

1. Program Number:

17120114-E

2. Project Title:

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

3. Principal Investigator(s) Names:

Mary Anne Bishop, Ph.D., Prince William Sound Science Center
Report prepared by: Anne Schaefer, M.Sc., Prince William Sound Science Center

4. Time Period Covered by the Report:

February 1, 2017-January 31, 2018 (Year 6)

5. Date of Report:

March 2018

6. Project Website (if applicable):

www.gulfwatchalaska.org
<http://pwssc.org/seabirds/>

7. Summary of Work Performed:

This project uses vessels of opportunity to monitor marine birds in Prince William Sound (PWS), Alaska during fall and winter (September through March). These time periods are critical for survival as food tends to be relatively scarce or inaccessible, the climate more extreme, light levels and day length reduced, and water temperatures cooler. By monitoring marine birds during fall and winter, we will improve our predictive models of species abundance and distribution across PWS in relation to biological and physical environmental factors. Furthermore, continued monitoring will help determine marine bird vulnerability to future perturbations and environmental change, including oil spills.

The specific objectives of this study are to:

1. Characterize the spatial and temporal distribution of marine birds in PWS during fall and winter.
2. Estimate marine bird abundance and distribution in areas with known seasonally predictable aggregations of predators and prey.

- a. relate marine bird presence to prey fields identified during concurrent hydroacoustic surveys.
 - b. characterize marine bird-humpback whale foraging dynamics.
3. Model species abundance in relation to physical and biological variables across time and space.

In FY17, all cruises were completed as expected and there have been no changes to the project. In this FY17 report, we summarize 2017 fieldwork and provide preliminary results addressing objectives 1, and 2a. Objectives 2b and 3 will be addressed as more data become available.

2017 Field Work and Preliminary Analyses

During FY17 (1 February 2017 – 31 January 2018), one observer (Anne Schaefer) with the Prince William Sound Science Center (PWSSC) conducted four marine bird surveys in PWS, covering a total of 1,241 km (Table 1; Fig. 1). In September 2017, we conducted seabird surveys as part of the Gulf Watch Alaska Integrated Marine Predator-Prey (IMPP) Survey (National Oceanic and Atmospheric Administration [NOAA]/U.S. Geological Survey [USGS]/PWSSC). The multi-project effort also surveyed humpback whales and forage fish (including euphausiids).

Ships of opportunity used for additional FY17 marine bird surveys included vessels surveying spot shrimp (Alaska Department of Fish and Game [ADF&G]) and juvenile walleye pollock (NOAA). We also surveyed marine birds concurrently with the annual maintenance cruise for the Ocean Tracking Network (OTN) acoustic arrays stationed across the major entrances and southwest passages of PWS and serviced by the PWSSC. We conducted an additional ship of opportunity marine bird survey during summer in the western Gulf of Alaska aboard the NOAA Ship Oscar Dyson, coordinated by Kathy Kuletz (17120114-L) and the GWA project management team (17120114-A) who were informed by NOAA that the cruise had available space to accommodate a seabird scientist.

All surveys followed established U.S. Fish and Wildlife Service (USFWS) protocols (USFWS 2007). Briefly, the observer recorded the number and behavior of all marine birds and mammals within a 300 m fixed-width strip (150 m on either side of the vessel) into a GPS-integrated data entry program (dLOG). The observer identified species to the lowest taxonomic unit possible. For each 3 km segment of the surveyed trackline, we calculated bird density (birds/km²) for 12 species or species groups for each survey (Table 2).

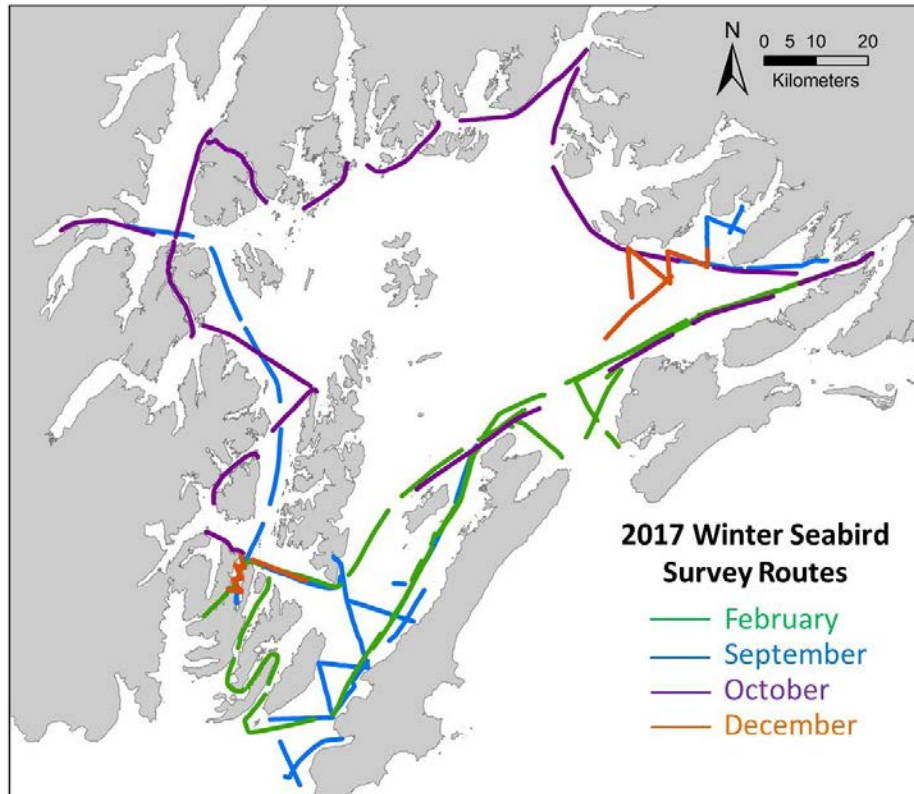


Figure 1. Spatial coverage of the four marine bird surveys completed in Prince William Sound, Alaska during FY17.

Table 1. Fall through winter marine bird surveys, FY17.

Cruise	Km surveyed	Observer	FY17 Cruise Dates
PWSSC OTN Maintenance	483	A. Schaefer	Feb 7-10 & 17-20, 2017
NOAA, USGS, PWSSC EVOSTC Gulf Watch Alaska IMPP	346	A. Schaefer	Sep 17-23, 2017
ADF&G Shrimp	331	A. Schaefer	Oct 12-23, 2017
NOAA Pollock	81*	A. Schaefer	Dec 1-6, 2017

*Inclement weather throughout this cruise limited the survey effort.

Table 2: Density (birds/ km² ± 1SE) of main species groups observed within the 300 m transect strip during FY2017. Highest density values observed for each species are indicated in bold.

Species Group	February	September	October	December
Murrelets	6.57 (1.85)	0.36 (0.11)	0.08 (0.04)	2.24 (0.85)
Murres	7.18 (0.86)	0.57 (0.23)	0.17 (0.13)	2.24 (0.94)
Cormorants	0.51 (0.11)	0.13 (0.05)	0.23 (0.10)	0.52 (0.28)
Loons	0.31 (0.10)	0.07 (0.03)	0.17 (0.05)	0.68 (0.32)
Mergansers	0.09 (0.06)	0 (0)	0.17 (0.17)	0 (0)
Large Gulls ^a	2.26 (0.43)	0.64 (0.11)	0.73 (0.12)	1.20 (0.29)
Small Gulls ^b	0.87 (0.29)	0.06 (0.03)	1.54 (0.45)	0.64 (0.24)
Black-legged Kittiwakes	0.18 (0.06)	5.47 (1.61)	1.19 (0.28)	0 (0)
Scoters	0 (0)	0.30 (0.20)	0.22 (0.13)	0.32 (0.28)
Grebes	0 (0)	0 (0)	0 (0)	0 (0)
Harlequin Ducks	0 (0)	0.05 (0.05)	0.13 (0.06)	0 (0)
Inshore Ducks ^c	0.06 (0.04)	0 (0)	0.96 (0.77)	1.20 (1.20)
Total	17.93 (2.88)	7.64 (1.76)	5.60 (1.23)	9.04 (1.96)

^aLarge gulls = primarily Glaucous-winged Gulls, but also Herring gulls

^bSmall gulls = primarily Mew gulls, but also Sabine's and Bonaparte's gulls

^cInshore ducks = include Barrow's and Common Goldeneye, and Bufflehead

Gulf Watch Alaska Integrated Marine Predator-Prey Survey

In September 2017, we conducted marine bird surveys as part of the Gulf Watch Alaska IMPP Survey (NOAA/USGS/PWSSC). The multi-project effort also surveyed humpback whales and forage fish (including euphausiids) to provide a better understanding of interspecies foraging dynamics and forage fish availability in PWS. Overall, humpback whale and marine bird numbers were lower than expected during the September survey. Results from the FY17 survey are summarized below:

Hydroacoustic/Marine Bird Transects: During the IMPP surveys, marine bird observations are recorded concurrent with hydroacoustic fish and krill surveys along fixed transect lines. These transects were designed to sample areas of persistent humpback whale feeding locations in Montague Strait, Bainbridge Passage, and Port Gravina. In September, bird observations were conducted simultaneously with hydroacoustic surveys, over 134.5 km of

effort. These survey results (in addition to observations recorded while transiting between sampling locations) are included in Table 2.

Forage Flock/Humpback Whale Foraging Dynamics: When a forage flock is encountered during surveys, the marine bird observer records if there are any marine mammals associated with the flock (within 150 m of flock), the time and position of the encounter, species composition, and number of individuals per species in the forage flock. During the September cruise, 5 foraging flocks were recorded during surveys. One humpback whale was associated with a flock of 46 birds (42 black-legged kittiwakes and 4 marbled murrelets) located off Gravina Point. The whale surfaced in the middle of the foraging flock, after which the group of birds quickly dispersed.

Focal follows of individual whales are conducted opportunistically, during which hydroacoustic surveys for fish and zooplankton occur simultaneously. During focal follows, the marine bird observer goes off formal survey effort and only records encounters between the focal whales and marine bird aggregations. During the September survey, only one focal follow was conducted. The focal follow occurred in Montague Strait over 7 km, during which the whale did not interact with any forage flocks.

Impact of North Pacific Heat Wave on Common Murre

Our long-term marine bird observations extended through a period of persistent high ocean temperatures in the North Pacific Ocean (aka “The Blob”) occurring from 2014 through 2016. Throughout the warm water event, we detected several changes in the behavior, abundance, and distribution of common murre in PWS during the non-breeding season.

Beginning in March 2015, observations of dead murre floating in the water or washed up on beaches began to be reported to wildlife officials along the Gulf of Alaska. The die-off continued through the summer and then spiked in December 2015 and early January 2016 after a period of severe storms and high winds. Examination of carcasses sent to the USGS National Wildlife Health Center determined starvation to be the cause of death.

During The Blob event, we observed higher densities of common murre within PWS throughout the non-breeding season (Fig. 2) as compared to years before and after the event. Common murre are typically scarce in PWS during early winter but become the most abundant birds by late winter (March). Since the end of the warm water period, murre densities appear to have decreased to levels below historical averages.

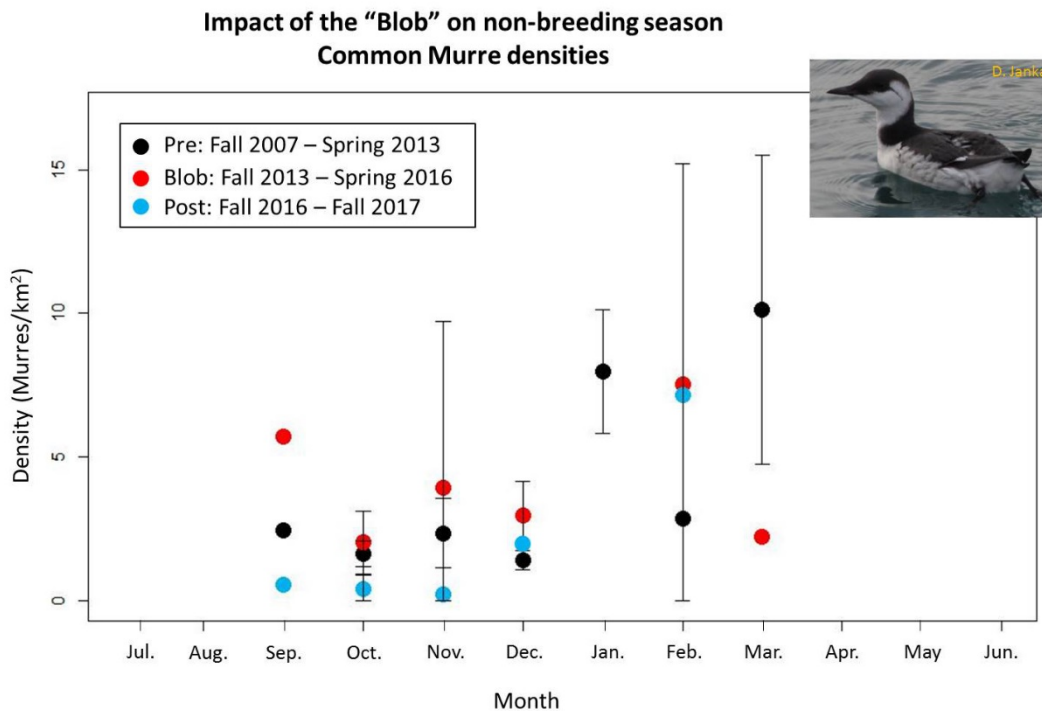


Figure 2. Throughout the recent period of persistent high ocean temperatures in the North Pacific Ocean known as the "The Blob" (Fall 2013-Spring 2016), we observed higher densities of common murre within Prince William Sound during the non-breeding season. However, since the end the warm water event (Fall 2016-Fall 2017), murre densities appear to have decreased to levels below historical averages. Error bars (95% C.I.) denote variance between surveys and are shown for months when two or more surveys were conducted during a given period.

The increased use of PWS by murres throughout the non-breeding season may have signaled a change in food availability in the Gulf of Alaska due to the unusually warm water temperatures. Therefore, murres may have used PWS as a refuge from poor conditions in the Gulf of Alaska.

Future Work

We are not proposing any major changes to this project for FY18. In FY18, marine bird observations will be conducted in February (Alaska Ocean Observing System [AOOS] funded OTN maintenance cruise, PWSSC), March (NOAA juvenile pollock survey), September (Gulf Watch Alaska IMPP Survey, NOAA/USGS/PWSSC), and October (ADF&G spot shrimp survey).

We are continuing our work to evaluate associations between Pacific herring (*Clupea pallasii*) and marine birds during winter. Pacific herring was identified as a resource

injured by the 1989 *Exxon Valdez* oil spill. Concurrent with the decline in Pacific herring abundance, several seabirds wintering in PWS have demonstrated a reduced capacity to recover post-oil spill, which could be related to reduced forage fish availability. Despite the dynamic association between seabirds and forage fish, few studies have addressed seabird-herring relationships during winter months and the potential for effects on population recovery. For this retrospective analysis, we are using seabird observation data collected concurrently with hydroacoustic herring surveys in PWS during 2008-2012 November and March cruises. Analysis of these data will allow us to characterize the abundance of seabird predators in relation to prey abundance and distribution and to understand habitat and fish school characteristics that influence seabird presence and abundance in PWS. Our findings will be submitted to a peer-reviewed journal in FY18.

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

Integrated Marine Predator-Prey Survey: Our project part of the pelagic monitoring component. This project shares research vessels associated with the IMPP Surveys conducted in September. Marine bird observations from this project are integrated into the humpback whale surveys (17120114-O) and forage fish surveys (17120114-C).

Our program also complements the pelagic component's PWS Marine Bird Summer surveys conducted by USFWS (17120114-M) and allows for regional comparisons of marine bird densities and environmental drivers with Seward Line/Gulf of Alaska (17120114-L) and Kachemak Bay/Lower Cook Inlet (17120114-J), and nearshore surveys in PWS, Kenai Fjords, Kachemak Bay, and Katmai (17120114-H).

2. Across Programs

a. Herring Research and Monitoring

As currently designed for FY17-21, the fall/winter marine bird project will not be conducting marine bird surveys onboard any PWS Herring Research and Monitoring (HRM) program cruises because no herring cruises are scheduled during the fall and winter months. However, our data will complement the suite of data collected by this program, including insertion of key predator data into the population modeling of herring. As part of the integrated marine predator-prey surveys we will collect forage fish for PI Kristin Gorman's Herring Age at Maturity project (17170111-D).

b. 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.

c. Lingering Oil

Data collected by our project is relevant for understanding trends in winter bird distribution in PWS with respect to studies of lingering oil.

B. Projects not Within a Trustee Council-funded program

Results from our project provide information on trends in the non-breeding abundance of marine birds that are part of a study at the Naked Island group (Naked, Storey, & Peak islands, project 17100853) to assess recovery of pigeon guillemots and other marine bird species (e.g., Arctic tern, parakeet auklet, tufted puffin) that were extirpated by mink introduced to the breeding islands.

C. With Trustee or Management Agencies

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

- Alaska Department of Fish and Game: Jan Rumble. ADF&G provides a berth for a marine bird observer during the October shrimp surveys.
- Alaska Ocean Observing System/Prince William Sound Science Center: Mary Anne Bishop. PWSSC provides a berth for a marine bird observer during the February cruise to download data from the OTN arrays. Currently PWSSC maintains the array for OTN on an annual basis and AOOS provides funding to cover the costs of array maintenance.
- National Oceanic and Atmospheric Administration: PI Ron Heintz. NOAA provided a berth for a marine bird observer during the December juvenile pollock survey and has agreed to provide a berth for their March 2018 juvenile pollock survey.
- U.S. Fish and Wildlife Service: Information from this project will feed into the *North Pacific Pelagic Seabird Database*, a database that is maintained by USFWS and USGS.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

Stocking, J. S., M. A. Bishop, and A. Arab. 2017. Spatio-temporal distributions of piscivorous birds in a subarctic sound during the nonbreeding season. *Deep-Sea Research II*. <http://dx.doi.org/10.1016/j.dsr2.2017.07.017>.

Bishop, M. A. 2018. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. *Exxon Valdez Oil Spill Restoration Project Final Report (Project 16120114-C)*. Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

Arimitsu, M., M. A. Bishop, S. Hatch, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaefer, and 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, January 2018, Anchorage, AK.

Schaefer, A. L., M. A. Bishop, and R. Thorne. 2018. Non-breeding marine bird response to forage fish schools in Prince William Sound, Alaska. **Poster Presentation**. Alaska Marine Science Symposium, January 2018, Anchorage, AK.

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

Bishop, M. A. 2017. Fall and Winter Seabird Abundance Data, Prince William Sound, 2007-2016, 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/rw1k1w>.

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

All data sets and metadata are on schedule.

- PWS Fall and Winter 2016-2017 seabird observations.csv": uploaded and published to data portal.
- PWS Fall and Winter 2017-2018 seabird observations.csv": uploaded to data portal and updated after each cruise; will be published summer 2018.

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comments and Responses on Revised FY17-21 Proposal, September 2016

In September 2016 the Science Panel commented: The Panel was pleased with the changes made by the PIs in response to Panel comments, including the methodology. Some concerns were raised about the interpretation of data given that survey tracks are specifically targeted to the presence of whales. If survey tracks are chosen because of whale foraging presence, then how useful will it be to use these data to detect associations? Almost by definition any birds in their survey will be associated with whales. The question is, how close and are they interacting? Is 150 m close enough? Too close?

PI Response: The methods for this project, including the integrated predator-prey surveys in PWS, were clarified in the FY2018 work plan.

Science Panel Comments and Responses on FY18 Work Plans, September 2017

In September 2017 the Science Panel commented: This proposal was very well presented and seems very reasonable. The Panel was pleased to see that the PI incorporated previous suggestions into the proposal. The Panel commends the PI's effort to integrate seabirds and mammals in her work on herring.

Regarding a statement on pg. 66 of this proposal: "As currently designed for FY17-21, the fall/winter marine bird project will not be working directly with the PWS Herring Research and Monitoring Program." The Panel would like clarification on what is meant here. The Panel recommends coordinating and collaborating to the extent reasonable.

PI Response: Thank you for the opportunity to clarify our coordination and collaboration with the HRM program. In past years, we have placed a marine bird observer onboard HRM project cruises. The HRM program has no scheduled cruises between September 2018 and March 2019. Thus, we are not able to collaborate directly with HRM during FY18. However, this project will share data with the HRM program and we will explore possibilities for joint publications.

11. Budget:

Please see the attached program workbook.

Personnel cost for this project was underspent in FY17 because projects nearing completion had salary funding that needed to be spent down first.