integrated Predator-Prey Surveys.

2. Relevance to the Invitation for Proposals

This study is focused within the EVOS spill area and is a continuation of a long-term data set initiated in 2007 monitoring several injured marine bird species that overwinter in PWS. As of the most recent 2014 list of injured species (EVOS 2014), marbled murrelet and pigeon guillemot are both species that occur in PWS during fall and winter that have not yet recovered. Kittlitz's murrelet, a species frequenting PWS during some winters, is considered an injured species with an unknown recovery status. Other marine bird species initially injured by the spill and wintering in PWS include common loon, cormorants (pelagic, red-faced, and double-crested), common murre, and bald eagle (EVOS 2014). In addition, our project will provide information on the impact of these marine bird species on Pacific herring, a species that has not recovered since the spill (EVOS 2014).

This marine bird research is also relevant to the invitation as it ties in a key upper trophic level predator (marine birds) to the pelagic component as described in the Invitation. These data will provide a baseline to interpret changes due to long-term oceanographic or climatic change or sudden perturbations. The project continues to develop and use other techniques that include Integrated Predator-Prey surveys that combine forage fish, krill, humpback whale, and marine bird surveys. Finally, this research will provide valued and requested information to the general public and resource managers regarding the basic ecology of marine bird species in PWS.

3. Project Personnel

MARY ANNE BISHOP, Ph.D.
Research Ecologist,
Prince William Sound Science Center
300 Breakwater, PO Box 705
Cordova, Alaska 99574
907-424-5800 x 228; mbishop@pwssc.org

Please see 2-page CV at the end of this document.

4. Project Design

A. OBJECTIVES

Our long-term monitoring has shown that the nonbreeding season cannot be characterized as a single time period when describing marine bird distribution and suggests that multiple surveys are required to quantify wintering populations and understand changes in marine bird distribution (Zuur et al. 2012, Bishop 2014, Dawson et al. 2015). For 2017-2022 this project will continue to conduct marine bird surveys in conjunction with marine research cruises, including the Integrated Predator-Prey Surveys, the ADF&G spot shrimp survey cruise, and the PWS Science Center Ocean Tracking Network maintenance cruise.

Objectives of this study are to:

1. Characterize the spatial and temporal distribution of marine birds in Prince William Sound during fall and winter.
2. Estimate marine bird abundance and distribution in areas with known seasonally predictable aggregations of predators and prey.
   a. relate marine bird presence to prey fields identified during concurrent hydroacoustic surveys.
   b. characterize marine bird-humpback whale foraging dynamics.
3. Model species abundance in relation to physical and biological variables across time and space.

Based on our long-term monitoring surveys, this project will provide information on fall and winter ecology of marine bird species injured by the oil spill that can be used to help restore and/or conserve their populations. In addition, the monitoring of top down forcing by marine birds and whales, which are important predators on herring and potentially other forage fish and krill, will also complement the suite of *PWS Herring Research & Monitoring* studies, including insertion of key data into the population modeling of herring.

B. PROCEDURAL AND SCIENTIFIC METHODS

Fall/Winter Marine Bird Surveys (Objectives 1-3)

This project will be a continuation of systematic, annual late fall and winter marine bird surveys begun in 2007 by M.A. Bishop and K. Kuletz and continued since 2012 by M.A. Bishop as a project in the GWA Pelagic component. Surveys will be conducted during the months of September, October, February, and March (funding dependent). Depending on the vessel of opportunity used, surveys will be coupled with the GWA Pelagic Integrated Predator-Prey surveys in September and March, and with vessels associated

with the ADF&G Spot Shrimp survey (October), or the PWS Science Center Ocean Tracking Network annual maintenance survey (February).

All surveys will employ established U.S. Fish and Wildlife Service (USFWS) protocols that have been adapted for GPS-integrated data entry programs (USFWS 2007). One observer will record the number and behavior of birds and marine mammals occurring along a strip transect width of 300 m (150 m both sides and ahead of the vessel, in distance bins of 50 m). Additionally, any noteworthy observations (e.g. marine mammals, forage flocks) will be recorded out to 1 km on either side. A forage flock will be defined as an aggregation of >10 individuals of one or more species that is either sitting on the water or flying, but showing a clear interest in the water surface. Observations of flying birds will be recorded as instantaneous scans of the entire survey window (1 scan/minute). Observations will be recorded into a GPS-integrated laptop computer using the program Dlog (Ford Consulting, Inc., Portland, OR). This GPS-integrated program provides location data at 15 sec intervals and for every entered observation. In addition, sea and weather conditions will be tracked on site by the observer.

Integrated Predator-Prey Surveys (Objective 2). We propose to combine surveys for marine bird, humpback whale, and forage fish (including euphausiids) projects into one (September/October) or two (September/October and March) integrated predator-prey surveys to provide a better understanding of interspecies foraging dynamics and forage fish availability in PWS. The September/October integrated survey will provide quantitative measures of predator density and distribution relative to prey availability to better understand predator-prey interactions at a crucial time when forage fish energy is maximized and while marine birds and humpback whales are provisioning for the upcoming winter. Because predators (marine birds and humpback whales) and prey will be surveyed together in the same location at the same time, this coordinated effort will facilitate an integrated analysis of how predator communities respond to changes in prey availability (quantity and quality). In addition to a planned research cruise in September/October, the proposed approach may also allow for in-kind contributions from National Oceanic and Atmospheric Administration (NOAA) for vessel charter and an additional survey in March, when humpback whales are returning from their migrations to feed and when we can assess the winter severity on forage fish.

While standard marine bird surveys will be conducted en route to fish and humpback whale sampling locations, the following modified methods will be used during hydroacoustic surveys and whale focal follows:

Hydroacoustic/Marine Bird Transects. Marine bird observations will be recorded using the same methods described above and concurrent with hydroacoustic fish and krill surveys along fixed transect lines (Figure 1). These transects were designed to sample areas of persistent humpback whale feeding locations in Montague Strait, Bainbridge Passage, and Port Gravina. Surveys will occur during daylight hours for coordinated analyses of predator-prey interactions within and among sub-regions.

Forage Flock/Humpback Whale Foraging Dynamics. When a forage flock is encountered during surveys, the observer will note if there are any marine mammals associated with the flock. For this study, a forage flock will be defined as an aggregation of >10 individuals of one or more species either sitting on the water or flying, but showing a clear interest in the water surface by either circling or hovering, and separated spatially from other such groups (Anderwald et al. 2011). A marine mammal will be considered associated with a forage flock if it surfaces within 150 m of the aggregation. Following Anderwald et al. (2011), the observer will record the time and position of the encounter, species composition, and number of individuals per species in the forage flock.

Focal follows of individual whales will be conducted opportunistically, during which hydroacoustic surveys for fish and zooplankton will occur simultaneously. During focal follows, the marine bird observer will go off of formal survey effort and will only record encounters between the focal whales and marine bird aggregations. Encounter time and position, species composition, and the number of individuals in the forage flock will be recorded, as well as the surfacing behavior and feeding events of the whales associated with each flock.

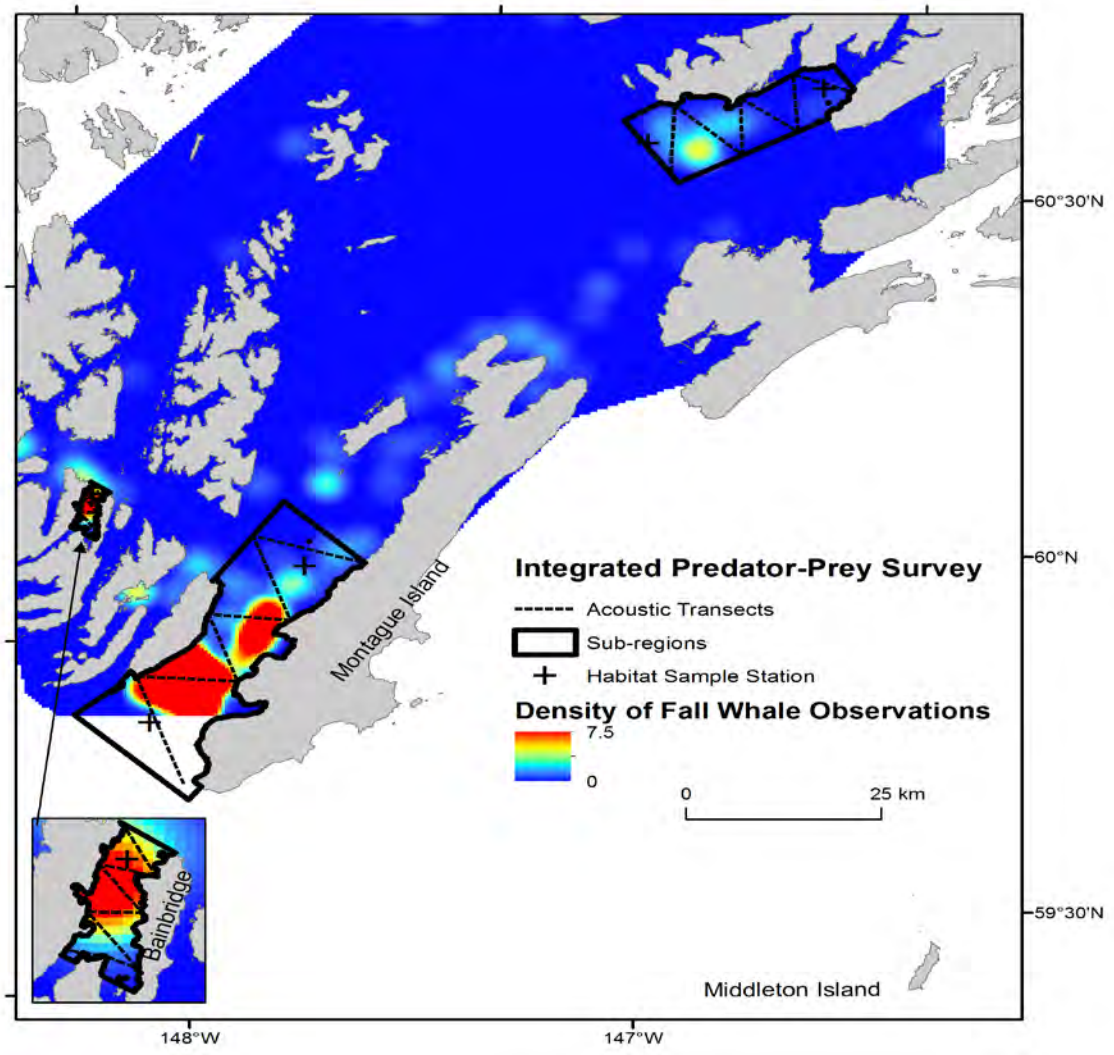

Figure 1. Proposed survey design for the Integrated Predator-Prey Surveys (September and March) in Prince William Sound. Marine bird density and whale counts will be assessed in conjunction with hydroacoustic transect for fish and krill. Habitat sampling will also take place within each sub-region. Kernel density of fall whale observations weighted by number of animals in each observation is shown in color.

C. Data Analysis and Statistical Method

Density (birds/km^2) of each marine bird species will be calculated for each 3 km segment of survey trackline. We will use data from all surveys conducted since 2007 to describe temporal and spatial variation of marine bird distribution and abundance within and across years. We will map all marine bird observations using ArcGIS.

Objectives 1 & 3: Using data from all surveys, we will model marine bird abundance and distribution in relation to physical and environmental factors and will identify marine bird habitat characteristics in PWS within and across years. For each 3 km of survey trackline, we will use GIS to spatially match explanatory variables and bird density values to the midpoint of each transect. Covariates will include physical, spatial, temporal, and environmental variables expected to influence detection and marine bird distribution (e.g. observer, distance bin, winter, time period, glare, sea and weather condition, sea surface temperature, bathymetry, slope, distance to land, marine habitat type).

We previously analyzed marine bird habitat associations using a two-stage hurdle model (Dawson et al. 2015, Zuur et al. 2012). However, a major assumption of the hurdle model is that all zeros are instances of absence, i.e. they are "true zeros". Failure to account for false zeros (birds present but not detected) can cause bias in estimates of parameter effects and their associated uncertainties (Mackenzie et al. 2002). Detection is not a perfect process, particularly in the case of sampling animals; therefore, the probability of detection given presence is nearly always <1 (see Dorazio et al. 2006). This detection probability can be estimated for a survey using repeated counts in a closed time interval, and the influence of detection-level explanatory variables examined. In cases of ships of opportunity, however, repeated surveys at a location are not possible, and a detection function cannot be directly estimated from the data.

This leads us to seek an analysis strategy for incorporating imperfect detection into our estimates of occupancy and relative abundance. For this analysis of marine bird distribution, we will transition to a modeling framework that allows us to incorporate some detection-level covariates into an explanation of a portion of the zero values. We will therefore use Zero-inflated Poisson (ZIP) models to incorporate zeros that we suspect are due to lack of detection of birds that were present (Ross et al. 2012, Arab 2015). ZIP models assume there are two zero generating processes: the first is governed by a binary distribution that generates structural zeros ("true" absence of birds), while the second is governed by a Poisson distribution that generates counts, some of which may be zero (marine birds were present but not detected). Unlike two-stage hurdle models (in which the presence-absence and count components of the data are fit separately), ZIP models estimate the parameters for the zero and non-zero parts of the model simultaneously. We will implement the ZIP models using a Bayesian hierarchical modeling approach, which will allow us to account for data sampling variability, parameter uncertainty, and potential dependence structures (e.g. spatial or temporal) in the data. Models will be fit in program R (R Core Team 2012) using integrated nested Laplace approximation (INLA). From these results, we will be able to create maps predicting marine bird distribution across PWS given spatial and environmental covariates.

Objective 2a: The September and March (funding-dependent) marine bird observations collected as part of the Pelagic Integrated Predator-Prey Surveys will be conducted concurrently with hydroacoustic fish surveys. This will allow us to directly relate marine bird presence and abundance to their prey and enable us to improve our estimates of herring consumption by marine bird predators. We will use two-step hurdle models (Zuur et al. 2012) to model marine bird occupancy and abundance in relation to fish school characteristics (e.g., fish biomass by depth, school density, school area, species composition, size structure, school depth) and habitat characteristics (e.g., SST, distance to shore, bathymetry, slope) known or expected to influence marine bird predation (Benoit-Bird et al. 2013, Ostrand et al. 2004, Speckman 2004, Day and Nigro 2000). First, logistic regression will be used to model the relative importance of covariates on marine bird presence or absence near fish schools. Marine birds will be considered present if they are within 150 m of the fish school. We will then evaluate the relative contribution of these covariates on the abundance of marine birds, only including data from bird-associated fish schools.

Additionally, the increased temporal resolution of sampling in the current proposal will enable us to include direct observations of marine bird presence from fall through winter in our herring consumption model (Bishop et al. 2015). In its current state, the consumption model uses the best available data about marine bird residency times and estimated marine bird consumption based on a daily energy budget projected over each species' assumed winter residency period. Refined data for each species will be used to update the residence time parameter in our current consumption model, thereby improving estimates of marine bird consumption of herring during winter.

Objective 2b: The September and March marine bird surveys also will be conducted simultaneously with humpback whale surveys, enabling us to characterize interspecies foraging dynamics. We will use a generalized linear model (GLM) with a binomial error structure to model whale presence and absence near a forage flock in relation to forage flock characteristics. Additionally, we will use the same model framework to evaluate the influence of forage flock characteristics on whale foraging behavior (whether a surface lunge by the whale was observed or not). Forage flock covariates may include the number of species present in the flock, the number of individuals, foraging mode (eg. surface seizing, pursuit diving), flock diversity, or the dominant guild or species present (Anderwald et al. 2011). Model selection will be guided using Akaike's Information Criterion (AIC; Akaike 1973).

Statistical rationale

At the end of 5 years of continued funding (September 2022), this study will have produced a long-term fall through winter data set that includes broad-scale coverage of PWS for each month up to 11 winters (Table 1). One goal of our research is to use our estimates of density as an index to track marine bird use of surveyed areas of PWS during fall and winter. However, our density estimates are quite variable over time and space, so reliably discerning trends is challenging (p-value = 0.061; Figure 2). To better understand how many years of data are required to achieve an acceptable level of precision of marine bird density over time (coefficient of variation of <20%), we simulated 3, 5, 9, 15, 20, and 25 years of density estimates using the average density, standard deviation, and trend (density ~ time) from 9 years of previously collected survey data. From this exercise we found that, given the current level of variation in winter marine bird densities, we need a minimum of 15-20 years of winter densities estimates to reach a coefficient of variation of <20% (5-10 additional years of survey effort).

Table 1. Total years of broad-scale PWS marine bird surveys by month, March 2007 – March 2022 (n = 56).

Month	Total Survey Years
September	7
October	11
November	10
December	4
January	2
February	9
March	13

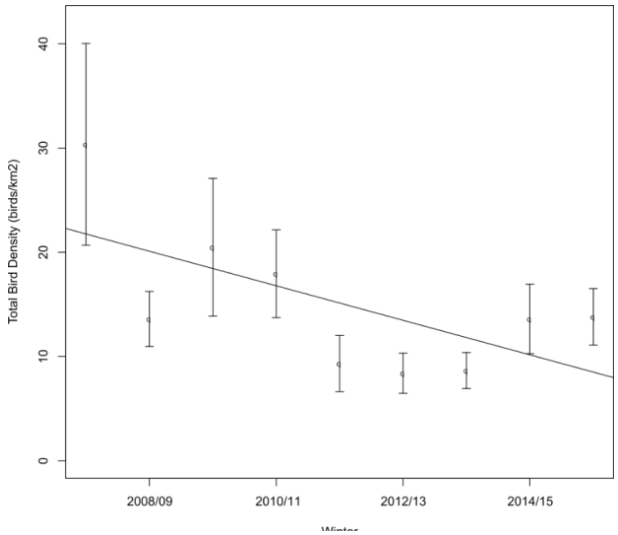

Figure 2. Average total marine bird densities, standard errors, and trend (slope = -1.66, *p*-value = 0.061) for 9 survey winters (2007/08-2015/16) in Prince William Sound, AK.

D. Description of Study Area

This study is part of an ongoing, long-term project investigating marine bird abundance and habitat associations during fall and winter in PWS (bounding coord: 61.292, -148.74; 61.168, -146.057; 60.273, -145.677; 59.662, -148.238). Our surveys will continue to take place in the inside waters of PWS (Figure 3).

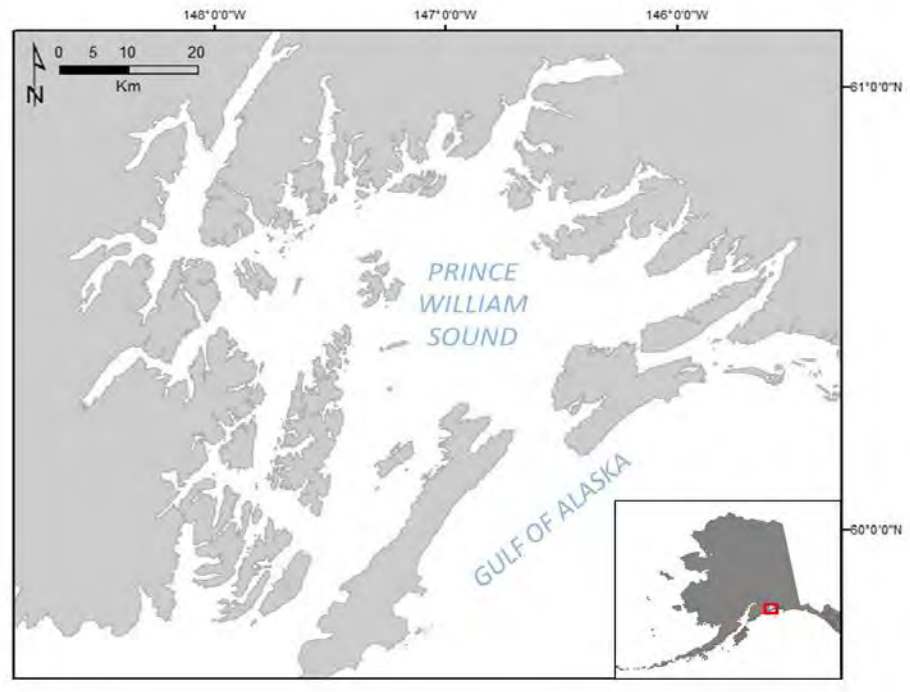

Figure 3. Marine bird surveys will take place in Prince William Sound in collaboration with cruises conducted by: ADF&G, PWS Science Center & the Gulf Watch Pelagic Integrated Predator-Prey surveys.

5. Coordination and Collaboration

WITHIN THE PROGRAM

This project is a component of the integrated GWA Long-term Monitoring of Marine Conditions and Injured Resources and Services. This long-term monitoring program is composed of several components (Environmental Drivers, Pelagic, and Nearshore Monitoring) with a series of projects in each component led by principal investigators from a number of institutions.

The fall and winter marine bird project is headed by Dr. Mary Anne Bishop, and is part of the Pelagic monitoring component. This projects shares research vessels associated with the Integrated Predator-Prey Surveys (Table 2). Marine bird observations from this project are integrated into the whale surveys (PIs Moran and Straley) and forage fish surveys (PIs Piatt and Arimitsu) through the Integrated Predator-Prey Surveys. This collaboration will afford efficiencies in field work, as well as facilitate greater understanding of predator-prey interactions in the Sound. Our program also complements the Pelagic Component's PWS Marine Bird Summer surveys conducted by US Fish & Wildlife Service (Kuletz & Kaler).

Table 2. Integrated predator-prey collaborations by objective. Objectives related to marine birds are bolded.

Objective	Index	Task	PI
a. Estimate humpback whale abundance, diet, and distribution			
	Whale counts by subregion	Integrated Surveys: whale counts, biopsies	Moran (NOAA)/ Straley (UAS)
	Whale Identification	Integrated Surveys: Photo ID	Moran (NOAA)/ Straley (UAS)
	Whale Diet	Integrated Surveys: scales, scat, biopsies, visual observations, hydroacoustics	Moran (NOAA)/ Straley (UAS)/ Arimitsu-Piatt (USGS)
b. Estimate marine bird abundance and distribution in seasonally predictable predator aggregation areas			
	Georeferenced marine bird counts, group size, behavior by species	**Integrated Surveys: marine bird transects**	**Bishop (PWSSC)**
b.i. Relate marine bird presence to prey fields identified during hydroacoustic surveys.			
	Spatial coherence of bird presence/ absence, acoustic estimates of forage fish and euphausiid biomass	**Integrated Surveys: hydroacoustic and marine bird transects**	**Arimitsu-Piatt (USGS)/ Bishop (PWSSC)**
b.ii. Characterize marine bird-humpback whale foraging dynamics			
	Georeferenced marine bird and whale counts, group size, behavior by species	**Data Collection Integrated Surveys: marine bird transects; whale focal follows**	**Bishop (PWSSC)/ Moran (NOAA)/ Straley (UAS)/ Arimitsu-Piatt (USGS)**
c. Estimate index of forage fish availability in seasonally predictable predator foraging areas			
	Species composition and biomass within persistent predator foraging areas	Integrated Surveys: hydroacoustic-trawl data	Arimitsu-Piatt (USGS)
	Density and depth distribution	Integrated Surveys: hydroacoustic-trawl data	Arimitsu-Piatt (USGS)
	Diet, energy density	Sample Analysis: forage fish	Moran (NOAA)
d. Estimate an index of euphausiid availability in seasonally predictable predator foraging areas			

Objective	Index	Task	PI
	Species composition and biomass within persistent predator foraging areas	Integrated Surveys: hydroacoustic-trawl data	Arimitsu-Piatt (USGS)
	Density and depth distribution	Integrated Surveys: hydroacoustic-trawl data	Arimitsu-Piatt (USGS)
e. Relate whales, marine birds and forage fish indices to marine habitat			
	Oceanographic parameters and zooplankton biomass	**Integrated Surveys: CTD and zooplankton samples**	**Arimitsu-Piatt (USGS)/ Moran (NOAA)/ Straley (UAS)/ Bishop (PWSSC)**

WITH OTHER EVOSTC-FUNDED PROGRAMS AND PROJECTS

In the past we have had observers onboard vessels associated with the PWS Herring Research and Monitoring Program. As currently designed, during this 5-year period the fall/winter marine bird project will not be working directly with the PWS Herring Research and Monitoring Program. However, our data will complement the suite of data being collected in this program, including insertion of key predator data into the population modeling of herring. And, as part of the Integrated Predator-Prey Surveys we will collect forage fish for P.I. Kristin Gorman's Herring Age at Maturity project.

WITH TRUSTEE AND MANAGEMENT AGENCIES

This long-term marine bird monitoring project uses as observing platforms vessels associated with other agencies. We have arrangements with the following agencies and organizations to place a marine bird observer onboard during these regularly scheduled annual surveys.

Alaska Department of Fish and Game: Jan Rumble. ADF&G provides a berth for a marine bird observer during the October shrimp surveys.

Prince William Sound Science Center: Mary Anne Bishop. PWS Science Center provides a berth for a marine bird observer during the February cruise to upload data from the Ocean Tracking Network arrays.

Finally, information from this project will feed into the *North Pacific Pelagic Seabird Database,* a database that is maintained by USFWS and U.S. Geological Survey (USGS).

6. Schedule

PROGRAM MILESTONES

1) Characterize the spatial and temporal distribution of marine birds in PWS during fall and winter.

   Data analyses incorporating data collected through October 2021 will be completed by January 2022 and incorporated into LTM program report by Mar 2022.

2) Estimate marine bird abundance and distribution in areas with known seasonally predictable aggregations of predators and prey.
   a. relate marine bird presence to prey fields identified during concurrent hydroacoustic surveys.
      Data analyses incorporating data collected through October 2021 will be completed by January 2022 and incorporated into LTM program report by Mar 2022.
   b. characterize marine bird- humpback whale foraging dynamics.

Data analyses incorporating data collected through October 2021 will be completed by January 2022 and incorporated into LTM program report by Mar 2022.

3) Model species abundance in relation to physical and environmental variables across time and space.

Data analyses incorporating data collected through October 2021 will be completed by January 2022 and incorporated into LTM program report by Mar 2022.

MEASURABLE PROGRAM TASKS

Measureable project tasks are presented by fiscal year and quarterly graphically in Table 3 and descriptively below.

Table 3. Schedule of Measurable Program Tasks

	FY17				FY18				FY19				FY20				FY21				FY22
Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
Task 1 Data Collection																					
Field cruises (Feb OTN, Oct ADF&G, Sep Integrated predator-Prey)	X		X		X		X		X		X		X		X		X		X		
Alternative Survey Schedule (w additional NOAA funds)	X				X				X				X				X				
Task 2 Data Processing/Mgmt																					
Data summary/analysis	X	X		X	X	X		X	X			X	X			X	X			X	
Upload data workspace	X				X				X				X				X				X
Metadata/data published	X				X				X				X				X				X
Task 3 Reporting																					
Annual Rpts	X				X				X				X				X				
Annual PI meeting				X				X				X				X				X	
FY Work Plan (DPD)			X				X				X				X						
5-Year Final Report																					X

FY 2017 (Year 6)

FY 17, 1st quarter (February 1, 2017 - April 30, 2017)
February: *Marine bird survey: PWS Science Center Ocean Tracking Network cruise*
March: *Publish metadata/database from winter 2015/16*
March: *Marine bird survey: Integrated Predator Prey Survey (funding dependent)*
April: *Upload winter 2016/17 data to workspace*
February-April: *Data analyses*

FY 17, 2nd quarter (May 1, 2017 - July 31, 2017)
May-July: *Data analyses*

FY 17, 3rd quarter (August 1, 2017 - October 31, 2017)
August: *Annual work plan*
September: *Marine bird survey: Integrated Predator-Prey Survey cruise*
October: *Marine bird survey: ADF&G spot shrimp cruise*

FY 17, 4th quarter (November 1, 2017 - January 31, 2018)
November: *GWA PI meeting*
December: *Marine bird survey: Integrated Predator-Prey Survey cruise*
January: *Data analyses*
January: *Alaska Marine Science Symposium*

FY 2018 (Year 7)

FY 18, 1st quarter (February 1, 2018 - April 30, 2018)
February: *Annual report*
February: *Marine bird survey: PWS Science Center Ocean Tracking Network cruise*
March: *Marine bird survey: Integrated Predator Prey Survey (funding dependent)*
March: *Publish metadata/database from winter 16/17*
April: *Upload winter 2017/18 monitoring data to workspace;*
February-April: *Data analyses*

FY 18, 2nd quarter (May 1, 2018 - July 31, 2018)
May-July: *Data analyses*

FY 18, 3rd quarter (August 1, 2018 - October 31, 2018)
August: *Annual work plan*
September: *Marine bird survey: Integrated Predator-Prey Survey cruise*
October: *Marine bird survey: ADF&G spot shrimp cruise*

FY 18, 4th quarter (November 1, 2018 - January 31, 2019)
November: *GWA PI meeting*
December: *Marine bird survey: Integrated Predator-Prey Survey cruise*
January: *Data analyses*

FY 2019 (Year 8)

FY 19, 1st quarter (February 1, 2019 - April 30, 2019)
February: *Annual report*
February: *Marine bird survey: PWS Science Center Ocean Tracking Network cruise*
March: *Publish metadata/database from winter 17/18*
March: *Marine bird survey: Integrated Predator Prey Survey (funding dependent)*
April: *Upload winter 2018/19 monitoring data to workspace;*
February-April: *Data analyses*

FY 19, 2nd quarter (May 1, 2019 - July 31, 2019)
May-July: *Data analyses*

FY 19, 3rd quarter (August 1, 2019 - October 31, 2019)
August: *Annual work plan*
September: *Marine bird survey: Integrated Predator-Prey Survey cruise*
October: *Marine bird survey: ADF&G spot shrimp cruise*

FY 19, 4th quarter (November 1, 2019 - January 31, 2020)
November: *GWA PI meeting*

December: *Marine bird survey: Integrated Predator-Prey Survey cruise*
January: *Data analyses*

FY 2020 (Year 9)

FY 20, 1st quarter (February 1, 2020 - April 30, 2020)
February: *Annual report*
February: *Marine bird survey: PWS Science Center Ocean Tracking Network cruise*
March: *Publish metadata/database from winter 2018/19*
March: *Marine bird survey: Integrated Predator Prey Survey (funding dependent)*
April: *Upload winter 2019/20 monitoring data to workspace;*
February-April: *Data analyses*

FY 20, 2nd quarter (May 1, 2020 - July 31, 2020)
May-July: *Data analyses*

FY 20, 3rd quarter (August 1, 2020 - October 31, 2020)
August: *Annual work plan*
September: *Marine bird survey: Integrated Predator-Prey Survey cruise*
October: *Marine bird survey: ADF&G spot shrimp cruise*

FY 20, 4th quarter (November 1, 2020 - January 31, 2021)
November: *GWA PI meeting*
December: *Marine bird survey: Integrated Predator-Prey Survey cruise*
January: *Data analyses*

FY 2021 (Year 10)

FY 21, 1st quarter (February 1, 2021 - April 30, 2021)
February: *Annual report*
February: *Marine bird survey: PWS Science Center Ocean Tracking Network cruise*
March: *Publish metadata/database from winter 2019/20*
March: *Marine bird survey: Integrated Predator Prey Survey (funding dependent)*
March: *Publish metadata/database from FY 19*
March: *Submit Proposal - GWA 2022-2026*
April: *Upload winter 2020/21 monitoring data to workspace*
February-April: *Data analyses*

FY 21, 2nd quarter (May 1, 2021 - July 31, 2021)
May-July: *Data analyses*

FY 21, 3rd quarter (August 1, 2021 - October 31, 2021)
August: *Annual work plan*
September: *Marine bird survey: Integrated Predator-Prey Survey cruise*
October: *Marine bird survey: ADF&G spot shrimp cruise*

FY 21, 4th quarter (November 1, 2021 - January 31, 2022)
November: *GWA PI meeting*
December: *Marine bird survey: Integrated Predator-Prey Survey cruise*
January: *Data analyses*

FY 2022 (Year 11)

FY 22, 1st quarter (February 1, 2022 - April 30, 2022)
February-March: *If third, 5-year period approved, prepare & conduct field work*
February-March: *Preparation of final report and/or other publications for 2nd five-year funding period*
March: *Publish metadata/database from winter 2020/21*
April: *Upload winter 2021/22 monitoring data to workspace*

7. Budget

This project is part of the Long-Term Monitoring of Marine Conditions and Injured Resources and Services, Pelagic Monitoring Component. Vessel costs are in the GWA long-term monitoring project humpback whale monitoring for the Integrated Predator-Prey cruises and additional NOAA funding is being sought for March cruises. An observer also will be onboard two other cruises: 1) annual ADF&G PWS shrimp survey and 2) the annual PWS Science Center maintenance cruise for the Ocean Tracking Network (funded by Alaska Ocean Observing System beginning in FY17).

LITERATURE CITED

Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. In Second International Symposium on Information Theory (B.N. Petrov and F. Csaki, Editors). Akadémiai Kiadó, Budapest, Hungary. pp. 267–281.

Anderwald, P., P.G.H. Evans, L. Gygax, and A.R. Hoelzel. 2011. Role of feeding strategies in seabird-minke whale associations. Marine Ecology Progress Series 424:219–227.

Arab, A. 2015. Spatial and spatio-temporal models for modeling epidemiological data with excess zeros. International Journal of Environmental Research and Public Health. 12:10536–10548.

Benoit-Bird, K.J., B.C. Battaile, S.A. Heppell, B. Hoover, D. Irons, N. Jones, K.J. Kuletz, C.A. Nordstrom, R. Paredes, R.M. Suryan, C.M. Waluk, and A.W. Trites. 2013. Prey patch patterns predict habitat use by top marine predators with diverse foraging strategies. PLoS ONE 8:e53348. doi:10.1371/journal.pone.0053348.

Bishop, M.A., J.T. Watson, K. Kuletz, and T. Morgan. 2015. Pacific herring (*Clupea pallasii*) consumption by marine birds during winter in Prince William Sound, Alaska. Fisheries Oceanography 24:1–13.

Day, R.H, and D.A. Nigro. Feeding ecology of Kittlitz's and Marbled murrelets in Prince William Sound, Alaska. Waterbirds 23:1–14.

Dawson, N.M., M.A. Bishop, K.J. Kuletz, and A.F. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coastal Alaska. Northwest Science 89:111–128.

Dorazio, R.M., J.A. Royle, B. Soderstrom, and A. Glimskar. 2006. Estimating species richness and accumulation by modeling species occurrence and detectability. Ecology 87:842–854.

Exxon Valdez Oil Spill Trustee Council. 2014. 2014 Update injured resources and services list. Anchorage, Alaska.

Mackenzie, D.I., J.D. Nichols, G.B. Lachman, S. Droege, J.A. Royle, and C.A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83:2248–2255.

Ostrand, W.O., S. Howlin, and T.A. Gotthardt. 2004. Fish school selection by marbled murrelets in Prince William Sound, Alaska: responses to changes in availability. Marine Ornithology 32:69–76.

R Core Team. 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Ross B.E., M.B. Hooten, D.N. Koons. 2012. An Accessible Method for Implementing Hierarchical Models with Spatio-Temporal Abundance Data. PLoS ONE 7(11): e49395. doi:10.1371/journal.pone.0049395

Speckman, S.G. 2004. Characterizing fish schools in relation to the marine environment and their use by seabirds in Lower Cook Inlet, Alaska. Dissertation, University of Washington, 163 pp.

USFWS. 2007. North Pacific pelagic seabird observer program observer's manual, inshore/small vessel version, November 2007. U.S. Fish and Wildlife Service, Migratory Bird Management Nongame Program, Anchorage, Alaska. Unpublished protocol manual, 25 pp.

Zuur, A.F., A.A. Saveliev, and E.N. Ieno. 2012. Zero inflated models and generalized linear mixed models with R. Highland Statics, Ltd.

ONLINE RESOURCES

http://portal.aoos.org/gulf-of-alaska.php#metadata/771492cd-94b6-47ab-952a-02b152a535cf/project/files

March 2007 PWS Seabird Observations.csv
Winter 2007-2008 PWS Seabird Observerations.csv
Winter 2008-2009 PWS Seabird Observerations.csv
Winter 2009-2010 PWS Seabird Observerations.csv
Winter 2010-2011 PWS Seabird Observerations.csv
PWS Fall and Winter 2011-2012 Seabird Observations.csv
PWS Fall and Winter 2012-2013 Seabird Observations.csv
PWS Fall and Winter 2013-2014 Seabird Observations.csv
PWS Fall and Winter 2014-2015 Seabird Observations.csv

PROJECT PERSONNEL CURRICULUM VITAE

MARY ANNE BISHOP, Ph.D.
Research Ecologist,
Prince William Sound Science Center
300 Breakwater, PO Box 705
Cordova, Alaska 99574
907-424-5800 x 228; mbishop@pwssc.org

EDUCATION

Ph.D.	Wildlife Ecology, 1988	University of Florida, Gainesville
M.S.	Wildlife and Fisheries Sciences, 1984	Texas A & M University, College Station
B.B.A.	Real Estate and Urban Land Economics, 1974	University of Wisconsin, Madison

RECENT PROFESSIONAL EXPERIENCE

6/99-present	Research Ecologist, Prince William Sound Science Center, Cordova, Alaska
4/90-3/94& 4/97-5/99	Research Wildlife Biologist, Copper River Delta Institute, Pacific Northwest Research Station, U.S. Forest Service, Cordova, Alaska
4/94-3/97	Research Wildlife Biologist, Center for Streamside Studies & Dept. Fisheries, University Washington, assigned to Copper River Delta Institute, Cordova, Alaska

SELECTED SCIENTIFIC PUBLICATIONS (10 of 53 publications)

Bishop, M.A., J.B. Buchanan, B. McCaffery, J.A. Johnson. 2016. Spring stopover sites used by the Red Knot *Calidris canutus roselaari* in Alaska, USA: connectivity between Copper River Delta and the Yukon-Kuskokwim River Delta. *Wader Study* 123 (2): i*n press.*

Bishop, M.A., J.T. Watson, K. Kuletz, T. Morgan. 2015. Pacific herring consumption by marine birds during winter in Prince William Sound, Alaska. *Fisheries Oceanography*. 24:1-13.

Bishop, M. A., B.F. Reynolds, S.P. Powers. 2010. An *in situ*, individual-based approach to quantify connectivity of marine fish: ontogenetic movements and residency of lingcod. *PLoS One* 5(12):e14267

Bishop, M.A., N. Warnock, and J. Takekawa. 2004. Differential spring migration of male and female Western Sandpipers at interior and coastal stopover sites. *Ardea* 92: 185-196.

Bishop, M.A. and S.P. Green. 2001. Predation on Pacific herring (*Clupea pallasi*) spawn by birds in Prince William Sound, Alaska. *Fisheries Oceanography* 10 (1): 149-158.

Cooney, R.T., J.R. Allen, **M.A. Bishop**, D.L. Eslinger, T. Kline, B.L. Norcross, *et al*. 2001. Ecosystem control of pink salmon (*Oncorhynchus gorbuscha*) and Pacific herring (*Clupea pallasi*) populations in Prince William Sound. *Fisheries Oceanography* 10(1): 1-13.

Dawson, N.M., **M.A. Bishop**, K.J. Kuletz, A.F. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coastal Alaska. *Northwest Science*. 89(2):111-128.

Eiler, J., and **M.A. Bishop.** 2016. Determining the post-spawning movements of Pacific herring, a small pelagic forage fish sensitive to handling, with acoustic telemetry. *Transactions of American Fisheries Society.* 145(2):427-439.

Reynolds, B.F., S.P. Powers, **M. A. Bishop.** 2010. Application of acoustic biotelemetry to assess quality of created habitats for Rockfish and Lingcod in Prince William Sound, Alaska. *PLoS One* 5(8): e12130.

Wille M, G.J. Robertson, H. Whitney, **M.A. Bishop**, J.A. Runstadler, et al. 2011. Extensive Geographic Mosaicism in Avian Influenza Viruses from Gulls in the Northern Hemisphere. *PLoS ONE* 6(6): e20664. doi:10.1371/journal.pone.0020664.

Zuur, A.F., N. Dawson, **MA. Bishop**, K. Kuletz, A.A Saveliev and E.N. Ieno. 2012. Two-stage GAMM applied on zero inflated Common Murre density data. Pages 155-188 in A.F. Zuur, A.A.Saveliev, E.N. Ieno (eds). Zero Inflated and Generalized Linear Mixed Models with R. Highland Statistics Ltd, Newburgh, United Kingdom.

Professional Collaborations

M. Armistisu (USGS), A Arab (Quanticipate Consulting), J. Buchanan (WDFG), K. Carpenter (CRWP), N. Dawson (PWSSC), J. Eiler (NOAA), N. Hill (MIT), E.N. Ieno (Highland Statistics), J. Johnson (USFWS) K. Kuletz (USFWS), S. Lewandoski (PWSSC), F. Li (Intl. Crane Foundation), B. McCaffrey (USFWS), M. McKinzie (PWSSC/Auburn University), J. Moran (NOAA), T. Morgan (PWSSC/ABR), E. Nol (Trent Univ.), J. Piatt (USGS), S. Powers (U. S. Alabama), R. Porter, B. Reynolds (PWSSC), D. Roby (OSU), J. Runstadler (MIT), A Saveliev (Highland Statistics), A. Schaefer (PWSSC), K. Sowl (USFWS), J. Stocking (PWSSC/UNC-Raleigh), J. Straley (UAS), Y. Suzuki (OSU), A. Taylor (UAA), D. Tsamchu (Tibet Plateau Institute of Biology), E. Weiser (U. Kansas), J. Watson (PWSSC), A. Zuur (Highland Statistics)

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$80.8	$83.2	$86.0	$88.7	$91.5	$430.1	
Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Contractual	$1.7	$1.7	$1.7	$1.7	$1.7	$8.5	
Commodities	$0.2	$0.2	$0.1	$0.1	$0.1	$0.7	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*waived*)							
SUBTOTAL	$82.7	$85.1	$87.8	$90.5	$93.3	$439.3	
General Administration (9% of subtotal)	$7.4	$7.7	$7.9	$8.1	$8.4	$39.5	N/A
PROJECT TOTAL	$90.1	$92.7	$95.7	$98.6	$101.7	$478.8	
Other Resources (Cost Share Funds)	$53.0	$53.0	$53.0	$53.0	$53.0	$265.0	

COMMENTS:
PWSSC waives the indirect cost on this proposal due to its administration of the overall proposal. This project is part of the Long-Term Monitoring of Marine Conditions and Injured Resources and Services (LTM), Pelagic Monitoring Component. We are using vessels of opportunity for the seabird observers. Vessel costs are in the Gulfwatch LTM project Humpback whale monitoring for 2 cruises; observers will also be onboard the annual ADFG Prince William Sound shrimp survey ($53K/yr) and the annual maintenance cruise for the Ocean Tracking Network (paid for by Alaska Ocean Observering System).

FY17-21

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

NON-TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
A. Schaefer	Research Assistant	5.0	5.9		29.5
M.A. Bishop	Principal Investigator	4.5	11.4		51.3
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	17.3	0.0	
				Personnel Total	$80.8

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY17

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
network & software subscriptions $100/staff mo	1.0
communications (phone & fax) $50/staff mo	0.5
printing & copying $25/staff mo	0.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$1.7

Commodities Costs: Description	Commodities Sum
supplies	0.2
Commodities Total	$0.2

FY17

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY17

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
A. Schaefer	Research Assistant	5.0	6.1		30.5
M.A. Bishop	Principal Investigator	4.5	11.7		52.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	17.8	0.0	
				Personnel Total	$83.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY18

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
network & softward subscriptions $100/staff mo	1.0
communications (phone & fax) $50/staff mo	0.5
printing & copying $25/staff mo	0.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$1.7

Commodities Costs: Description	Commodities Sum
Supllies	0.2
Commodities Total	$0.2

FY18

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY18

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
A. Schaefer	Research Assistant	5.0	6.4		32.0
M.A. Bishop	Principal Investigator	4.5	12.0		54.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	18.4	0.0	
				Personnel Total	$86.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY19

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
network & software subscriptions $100/staff mo	1.0
communications (phone & fax) $50/staff mo	0.5
printing & copying $25/staff mo	0.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$1.7

Commodities Costs: Description	Commodities Sum
supplies	0.1
Commodities Total	$0.1

FY19

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY19

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
A. Schaefer	Research Assistant	5.0	6.6		33.0
M.A. Bishop	Principal Investigator	4.6	12.1		55.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	18.7	0.0	
				Personnel Total	$88.7

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY20

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
network & software subscriptions $100/staff mo	1.0
communications (phone & fax) $50/staff mo	0.5
printing &copying $25/staff mo	0.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$1.7

Commodities Costs: Description	Commodities Sum
supplies	0.1
Commodities Total	$0.1

FY20

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY20

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
A. Schaefer	Research Assistant	5.1	7.0		35.7
M.A. Bishop	Principal Investigator	4.5	12.4		55.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	19.4	0.0	
				Personnel Total	$91.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY21

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
network & software subscriptions $100/staff mo	1.0
communications (phone & fax) $50/staff mo	0.5
printing & copying $25/staff mo	0.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$1.7

Commodities Costs: Description	Commodities Sum
supplies	0.1
Commodities Total	$0.1

FY21

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY21

Project Title: Seabird abundance & habitat associations during fall & winter in PWS
Primary Investigator: M.A. Bishop

FORM 3B
EQUIPMENT DETAIL