FY20 EVOSTC NEW PROJECT PROPOSAL

Proposals requesting FY20 funding are due to shiway.wang@alaska.gov and elise.hsieh@alaska.gov by August 16, 2019. Please note that the information in your proposal and budget form will be used for funding review. Late proposals, revisions or corrections may not be accepted. We may make inquiries regarding the project and proposer(s), including consulting with agencies or other parties that may be interested in this work. Please indicate below if your proposal contains confidential information.

Does this proposal contain confidential information? ☐Yes ☒No

Project Number and Title

20200130 Status and recovery of Kittlitz's and marbled murrelets within an EVOS affected area, Kachemak Bay

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

23 August 2019

Project Abstract

The abstract should provide a brief overview of the overall goals and hypotheses of the project and provide sufficient information for a summary review as this is the text that will be used in the public work plan and may be relied upon by the PAC and other parties.

Kittlitz's murrelet (*Brachyramphus brevirostris*) and marbled murrelet (*B. marmoratus*) are two seabird species that were impacted by the Exxon Valdez Oil Spill (EVOS), with an estimated 5-10% and 6-12% of the spill zone population killed by acute oiling, respectively (Carter & Kuletz 1995). Recovery status of Kittlitz's murrelets following the EVOS remains unknown, while marbled murrelets are considered to be not recovering (EVOSTC 2014). Kittlitz's murrelet became a candidate species for listing under the Endangered Species Act (ESA) in 2004 and was found not warranted for listing in 2013 due to insufficient or inconclusive knowledge, but remains a species of conservation concern for the US Fish and Wildlife Service (FWS). The marbled murrelet is more abundant and widespread in Alaska, but remains a species of conservation concern due to evidence of population declines (Piatt et al. 2007) and is listed as a Threatened species from British Columbia to California. Both murrelet species require at-sea surveys to obtain population estimates, as they do not nest in colonies, and nest sites are inland, cryptic, and difficult to find and monitor (Day et al. 1999; Kuletz et al. 2011a, 2011b).

The overall goal of this project is to provide updated population trend information for both *Brachyramphus* species throughout the spill zone with our field work focused on Kachemak Bay and Lower Cook Inlet (LCI). Results will be compared to vessel-based surveys conducted at other EVOS impacted areas, including core murrelet sites (i.e., Kodiak Archipelago, Resurrection Bay, Northwestern Fjord, Prince William Sound) in southcentral Alaska (Fig. 1). This project will fully analyze existing murrelet survey data along with updated population estimates. Integrating data sets and assessing population trends over a broad range will inform the Exxon Valdez Oil Spill Trustee Council (EVOSTC) efforts to determine recovery of these affected species. This would be the first proposed effort to bring together data on both murrelet species, in conjunction with oceanographic data, from all sub regions of the spill zone.

We propose to conduct vessel-based surveys to update population trend data for Kachemak Bay, a region affected by the EVOS. Available historic data and the relative accessibility of Kachemak Bay murrelet populations provide a cost-efficient opportunity to examine decadal trends, patterns of distribution over time, and habitat use. Furthermore, historic and on-going oceanographic and zooplankton studies in the LCI region will enable us to examine potential influences of environmental conditions on murrelet trends.

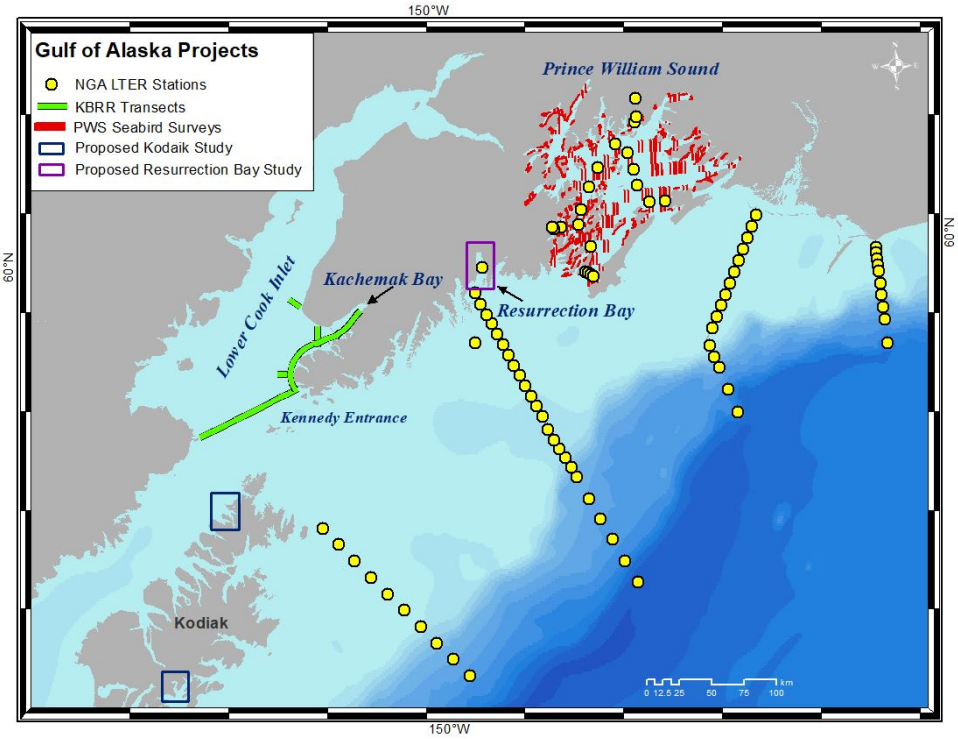

Figure 1. The EVOS area, showing locations of projects that would be complementary to the proposed *Brachyramphus* murrelet project in Kachemak Bay.

EVOSTC Funding Requested* *(must include 9% GA)*					
FY20	**FY21**	**FY22**	**FY23**	**FY24**	**TOTAL**
$226,938	**$129,566**	**$138,748**	**$135,366**	**$55,565**	**$686,184**

Non-EVOSTC Funds to be used, please include source and amount per source:					
FY20	**FY18**	**FY22**	**FY23**	**FY24**	**TOTAL**
$48,144	**$49,408**	**$50,711**	**$52,052**	**$47,433**	**$247,748**

**If the amount requested here does not match the amount on the budget form, the request on the budget form will considered to be correct.*

1. PROJECT EXECUTIVE SUMMARY

Please provide a summary of the project including key hypotheses and overall goals. Describe the background and history of the problem. Include a scientific literature review that covers the most significant previous work history related to the project. Include which injured resources and services will be studied and describe how these resources and services will benefit from this project.

Two injured resources will be studied:

(1) Kittlitz's murrelet – an injured species with unknown recovery (EVOSTC 2014). The proposed study will determine the current status to address the question of recovery. Additionally, our study will contribute to FWS data to evaluate the conservation status of a species which was a candidate species for listing under the ESA in 2004 and was found not warranted for listing in 2013 due to lack of sufficient population trend data. It remains a species of concern for the FWS, and for international professional and conservation groups (Pacific Seabird Group, International Union for Conservation of Nature). Alaska has the majority of the world population.

(2) Marbled Murrelet – an injured species, not recovering (EVOSTC 2014). The proposed study will determine current status to address the question of recovery. The marbled murrelet is a species of conservation concern for the FWS in Alaska, and is federally listed as threatened under the ESA in Washington, Oregon, and California, and State-listed as Endangered in California and Threatened in Oregon and Washington. The majority of the world's population occurs in Alaska (Piatt et al. 2007).

The proposed study will provide current population estimates for both murrelet species, along with distribution and habitat use. Kachemak Bay and the greater Lower Cook Inlet region are critically important areas for Kittlitz's murrelets, with an estimated 9% of the total world population (Service 2013). The goal of this project is to provide an updated population estimate for *Brachyramphus* murrelets in Kachemak Bay and to work with collaborators to provide trend information for the species across the spill zone.

The Gulf of Alaska GOA has undergone periods of ocean warming and most recently, massive and persistent heatwaves, resulting in cascading trophic effects affecting fish abundance and distribution (Zador and Yasumiishi 2018). In 2014-2016, other fish-eating seabirds, primarily common murres, had wide-spread mass mortality events and breeding failures in the GOA. Long-term trends in PWS indicate that pelagic feeding marine birds (such as murrelets) have not recovered as well as benthic-feeding coastal birds (Cushing et al. 2018). The impact of these changes on *Brachyramphus* murrelets is unknown, although there is evidence from the GOA Seward Line off-shore surveys that murrelets respond to warmer oceans by moving closer to coastal and fjord habitats (Kuletz et al. 2018). By examining murrelet trends across the broader EVOS affected area, in conjunction with oceanographic conditions, we seek to determine if there are differences in murrelet trends among regions that may coincide with environmental conditions, thereby identifying factors potentially inhibiting murrelet recovery. Improved understanding of environmental influences on murrelet trends and distribution patterns across the Gulf Watch Alaska area may also inform the fisheries management process in the GOA.

2. PROJECT HISTORY

Is this a new or continuing project? If continuing, please describe the history of the project and what has been accomplished to date. Please include any references to products (i.e., publications, reports, and websites).

This would be a new EVOSTC project, but one which builds upon previous murrelet surveys in Kachemak Bay, dating from 2004-2007 (July and August surveys, funded by an Alaska Department of Fish and Game, State Wildlife Grant), and July surveys in 2011 and 2016. This study will contribute data comparable to the EVOSTC funded project on marine birds in PWS (EVOSTC Project 20120114-M), and offshore data from the Seward Line project (2006-2022; funded by FWS and the North Pacific Research Board).

The Kachemak Bay surveys have two components: (1) a July population survey (Fig. 2), which captures peak murrelet abundance of adults after-hatch-year (AHY) birds; and (2) the August juvenile surveys (Fig. 3), to derive a population estimate of juvenile hatch year (HY) murrelets in Kachemak Bay. The latter component of the study builds upon prior studies in the area that determined HY densities and HY: AHY ratio estimates. The ratio is a productivity index commonly used for *Brachyramphus* murrelets (Kuletz and Kendall 1998; Kissling et al. 2013).

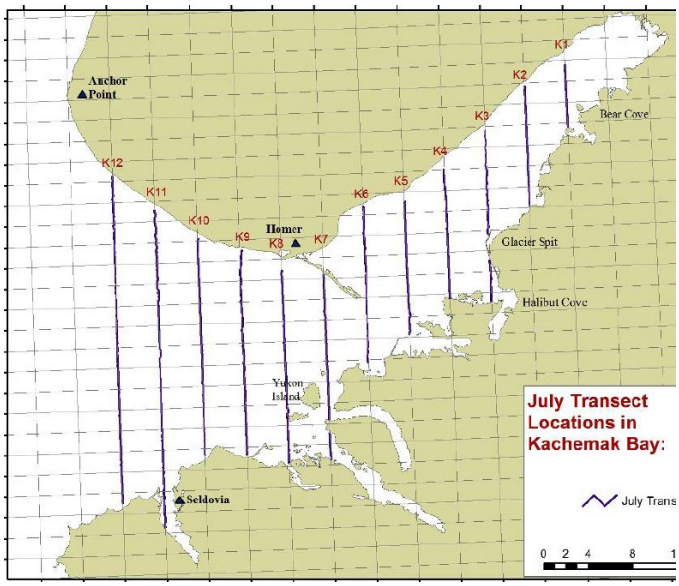

Figure 2. The Kachemak Bay study area and transects surveyed for adult population estimates in July of 2005-2007, 2011, and 2016.

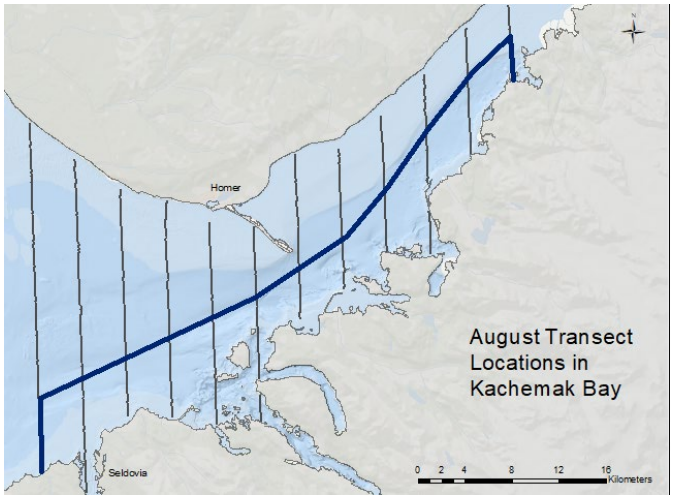

Figure 3. Proposed transects for adult and juvenile murrelet surveys in core post fledging habitat along the southern portion of the bay, bounded by blue box.

3. PROJECT DESIGN

A. Objectives

List the objectives of the proposed research and briefly state why the intended research is important. If your proposed project builds on recent work, provide detail on why the data set needs to be continued and whether any changes are proposed. If the proposed project is for new work, explain why the new data is needed.

1) **Objective 1**. Obtain current population estimates and long term trends for Kittlitz's murrelets and marbled murrelets in Kachemak Bay.

The proposed project in Kachemak Bay will provide information on *Brachyramphus* murrelets that were impacted within the EVOS region. Surveys conducted in Kachemak Bay during 2005-2007 estimated the Kittlitz's' murrelet population to be 2,020 birds (SD ± 1108), and marbled murrelets at 11,060 birds (SD ± 1245) (Kuletz et. al 2011). The greater error for Kittlitz's murrelets indicates a need to increase survey coverage in identified hot spots of activity for that species (Fig. 4). Marbled murrelets in contrast are more widely distributed across the bay (Fig. 5). The issue of clustered Kittlitz's murrelet distribution will be addressed by adding additional systematic transects 2-km apart in the hotspot areas to improve confidence intervals.

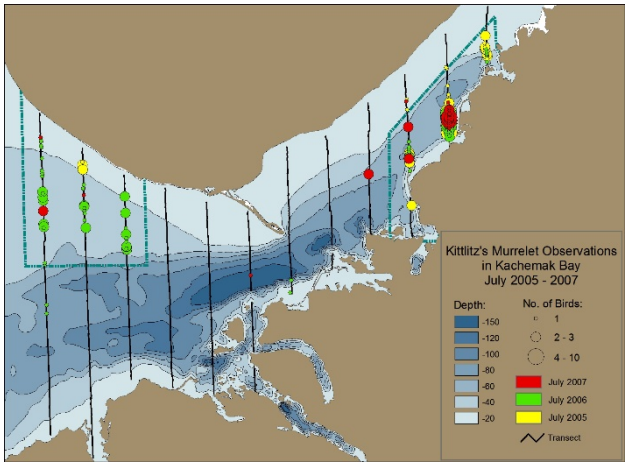

Figure 4. Distribution of Kittlitz's murrelets during July surveys for 2005 – 2007, showing bathymetry. The two Kittlitz's murrelet hot spots are outlined in a blue dashed line.

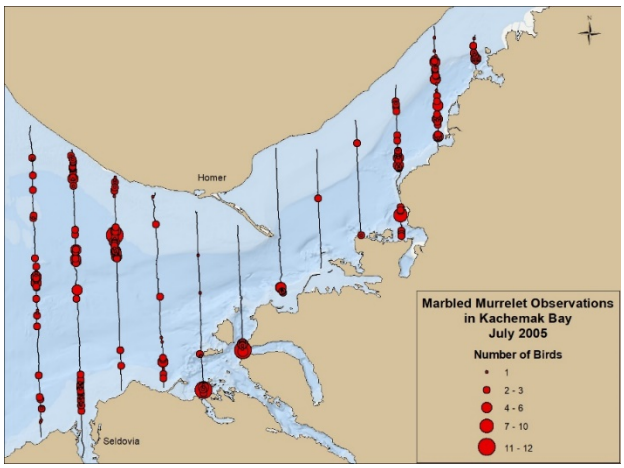

Figure 5. Distribution of Marbled murrelets during July surveys in 2005, showing bathymetery. Marbled murrelets are widely distributed across the across the bay.

2) **Objective 2.** Track annual abundance of adult and juvenile Kittlitz's murrelets and marbled murrelets in Kachemak Bay;

Kittlitz's and marbled murrelets differ from most seabirds species in that they do not nest in colonies, rather they are dispersed at inland nest sites. In August, we will conduct juvenile murrelet surveys in Kachemak Bay during the murrelet fledging period to measure murrelet productivity and compare results to prior studies.

3) **Objective 3.** Describe the distribution of murrelets within Kachemak Bay, and identify marine habitats used by murrelets;
Kachemak Bay is an ideal location to study both Kittlitz's and marbled murrelets because the marine areas used are readily accessible and occupy a diverse marine habitat. We propose using spatial murrelet distribution data to identify key habitat characteristics preferred by murrelets in Kachemak Bay. We will also examine whether murrelets respond to changing environment conditions by shifting distribution within the bay.

4) **Objective 4.** Synthesize results from Kachemak Bay with those from other regions in the spill zone, including Prince William Sound, Resurrection Bay, and Kodiak;
The proposed project will provide current population and trend information for Kittlitz's and marbled murrelets that can be compared to other vessel based murrelet surveys. We will share information with other regional murrelet projects to provide a comprehensive overview of *Brachyramphus* murrelets in the EVOS impacted areas.

B. Procedural and Scientific Methods

For each objective listed in A. above, identify the specific methods that will be used to meet the objective. In describing the methods for collection and analysis, identify measurements to be made and the anticipated precision and accuracy of each measurement and describe the sampling equipment in a manner that permits an assessment of the anticipated raw-data quality.

If applicable, discuss alternative methods considered, and explain why the proposed methods were chosen. In addition, projects that will involve the lethal collection of birds or mammals must comply with the EVOSTC's policy on collections, available on our website.

Objective 1. Obtain current population estimates and long term trends in Kachemak Bay;
Kachemak Bay provides a unique logistical opportunity to study murrelets, since the entire study area can be safely accessed on a daily basis via small boat from Homer (weather permitting), and does not require additional support vessels to reach remote study site locations. Boat based surveys will be conducted in Kachemak Bay using standard FWS strip transect protocol (Kendall and Agler 1998; Kuletz et al. 2008) and modified to allow distance sampling analysis. Survey crews will undergo training to ensure murrelet species identification and distance estimation. Observers will practice estimating distances (in 25-m bins) from the boat to decoys on the water using a laser rangefinder to check accuracy.

Transects are distributed systematically in 4-km intervals across the bay, perpendicular to shore, running north to south along longitudinal lines (Fig. 2). Transects will be located at 2-km intervals in previously identified areas of high Kittlitz's density (Fig 4.). Survey will be conducted in mid-July to coincide with prior surveys conducted in 2005-2007 and to minimize variability from seasonal shifts in murrelet abundance in the bay (Kuletz et al. 2008). ArcGIS will be used to generate track lines for each transect and calculate individual transect lengths.

The July surveys will be conducted once per year and take 5-7 days to complete; we've added an extra 1-2 days to accommodate the extra transect lines in the Kittlitz's murrelet hotspots. Surveys will be conducted between 0600 and 1700 hours by two observers and one boat driver using an 8-m fiberglass boat. GPS referenced transects will be surveyed at approximately 5-7 knots. Two observers will stand on opposite sides of the boat and record all birds observed on each side out to 150-m for a total transect width of 300-m, and use 10x42 binoculars to aid identification as needed. The observers will enter sightings directly into a laptop computer

using DLOG3 survey software (R.G. Ford, Inc., Portland, OR), integrated with a Global Positioning System (GPS). The program logs latitude and longitude for each record, and automatically writes to record location data at 20 second intervals to track effort and associated environmental conditions (weather, observing conditions, Beaufort Sea State, glare, fog).

For each murrelet or murrelet group we will record the murrelet's distance from the centerline of the boat in 25-m bins. Species' behavior will be recorded as on water, in air, or foraging. Flying birds will be counted continuously, similar to PWS marine bird surveys (Kaler et al. 2018). Observations of birds holding fish will be used to determine diet and as an indication of chick-feeding activity and chronology.

Objective 2. Track abundance of adults and juveniles of both murrelet species relative to oceanographic conditions;
Based on previous studies in Kachemak Bay (Kuletz et al. 2008), juvenile Kittlitz's murrelets are clustered in distribution (Fig. 6), than the more widely distributed and abundant juvenile marbled murrelet (Fig. 7). The juvenile murrelet surveys will be conducted in August, with the survey area based on the July sampling grid, with a core focus in the south side of Kachemak Bay; this area was identified in prior surveys as important juvenile habitat (Fig.3) (Kuletz and Piatt 1999; Kuletz et al. 2008). The modified study design will produce an average density and population estimate of juvenile and adult murrelets in the post-fledging time period.

The August surveys will require three repetitions that will take approximately four days each to complete. We will follow similar survey protocol as the July surveys with the exception that transect pauses will be allowed to determine if birds are juveniles (HY birds resemble adults going into basic plumage). During deviation from the transect we will cease survey effort, enter a waypoint into the navigation system, and go off transect to get a better look at the bird. The distance traveled during this time will not be included in the transect route used later to calculate densities. After age class is confirmed, the vessel will return to the waypoint and resume "on transect" effort.

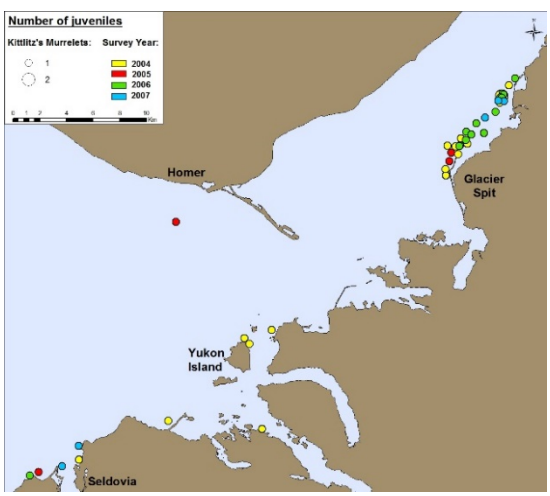

Figure 6. Distribution of juveniles (hatch-year birds) Kittlitz's murrelets during August surveys of 2004-2007 in Kachemak Bay.

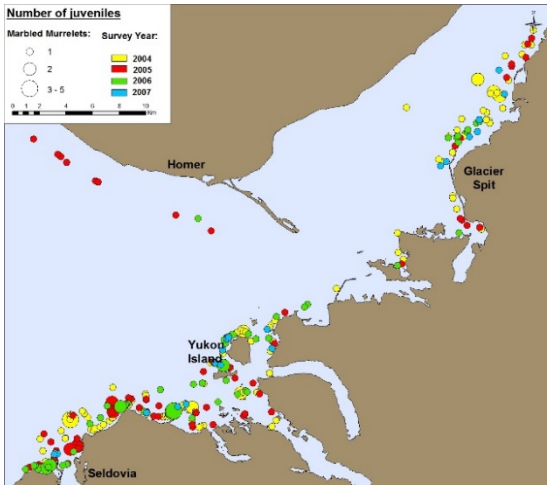

Figure 7. Distribution of juveniles (hatch-year birds) marbled murrelets during August surveys of 2004-2007 in Kachemak Bay.

Objective 3. Describe the distribution of murrelets within Kachemak Bay, and identify important marine habitats;
We will examine the relationship between murrelet distribution and environmental variables in Kachemak Bay to identify marine habitat characteristics and use for both species and HY:AHY murrelets. During the surveys we will collect environmental data on sea surface temperature, salinity and turbidity. Archived geo-spatial data from Kachemak Bay will be used to reference the additional variables of water depth, distance to shore, and chlorophyll a.

In earlier studies conducted in 2004-2007 the distribution of marbled murrelets indicated that they use a variety of marine habitats within the bay, from the highly mixed waters of the outer bay to the highly stratified waters of the inner bay. In contrast, Kittlitz's murrelets were primarily found in the highly stratified waters of the inner bay, where glacial outflow was most intense near Grewingk Glacier (Fig. 8). A particular feature of these areas was a layer of clear water typically < 5 m below the surface layer of turbid water. Water depth appears to be a primary limiting factor, as most murrelets occurred in water < 60 m deep (Kuletz et al. 2008).

Objective 4. Synthesize results from Kachemak Bay with those from other regions in the spill zone;
Our goal is to coordinate with other marine bird survey projects within the EVOS region in core *Brachyramphus* murrelet sites. We have contacted other *Brachyramphus* project Principal Investigators including Kodiak Archipelago, Resurrection Bay, Northwestern Fjord, and Prince William Sound regarding potential opportunities to collaborate region wide. The pending collaborative opportunities could provide valuable comparisons regarding *Brachyramphus* murrelet abundance, population trends, indices of productivity, and habitat use among regions. Further, it would provide a comprehensive overview of population trend data in southcentral Alaska.

C. Data Analysis and Statistical Methods

Describe the process for analyzing data. Discuss the means by which the measurements to be taken could be compared with historical observations or with regions that are thought to have similar ecosystems. Describe the statistical power of the proposed sampling program for detecting a significant change in numbers. To the extent that the variation to be expected in the response variable(s) is known or can be approximated, proposals should demonstrate that the sample sizes and sampling times (for dynamic processes) are of sufficient power or robustness to adequately test the hypotheses. For environmental measurements, what is the measurement error associated with the devices and approaches to be used?

We will generate population estimates for Kittlitz's and marbled murrelet populations in Kachemak Bay using the program DISTANCE (Thomas et al. 2010). Surveys will follow distance sampling protocol by binning all murrelet observations on the water and in the air into 25-m distance bins extending from the centerline of the vessel out to 150-m. A detection function will be estimated for all *Brachyramphus* murrelets. Detection models with species specific detection functions will be estimated and evaluated using model selection techniques. We will also reanalyze murrelet data collected during surveys in 2005-2007, 2011, and 2016 in Kachemak Bay using similar methodology to provide consistent population estimates for comparison; thereby allowing us to analyze long-term trend data for both murrelet species.

We will use spatial distance sampling (Miller et al. 2013) implemented through the R package dsm (Miller et al. 2019) to estimate murrelet density across the study area. These density maps can be used to identify murrelet hotspots in the bay that are consistent across years. In addition, we propose reanalyzing prior historic data using the same spatial distance methodology to identify changes in murrelet density since 2005. Specifically, the generalized additive model (GAM, Wood 2017) methods used in spatial distance sampling allow for estimation of among years trends and space-time interaction in the density surface (e.g., Kissling et al. 2007).

D. Description of Study Area

Where will the project be undertaken? Describe the study area, including maps and figures, if applicable, decimally-coded latitude and longitude readings of sampling locations or the bounding coordinates of the sampling region (e.g., 60.8233, -147.1029, 60.4739, -147.7309 for the north, east, south and west bounding coordinates).

The proposed study will take place in Kachemak Bay, Alaska, a large bay located northeast of the Kennedy Entrance into LCI (Fig. 8); the latter is a large tidal estuary that exchanges water with the GOA via the Alaska Coastal Current. Compared to the outer bay (mouth of the bay to Homer Spit), the inner bay (roughly Homer Spit to head of the bay) is characterized by higher surface water temperatures, lower salinity levels, and highly stratified layers with high turbidity (Speckman et al. 2005; Renner et al. 2017). These marine features are largely the result of melting snow pack and glacial runoff along the south shore, and river runoff at the bay head, which flows westward along the north shore. The heterogeneity within the bay results in strong habitat gradients affecting murrelet distribution (Kuletz et al. 2008; Renner et al. 2017). On a broader scale, the range in coastal and marine habitats among the study sites in the spill zone (Fig. 1) will allow for robust comparisons in murrelet trends and habitat use throughout the region.

The study area will be bounded in Kachemak Bay by the following coordinates:

NW Boundary: 59.698 N, 151.810 W
SW Boundary: 59.437 N, 151.810 W
SE Boundary: 59.721 N, 151.060 W
NE Boundary: 59.788, 151.060 W

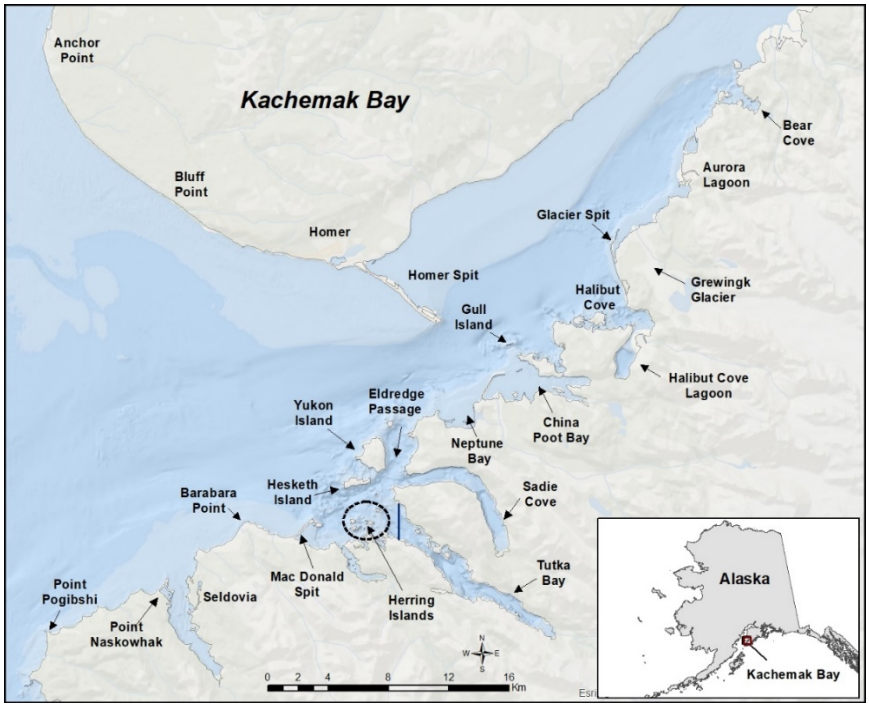

Figure 8. Kachemak Bay study area place names.

4. COORDINATION AND COLLABORATION

A. Within an EVOSTC Funded Program

Provide a list and clearly describe the functional and operational relationships with the other EVOSTC-funded Program (Herring Research and Monitoring, Gulf Watch Alaska and Data Management Programs). This includes any coordination that has taken or will take place and what form the coordination will take (project guidance, shared field sites or researchers, research platforms, sample collection, data management, equipment purchases, etc.).

Gulf Watch Alaska

This project will closely coordinate and collaborate with Gulf Watch Alaska programs (PWS marine bird surveys, Project 20120114-M; Nearshore monitoring, Project 19120114-H) to collect comparable data on murrelets, permitting more comprehensive inferences on broader population trends of Kittlitz's and marbled murrelets in the spill affected area. We will coordinate field logistics and data sharing with all other Gulf Watch Alaska programs, as possible or requested.

Additionally, we will collaborate with the LCI oceanographic and plankton monitoring project of the Kachemak Bay Research Reserve, the Northern Gulf of Alaska Long Term Ecosystem Research project (funded primarily by National Science Foundation and NPRB), and (pending funding) proposed projects in Resurrection Bay and the Kodiak Archipelago (Fig. 1). We will share results and collaborate to ensure consistency of data collection and to compare results across regions. The goal is to improve our understanding of murrelet trends in core areas of southcentral Alaska.

Herring Research and Monitoring

Brachyramphus murrelets rely on herring and other small forage fish (Bishop et al. 2015; Day et al. 1999, Piatt et al. 2007) during the summer breeding season and may therefore be impacted by low herring numbers. Data

provided by the Herring Project would offer insight into prey availability in southcentral Alaska, which may also be reflected in murrelet HY: AHY ratio estimates and annual HY population estimates.

Data Management

The proposed project will submit data and produce FGDC compliant metadata in accordance with data management requirements. Data will be archived at the AOOS-Gulf Watch Alaska Workspace and the North Pacific Pelagic Seabird Database (https://www.usgs.gov/centers/asc/science/north-pacific-pelagic-seabird-database?qt-science_center_objects=0#qt-science_center_objects).

B. With Other EVOSTC-funded Projects

Indicate how your proposed project relates to, complements or includes collaborative efforts with other proposed or existing projects funded by the EVOSTC that are not part of an EVOSTC-funded program.

Prince William Sound Marine Bird Population Trends (EVOSTC Project 20120114-M)
Marine bird surveys in Prince William Sound will be conducted in July using similar survey methodology as we will use in Kachemak Bay. We will coordinate data sharing and analysis to determine murrelet population estimates and trends between PWS and Kachemak Bay, and examine environmental conditions and habitats with respect to those trends. These comparisons will only address adult populations, as the PWS surveys do not include August juvenile surveys. We also propose to examine the potential to improve the PWS survey population estimates for Kittlitz's murrelets by adding additional systematic transects in several fjords identified as key Kittlitz's murrelet habitat; these transects would follow those used in previous studies (Allyn et al. 2013; Kuletz et al. 2003).

Pigeon Guillemot Restoration Project (EVOSTC Project 19110853)
The proposed project will collaborate with the Pigeon Guillemot Restoration Project to share available data on pigeon guillemot abundance and trend data in Kachemak Bay with those obtained in PWS.

C. With Trustee or Management Agencies

Please discuss if there are any areas which may support EVOSTC trust or other agency work or which have received EVOSTC trust or other agency feedback or direction, including the contact name of the agency staff. Please include specific information as to how the subject area may assist EVOSTC trust or other agency work. If the proposed project requires or includes collaboration with other agencies, organizations or scientists to accomplish the work, such arrangements should be fully explained, and the names of agency or organization representatives involved in the project should be provided. If your proposal is in conflict with another project or program, note this and explain why.

The proposed project supports the US Fish and Wildlife Service's Migratory Bird Management mission to advance the conservation of migratory birds. In addition to informing the EVOSTC regarding recovery of impacted resources, the project will inform other management agencies (Alaska Department of Fish and Game, Alaska Maritime National Wildlife Refuge, National Park Service) with lands and waters adjacent to the proposed study area.

D. With Native and Local Communities

Provide a detailed plan for any local and native community involvement in the project.

We will work with local communities of Homer, Port Graham, and Seldovia to inform them of our surveys, share results, and potentially integrate regional citizen science data when applicable. We would look to engage in local community outreach events including giving educational talks, informational flyers, and coordinating with the

Center for Alaska Coastal Studies and Alaska Maritime Refuge, based in Homer, to identify other cooperative outreach opportunities.

DELIVERABLES

List and describe expected products that will come from this project. Deliverables include but are not limited to papers, reports, recordings, films, websites, presentations, data and metadata. Project PI(s) will be responsible for all deliverables unless otherwise noted below.

- Data delivered to AOOS/GWA site, and submitted to the North Pacific Pelagic Database.
- Reports, summarizing survey results (e.g., murrelet densities, distribution maps for murrelets of both species and age groups).
- Final synthesis publication examining abundance, trend, distribution and habitat use of *Brachyramphus* murrelets throughout the EVOS region.
- Presentations at the Alaska Marine Science Symposium and other seabird or marine-oriented professional meetings.

5. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

Milestones are annual steps to meet overall project objectives.

Tasks are annual steps to meet milestones (for example, sample collection, data analysis, manuscript submittal, etc.)

Deliverables are products that will be produced from the project (see section 5 above).

For each milestone, task, and deliverable listed, specify by each quarter of each year these will be accomplished.

For multi-year projects, reviewers will use this information in conjunction with annual project reports to assess whether the project is meeting its objectives and is suitable for continued funding.

Project milestone and task progress by fiscal year and quarter, beginning February 1, 2017. Yellow highlight indicates proposed fiscal year Work Plan. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

	FY20				FY21				FY22				FY23				FY24			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone Logistics																				
Field Work Preparations	X				X				X				X							
Conduct July Survey		X				X				X				X						
Conduct August Survey			X				X				X				X					
Milestone 2 Data Management																				
Data QAQC & Metadata			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Analysis & Summary					X				X				X				X			
Reporting																				
Annual reports					X				X				X				X			
FY work plan			X				X				X									
Final report																				
Annual PI meeting				X				X				X				X				X

Deliverables																				
Peer reviewed paper 1																				X
Data posted online						X				X				X				X		

6. Budget

Budget Forms (Attach)

Please provide completed budget forms. Please note that costs associated with international travel for meetings, symposia, or presentations will not be considered for funding. Costs associated with outreach or education efforts shall not exceed 2% of the total project budget (before including the 9% GA).

Budget Category:	Proposed FY 20	Proposed FY21	Proposed FY22	Proposed FY23	Proposed FY24	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$51,500.0	$62,933.0	$64,821.4	$66,765.4	$37,704.9	$283,724.7	
Travel	$12,000.1	$15,300.1	$15,696.8	$16,105.9	$9,773.0	$68,875.9	
Contractual	$0.0	$30,000.0	$30,000.0	$30,000.0	$0.0	$90,000.0	
Commodities	$9,500.0	$10,635.0	$12,774.0	$11,317.0	$3,500.0	$47,726.0	
Equipment	$135,200.0	$0.0	$4,000.0	$0.0	$0.0	$139,200.0	
Indirect Costs (*will vary by proposer*)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$208,200.1	$118,868.1	$127,292.1	$124,188.4	$50,977.9	$629,526.6	
General Administration (9% of subtotal)	$18,738.0	$10,698.1	$11,456.3	$11,177.0	$4,588.0	$56,657.4	
PROJECT TOTAL	**$226,938.1**	**$129,566.2**	**$138,748.4**	**$135,365.3**	**$55,565.9**	**$686,184.0**	
Other Resources (Cost Share Funds)	$48,144.0	$49,408.3	$50,710.6	$52,051.9	$47,433.4	$247,748.2	N/A

Sources of Additional Funding

Identify non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal. Please attach documentation from additional project funding sources which confirms and describes matching funds, including date(s) the matching funds are/will be authorized.

The FY20 estimated budget includes cost of vessel refurbishment or replacement for one vessel ($130,000). The FWS fleet was reduced in FY19 due to age and deterioration of boats and motors. The three boats retained are required during July to conduct the PWS surveys and therefore not available for Kachemak Bay work. We may be able to refurbish the Alaska Maritime Refuge's Boston Whaler stored in Homer, AK, which they will loan MBM; however, this vessel is 25 years old and may also need to be replaced. Total salary request from EVOSTC is $283,724, and $90,000 for contractual services; the remainder is for operational survey costs, synthesis, and publication. Total request from EVOSTC with 9% GA is $686,184.

Sources of Additional Funding

Is there any other funding support for this project? Please list any non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal.

The FWS, Migratory Bird Management, will provide In-kind support in the form of salaries, travel, equipment, lodging, and administrative support, beyond that requested in our budget. Total contributions for contributed salaries and survey support are estimated at $247,748. Specific items of in-kind contribution include:

- Salaries and administrative support for Co-PIs and Biometrician
- Two ruggedized laptops with hand-held GPS (as backups; will require new purchases as well)
- Updated Dlog or similar survey software
- Use of FWS truck for travel to Homer, AK and hauling boat as necessary
- Lodging for field crew at Alaska Maritime Refuge bunkhouse in Homer, AK (when available)

- Safety gear for vessel use, misc. equipment as backup
- Historical and concurrent data already available and processed for the study area

7. Literature Cited

Provide literature cited in the proposal.

Allyn, A.J., A. McKnight, K. McGarigal, C.R. Griffin, K.J. Kuletz, and D.B. Irons. 2012. Relationships among Kittlitz's murrelet habitat use, temperature-depth profiles, and landscape features in Prince William Sound, Alaska, USA. *Marine Ecology Progress Series* 466:233-247.

Bishop, MA, Watson, JT, Kuletz, KJ, and Morgan, T. 2015. Pacific Herring (Clupea pallasii) consumption by marine birds during winter in Prince William Sound, Alaska. *Fisheries Oceanography* 24:1-13.

Carter, H.R. and K.J. Kuletz. 1995. Mortality of marbled murrelets due to oil pollution in North America. Pages 261-269 *in* C.J. Ralph, G.L. Hunt, Jr., M.G. Raphael, and J.F. Piatt (editors). Ecology and conservation of the marbled murrelet. USDA Forest Service General Technical Report PSW-GTR-152.

Cushing, D.A., Roby, D.D., & Irons, D.B. 2018. Patterns of distribution, abundance, and change over time in a subarctic marine bird community. *Deep-Sea Research Part II* 147: 148-163.

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Kuletz, K.J. & Piatt, J.F. 1999. Juvenile Marbled Murrelet nurseries and the productivity index. *Wilson Bulletin* 111: 257- 261.

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Piatt, J.F., Kuletz, K.J., Burger, A.E., Hatch, S.A., Friesen, V.L., Birt, T.P., Arimitsu, M.L., Drew, G.S., Harding, A.M.A. & Bixler, K.S. 2007. Status review of the Marbled Murrelet (*Brachyramphus* marmoratus) in Alaska and British Columbia. Open File Report 2006–1387. Reston, VA: US Geological Survey.

Renner, M, Kuletz, K. J, Labunski, E. 2017. Seasonality of Seabird Distribution in Lower Cook Inlet. US Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Regional Office, Anchorage, AK. OCS Study BOEM 2017-011 Available at: https://www.boem.gov/2017-011/

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Speckman, S.G., Piatt, J.F., Minte-Vera, C.V. & Parrish, J.K. 2005. Parallel structure among environmental gradients and three trophic levels in a subarctic estuary. *Progress in Oceanography* 66: 25-65.

Thomas, L., Buckland, S. T., Rexstad, E. A., Laake, J. L., Strindberg, S., Hedley, S. L., Bishop, J. R., Marques, T. A. and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47:5-14.

Wood, S. N. 2017. Generalized additive models: an introduction with R. Chapman and Hall/CRC

Zador, S. and Yasumiishi, E. 2018. Ecosystem Status Report 2018, Gulf of Alaska. NPFMC Gulf of Alaska SAFE Report, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99301

8. Project Personnel

The CV's of all Principal Investigators and other senior personnel involved in the proposal must be provided. Each resume is limited to two consecutively numbered pages and must include the following information:

• A list of professional and academic credentials, mailing address, and other contact information (including e-mail address)

• A list of up your most recent publications most closely related to the proposed project and up to five other significant publications. Do not include additional lists of publications, lectures, etc.

• A list of all persons (including their organizational affiliations) in alphabetical order with whom you have collaborated on a project or publication within the last four years. If there have been no collaborators, this should be indicated.

All of the Co-PIs have extensive experience in working with EVOSTC projects in the spill zone, as well as projects funded by other agencies. Ms. Labunski and R. Kaler have both led field programs, coordinated within GWA, and managed data archiving and analysis for multiple projects noted in this proposal. Dr. Kuletz is PI for the seabird component of two long-term monitoring projects in the GOA, the Seward Line (spring and fall surveys, 2006-2019, with historic data available starting in 1998) and the Long-term Ecological Research Monitoring project (spring, summer, fall surveys, 2018 – 2019 and on-going). In previous LCI and Kachemak work under funding from the Bureau of Ocean Energy Management, Dr. Kuletz and Ms. Labunski worked with Dr. Holderied (NOAA) and the Kachemak Bay Research Reserve (KBRR) to conduct marine bird surveys in conjunction with KBRR oceanographic monitoring surveys in Kachemak Bay and Lower Cook Inlet.

Elizabeth Labunski, Lead-PI. Will be responsible for project coordination; oversee data collection, preparation of reports and publications. Previous EVOSTC funding: None. Ms. Labunski was field leader for the previous Kachemak Bay surveys from 2004 - 2011 (coordinated data collection, data management and summaries, co-wrote reports and publications, and produced geospatial visualizations and analyses.

Robert Kaler, Co-PI. Will assist with data collection, preparation of reports and publications. Previous EVOSTC funding: 13120114-K (2012-2016), 20120114-M (2017-2021), 19100853 (2014-2018), 19110853 (2019-2021).Mr. Kaler runs the PWS marine bird surveys and will assist with integration of these data with the Kachemak Bay survey data.

Kathy Kuletz, Co- PI. Will assist collaboration with other projects and with reports and publications. Previous recent EVOSTC funding: 13120114-K (2012-2016), 20120114-M (2017-2021); 19110853 (2019-2021). For full history see, EVOSTC Researcher Projects.

Erik Osnas, Co-PI. Will advise on study design and analysis, conduct analyses and assist with publications. Previous EVOSTC funding: None. Dr. Osnas is a biometrician with FWS with experience in multiple Alaskan projects.

Publications from previous work in Kachemak Bay and relevant publications for Prince William Sound include:

Agler, B.A., Kendall, S.J. & Irons, D.B. 1998. Abundance and distribution of Marbled and Kittlitz's murrelets in southcentral and southeast Alaska. *Condor* 100: 254-265.

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Allyn, A.J., A. McKnight, K. McGarigal, C.R. Griffin, K.J. Kuletz, and D.B. Irons. 2012. Relationships among Kittlitz's murrelet habitat use, temperature-depth profiles, and landscape features in Prince William Sound, Alaska, USA. *Marine Ecology Progress Series* 466:233-247.

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EDUCATION

2013 *Post Baccalaureate Degree*- Geographic Information Systems and Remote Sensing, University of Alaska

2000 *Bachelor of Science*- Wildlife Biology, State University of New York College of Environmental Science and Forestry

PROFESSIONAL EXPERIENCE

2001-present Wildlife Biologist, U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage Alaska

2000-1999 Wildlife Biologist, U.S. Geological Survey, Alaska Science Center, Anchorage Alaska

SELECT PUBLICATIONS

Kuletz, K. J., Cushing, D. A., Osnas, E. E., **Labunski**, E. A., & Gall, A. E. (2019). Representation of the Pacific Arctic seabird community within the Distributed Biological Observatory array, 2007–2015. *Deep Sea Research Part II: Topical Studies in Oceanography*.

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Kuletz, K.J., M.C. Ferguson, B.H. Hurley, A.E. Gall, E.A. **Labunski**, & T.C. Morgan. 2015. Seasonal spatial patterns in seabird and marine mammal distribution in the eastern Chukchi and western Beaufort seas: Identifying biologically important pelagic areas. *Progress in Oceanography* 136:175-200.

Suryan, R.M., K.J. Kuletz, S.L. Parker-Setter, P.H. Ressler, M.T Renner, J.K Horne, E.V. Farley, & E.A. **Labunski**. 2016 Temporal shifts in seabird population and spatial coherence with pretty in the southeastern Bering Sea. *Marine Ecology Progress Series* 549:199-215.

RECENT COLLABORATORS

Adrian Gall (ABR Inc.), Dan Cushing (Pole Star Ecological Research), Ed Farley (NOAA Fisheries), Megan Ferguson (NOAA Marine Mammal Program), Jackeline Grebmeier (University of Maryland), Kris Holderied (NOAA Kasitsna Bay), Russ Hopcroft (University of Alaska), Katrin Iken (University of Alaska), Robb Kaler (USFWS Migratory Bird Management), Kathy Kuletz (USFWS Migratory Bird Management), Sue Moore (NOAA), Erik Osnas (USFWS Migratory Bird Management), Heather Renner (Alaska Maritime NWR), Martin Renner (Tern Again Consulting), R. Suryan (NOAA).

ROBERT (ROBB) KALER

CURRICULUM VITAE

WILDLIFE BIOLOGIST, US FISH AND WILDLIFE SERVICE, 1011 EAST TUDOR ROAD, ANCHORAGE ALASKA 99503

EDUCATION

2007 – M.Sc, Kansas State University, Manhattan, KS (Biology)
1997 – B.Sc, The Evergreen State College, Olympia, WA (Wildlife Biology)

WORK EXPERIENCE (2002-present)

2010-present ~Wildlife Biologist, Migratory Bird Management, US Fish and Wildlife Service (USFWS), Anchorage, Alaska
2008-2011 ~ Principle Investigator: Kittlitz's murrelet breeding biology study at Agattu Island, Alaska Maritime National Wildlife Refuge-USFWS, Homer, Alaska
2005-2007 ~ Graduate Research Assistant, Kansas State University, Kansas. Project: Restoring Evermann's Rock Ptarmigan at Agattu Island, Western Aleutian Islands, Alaska

PUBLICATIONS (2009-present)

Dragoo, D.E., H.M. Renner, and R.S.A. **Kaler**. 2019. Breeding status and trends of seabird in Alaska, 2018. U.S. Fish and Wildlife Service Report AMNWR 2019/03. Homer, Alaska.

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Felis, J.J., M.L. Kissling, R.S.A. **Kaler**, L.A. Kenney, and M.J. Lawonn. 2016. Identifying Kittlitz's Murrelet nesting habitat in North America at the landscape scale. Journal of Fish and Wildlife Management.

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.

Kaler, R.S.A., L.A. Kenney, A.L. Bond, and C.A. Eagles-Smith. 2014. Mercury concentrations in breast feathers of three upper trophic level predators from the western Aleutian Islands, Alaska. Archives of Environmental Toxicology.

Kenney, L.A. and R.S.A. **Kaler**. 2013. Identifying nesting habitat of Kittlitz's Murrelet Brachyramphus brevirostris: Old nests lead to a new breeding record. Marine Ornithology 41:95-96.

Gregory, A.J., R.S.A. **Kaler**, T.J. Prebyl, B.K. Sandercock, and S.M. Wisely. 2012. Influence of translocation strategy and mating system on the genetic structure of a newly established population of island ptarmigan. Conservation Genetics 13:465-474.

Kaler, R.S.A., and B.K. Sandercock. 2011. Effects of translocation on the behavior of island ptarmigan in B.K. Sandercock, K Martin, and G. Degelbacher (eds.). Ecology, conservation, and management of grouse. Studies in Avian Biology 39:295-306.

Manning, J. A. and R.S.A. **Kaler**. 2011. Effects of survey methods on Burrowing Owl Behaviors. Journal of Wildlife Management 75:525-530.

Braun, C.E., W.P. Taylor, S.E. Ebbert, R.S.A. **Kaler**, and B.K. Sandercock. 2011. Protocols for successful translocation of ptarmigan. In R. T. Watson, T. J. Cade, M. Fuller, G. Hunt, and E. Potapov (eds.). Gyrfalcons and ptarmigan in a changing world. The Peregrine Fund, Boise, Idaho, USA.

Kaler, R., S. Ebbert, C. Braun, and B. Sandercock. 2010. Demographic measures of translocation success: reintroduction of an island population of Evermann's Rock Ptarmigan. Wilson Journal of Ornithology 122:1-14 (Winner of 2010 Edwards Prize (Best Paper of the Year).

Kaler, R., L. Kenney, and B. Sandercock. 2009. Breeding ecology of Kittlitz's Murrelets at Agattu Island, Aleutian Archipelago, Alaska. Waterbirds 32:363-373.

HONORS AND AWARDS

2016 Regional Director's Award for External Costumer Service, USFWS
2010 Edwards Prize for Best Article of the Year in The Wilson Journal of Ornithology (Vol. 122), Wilson Ornithological Society <http://www.wilsonsociety.org/awards/edwardsprize.html>
2010 Recipient, Star Award, U.S. Fish and Wildlife Service, Division of Migratory Birds, Region 7, Alaska
2007 Recipient, Best Student Presentation Award, The Wildlife Society annual meeting, Tucson, Arizona
2007 Nominee, Golden Key Award for Excellence in Undergraduate Teaching, Kansas State University
2007 Recipient, James Ackert Award for Outstanding Student Presentation, Division of Biology, Kansas State University

GRANTS

2012 North Pacific Seabird Data Portal expansion, National Fish and Wildlife Foundation, Alaska Fish & Wildlife Fund, $40,000
2012 FWS Fisheries and Ecological Services Endangered Species Branch, $18,750
2011 Mercury and feathers in three avian species at Agattu Islands, Avian Health and Disease Program, U.S. Fish and Wildlife Service, $15,125
2011 Agattu Island Kittlitz's murrelet breeding biology study, Ecological Services Endangered Species Branch, $50,000
2010 Kittlitz's murrelet Monitoring Plan, Avian Health and Disease Program, U.S. Fish and Wildlife Service, $25,000
2010 Kittlitz's murrelet breeding biology at Agattu Island, National Fish and Wildlife Foundation, Alaska Fish & Wildlife Fund, $15,600
2010 Kittlitz's murrelet breeding biology at Agattu Island, U.S. Fish and Wildlife Service, Challenge Cost-share Grant, $5,000
2010 North Pacific Seabird Information Network, Alaska Department of Fish and Game, Wildlife Diversity Program, $375,000

SERVICE

2015-present, East Asian Australasian Flyway Partnership Seabird Working Group, Chair
2014-2017, Pacific Seabird Group Alaska/Russia Regional Representative, Executive Committee member
2014-present, Pacific Seabird Group Seabird Monitoring Committee, Chair
2013 Reviewer, The Condor; ICES Journal of Marine Science
2009 Reviewer, Studies in Avian Biology
2008 Reviewer, Wilson Journal of Ornithology
2007 Webmaster, Biology Graduate Student Association, Kansas State University
2006-2007 Secretary, Biology Graduate Student Association, Kansas State University
2006-2007 Chair, Fundraising Committee, Biology Graduate Student Association Kansas State University
2006 Assistant Webmaster, Biology Graduate Student Association, Kansas State University
2006 Chair, Travel Grant Committee, Biology Graduate Student Association, Kansas State University

MEMBERSHIPS TO PROFESSIONAL SOCIETIES

American Ornithologists' Society (2005), Pacific Seabird Group (2007), Wilson Ornithological Society (2005), Cooper Ornithological Society (2010)

COLLABORATIONS

Barb Bodenstein and Robert Dusek (USGS National Wildlife Health Center), Alex Bond (Royal Society for the Protection of Birds), Collin Eagles-Smith (USGS-Corvallis), David Irons (US Fish and Wildlife Service, retired), Julia Parrish (University of Washington), John Piatt (USGS, Alaska Science Center), Heather Renner (Alaska Maritime National Wildlife Refuge), Frank von Hippel (University of Alaska Anchorage)

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	Expert member, 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
2000–2006	NOAA/N. Pacific Fisheries Manage. Council Groundfish Fisheries Plan Team
1998-2014	Seabird Specialist, Migratory Bird Management, USFWS, Anchorage, Alaska

SYNERNISTIC ACIVITIES RELEVANT TO THE PROPOSED PROJECT

- PI -'Seabird Distribution in the Offshore Environment' (2010–current; 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
- Co-PI for seabird projects in Lower Cook Inlet (BOEM, EVOS, ADFG, USFWS)
- Assisted NOAA & NPFMC with Programmatic Environmental Impact Statements
- Collaboration with NOAA and Univ. of Washington, studies of fisheries seabird bycatch
- Detailed during Deepwater Horizon Oil Spill – assisted implementation of studies
- Marine Important Bird Areas Committee (Audubon working group)
- Reviewer for several peer-reviewed journals and lead reviewer for seabirds for United Nations World Ocean Assessment (http://www.worldoceanassessment.org/)
- Lead author, seabird sections, for State of the Arctic Marine Biodiversity Report (CAFF/Arctic Council) and the Central Arctic Ocean Assessment (ICES/PAME)

SELECTED PUBLICATIONS RELEVANT TO THIS PROJECT

Allyn, A.J., A. McKnight, K. McGarigal, C.R. Griffin, K.J. **Kuletz**, and D.B. Irons. 2012. Relationships among Kittlitz's murrelet habitat use, temperature-depth profiles, and landscape features in Prince William Sound, Alaska, USA. *Marine Ecology Progress Series* 466:233-247.

Day, R.H., **Kuletz**, K.J. & Nigro, D.A. 1999. Kittlitz's Murrelet (*Brachyramphus brevirostris*). In Poole, A. (Ed). The birds of North America, No. 435. Philadelphia, PA, & Washington, DC: Academy of Natural Sciences & American Ornithologists' Union.

Kuletz, K., D. A. Cushing, E.E. Osnas, E.A. Labunski, A.E. Gall. 2019. Representation of the Pacific Arctic seabird community within the Distributed Biological Observatory array, 2007-2015. *Deep Sea Research II,* 162:191-210.

Kuletz, K.J., Speckman, S.G., Piatt, J.F. & Labunski, E.A. 2011. Distribution, population status and trends of Kittlitz's Murrelet *Brachyramphus brevirostris* in Lower Cook Inlet and Kachemak Bay, Alaska. *Marine Ornithology* 39: 85–95.

Santora, J.A., L.B. Eisner, K.J. **Kuletz**, C. Ladd, M. Renner, G.L. Hunt Jr. 2018. Biogeography of seabirds within a high-latitude ecosystem: Use of a data assimilative ocean model to assess impacts of mesoscale oceanography. *J. Marine Systems* 178: 38–51.

Other relevant publications:

Kuletz, K., M. Ferguson, A. Gall, B. Hurley, E. Labunski, T. Morgan. 2015. Seasonal Spatial Patterns in Seabird and Marine Mammal Distribution in the Eastern Chukchi and Western Beaufort Seas: Identifying Biologically Important Pelagic Areas. *Progress in Oceanography* 136:175-200.

Kuletz, K. J., S.W. Stephensen, D.B. Irons, E.A. Labunski, & K.M. Brenneman. 2003. Changes in distribution and abundance of Kittlitz's murrelets *Brachyramphus brevirostris* relative to glacial recession in Prince William Sound, Alaska. *Marine Ornithology* 31:133-140.

Kuletz, K.J., Nations, C.S., Manly, B.F.J., Allyn, A., Irons, D.B. & Mcknight, A. 2011. Distribution, abundance, and population trends of the Kittlitz's Murrelet *Brachyramphus brevirostris* in Prince William Sound, Alaska. *Marine Ornithology* 39: 97–109.

Moore, S. and K. **Kuletz**. 2019. Marine birds and mammals as ecosystem sentinels in and near Distributed Biological Observatory regions: an abbreviated review of published accounts and recommendations for integration to ocean observatories. *Deep Sea Research II,* 162:211-217. https://doi.org/10.1016/j.dsr2.2018.09.004

Smith MA, Sullender BK, Koeppen WC, **Kuletz** KJ, Renner HM, et al. 2019. An assessment of climate change vulnerability for Important Bird Areas in the Bering Sea and Aleutian Arc. *PLOS ONE* 14(4): e0214573. https://doi.org/10.1371/journal.pone.0214573

RECENT COLLABORATORS

C. Ashjian (Woods Hole Ocean. Inst.); M.A. Bishop (Prince William Sound Science Center); Kelly Benoit-Bird (Oregon State U.); R. Day (ABR, Inc., Fairbanks); E. Farley (NOAA); M. Ferguson (NOAA); A. Gall (ABR); J. Grebmeier (U. Maryland); R. Hopcroft (U. of Alaska, Fairbanks); G. L. Hunt, Jr. (U. Washington); A. Kataysky (UAF); S. Moore (NOAA); F. Mueter (UAF); S. Parker-Stetter (U. Washington); J. Piatt (Alaska Science Center, USGS); H. Renner (USFWS); M. Renner (Tern Again Consulting); M. Sigler (NOAA); R. Suryan (NOAA); A. Trites (U. British Columbia).

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

Athina Catherine Pham (MS, 2016) – Hawaii Pacific University, Honolulu, HI
Nathan Jones (MS, 2012) – Moss Landing Marine Lab, Moss Landing, CA
Brian Hoover (MS, 2012) - Moss Landing Marine Lab, Moss Landing, CA
Andrew Allyn (MS, 2011) - University of Massachusetts Amherst, MA

ERIK E. OSNAS

Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Alaska Region

EDUCATION

2004 *Ph. D. – Ecology, Evolution and Behavior,* Indiana University.
1998 *Master of Science - Zoology,* University of Western Ontario.
1995 *Bachelor of Science - Wildlife and Fisheries Biology,* University of California, Davis.

PROFESSIONAL EXPERIENCE

2015 to present, Wildlife Biologist (Biometrician), Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Alaska Region
2012 to 2015, Wildlife Biologist/Post-doctoral Research Associate, USGS Patuxent Wildlife Research Center, Laurel, Maryland
2012 Lecturer, Department of Ecology and Evolutionary Biology, Princeton University
2008 to 2012, Post-doctoral Research Associate, Princeton University
2005 to 2008, Assistant Scientist, Department of Forest and Wildlife Ecology, University of Wisconsin

SELECTED PUBLICATIONS

Kuletz, K. J., Cushing, D. A., Osnas, E. E., Labunski, E. A., & Gall, A. E. (2019). Representation of the Pacific Arctic seabird community within the Distributed Biological Observatory array, 2007–2015. *Deep Sea Research Part II: Topical Studies in Oceanography*.

Jennelle, C. S., Walsh, D. P., Samuel, M. D., Osnas, E. E., Rolley, R., Langenberg, J., ... & Heisey, D. M. (2018). Applying a Bayesian weighted surveillance approach to detect chronic wasting disease in white-tailed deer. *Journal of applied ecology*, *55*(6), 2944-2953.

Fleming-Davies, A. E., Williams, P. D., Dhondt, A. A., Dobson, A. P., Hochachka, W. M., Leon, A. E., Osnas, E.E. & Hawley, D. M. (2018). Incomplete host immunity favors the evolution of virulence in an emergent pathogen. *Science*, *359*(6379), 1030-1033.

Cohen, J. B., Hecht, A., Robinson, K. F., Osnas, E. E., Tyre, A. J., Davis, C., ... & Melvin, S. M. (2016). To exclose nests or not: structured decision making for the conservation of a threatened species. *Ecosphere*, *7*(10), e01499.

Osnas, E. E., Zhao, Q., Runge, M. C., & Boomer, G. S. (2016). Cross-seasonal effects on waterfowl productivity: Implications under climate change. *The Journal of wildlife management*, *80*(7), 1227-1241.

Osnas, EE, P Hurtado, and AP Dobson. 2015. Evolution of virulence across space during an epidemic. *American Naturalist*, *185*(3), 332-342.

Heisey, DM, EE Osnas, P Cross, DO Joly, JA Langenberg, and MW Miller. 2010. Linking process to pattern: estimating spatiotemporal dynamics of a wildlife epidemic from cross-sectional data. *Ecological Monographs,* 80: 221-240.

Osnas, EE, DM Heisey, R Rolley, and MD Samuel. 2009. Spatial and temporal patterns of chronic wasting disease: fine scale mapping of a wildlife epidemic in Wisconsin. *Ecological Applications,* 19: 1311-1322.

COLLABORATORS

Boomer, Scott, Division of Migratory Bird Management, U.S. Fish and Wildlife Service
Cushing, D. A., Pole Star Ecological Research, LLC. Anchorage, AK
Dhondt, Andre. A., Corrnell Lab of Ornithology & Department of Ecology and Evolution, Cornell University
Dobson, Andrew P., Department of Ecology and Evolution, Princeton University
Fischer, Julian, Division of Migratory Bird Management, U.S. Fish and Wildlife Service
Fleming-Davies, A. E, Department of Biology, University of San Diego
Frost, Charles, Division of Migratory Bird Management, U.S. Fish and Wildlife Service
Gall, A. E, ABR, Inc., Environmental Research & Services
Hawley, Dana M., Department of Biological Sciences, Virginia Tech
Heisey, D. M., USGS National Wildlife Health Center (retired)
Hochachka, W. M., Cornel Lab of Ornithology, Cornell University
Hurtado, Paul, Department of Mathematics and Statistics, University of Nevada, Reno
Jennelle, C. S., Minnesota Department of Natural Resources
Kuletz, Kathy, Division of Migratory Bird Management, U.S. Fish and Wildlife Service
Labunski, Elizabeth A., Division of Migratory Bird Management, U.S. Fish and Wildlife Service
Runge, Michael, USGS Patuxent Wildlife Research Center
Samuel, M. D., USGS Cooperative Wildlife Research Unit, University of Wisconsin (retired)
Walsh, D. P., USGS National Wildlife Health Center
Zhao, Qing, Department of Wildlife Ecology, University of Missouri