

EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
FY20 (YEAR 9) CONTINUING PROJECT PROPOSAL SUMMARY PAGE

Project Number and Title

Gulf Watch Alaska: Pelagic Component Project

20120114-M—Continuing the Legacy: Prince William Sound Marine Bird Population Trends

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

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Project Abstract

We will conduct small boat surveys to monitor the abundance of marine birds in Prince William Sound (PWS), Alaska. The surveys are conducted every two years and therefore occur during July 2018 and 2020 during the current Gulf Watch Alaska (GWA) funding cycle (FY17-21). Fifteen July surveys over a 30-year period have monitored population trends of marine birds in PWS after the *Exxon Valdez* oil spill. These surveys are the primary means to determine whether populations injured by the spill are recovering. Data collected from 1989 to 2018 indicated that pigeon guillemots (*Cephus columba*), marbled murrelets (*Brachyramphus marmoratus*), and Kittlitz's murrelets (*B. brevirostris*) are exhibiting long-term declines in PWS. Black-legged kittiwake (*Rissa tridactyla*) densities have also declined in PWS, at the same time that nearly complete kittiwake breeding failures were observed (2016-2018). We will continue to examine overall population trends for all marine birds in PWS, which benefit the nearshore and forage fish components of GWA, the Herring Research and Monitoring program, and the pigeon guillemot restoration project (project 20100853, PI Kuletz/Kaler/Irons) at the Naked Island Group.

We are requesting additional funds in FY20 and FY21 to continue offshore seabird surveys on the Seward Line (project 20120114-L, PI Hopcroft) that are now a part of the Northern Gulf of Alaska Long-Term Ecological Research (LTER) project. Leveraged funding previously acquired is insufficient to support the extended sampling of the LTER. These surveys continue a 20-year time series on the Seward Line and link shifts in seabird abundance and cross-shelf distribution to annual and long-term patterns observed in the inshore waters of PWS.

EVOSTC Funding Requested* (must include 9% GA)

FY17	FY18	FY19	FY20	FY21	TOTAL
\$24,900	\$222,200	\$24,900	\$247,970*	\$50,670*	\$570,640

Non-EVOSTC Funds to be used, please include source and amount per source: (see Section 6C for details)

FY17	FY18	FY19	FY20	FY21	TOTAL
\$23,000	\$56,000	\$23,000	\$134,317*	\$100,403*	\$336,720

* Totals for FY20-FY21 include an **additional annual requests of \$25.8K** (includes 9% GA) to extend at-sea seabird surveys to the recently expanded Seward Line - Northern Gulf of Alaska Long-Term Ecological Research (LTER) project. Please see Sections 2C and 6B for details. Totals for non-EVOSTC funds include PI time, the North Pacific Research Board grant that funds surveys on the Seward Line portion of the new LTER, and the US Fish and Wildlife Service contributions to that project.

1. PROJECT EXECUTIVE SUMMARY

Pelagic Component

The pelagic component research team proposed for FY17-21 to continue monitoring key pelagic species groups in Prince William Sound (PWS) using the same five projects focused on killer whales, humpback whales, forage fish, and marine birds (two projects: summer and fall-winter). Thus, the two over-arching questions for the pelagic component to answer during this 5-year period are:

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

PWS Summer Marine Bird Monitoring

Boat-based marine bird surveys have been conducted on randomized transects in PWS (Fig. 1), Alaska, over a 30-year period following the 1989 *Exxon Valdez* oil spill (EVOS). In order to better understand the dynamics of a marine bird community that has experienced the simultaneous effects of a major oil spill and climate variability, this project collects additional information to monitor the distribution and abundance of marine birds in PWS. The FY20 objectives of this project are to: (1) determine the abundance of marine bird populations in PWS during July 2020 in both oiled and unoiled regions; and (2) determine population abundance of marine bird populations in PWS during July 2020 for PWS as a whole, and (3) compare abundance trends to our 30-year time series.

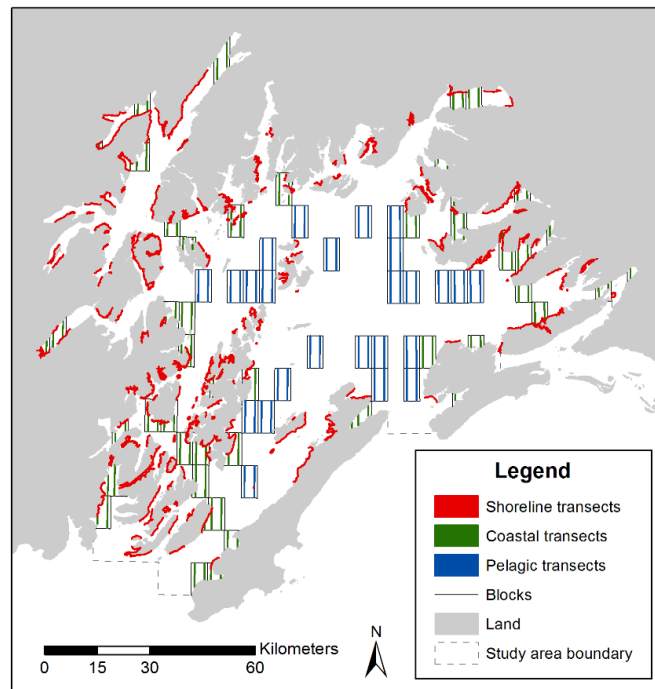


Figure 1. Location of marine bird survey transects using three strata (shoreline, coastal, pelagic) within Prince William Sound, Alaska.

Using data collected during small boat surveys (1989-2012), Cushing (2018) used taxon- and community-centric approaches to examine patterns of marine bird distribution and abundance in PWS and found marine bird communities as a whole to be spatially structured along a primary onshore-offshore environmental gradient, and secondarily structured along an estuarine-marine environmental gradient. Cushing (2018) also investigated spatial habitat associations and temporal change of *Brachyramphus* murrelets and found that abundance estimates for both marbled murrelets and Kittlitz's murrelets decreased by more than two-thirds over the study period. There was no evidence that rates of change differed along environmental or geographic gradients and no evidence that changes in seasonal patterns of abundance occurred. Density (birds/km²) of marbled and Kittlitz's murrelets continued a long-term pattern of decline in 2018 (Fig 2A, 2B). Additionally, densities of pigeon guillemots continued to decrease sound wide (Fig 2C), even with the gradual increase in pigeon guillemots at the Naked Island group, where predator control has been successful (project 20100853, PI Kaler/Irons). Also notable, complete or nearly-complete breeding failures of black-legged kittiwakes occurred in PWS 2016-2018 (Dragoo et al. 2017, 2018) and density of kittiwakes have trended downward during the same period (Fig. 2D). In 2020, we will continue to explore the hypothesis that climate variability has differentially affected nearshore and offshore components of PWS trophic groups, and how this may have contributed to the failure of some taxa to recover from effects of the EVOS.

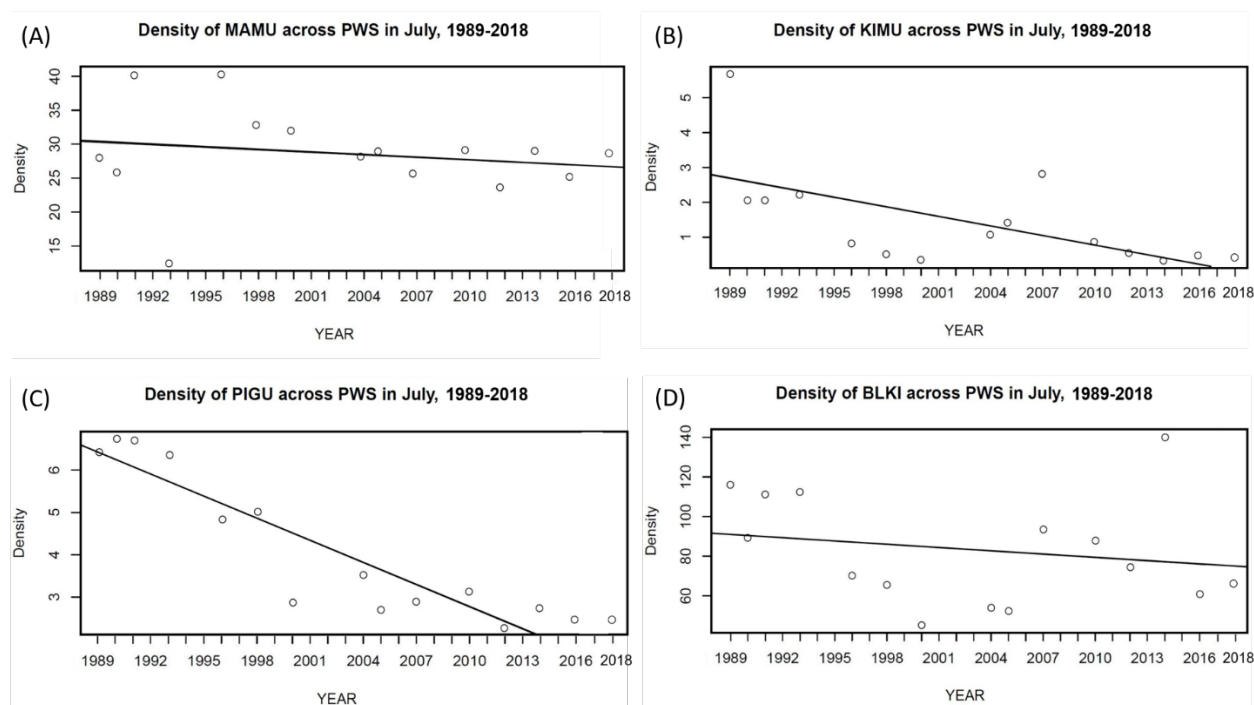


Figure 2. Density (birds/km²) estimated for (A) marbled murrelet [MAMU], (B) Kittlitz's murrelet [KIMU], (C) pigeon guillemot [PIGU], and (D) black-legged kittiwake [BLKI] across Prince Williams Sound, Alaska, 1989-2018.

Dr. Kuletz and Mr. Kaler are working with Axiom Data Science staff to ensure data management requirements are met. Dr. Kuletz and Mr. Kaler are also working with FWS Migratory Bird biometricians (Dr. Eric Osna and Dr. Charles Frost) to streamline the QA/QC process, data analysis, and report creation using applications created with Program R (www.r-project.org). We are also working with the GWA Science Coordinator (project 20120114-A, PI Suryan) and other GWA investigators to integrate marine bird datasets across GWA. Marine birds are the

only taxa where species are represented across all three GWA components - Nearshore, Pelagic, and Environmental Drivers. We expect data integration to be completed in FY20, which will allow GWA region-wide analyses of marine bird data.

Seward Line and Northern Gulf of Alaska Long-term Ecological Research (Unfunded priority FY20 and FY21)

We are proposing an addition of \$25.8K per year (including 9% GA) in FY20 and FY21 to add extended Seward Line – Long-Term Ecological Research (LTER) seabird surveys. Currently seabird surveys are funded by the North Pacific Research Board for the Seward Line (Fig. 3; one line, spring and fall cruises); this project has been extended to four lines, spring, summer, fall (Fig. 3) but without funding for the additional time at sea for seabird observers. Because the Seward Line is now part of the LTER, it is not possible to conduct only the Seward Line portion of the cruises.

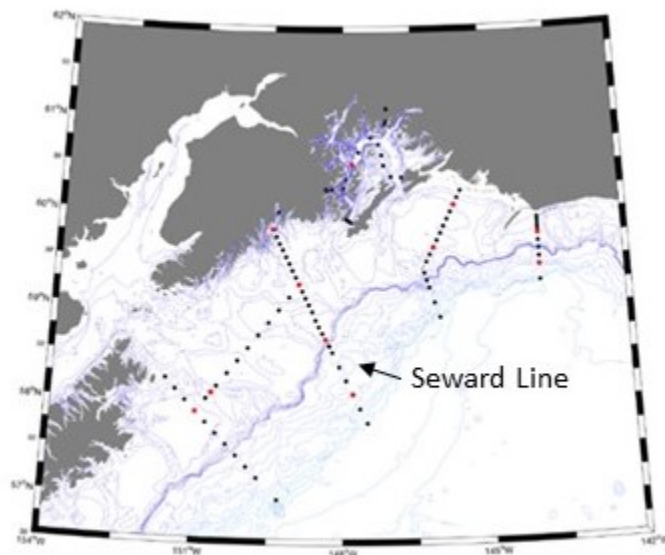


Figure 3. Northern Gulf of Alaska LTER and Seward Line monitoring stations to be surveyed annually in April/May, July, and September. Seabird surveys are conducted during transit among stations and ports of call.

This additional funding would allow us to maintain a 20-year time series sampling of the Seward Line. Previous analyses of Seward Line data from 2007-2016 found that during warm years, species that tend to be on the inner shelf (e.g., murrelets, murres, kittiwakes) moved farther inshore and into PWS. Species that tend to be more pelagic (e.g., albatrosses, storm-petrels) were less influenced by the warm water conditions. The unprecedented murre die off that occurred in the Gulf of Alaska in 2015/2016 was presaged by a sharp increase in murre density in the inner shelf and PWS during the Seward Line surveys in fall 2014 and spring 2015. These results illustrate the value of monitoring offshore patterns of distribution and abundance of seabirds to better understand population trends in inshore waters. The expanded LTER sampling would allow us to assess how bird abundance and distribution changes over a larger portion of the Gulf of Alaska and will link upper trophic level species to ecological process studies of the LTER.

We are not proposing any changes to the PWS portion of this project for FY20.

2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Project Milestones and Tasks

Table 1. This table breaks down project deliverables and their status into milestones and tasks by fiscal year and quarter, beginning February 1, 2017. Yellow highlight indicates proposed fiscal year workplan.

Additional milestones and/or tasks have been added in red. C = completed, X = not completed or planned.

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	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone 1: admin & logistics																				
Contracting & hiring					C	C							X	X						
Recruit volunteers, housing/travel & permits					C	C							X	X						
Survey vessel Preparation & Winterization		C	C			C		C						X	X					
Milestone 2: data acquisition & processing																				
Boat-based marine bird survey							C													
Marine bird data processing								C	C						X	X				
Milestone 3: data management																				
Database mgmt./QAQC	C	C	C	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X
Metadata	C								C								X			
Workspace upload		C								C				X				X		
Milestone 4: analysis & reporting																				
Analysis and summary	C				C								X				X			
Annual Reports	C				C				C				X				X			
Annual Pls meeting				C				C				X				X				X
FY Work Plan			C				C				C				X					
Permit reports				C				C				X				X				X
New Milestone 5: LTER Surveys																				
Seward Line & LTER surveys														X	X			X	X	
Seward Line & LTER data processing															X	X			X	X

In addition to the primary project deliverables in Table 1, during the past year we presented at the Pacific Seabird Group annual conference (see Section 7) and contributed data for the Suryan et al. GWA synthesis manuscript. We anticipate completing FY19 and FY20 milestones and tasks as planned.

B. Explanation for not completing any planned milestones and tasks

All sampling, milestones, and tasks were completed in accordance with our proposal and with sampling protocols available on the GWA Research Workspace.

C. Justification for new milestones/tasks

No new milestones or tasks are proposed in FY20 for the PWS surveys.

The requested funds for the combined Seward Line and LTER surveys will allow the continued collection of seabird survey data along the Seward Line (currently in-kind contribution to project 20120114-L, PI Hopcroft, funded by NPRB). This in-kind contribution to GWA is at risk of loss because there are insufficient funds to support seabird observers on the extended LTER surveys that have subsumed the Seward Line. The new funding request would support a seabird observer on the LTER cruises, thereby maintaining the spring and fall time series of Seward Line surveys (capturing trends in the full suite of seabird species that are present seasonally), greatly expand the spatial coverage of GOA seabird surveys to include the whole GWA study area, and add an additional summer survey.

3. PROJECT COORDINATION AND COLLABORATION
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A. Within an EVOSTC-funded Program

Gulf Watch Alaska

The proposed project will collaborate closely with the Forage Fish (project 20120114-C, PI Arimitsu) and Fall-Winter Marine Bird Surveys (project 20120114-E, PI Bishop) projects to collect comparable marine bird data, allowing us to compare summer and winter seabird communities and distributions. The shoreline surveys of our project will also be complimentary to the Nearshore component of GWA (project 20120114-H, PI Coletti) and the pelagic surveys (PI Kuletz) complimentary to the Environmental Drivers component (project 20120114-L, PI Hopcroft). Integration of GWA marine bird datasets will allow for comparisons across marine habitats and regions.

If funded, extended LTER surveys would greatly expand collaborations with physical and biological oceanographic sampling throughout the Gulf of Alaska (projects 20120114-L, PI Hopcroft, 20120114-I PI Danielson, 20120114-D PI Batten) and assessing the abundance and distribution of seabirds offshore of the focal colony-based Middleton Island seabird studies (project 20120114-C, PI Arimitsu).

Herring Research and Monitoring

This project provides relevant data on marine bird abundance, distribution, and foraging activities to the Herring Research and Monitoring program.

Data Management

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.

B. With Other EVOSTC-funded Projects

This PWS marine bird project complements the EVOS Trustee Council (EVOSTC) funded effort to restore pigeon guillemot to the Naked Island Complex (Naked, Peak, and Storey islands; control island for comparison: Fool, Little Smith, and Smith Islands). Dr. Kuletz, Mr. Kaler, and Dr. David Irons are co-PIs for the pigeon guillemot restoration study (project 20100853). Data collected on marine birds from the Naked Islands region, as well as population and productivity data collected at black-legged kittiwake colonies in PWS will be used to quantify population trends of species anticipated to benefit from mink removal efforts (pigeon guillemots, tufted and horned puffins, parakeet auklets, and arctic terns).

C. With Trustee or Management Agencies

The project supports the US Fish and Wildlife Service's (USFWS's) Migratory Bird Management mission to advance the conservation of migratory birds. The project will also inform other management agencies (US Forest Service, National Park Service, Alaska Department of Fish and Game) with lands and waters adjacent to our study area. The continuation of the Seward Line seabird surveys and expanded LTER surveys will complement the PWS marine bird surveys and allow us to examine oceanographic and plankton data in conjunction with seabird distribution and relative abundance, with a seasonal component, across the GWA study area. Including these offshore waters and linking them to the inshore studies will also inform the fisheries management process in the Gulf of Alaska. Data on population trends are provided to the Alaska Maritime National Wildlife Refuge for inclusion in their annual report on status and trends of seabirds in Alaska.

4. PROJECT DESIGN

A. Overall Project Objectives

Objective 1. Determine population abundance, with 95% confidence limits, of marine bird populations in Prince William Sound during July 2020 in both oiled and unoled regions.

Objective 2. Determine population abundance, with 95% confidence limits, of marine bird populations in Prince William Sound as a whole during July 2020.

B. Changes to Project Design and Objectives

No changes will be made to project design or objectives in FY20 for the PWS surveys.

The addition of funds to complete the unfunded portions of the LTER surveys will improve our understanding of trends observed in PWS and throughout the Gulf of Alaska shelf. It adds a third objective to this project: Determine the distribution and species composition of marine birds in the offshore waters of the northern Gulf of Alaska and identify seasonal and inter-annual patterns that affect population trends in PWS.

The LTER seabird surveys will follow the protocol and study design of the LTER; for details see progress reports to the North Pacific Research Board for the Seward Line Long-term Monitoring Project / Seabird Component. Available at: <http://www.sfos.uaf.edu/sewardline/> and www.aaos.org/project-seward-line-monitoring/

5. PROJECT PERSONNEL – CHANGES AND UPDATES

No changes have been made to project personnel.

6. PROJECT BUDGET

A. Budget Forms (See GWA FY20 Budget Workbook)

Please see project budget forms compiled for the program.

B. Changes from Original Project Proposal

No changes to the project budget have been made for the PWS surveys.

We are requesting an additional \$25,768 per year (including 9%/GA) for FY20-21 to cover the costs of conducting the extended LTER seabird surveys (Table 2). All requested additional funds are contractual, to extend the on-going work of Dan Cushing (Pole Star Ecological Research LLC), who has been under contract with the USFWS to conduct Seward Line surveys, process data, conduct analyses and produce reports. As a contractor, Mr. Cushing is responsible for all travel, salaries and supplies related to these surveys. The estimate is based on a daily rate of \$310, which includes: i) travel (\$2.7K); ii) days on surveys (8 extra days during spring and fall surveys, plus 18 days for new July survey); iii) data processing, quality control and archiving (10 days); extra summary analyses and reports (3 cruise reports and longer annual reports, total 20 days); integration and analysis of LTER with Seward Line data (10 days); and supplies (laptop upgrade, replacements as needed, \$4K).

Table 2. Request for additional funding (in thousands of dollars) by budget category including GA. Funds will support LTER surveys (and Objective 3) through FY21.

Budget Category	New Request FY20	New Request FY21	Total New Request
Personnel	\$0.0	\$0.0	\$0.0
Travel	\$0.0	\$0.0	\$0.0
Contractual	\$23.6	\$23.7	\$47.3
Commodities	\$0.0	\$0.0	\$0.0
Equipment	\$0.0	\$0.0	\$0.0
Annual Subtotal	\$23.6	\$23.7	47.3
9% GA	\$2.2	\$2.3	\$4.5
Total with GA	25.8	\$25.8	\$51.6

C. Sources of Additional Project Funding

For the PWS marine bird surveys, Dr. Kathy Kuletz salary (GS-13, \$11.5K per month) for two months/year and one month of GS-11 (\$6.4K) are provided as in-kind support per year. Dr. Kuletz will provide the project leader guidance and assist with data analysis and reporting. In-kind support from USFWS also includes travel to professional meetings to present results of this study (\$2K/year) and survey supplies (backup laptop, software, GPS unit) for \$5K.

If funded, the Seward Line and LTER surveys would leverage additional funding from the North Pacific Research Board (\$34.1K in FY20 and \$30.8K in FY21), as well as the in-kind in personnel time that was contributed to the Seward Line (Dr. Kuletz, 1 month/year and GS-11, 1 month/year).

7. FY17-19 PROJECT PUBLICATIONS AND PRODUCTS

Publications

- Cushing, D., D. Roby, and D. Irons. 2018. Patterns of distribution, abundance, and change over time in a subarctic marine bird community. *Deep Sea Research Part II* 147:148-163.
<https://doi.org/10.1016/j.dsr2.2017.07.012>
- Dragoo, D., H. M. Renner, and R. S. A. Kaler. 2017. Breeding status and population trends of seabirds in Alaska, 2017. U.S. Fish and Wildlife Service Report AMNWR 2018/02. Homer, Alaska.
- Dragoo, D., H. M. Renner, and R. S. A. Kaler. 2018. Breeding status and population trends of seabirds in Alaska, 2018. U.S. Fish and Wildlife Service Report AMNWR 2019/03. Homer, Alaska.
- Esler, D., B. E. Ballachey, C. Matkin, D. Cushing, R. Kaler, J. Bodkin, D. Monson, G. Esslinger, and K. Kloecker. (in press). Timelines and mechanisms of wildlife population recovery following the *Exxon Valdez* oil spill. *Deep Sea Research Part II* 147:36-42. <https://doi.org/10.1016/j.dsr2.2017.04.007>
- Kuletz, K., and R. Kaler. 2018. Continuing the legacy: Prince William Sound marine bird population trends. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-M.
- Kuletz, K., and R. Kaler. 2019. Continuing the legacy: Prince William Sound marine bird population trends. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-M.
- Kaler, R., E. Labunski, and K. J. Kuletz. 2018. Prince William Sound marine bird surveys. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-K), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.
- Stephensen, S., D. Irons, W. Ostrand, and K. Kuletz. 2016. Habitat selection by Kittlitz's *Brachyramphus brevirostris* and Marbled Murrelets *B. marmoratus* in Harriman Fjord, Prince William Sound, Alaska. *Marine Ornithology* 44:31-42. <http://www.marineornithology.org/content/get.cgi?rn=1152>

Published and updated datasets

DataONE Published Datasets

- Kaler, R., and K. Kuletz. 2017. Prince William Sound Marine Bird Data, Alaska, 2012-2016, Gulf Watch Alaska Pelagic Component. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace. <https://doi.org/10.24431/rw1k113>
- Kuletz, K. J. 2017. Seward Line and Lower Cook Inlet Marine Bird Survey Data, 2006-2016, Gulf Watch Alaska Nearshore Component. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace. <https://doi.org/10.24431/rw1k1m>.

Gulf of Alaska Data Portal Datasets

- Kuletz, K. J. 2019. Seward Line and Lower Cook Inlet Marine Bird Survey Data, 2006-2017, Gulf Watch Alaska Nearshore Component. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Gulf of Alaska Data Portal.

Research Workspace

Kaler, R., and K. Kuletz. 2019. Prince William Sound Marine Bird Data, Alaska, 2018, Gulf Watch Alaska Pelagic Component. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

Kuletz, K. J. 2019. Seward Line and Lower Cook Inlet Marine Bird Survey Data, 2018, Gulf Watch Alaska Nearshore Component. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

Presentations

Arimitsu, M., M. Bishop, D. Cushing, S. Hatch, B. Heflin, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaefer, J. Straley. 2018. Changes in marine predator and prey populations in the aftermath of the North Pacific Heat Wave: Gulf Watch Alaska Pelagic update 2017. **Poster Presentation**. Alaska Marine Science Symposium, Anchorage, AK. 22-26 January 2018.

Cushing, D., K. Kuletz, R. Hopcroft, S. Danielson, and E. Labunski. 2017. Shifts in cross-shelf distribution of seabirds in the northern Gulf of Alaska under different temperature regimes, 2007-2015. **Poster Presentation**. The 44th Meeting of the Pacific Seabird Group, Tacoma, WA. 21-25 February 2017.

Cushing, D. A., K. J. Kuletz, R. R. Hopcroft, S. L. Danielson, and E. A. Labunski. 2017. Poster presentation. Shifts in cross-shelf distribution of seabirds in the Northern Gulf of Alaska under different temperature regimes, 2007-2016. Annual meeting of the Pacific Seabird Group, Tacoma, Washington.

Esler, D., B. Ballachey, C. Matkin, D. Cushing, R. Kaler, J. Bodkin, D. Monson, G. Esslinger, and K. Kloecker. 2016. Long-term data provide perspective on ecosystem recovery following the *Exxon Valdez* oil spill. **Oral presentation**. Gulf of Mexico Oil Spill and Ecosystem Science Conference, Tampa, Florida.

Kuletz, K. 2019. Data from GWA-funded marine bird surveys and LTER surveys were presented at the Marbled Murrelet Technical Committee, Kittlitz's Murrelet Technical Committee, Tufted Puffin Technical Committee, Seabird Monitoring Committee, and Short-tailed Albatross Recovery Team meeting. **Oral presentation**. Pacific Seabird Group (PSG) annual conference, 27 February-2 March 2019, Kauai, Hawaii.

Kuletz, K. J., D. A. Cushing, R. R. Hopcroft, S. L. Danielson, and E. A. Labunski. 2017. Running hot and cold: Shifts in seabird distribution in the Northern Gulf of Alaska under different temperature regimes, based on Seward Line surveys, 2017-2015. **Poster presentation**. Alaska Marine Science Symposium, Anchorage, Alaska.

K. Kuletz, R. Hopcroft, S. Danielson, J. Santora, W. Sydeman, B. Hoover, D. Cushing. 2018. Seabird distribution relative to biophysical oceanographic properties in North Pacific ecosystems: a comparison of the Gulf of Alaska and California Current Ecosystem LTERs. **Poster presentation**. All Scientist Meeting of Long-term Ecosystem Research projects, sponsored by the National Science Foundation, September 30 – October 4, 2018, Pacific Grove, California.

Piatt, J., T. Jones, K. Kuletz, H. Renner, J. Parrish, R. Corcoran, S. Schoen, B. Bodenstein, R. Kaler, M. Garcia-Reyes, H. Coletti, M. Arimitsu, R. Duerr, K. Lindquist, J. Lindsey, and W. Sydeman. 2018. Unprecedented scale of seabird mortality in the NE Pacific during the 2015-2016 marine heat wave. **Oral Presentation**. Alaska Marine Science Symposium, Anchorage, AK. 22-26 January 2018.

Outreach

- Kaler, R., K. Kuletz, D. Dragoo, and H. Renner. 2017. Unusual observations of seabirds in the Gulf of Alaska following the 2015-2016 mass die-off. Delta Sound Connections. <http://pwssc.org/wp-content/uploads/2017/06/DSC-2017-web2.pdf>.
- Robinson, R., A. Rademacher, R. Kaler, and D. Aderhold 2018. Coastal Observation and Seabird Survey Team die off alert training in Seldovia, AK, May 18.
- Kaler, R. 2019. Naked Island Seabird Restoration, Youth Marine Expedition, Organized by Lisa Matlock, Prince William Sound Regional Citizen's Advisory Council. The youth on this trip were a mix of grades 6-8 and included both diverse urban Anchorage kids (some of whom had never been on a hike or on a boat before this trip) and kids from the EVOS region (this year included Cooper Landing, Seward, Girdwood, and Whittier). The EVOS funded seabird restoration effort at the Naked Islands group provided the youth a chance to learn about field biology, social attraction efforts to expedite the recovery of extirpated seabirds, and learn about what seabirds feed their young. Special thanks to Sam Stark and Alexa Piggot (Oregon State University) for making time to connect kids with nature.

LITERATURE CITED

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