

FY 22-31 *PROJECT* PROPOSAL
LONG-TERM RESEARCH AND MONITORING PROGRAM

Does this proposal contain confidential information? Yes No

Project Number and Title

Gulf Watch Alaska Long-Term Monitoring Program: Pelagic Ecosystem Monitoring Component

22120114-M: Prince William Sound Marine Bird Surveys and Associated Shelf Waters

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

August 13, 2021

Project Abstract (maximum 300 words)

We propose to conduct marine bird surveys in Prince William Sound (PWS) and the Northern Gulf of Alaska (NGA). In PWS, we will conduct small boat surveys to monitor abundance of marine birds during July in alternating years (2023-2029) to continue the time series used to monitor population trends for marine birds following the 1989 T/V Exxon Valdez oil spill (EVOS). Data indicate that pigeon guillemots (*Cephus columba*), marbled murrelets (*Brachyramphus marmoratus*), Kittlitz's murrelets (*B. brevirostis*), and tufted puffins (*Fratercula cirrhata*) are exhibiting long-term declines in PWS. Furthermore, declines of offshore-associated genera of marine birds in PWS suggest that changes have occurred in the pelagic food webs of PWS. Because many seabirds use waters outside of PWS, we propose to include marine bird surveys in the shelf waters of the NGA. For offshore waters, at-sea seabird surveys will be conducted in spring, summer, and fall in collaboration with the multi-disciplinary Seward Line and the NGA Long Term Ecosystem Research site (NGA-LTER; 2018-present). The Seward Line portion is funded by the EVOSTC and North Pacific Research Board and will assess how seabird abundance and distribution responds to Environmental Drivers and lower trophic level changes. Together, the PWS and NGA-LTER surveys will (i) build upon long-term data sets to monitor population recovery of marine bird species following the EVOS, and (ii) provide managers and researchers with a tool to track impacts of environmental variability and climate change on upper trophic level marine predators. This project compliments the Nearshore and Pelagic Monitoring Components of the Gulf Watch Alaska Long - Term Research and Monitoring program (GWA-LTRM) by providing data on marine bird habitat use, changes in distribution, and population trends. Results will expand the capacity of the GWA-LTRM program to interpret observed marine ecosystem patterns in the NGA.

EVOSTC Funding Requested (must include 9% GA)

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$96,001	\$410,406	\$93,483	\$331,540	\$102,037	\$1,033,467
FY27	FY28	FY29	FY30	FY31	FY27-31 Total
\$369,172	\$106,221	\$333,393	\$115,724	\$100,334	\$1,024,843
FY22-31 Total					\$2,058,310

Non-EVOSTC Funds to be used, (round to the nearest hundred) please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$29,053	\$30,429	\$32,841	\$33,841	\$35,879	\$162,043
FY27	FY28	FY29	FY30	FY31	FY27-31 Total
\$36,513	\$39,228	\$38,225	\$41,027	\$41,918	\$196,911
FY22-31 Total					\$358,954

Non-EVOSTC funds are in-kind funds from U.S. Fish and Wildlife Service for PI salary and equipment.

1. EXECUTIVE SUMMARY (maximum ~1500 words, not including figures and tables)
Background and History

The waters and shorelines of Prince William Sound (PWS) provide important feeding, resting, and breeding sites for many marine birds and mammals (Isleib and Kessel 1973, Hogan and Murk 1982). When the *T/V Exxon Valdez* grounded on Bligh Reef in PWS and spilled 40 million liters of crude oil into the surrounding waters, the direct mortality to marine birds in PWS and the Gulf of Alaska (GOA) was estimated at approximately 250,000 birds (Piatt and Ford 1996). In the years following the oil spill it was difficult to distinguish between the impacts of the spill and background variability in pelagic populations such as whales, marine birds, and forage fish. The main problem was that long-term baseline data for these species groups were largely absent. As a result, managers struggled to make informed decisions in their assessment of damages and recommendations for recovery.

Since 1989, 15 summer (July) marine bird surveys have been conducted to monitor population trends of marine birds in PWS. These surveys are the primary means to determine population trends and recovery following the EVOS and provide insight into changes in marine bird communities in the GOA owing to effects of climate variability (Cushing et al. 2018), including the 2014-2016 northeast Pacific marine heat wave (Piatt et al. 2020). As of the most recent comprehensive assessment of marine bird population recovery in PWS (1989-2016; Kaler et al. 2016), recovery is underway for many taxa. Bald Eagles, “cormorants,” and Harlequin Ducks are recovering, while “mergansers”, “murrelets”, Pigeon Guillemots, and “terns” are not recovering. The population status of Black-legged Kittiwakes, Black Oystercatchers, Bufflehead, “goldeneyes,” “grebes”, “loons,” Mew Gulls, “murre”, and “scoters” are unknown. Compared to previous trend reports on species recovery following the *Exxon Valdez* oil spill (EVOS), Harlequin Ducks are a new species that appear to have increased in oiled areas. With regard to patterns of decline, “mergansers” joined the list with “murrelets”, Pigeon Guillemots, and “terns” which continue to decrease in oil affected areas.

Using the estimates of summer population numbers derived from marine bird survey, data from 1989 to 2018 indicate that pigeon guillemots (*Cephus columba*), murrelets (*Brachyramphus* spp.), and tufted puffins (*Fatercula cirrhata*) are exhibiting long-term declines in PWS (Fig. 1). Abundance of pelagic species (e.g., murre, jaegers, storm-petrels) increased in PWS in 2016 and 2018 and may be indicative of birds moving from open waters of the GOA into PWS in search of food during and following the northeast Pacific marine heatwave (Fig. 1). Similarly, in 2016 and 2018 abundance estimates for black-legged kittiwake (*Rissa tridactyla*) declined and coincided with nearly complete breeding failure at PWS colonies monitored by U.S. Fish and Wildlife Service

(USFWS; D. Irons, unpublished data), 2016–2018, indicating poor summer feeding conditions in PWS during and following northeast Pacific marine heatwave.

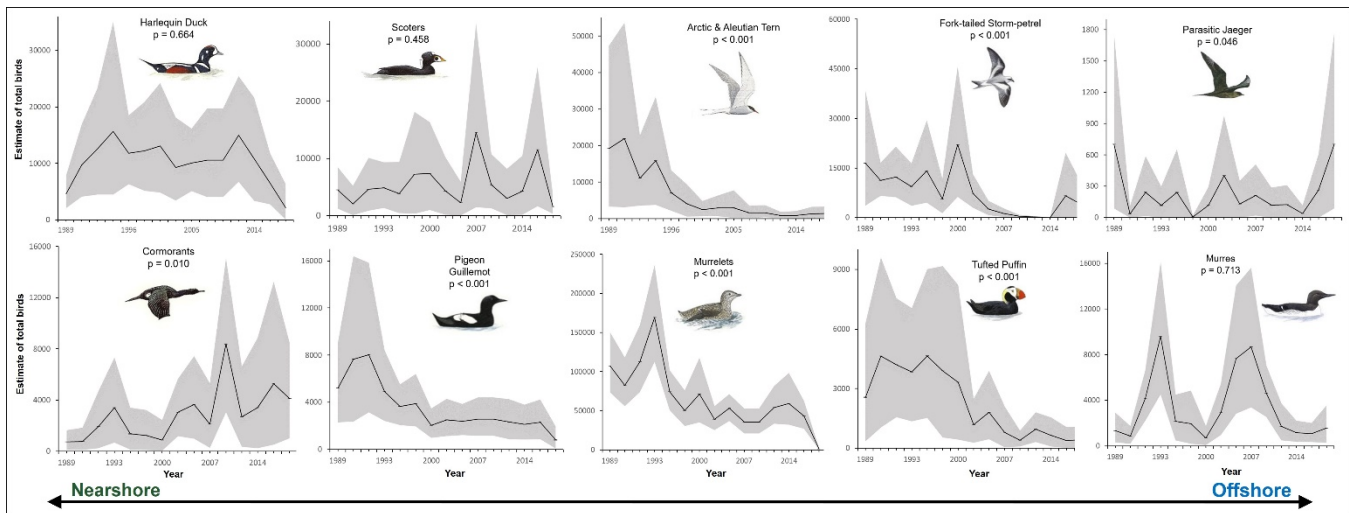


Figure 1. Estimates of summer population numbers (black line), 95% confidence intervals (grey area) and significance value (p) from linear regression analysis of marine birds in Prince William Sound (PWS), Alaska, 1989–2018. Species or species groups are shown ordered along a gradient of nearshore (left) to offshore (right) to represent feeding strategy. Abundance of nearshore species or species groups declined in 2018 while offshore species or species groups increased in PWS in 2016 and 2018.

Long Term Research and Monitoring Program - Pelagic Component

The overall goals of the Pelagic Component are to (1) determine the population trends of key pelagic species groups in PWS and their abundance in adjacent shelf waters, and (2) improve our understanding of predator – prey relationships and their effects on ecosystem changes. There are three primary research questions shaping the research of the Pelagic Component over the next decade (2022-2031):

1. What are the population trends of key pelagic species groups in PWS - killer whales, humpback whales, marine birds, and forage fish?
2. What are annual indicators of ecosystem flux in these upper-level predators (e.g., population changes, shifts in distribution or abundance, variation in condition of individuals, changes in predator/prey relationships)?
3. How do these measurements interface with Environmental Drivers and with measurements in the nearshore and shelf environment to inform a larger picture of ecosystem change?

The Pelagic Component research team is proposing to continue monitoring species groups that play a pivotal role in the pelagic ecosystem as trophic indicators for short- and long-term ecosystem change: killer whales, humpback whales, forage fish, and marine birds (this proposal, and Bishop/Schaefer proposal). However, modifications have been made to some projects for greater integration, increased precision of information, and achieving new goals. Ultimately this will provide more information to the EVOS Trustee Council (EVOSTC), agency resource managers, non-governmental organizations, and the public.

The PWS surveys will benefit restoration of PWS by determining whether populations that declined due to the spill are recovering and by identifying which species are still of concern. To evaluate possible effects of climate on marine bird populations, we will explore patterns of marine bird population trends with oceanographic data and environmental variables (e.g., sea surface temperatures, sea surface salinity) collected by partners (Alaska Ocean Observing System, National Oceanic and Atmospheric Administration [NOAA], Prince William Sound Science Center [PWSSC], U.S. Geological Survey [USGS]).

Long-term multidisciplinary oceanographic sampling of the Seward Line in the NGA during May and September has been funded by the North Pacific Research Board (NPRB), including seabird surveys. Beginning in 2018, the National Science Foundation (NSF) supported the initiation of a Long Term Ecological Research (LTER) site in the northern GOA (NGA). As part of this new NGA LTER site, the NSF funded expanded sampling of physical and chemical oceanography and lower trophic levels along additional lines near Middleton Island and productive banks near Kodiak Island, as well as a third annual cruise during July. The NGA LTER program focuses on the influence of long-term and large-scale phenomenon on ecosystems and does not include direct support for seabird surveys. However, the NGA LTER sampling program is intended to provide a scaffolding – including valuable ship time and a comprehensive suite of environmental data – upon which to build further collaborative research efforts. Continued funding from NPRB and EVOSTC (May and September surveys) will permit collection of seabird survey data on all Seward Line and NGA LTER cruises.

2. RELEVANCE TO THE INVITATION (maximum 300 words)

The proposed project is relevant to the Invitation for Proposals in terms of (i) monitoring the restoration of species impacted by EVOS, and (ii) contributing to an integrated evaluation of the possible effects of climate change on the pelagic ecosystem. Continuation of the summer PWS marine bird population trends project will add four new data points (2023, 2025, 2027, and 2029) to a legacy data set spanning over 30 years, one of the longest data streams available for PWS and the NGA. These legacy data provides the EVOSTC and Gulf Watch Alaska (GWA) - Long-Term Research and Monitoring (LTRM) researchers with a meaningful way to track species recovery following the spill. Furthermore, the proposal is relevant to the Invitation which noted the need to evaluate the possible effects of climate change. The marine bird surveys in PWS and the adjacent shelf waters contribute baseline information which will aid in interpretation of observations of pelagic bird species influenced by factors such as short-term or decadal-scale climate variability (e.g., El Niño Southern Oscillation or Pacific Decadal Oscillation) and long-term climate change (i.e., global warming).

Data collected during the proposed marine bird survey project will provide detailed population trend data and distribution maps for approximately 21 species or species groups (e.g., “loons”, “murrelets”) of birds in the PWS region, providing important information to managers (e.g., Bureau of Ocean Energy and Management, National Marine Fisheries Service, Chugach National Forest) and marine researchers (e.g., GWA, PWSSC, USGS, university researchers). Owing to their reliance on the marine ecosystem, marine bird species are important indicators of the status of pelagic ecosystems, and these data have broad utility in efforts to inform policy makers, resource managers, and the general public.

3. PROJECT HISTORY (maximum 400 words)

The summer PWS marine bird survey project is a continuation of a long-term monitoring time series (July 1989-2018), including of a series of Restoration Projects: 93045 (Agler et al. 1994), 94159 (Agler et al. 1995), 96159

(Agler and Kendall 1997), 98159 (Lance et al. 1999), 00159 (Stephensen et al. 2001), 040159 (Sullivan et al. 2004), 050751 (McKnight et al. 2006), 080751 (McKnight et al. 2008), and 10100751 (Cushing et al. 2012).

Fieldwork takes place in PWS where the oil spill occurred and includes ~2,000 linear km of transects. Our project proposes to add additional data following the established protocols and study design (Klosiewski and Laing 1994). The information collected includes marbled murrelet and pigeon guillemots, two bird species designated by EVOSTC as “not recovered”, and Kittlitz’s murrelet which has been designated as “recovery unknown” (EVOSTC 2014). A list of accomplishments under the GWA program are included in Table 1 and referenced in the literature cited section.

The spring, summer, and fall NGA LTER survey project expand on data from 2006 to present in waters offshore of PWS and adjacent shelf areas. Field work takes place aboard dedicated oceanographic research cruises on the Seward Line, and was recently expanded to cover three additional oceanographic sampling lines from the Copper River westward to Cook Inlet. Marine bird data from the Seward Line project (2006-2020) are archived in the North Pacific Pelagic Seabird Database (NPPSD) managed by the USGS-Alaska Science Center.

Table 1. List of accomplishments for the July Prince William Sound Marine Bird Survey project, 2012-2020, as part of the Gulf Watch Alaska program. For further detail see also project accomplishments in Section 9 – Literature Cited.

Metric	Number	Details
Total summer survey seasons	4	July 2012, July 2014, July 2016, July 2018
Peer-reviewed project publications	2	Esler et al. 2017, Cushing et al. 2018
Peer-reviewed synthesis publications	2	Arimitsu et al. 2021, Suryan et al. 2021
Published datasets	3	Kaler 2017, Kuletz 2017, Kuletz 2019
Exxon Valdez Oil Spill Trustee Council (EVOSTC) Final reports	1	Kaler et al. 2017
EVOSTC syntheses	3	Arimitsu et al. 2020, Suryan et al. 2020, Bishop 2015
EVOSTC annual reports	8	Annually in Mar, 2013-2020
Professional Conferences - posters	9	Alaska Marine Science Symposium (AMSS), Alaska Bird Conference, Pacific Seabird Group
Professional Conferences - presentations	3	Arimitsu et al. 2020 (Pacific Seabird Group), Kuletz et al. 2016 (AMSS), Cushing et al. 2016 (AMSS)
Gulf Watch Alaska Annual principal investigators meetings	8	Present annual updates at PIs meeting Oct/Nov
Popular Press	2	Delta Sound Connections
Public Presentations	5	PWS Natural History Symposium, Seldovia Tribal Council meeting, Alaska Zoo, Opportunities for Life Long Education
Workshop and Information Sharing	12	Pacific Seabird Group Technical Committees, Pacific Seabird Group Seabird Monitoring Committee, Marine Stewardship Council, Chugach Regional Resources Commission

4. PROJECT DESIGN

A. Objectives and Hypotheses

Our long-term monitoring has shown that the breeding season cannot be characterized as a single time period and describing marine bird distribution and community composition requires multiple surveys to quantify summer populations and understand changes in marine bird distribution (Bishop and Kuletz 2011, Zuur et al. 2012, Bishop and Kuletz 2013, Bishop 2015, Dawson et al. 2015, Cushing et al. 2018, Bishop 2018, Stocking et al. 2018, Schaefer et al. 2020). For 2022-2031, this project will continue to conduct marine bird surveys in conjunction with the GWA LTRM Pelagic Component (fall and winter marine birds, forage fish, and killer and humpback whale projects).

Objectives

The objectives of this study are to:

- (1) Characterize the spatial and temporal distribution of marine birds in PWS during summer and the NGA during spring, summer, and fall;
- (2) Estimate marine bird abundance and distribution in areas with seasonally predictable aggregations of predators and prey; and
- (3) Model species density and distribution in relation to physical and biological variables across time and space.

Building upon our long-term monitoring dataset, this project will provide valuable information on summer ecology of marine bird species injured by the oil spill that can be used to help restore and/or conserve their populations in PWS. 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 euphausiids, will complement the suite of PWS Herring Research and Monitoring (HRM) studies included in the LTRM program.

Hypotheses

The proposed study will address the following hypotheses:

- (1) Marine bird distribution, abundance, and species composition varies with physical and biological habitat characteristics within the summer season (PWS only) and spring-summer-fall seasons (NGA).
- (2) Climate variability has differentially affected nearshore and offshore regions of PWS and NGA marine food webs, including marine birds.

To address the first hypothesis, we will conduct a summer PWS survey every odd year, and spring, summer, and fall NGA surveys every year. Using the marine bird abundance estimates for each season, the second hypothesis will be addressed using a comprehensive suite of environmental and oceanographic data for PWS and the NGA collected during research cruises and from remote sensing (Alaska Ocean Observing System, NOAA, PWSSC, University of Alaska Fairbanks, USGS).

B. Procedural and Scientific Methods

The summer PWS marine bird survey project will be a continuation of systematic, summer marine bird surveys begun in 1989 by the USFWS, and continued since 2012 by D. Irons, K. Kuletz, and R. Kaler as a project in the GWA Pelagic Component. With one exception, survey methodology and design will remain identical to that of past marine bird surveys conducted by the USFWS in 1989, 1990, 1991 (Klosiewski and Laing 1994), 1993 (Agler et al. 1994), 1994 (Agler et al. 1995), 1996 (Agler and Kendall 1997), 1998 (Lance et al. 1999), 2000 (Stephensen et al. 2001), 2004 (Sullivan et al. 2005), 2005 (McKnight et al. 2006), 2007 (McKnight et al. 2008), 2010, 2012 (Cushing et al. 2012), 2014, 2016, and 2018 (Kaler et al. 2017, Kuletz and Kaler 2019). The one change in protocol will be collecting distance information for each marine bird observation using 50 m distance bins out to 100 m on both sides of the survey boat. As in previous years, we will use three 7.7 m fiberglass boats traveling at speeds of 10-20 km/hr to survey transects over a 3-week period.

We will continue to use a stratified random sampling design containing three strata: shoreline, coastal-pelagic, and pelagic for the PWS surveys (Klosiewski and Laing 1994). The shoreline stratum will consist of waters within 200 m of land. Irons et al. (1988) divided this stratum, by habitat, into 742 transects with a total area of 820.74 km². Shoreline transects will vary in size, ranging from small islands with <1 km of coastline to sections of the mainland with over 30 km of coastline. Mean transect length will be 5.55 km. During summer, we plan to survey 212 shoreline transects. All transects were randomly chosen, and the same transects are used each survey (Klosiewski and Laing 1994).

For the spring, summer, and fall NGA surveys, this project will be a continuation of systematic, annual marine bird survey begun in 2006 by the USFWS as part of the Seward Line Long-term Observation Program (<http://www.sfos.uaf.edu/sewardline/>) and continued annually by K. Kuletz as a project in the GWA Pelagic Component since 2019 with addition support provided by the North Pacific Research Board. All surveys will employ established USFWS protocols that have been adapted for GPS-integrated data entry programs (USFWS 2007). One observer will record the number, species, and behavior of marine birds and mammals occurring along a strip transect with a width of 300 m in distance bins of 100 m. Any noteworthy observations (e.g., marine mammals, forage flocks) will be recorded out to 1 km on either side and flying birds will be recorded continuously. Additionally, sea and weather conditions will be tracked on site by the observer. We will record observations into a GPS-integrated laptop computer using a new survey program (SeaLog) developed by the Department of the Interior and ABR, Inc. SeaLog records GPS locations of the vessel track line and for each entered observation. All marine bird survey groups across GWA LTRM will be using this program, facilitating comparison and interpretation of data across survey efforts and regions.

For the NGA surveys, density (birds/km²) of each marine bird species will be calculate for each 3 km segment of survey track line using QA/QSea program. This processing program integrates with the new datalogging program, SeaLog.

C. Data Analysis and Statistical Methods

Objectives 1 & 3:

Using data from all surveys, we will model marine bird density and distribution in relation to physical and environmental factors and identify marine bird habitat characteristics in PWS within and across years since 1989. For each 3 km of survey track line, 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 (e.g., observer, distance bin, glare) and marine bird distribution (e.g., winter, time period, sea and weather state, sea surface temperature, bathymetry, slope, distance to land, marine habitat type).

Surveys conducted aboard research cruises in the NGA in conjunction with the Seward Line Long-term Observation Program/Long Term Ecological Research program will also allow us to examine distribution and abundance of marine birds in relation to synoptic *in-situ* physical and biological variables, such as sea surface temperature (SST), salinity, measures of zooplankton, or chlorophyll a concentration during spring, summer, and fall.

Building upon previous modeling efforts led by PWS Fall/Winter PIs Bishop and Schaefer, we will implement two-step spatially explicit Poisson hurdle models to characterize marine bird distributions in PWS within and across summers (Stocking et al. 2018, Arab 2015). These models account for zero-inflation in the data, which is common in marine bird data due to the irregular distribution of individuals. Hurdle models are comprised of two components: the first uses the binomial distribution to model the probability of observing zero birds while the second process uses the truncated Poisson distribution to estimate the probability of the observation value (the number of birds observed) given a non-zero observation. To account for spatial autocorrelation of observations, we will include spatially correlated error terms based on the Matérn covariance function in all models. Models will be implemented 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 (Stocking et al. 2018, Arab 2015). Models will be fit in Program R (R Core Team 2020) 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.

Shoreline transects will be treated as a simple random sample; whereas the coastal-pelagic and pelagic transects will be analyzed as two-stage cluster samples of unequal size (Cochran 1977). Nonparametric density (birds/km²) and population estimates will be derived from 10,000 bootstrap estimates for each species or species group in each strata (nearshore, coastal, pelagic) and zone (oiled, not oiled). We will estimate the density of birds counted on the combined transects for a block and multiply by the area of the sampled block to obtain a population estimate for each block; any land or shoreline area (within 200m of land) intersecting a block will be subtracted from the total area of that block. We then will add the estimates from all blocks surveyed and divide by the sum of the areas of all blocks surveyed. We will calculate the population estimate for a stratum by multiplying this estimate by the area of all blocks in the strata. Population estimates for each species and for all birds in PWS will be calculated by adding the estimates from the three strata, and we will calculate 95% confidence intervals for these estimates from the sum of the variances of each stratum (Klosiewski and Laing 1994). Nonparametric means, 95% confidence intervals, trends over time, and linear regression analyses will be completed in Program R (R Core Team 2020).

Trends in the oiled region

We will perform a linear regression on log-transformed population estimates over time in the oiled region of PWS. Prior to calculating the log₁₀ of each population estimate, we will add a constant of 0.167 to each estimate to avoid the undefined log₁₀ of 0. In all analyses we will use a test size alpha = 0.10 to balance Type I and Type II errors. The reasons for this include: 1) variation is often high and sample sizes low (presently, n = 16 survey years); and 2) monitoring studies are inherently different from experiments and the number of tests

being run with a multi-species survey are many, therefore, controlling for the number of tests by lowering alpha levels (e.g., Bonferroni adjustment) might obscure trends of biological value.

Comparing trends between oiled and unoiled regions

We will use the regression technique detailed above to perform regression analyses on population estimates in the unoiled region. We will use a homogeneity of slopes test (Freud and Littell 1981) to compare population trends between the oiled and unoiled zones of PWS to examine whether species with population estimates of >500 individuals have changed over time. To do this, we must assume that marine bird populations increase at the same rate in the oiled and unoiled zones of PWS. Significantly different slopes would indicate that population abundance of a species or species group changed at different rates.

Taxa showing no difference in trends between the oiled and unoiled regions will be considered “not recovering.” Taxa showing significantly greater trends in the oiled region compared with the unoiled region will be considered “recovering.” Taxa showing significantly greater trends in the unoiled region compared to the oiled region will be considered to be suffering “continuing and increasing effects.”

Overall, a species will be considered “recovering” if it meets the requirements for this category in either the regression analysis within the oiled region or the homogeneous slopes analysis.

To determine optimum survey frequency, we conducted a power analysis to estimate the probability of detecting trends in abundance using linear regression from a given number of samples (Taylor and Gerrodette 1993). We examined our power to detect trends when coefficient of variation (CV) of the population was 0.30 (greater than the mean CV from previous surveys for 73% of the injured species; Fig. 2) and when the CV = 0.13 (the mean summer CV for *Brachyramphus* murrelets, which had the lowest CV among injured species). Models of seabird population growth predict most species cannot increase more than 12% per year (Nur and Ainley 1992), so we used 10% for our comparisons. With CV=0.30 the probability of detecting an average annual change of 10% would be 92% based on using survey data from 1989-2010 (Fig. 2).

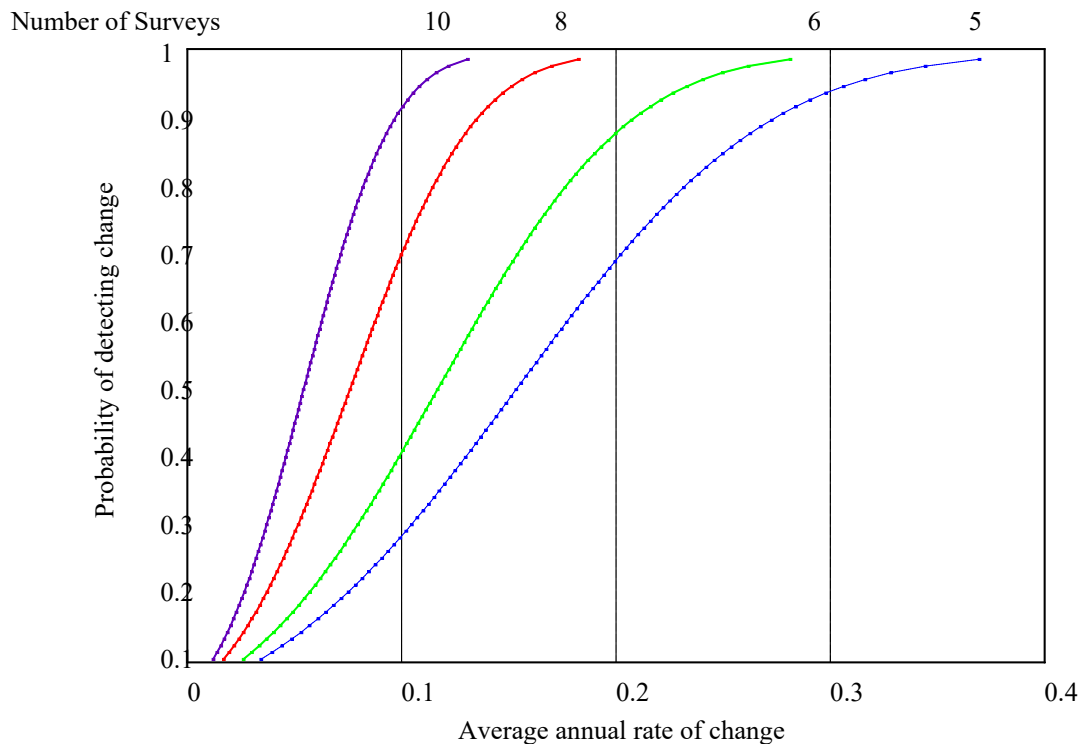


Figure 2. Estimated power based on numbers of surveys (5, 6, 8, and 10) conducted to detect a trend in marine bird populations in Prince William Sound when the coefficient of variation = 0.30.

D. Description of Study Area

Prince William Sound

For the PWS surveys, our study area is the inside waters of PWS (Fig. 3, bounding coordinates: 61.292, -148.74; 61.168, -146.057; 60.273, -145.677; 59.662, -148.238), an area of approximately 9000 km². Marine bird surveys were conducted in July during 12 years within the interval 1989-2012. Surveys were conducted from 7.6-m boats, using 200m-wide strip-transects. The same transects, totaling approximately 2000 linear km, are surveyed during each survey year (every even year since 2010).

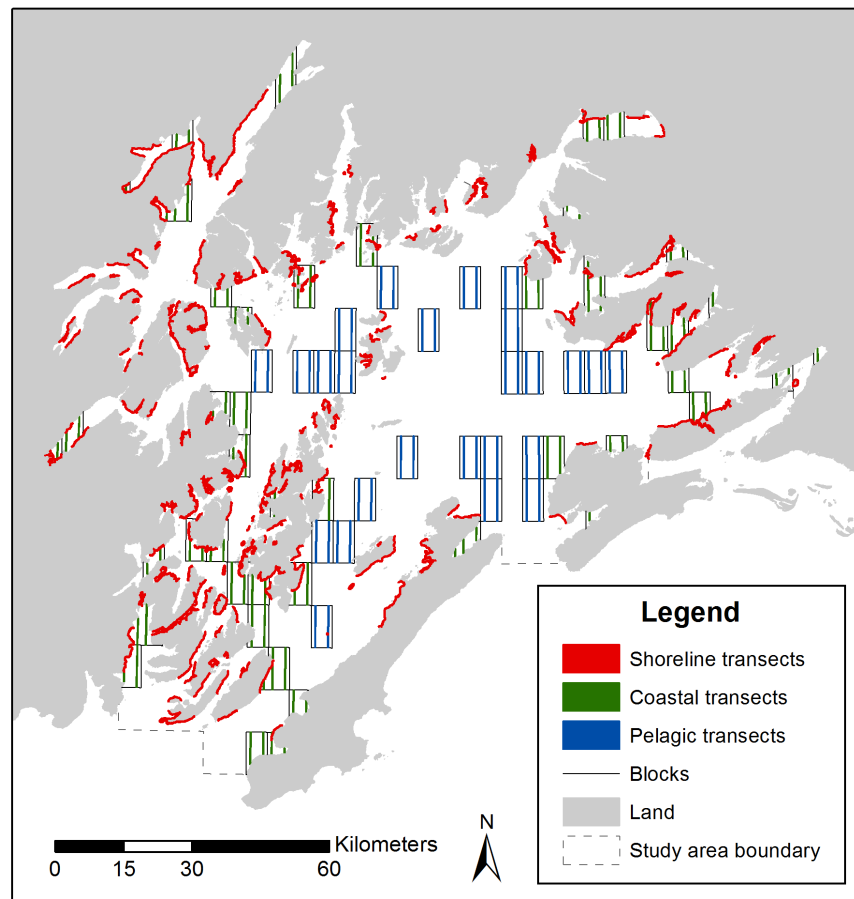


Figure 3. The study location comprised of the inside waters of Prince William Sound, located in the northern Gulf of Alaska. Birds will be counted along randomly selected transects (200 m wide) from three strata (shoreline, coastal, and pelagic). All birds within 100 m on either side, above, or ahead of the boat will be counted.

Northern Gulf of Alaska

For the NGA sampling, the proposed study area would cover a region of the continental shelf from the Copper River and Middleton Island in the east to Kodiak Island in the west (Fig. 4). Marine bird surveys would be conducted in conjunction with multidisciplinary sampling that includes physical and chemical oceanography and lower trophic levels.

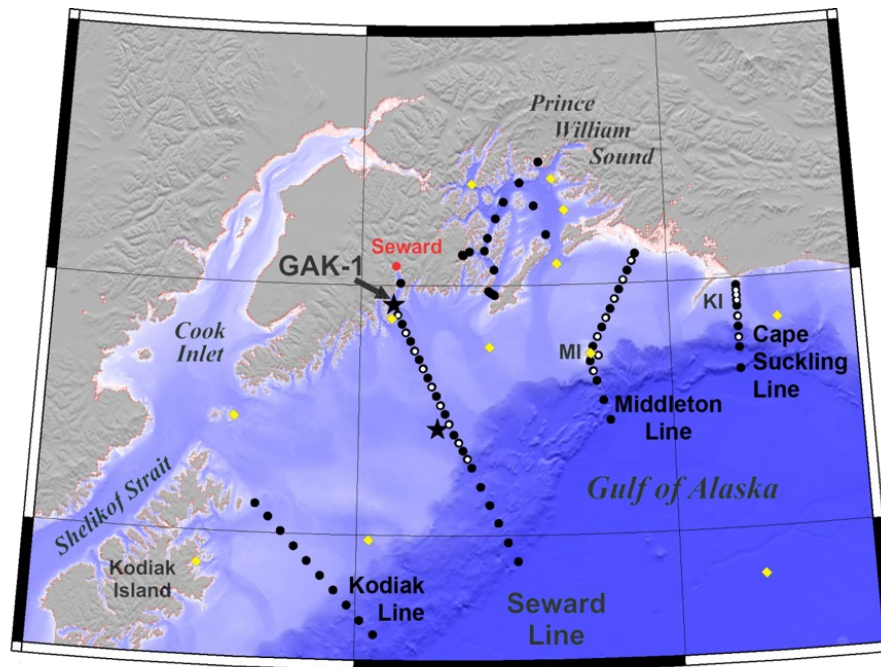


Figure 4. The northern Gulf of Alaska sampling stations. Conductivity and temperature at depth casts without water sampling as open symbols. Yellow diamonds represent locations of meteorological data from National Oceanic and Atmospheric Administration buoys or ground stations. Star shows position of National Science Foundation Long Term Ecological Monitoring mooring. Cape Suckling is low priority.

5. COORDINATION AND COLLABORATION

A. With the Alaska SeaLife Center or Prince William Sound Science Center

The summer PWS marine bird survey shares several objectives with the fall and winter PWS marine bird surveys led by PWSSC (project 22120114-E, principal investigators [PIs] Bishop and Schaefer). Additionally, since March 2019, PWSSC has surveyed portions of the summer nearshore transects during their March and November research cruises with the intent for future comparisons with historical data. Future collaboration with PWSSC will include sharing any automated workflow step for data collection, processing, analysis/modeling, and reporting. Lastly, measurement of physical and biological variable collected during the PWSSC's oceanography research cruises in PWS (project 22120114-G, PI Campbell) may provide insight in to observed marine bird abundance and distribution.

B. Within the EVOSTC LTRM Program

Environmental Drivers Component

The marine bird surveys proposed for the shelf waters of the GOA collaborates with the Environmental Drivers component to conduct seabird surveys while the research vessel transits between stations (Seward Line, project 22120114-L, PI Hopcroft). We will be integrating the seabird data with environmental and zooplankton data collected during concurrent cruises. Additionally, we plan to collaborate with the PWSSC-led Monitoring of Oceanographic Conditions in PWS project (22120114-G, PI Campbell) to evaluate patterns of marine bird population trends and distribution relative to physical and biological variables monitored by their research boat or at deployed moorings in PWS.

Pelagic Monitoring Component

The summer PWS marine bird survey project is part of the pelagic monitoring component (forage fish, humpback whale, killer whale, and marine bird) and will continue to focus on physical and biological features of locations where forage fish, whales, and seabirds have been found to overlap in time and space (e.g., Montague Strait). We will work closely with the forage fish project (22120114-C, PIs Arimitsu and Piatt) to evaluate patterns in prey abundance and quality that may influence marine bird distribution and trends in PWS.

Nearshore Monitoring Component

A cross-component (nearshore and pelagic) effort continues (projects 22120114-C, E, H, L, M, and O) with the intent to integrate bird survey data to examine spatial and temporal trends in a variety of species and guilds across the NGA. The pelagic and Nearshore Components worked with ABR Inc. to create a survey tool (SeaLog) and a processing tool (QAQSea) for rapid QA/QC as well as automating the processing required to upload survey data into the NPPSD maintained by the USGS. Previous efforts compiled Nearshore survey data from all four regions and provided to USGS for the NPPSD v3 release in 2020 (Drew and Piatt 2015). Incorporation of all GWA LTRM marine bird survey data into NPPSD will allow for larger scale analyses of marine bird trends throughout the north Pacific over time.

Lingering Oil Monitoring Component

Many of our nearshore surveys are in the bays (e.g., Whale, Zaikof, Rocky, Lower Herring) and waters adjacent to the sampling locations of the lingering oil monitoring project (22200114-P). Our data would be available to share if needed to examine correlations with impacts of lingering oil.

Herring Research and Monitoring Component

We intend to use information on abundance and distribution of herring in PWS collected by the HRM component as a potential explanatory variable in interpreting observed changes in distribution and population trends of marine birds in PWS. The analysis depends on the data collected by the HRM component in 2022-3031.

Synthesis and Modeling Component

We will contribute data as needed for synthesis and modeling efforts undertaken during FY22-31. In the past, we have contributed data to and assisted with development of two synthesis efforts: Arimitsu et al. 2021, and Suryan et al. 2021.

Data Management Project

This project coordinates with the data management program by submitting data and preparing metadata for publication on the Gulf of Alaska Data Portal and DataOne within the timeframes required.

C. With Other EVOSTC-funded Projects (not within the LTRM Focus Area)

This project will coordinate with other EVOSTC-funded projects as appropriate by providing data, discussing the relevance and interpretation of data, and collaborating on reports and publications. Of particular note, this project will share data and relevant information with the pigeon guillemot restoration project (PIs Kuletz and Kaler) on the Naked Island complex, which includes a PWS-wide black-legged kittiwake colony census for productivity. As the EVOSTC funds future projects outside the GWA-LTRM program we will evaluate their applicability to our project and coordinate as appropriate.

D. With Proposed EVOSTC Mariculture Focus Area Projects

We look forward to working with the EVOSTC's Mariculture Program and projects they embark on. We anticipate they will be interested in GWA-LTRM datasets and we expect there will be opportunities for coordination and collaboration. We propose to work with any mariculture activities and provide input on best management practices with regard to how marine birds interact with mariculture gear and associated farm activities. Some marine birds, such as sea ducks and gulls, are known predators or cause disturbance in mariculture areas. We will share our data as needed or requested by the Mariculture Focus Area projects.

E. With Proposed EVOSTC Education and Outreach Focus Area Projects

The GWA LTRM program will develop an outreach plan that includes coordination and collaboration with the Trustee's Education and Outreach Program and projects. We look forward to participating in education and outreach opportunities where our project findings can contribute to a better understanding of the Gulf of Alaska ecosystem by the general public.

We will work with the Education and Outreach program and GWA to develop and deliver marine bird informational products to students and the public. Examples of these products may include contributing articles describing our research and seabird ecology to the annual publication of *Delta Sound Connections*, developing a summer seabirds field trip for local Whittier students, delivering lectures at the PWS Natural History Symposium, or creating social media or blog posts about marine bird surveys.

F. With Trustee or Management Agencies

This long-term marine bird monitoring project has a long history of collaborating and working closely with other agencies.

National Park Service (NPS; H. Coletti): We collaborate with NPS biologist as part of the GWA Nearshore Component.

NOAA (J. Moran): We collaborate with NOAA biologists as part of the GWA Pelagic Component.

USGS (M. Arimitsu, J. Piatt, G. Drew): We are currently collaborating with USGS biologists (M. Arimitsu, J. Piatt) as part of the GWA Pelagic Component. Further, information from this project is contributed to the NPPSD, a database maintained by USGS. During spring 2019, we worked with G. Drew to prepare survey data from 2007-2016 for the updated version of the NPPSD (v 3.0) which was released in spring 2020 (Drew and Piatt 2020). We are currently working with USGS to beta-test the new SeaLog and QA/QSea data collection and processing programs developed for at-sea surveys.

U.S. Forest Service: We have worked closely with the U.S. Forest Service (Chugach Ranger District) on a variety of projects. Most recently, we working with the U.S. Forest Service to remove invasive mink to restore pigeon guillemot breeding colonies on Naked, Story, and Peak Islands in PWS. We will continue to collaborate and provide assistance whenever needed.

G. With Native and Local Communities

The GWA-LTRM program and this project are committed to involvement with local and Alaska Native communities. Our vision for this involvement will include active engagement with the Education and Outreach Focus Area (see above), and project-level engagement. During the first year of the funding cycle (FY22), the GWA-LTRM program will reach out to local communities and Alaska Native organizations in the spill affected

area to ask what engagement they would like from us and develop an approach that invites involvement of PIs from each project, including this one. Our intent as a program is to provide effective and meaningful community involvement that complements the work of the Education and Outreach Focus Area and allows communities to engage directly with scientists based on local interests.

In addition, this project will continue engaging with local communities as we have during the first 10 years of the program, including assisting with educational field trips for local students, delivering presentations at the PWS Natural History Symposium and to the Chugach Regional Resources Commission Board of Directors, and developing social media and blog posts about our research.

6. DELIVERABLES

The PWS marine bird survey project has consistently met all deliverables and will continue to be responsive to the EVOSTC. Anticipated deliverables are listed in Table 2.

Table 2. List and description of summer Prince William Sound marine bird survey deliverables for 2022-2031.

Deliverable	Description
Progress Reports	Submit annually
Final Report	Submit within required timeframe
Data & Metadata	Upload data to Alaska Ocean Observing System workspace annually; Publish data to DataONE as required; Contribute data to North Pacific Pelagic Seabird Database on regular basis
Synthesis & Modeling Efforts	Contribute data and assist with analyses and interpretation as needed
Peer-reviewed Publications	We will publish scientific papers to peer-reviewed journals. Topics may include marine bird-forage fish linkages, climate variability and marine heatwave, nearshore versus offshore drivers of the marine bird community in Prince William Sound and northern Gulf of Alaska, and changes in the spatial and temporal distribution of marine birds in Prince William Sound during summer.
Professional presentations	Prepare and deliver oral and poster presentations on a regular basis for professional meetings such as Alaska Marine Science Symposium, Pacific Seabird Group, or Alaska Bird Conference
Public Outreach	Regularly contribute to Delta Sound Connections. Locally give presentations to Tuesday night Prince William Sound Science Center Lecture Series and participate in field trips for local students
Website	Maintain up-to-date project description on the Gulf Watch Alaska website

7. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

Project milestones and tasks by fiscal year and quarter, beginning February 1, 2022. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone: admin & logistics																				
Contracting & hiring	X	X			X	X			X	X			X	X			X	X		
Recruit volunteers, housing/travel & permits					X	X							X	X						
Survey vessel Preparation & Winterization						X	X							X	X					
Milestone: data acquisition & processing																				
PWS marine bird survey (alt. years)							X								X					
Seward Line and LTER marine bird survey		X	X			X	X													
PWS marine bird data processing							X	X							X	X				
Seward Line and LTER marine bird data processing			X	X			X	X			X	X			X	X			X	X
Milestone: data management																				
Database mgmt./QAQC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metadata					X				X				X				X			
Workspace upload	X				X				X				X				X			
Milestone: analysis & reporting																				
Analysis and summary	X				X								X				X			
Annual Reports					X				X				X				X			
Annual PIs meeting			X					X				X				X				X
Permit reports			X					X				X				X				X
Deliverables																				
Peer reviewed paper			X									X								
Data published online			X					X				X				X				X

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone: admin & logistics																				
Contracting & hiring	X	X			X	X			X	X			X	X			X	X		
Recruit volunteers, housing/travel & permits					X	X							X	X						
Survey vessel Preparation & Winterization						X	X							X	X					
Milestone: data acquisition & processing																				
PWS marine bird survey (alt. years)							X								X					
Seward Line and LTER marine bird survey		X	X			X	X													
PWS marine bird data processing							X	X							X	X				
Seward Line and LTER marine bird data processing			X	X			X	X			X	X			X	X			X	X
Milestone: data management																				
Database mgmt./QAQC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metadata					X				X				X				X			
Workspace upload	X				X				X				X				X			
Milestone: analysis & reporting																				
Analysis and summary	X				X								X				X			
Annual Reports	X				X				X				X				X			
Annual Pls meeting			X				X				X				X				X	
Permit reports			X				X				X				X				X	
Final Report																				X
Deliverables																				
Peer reviewed paper			X								X									
Data published online			X				X				X				X					X

8. BUDGET

A. Budget Forms (Attach)

Please see Gulf Watch Alaska - Long-Term Research and Monitoring workbook.

Budget Category:		Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel		\$28,907	\$122,278	\$31,869	\$136,816	\$37,377	\$357,247	
Travel		\$2,168	\$20,913	\$2,193	\$21,384	\$2,219	\$48,877	
Contractual		\$43,500	\$110,058	\$45,702	\$113,952	\$48,016	\$361,228	
Commodities		\$0	\$21,020	\$6,000	\$27,613	\$6,000	\$60,633	
Equipment		\$13,500	\$102,250	\$0	\$4,400	\$0	\$120,150	
Indirect Costs	Rate = 0%	\$0	\$0	\$0	\$0	\$0	\$0	
SUBTOTAL		\$88,075	\$376,519	\$85,764	\$304,165	\$93,612	\$948,135	
General Administration (9% of subtotal)		\$7,927	\$33,887	\$7,719	\$27,375	\$8,425	\$85,332	N/A
PROJECT TOTAL		\$96,001	\$410,406	\$93,483	\$331,540	\$102,037	\$1,033,467	
Other Resources (In-Kind Funds)		\$29,053	\$30,429	\$32,841	\$33,841	\$35,879	\$162,043	

Budget Category:		Proposed FY 27	Proposed FY 28	Proposed FY 29	Proposed FY 30	Proposed FY 31	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE	TEN YEAR TOTAL
Personnel		\$150,847	\$38,739	\$152,821	\$44,843	\$35,370	\$422,619		\$779,866
Travel		\$22,313	\$2,264	\$22,729	\$2,325	\$2,354	\$51,985		\$100,862
Contractual		\$118,001	\$50,447	\$122,214	\$53,001	\$54,326	\$397,989		\$759,217
Commodities		\$28,366	\$6,000	\$6,000	\$6,000	\$0	\$46,366		\$106,999
Equipment		\$19,163	\$0	\$2,101	\$0	\$0	\$21,264		\$141,414
Indirect Costs	Rate = 0%	\$0	\$0	\$0	\$0	\$0	\$0		\$0
SUBTOTAL		\$338,689	\$97,450	\$305,865	\$106,169	\$92,050	\$940,223		\$1,888,358
General Administration (9% of subtotal)		\$30,482	\$8,771	\$27,528	\$9,555	\$8,284	\$84,620	N/A	\$169,952
PROJECT TOTAL		\$369,172	\$106,221	\$333,393	\$115,724	\$100,334	\$1,024,843		\$2,058,310
Other Resources (In-Kind Funds)		\$36,513	\$39,228	\$38,225	\$41,027	\$41,918	\$196,911		\$358,954

B. Sources of Additional Funding

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$29,053	\$30,429	\$32,841	\$33,841	\$35,879	\$162,043
FY27	FY28	FY29	FY30	FY31	FY27-31 Total
\$36,513	\$39,228	\$38,225	\$41,027	\$41,918	\$196,911
FY22-31 Total					\$358,954

Dependent upon annual funding allocations, USFWS will provide In-Kind contribution of the USFWS Alaska Seabird Coordinator (GS-13, 2 months/year = \$20K in FY22 with 5% increase per year to FY31) and the USFWS

Seabird GIS Biologist (GS-11, 1 months/year = \$7K with 5% increase per year to FY31). USFWS funds included as in-kind or as contributions are included for planning purposes only and nothing contained in this proposal shall be construed as binding the USFWS to expend in any one fiscal year any sum in excess of its appropriations or funding in excess or what it has received for the collaborative work outlined in this proposal or involving the Federal government in any obligation to pay money before funds have been appropriated for that purpose unless otherwise allowed by law. Although not included in total contribution above, the USFWS is committed to using four (4) 25-ft survey boats with twin outboard engines and marine electronics, safety equipment (floatation jackets, immersion suits, emergency location beacons), survey computers, and GPS receivers.

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10. PROJECT PERSONNEL

Dr. KATHY J. KULETZ

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PROFESSIONAL PREPARATION

Ph.D. Biology	Univ. of Victoria, B.C., Canada (2005)
M. S. Ecology & Evolutionary Biology	University of California, Irvine (1983)
B. S. Wildlife Ecology	CA State Polytech. U., San Luis Obispo (1974)

APPOINTMENTS

2014-current	Seabird Coordinator, Migratory Bird Management, USFWS, Anchorage, Alaska
2009-current	U.S. Representative for Circumpolar Seabird Group (CAFF Arctic Council)
2004-current	Short-tailed Albatross Recovery Team (Endangered Species/ USFWS)
2015-2016	Chair, Pacific Seabird Group (http://www.pacificseabirdgroup.org/)
2007-2012	Science & Statistical Committee of North Pacific Fisheries Management Council
1998-2014	Seabird Specialist, Migratory Bird Management, USFWS, Anchorage, Alaska

SYNERGISTIC ACTIVITIES RELEVANT TO THE PROPOSED PROJECT

- PI -‘Seabird Distribution in the Offshore Environment’ (2010–2021; BOEM IA)
- Co-PI for ‘Seward Line Long-term Monitoring Project’ (2014-2024; NPRB grants)
- Co-PI for GulfWatchAlaska surveys, Prince William Sound (2012-2022; EVOS grants)
- Co-PI on multiple Arctic research programs (AMBON, AIERP, ArcticEIS, SOAR)
- PI for ‘Aleutian Islands Seabird Risk Assessment’ (2012- 2015; USFWS special grant)
- PI for Seabirds, Bering Sea Integrated Research Program (2008-2012; NPRB grant)
- Co-PI for ‘Seabirds as Predators on Juvenile Herring’ (2006-2013; EVOS grant)
- PI for North Pacific Pelagic Seabird Observer Program (2006-2008; NPRB grant)
- PI and Co-PI for multiple *Exxon Valdez* Oil Spill (EVOS) projects, 1989 - 1999
- Assisted NOAA & NPFMC with Programmatic Environmental Impact Statements
- Detailed during Deepwater Horizon Oil Spill – assisted implementation of studies
- Marine Important Bird Areas Committee (Audubon working group)
- Reviewer for many peer-reviewed journals; Associate Editor for *Marine Ornithology*
- Lead author, seabird section, for State of the Arctic Marine Biodiversity Report (CAFF/Arctic Council) and the Central Arctic Ocean Assessment (ICES/PICES/PAME)
- Member of PICES Working Group on IEA of the N. Bering and Chukchi Sea (WG44)

SELECTED RECENT PUBLICATIONS

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. **Kuletz**, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, S. K., J. Straley, and V. von Biela. 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. *Global Change Biology*. <https://doi.org/https://doi.org/10.1111/gcb.15556>

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Others included as co-authors in list of selected publications, above.

Graduate Students advised (on their committees and using data collected during projects):

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RELEVANT PROFESSIONAL EXPERIENCE

Wildlife Biologist, Seabird Section, Migratory Bird Management, USFWS, Anchorage, Alaska:
Principle Investigator for (i) Prince William Sound (PWS) summer marine bird surveys, and (ii) Naked Island pigeon guillemot restoration project.
My position responsibilities include: Alaska FWS Seabird Die-off Response Team Coordinator (2015-present), Pacific Seabird Group Seabird Monitoring Committee Coordinator (2014-present), and East Asian-Australasian Flyway Partnership Seabird Working Group Chair (2015-present).

MOST RELEVANT PUBLICATIONS

- J. Piatt, J. Parrish, H. Renner, S. Schoen, T. Jones, M. Arimitsu, K. Kuletz, B. Bodenstein, M. García-Reyes, R. Duerr, R. Corcoran, **R. Kaler**, G. McChesney, R. Golightly, H. Coletti, R. Suryan, H. Burgess, J. Lindsey, K. Lindquist, P. Warzybok, J. Jahncke, J. Roletto, and W. Sydeman. 2020. Extreme mortality and reproductive failure of common murrelets resulting from the northeast Pacific marine heatwave of 2014-2016. *PLoS ONE* 15: <https://doi.org/10.1371/journal.pone.0226087>.
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- R. Kaler**, E. Labunski, and K. Kuletz. 2017. Prince William Sound marine bird population trends, 2012-2016. *Exxon Valdez Oil Spill Long-term Monitoring Program Final Report*.
- Dragoo, D.E., H.M. Renner, and R.S.A. **Kaler**. 2017. Breeding status and trends of seabird in Alaska, 2015. U.S. Fish and Wildlife Service Report AMNWR 2017/02. Homer, Alaska.
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- Dragoo, D.E., H.M. Renner, and R.S.A. **Kaler**. 2016. Breeding status and trends of seabird in Alaska, 2015. U.S. Fish and Wildlife Service Report AMNWR 2016/03. Homer, Alaska.

EDUCATION

- 2007 M.Sc. Biology. Kansas State University, Manhattan, Kansas, USA.
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United States Department of the Interior



FISH AND WILDLIFE SERVICE

1011 East Tudor Road
Anchorage, Alaska 99503-6199

10 August 2021

To: Mandy Lindeberg - NOAA, GWA-LTRM Program Lead
Shiway Wang, EVOSTC Executive Director

Re: Letter of Commitment for EVOSTC Project 21120114-M

I am pleased to provide this letter of commitment for the proposed project “21120114-M; Prince William Sound Marine Bird Surveys and Associated Shelf Waters” led by principal investigators (PI) Kathy Kuletz and Robb Kaler. Dr. Kuletz and Mr. Kaler are full time biologists with the Alaska Region of the U.S. Fish and Wildlife Service (USFWS). This proposal was drafted by the PIs in response to the EVOSTC’s FY22-31 Invitation for Proposals and subsequent request for final submission on August 13, 2021. The cost for this project over a ten-year period is \$2,058,900 (without 9% EVOSTC General Administration). This includes non-EVOSTC funds that are in-kind contributions (e.g., salaries of permanent staff, field travel, contracts, commodities, and equipment) totaling an estimated \$359,600 for the life of the project. This proposal is part of the larger multi-agency Gulf Watch Alaska Long-Term Research and Monitoring (GWA-LTRM) Program proposal package. This package represents a continued commitment of the successful long-term research and monitoring projects supported by the EVOSTC and various agencies and organizational investments that began in 1989 and have continued with additional components since 2012.

The USFWS funds included as in-kind or as contributions are for planning purposes only and nothing contained in this proposal shall be construed as binding USFWS to expend in any one fiscal year any sum in excess of its appropriations or funding in excess or what it has received for the collaborative work outlined in this proposal or involving the Federal government in any obligation to pay money before funds have been appropriated for that purpose unless otherwise allowed by law.

Sincerely,

ERIC TAYLOR

Digitally signed by ERIC
TAYLOR
Date: 2021.08.12 12:28:00
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Eric J. Taylor, Ph.D.
Chief, Migratory Bird Management
Authorized Representative of U.S. Fish and Wildlife Service
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