ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

12120114-A

2. Project Title: *See,* Reporting Policy at III (C) (2).

Continuous Plankton Recorder Sampling

3. Principal Investigator(s) Names: *See,* Reporting Policy at III (C) (3).

Sonia Batten

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014-January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

March 1, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

and information on the whole North Pacific CPR survey available at:

http://pices.int/projects/tcprsotnp/default.aspx

www.sahfos.org

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

There were no issues with the sampling during 2014 and all six transects were sampled successfully. We did begin the sampling season earlier, in March, since conditions were unusually warm in early 2014 and we wanted to capture the start of the spring increase. The final sampling was therefore a little early, at the very end of August, instead of September. The table below gives the actual sampling dates. At this time, data are finalized for March to June samples, and still provisional for the July and August samples.

Deliverable/Milestone	**Status**
February 2014 Set up for start of field season, ship equipment to west coast ports	• Completed
March 2014 • First transect	• Sampled 22-24 March, data available
April 2014 • Second transect	• Sampled 24-26 April, data available
May 2014 • Third transect	• Sampled 24-26 May, data available

June 2014 • Fourth transect	• Sampled 26-28 June, data available
July 2014 • Fifth transect	• Sampled 26-28 July, data available
August 2014 • Sixth transect	• Sampled 28-30 August, preliminary data available

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

8a. Within Gulf Watch Alaska, the main collaborative focus has been understanding how the physical environment influences the plankton variability. This work was included in the Environmental drivers sections of the Synthesis Report, was presented at AMSS 2015, and is also included in a manuscript in preparation. We have also focused in the last few months on integrating the plankton data with herring larvae growth measurements made within the Herring Research and Monitoring program. Again, a manuscript is in preparation, and an example is given below in the highlights section.

8b and c. At this time there is no coordination with other EVOS TC funded projects, or other Trustee Agencies.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

Publications produced during the reporting period: None published during the year.

Conference and workshop presentations and attendance during the reporting period:

- Dr Batten gave 2 talks at the North Pacific Marine Science Organisation (PICES) Annual Meeting, One was given in the general Biology session: "*Pseudo-nitzschia* diversity in the North Pacific from Continuous Plankton Recorder surveys" and one talk was given in a session devoted to plankton time series: "The North Pacific CPR Survey; History, evolution and lessons learned".
- Dr Batten gave a talk at the January 2015 Alaska Marine Science Symposium entitled "Interannual variability in lower trophic levels on the Alaskan Shelf"

Data and/or information products developed during the reporting period, if applicable:

- Contribution to the NOAA Ecosystem Considerations report, http://access.afsc.noaa.gov/reem/ecoweb/index.cfm.
- Data sets and associated metadata have been uploaded to the program's data portal.
- Finalised 2013 plankton data were uploaded, together with the metadata (2014 will be uploaded later in 2015 when all 2014 data have been finalized).
- 2014 along-transect temperature data were uploaded.

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

N/A

11. Budget: *See,* Reporting Policy at III (C) (11).

No deviations in spending from the proposed budget, see attached.

ATTACHMENT C *EVOSTC Annual Project Report Form*

Form Rev. 10.3.14

1. Program Number: *See,* Reporting Policy at III (C) (1).

14120114-C

2. Project Title: *See,* Reporting Policy at III (C) (2).

Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound.

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

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

Report prepared by: Anne Schaefer

4. Time Period Covered by the Report: *See,* Reporting Policy at III (C) (4).

February 1, 2014 – January 31, 2015

5. Date of Report: *See,* Reporting Policy at III (C) (5).

February 17, 2015

6. Project Website (if applicable): *See,* Reporting Policy at III (C) (6).

www.gulfwatchalaska.org

http://pwssc.org/research/birds-2/seabirds/

7. Summary of Work Performed: *See,* Reporting Policy at III (C) (7).

The objectives of this project are:

1. Characterize the spatial and temporal distribution of seabirds in PWS during late fall and winter.
2. Relate seabird presence to prey fields identified during hydroacoustic surveys.
3. Identify critical biological and physical habitat characteristics for seabirds across PWS within and between winters.
4. Utilize increased temporal sampling resolution to improve our estimates of consumption of herring by seabirds during the winter.

For this FY14 report we provide preliminary results that address objectives 1, 3 and 4. Objective 2 will be addressed as hydroacoustic survey data becomes available from the juvenile herring surveys.

2014 Field Work and Preliminary analyses

During FY14 (1 February 2014-31 January 2015), two observers (Jessica Stocking and Anne Schaefer) with the Prince William Sound Science Center (PWSSC) performed seven marine bird surveys in PWS covering a total of 2041 km (Table 1). Six surveys occurred during fall and winter months while a seventh survey was conducted in summer (July) 2014 as part of a joint-pilot survey with NOAA and USGS. The July survey developed methods for characterizing multispecies predator-prey aggregations, specifically interactions between humpback whales, forage fish, and forage flocks of seabirds. The ships of opportunity used for the 2014 surveys included vessels surveying Pacific herring (EVOS Herring

Research Monitoring PWSSC), spot shrimp (Alaska Dept Fish & Game), and humpback whales (EVOS Gulf Watch NOAA). We also surveyed marine birds concurrently with the annual maintenance of the Ocean Tracking Network (OTN) acoustic arrays that are stationed across the major entrances and southwest passages of PWS and serviced by the PWSSC.

All surveys followed the established U.S. Fish and Wildlife Service 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). Observers identified species to the lowest taxonomic unit possible. For each 3-km segment of the surveyed trackline, we calculated bird density (birds/km^2) for 11 species or species groups (Table 2).

<u>Comparison of 2013/2014 and 2014/2015 winters.</u> Although this reporting period only covers surveys completed in 2014, we present data summaries for the 2013/14 winter (n = 5) and the 2014/15 winter (up to December 2014, n = 4), with emphasis placed on the 2014 surveys (n=6). Due to the unique nature of the July survey, it is not included in any summary data in this report, unless specifically noted.

During the 2014 surveys we observed 34 avian species during 1917 km of survey effort (excluding July), with an average density of 10.99 ± 32.62 (SD) per square km. When we analyzed by winter, during the 2013/14 winter, 33 species were observed over 1348 km of surveyed tracklines, with an average density of 8.59 ± 16.30 (SD) marine birds per square kilometer. Birds were observed in the greatest densities in December. To date for the 2014/15 winter, we have observed 31 species in 1363 km of survey effort. Average density for the four cruises (Sept., Oct., Nov., Dec.) has been 11.38 ± 36.71 (SD) marine birds per square kilometer with the highest density recorded during September.

We observed pronounced temporal patterns in species occurrence over both winters, emphasizing the importance of not characterizing the nonbreeding season as a single time period when describing seabird communities (Fig. 1, Table 2). During the two winters, we observed the highest densities of *Brachyramphus* murrelets in December (2013/14 winter) and November (2014/15 winter). The lowest densities of *Brachyramphus* murrelets were recorded in September (2014) and October (2013 and 2014) when murrelets emigrate from PWS to complete their pre-basic molt. Across both winters, murrelets were distributed throughout PWS with the highest densities occurring in the northeastern portion of the Sound (Figs. 2, 3).

As in previous years, during 2014 common murre was the most numerous species observed during PWS marine bird surveys. Common murre was most dense in December during the 2013/14 winter and in September during the 2014/15 winter (Table 2). Similar to *Brachyramphus* murrelets, the highest congregations of murres were observed in the northeastern region of the Sound (Figs. 2, 3). Black-legged kittiwakes were broadly distributed throughout PWS in both winters (Figs. 2, 3) and had the highest observed densities of any species, peaking in September 2014. After the breeding season, kittiwakes disperse to over-wintering areas outside of PWS (McKnight et al. 2011), which was evident in the drop of observed densities during November and December both years, as well as February 2014. Loons were recorded primarily along the eastern side of PWS (Figs. 2, 3), with densities peaking in February 2014. Other notable observations made during 2014 were fork-tailed storm petrels, shearwaters, jaegers, and red-necked phalaropes, which were observed only during the September survey (with the exception of one storm petrel observation in December).

Collaborative September Montague Strait project. An analysis of the previous seven winters of marine bird surveys (2007/08 through 2013/2014) showed that Montague Strait is a "hotspot" for marine birds (Fig. 4). Similarly, the Gulf Watch NOAA Humpback Whale project identified this area as a "hotspot" for whales and the Herring Research Management (HRM) Post-spawn movements of Herring project previously has recorded acoustic-tagged herring reappearing in Montague Strait from September through December (M. Bishop unpubl. data). Based on these results, in September 2014 we collaborated with three other EVOS-funded projects (Gulf Watch NOAA Humpback Whale, Gulf Watch USGS forage fish, PWSSC (HRM) Validation project) to investigate multispecies predator-prey aggregations, specifically interactions between humpback whales, forage fish, and forage flocks of seabirds, in Montague Strait. In particular, the September survey addressed objective 4 of this project.

Humpback whales may take advantage of seabird feeding activity by using feeding flocks of marine birds as visual cues to prey concentrations. To characterize these relationships between marine predators and their prey resources, we recorded marine bird observations concurrent with humpback whale surveys and hydroacoustic transects. We focused particular attention on foraging flocks of marine birds and noted whether or not any whales were associated with the flock. In future surveys, when possible during whale/forage flock interactions, we will take repeated observations every 30 seconds and record variables such as the distance between the whale and the flock, whale behavior (traveling or diving), and the size and density of the forage flock.

During the September survey, we observed 10 foraging flocks, of which 2 were associated with humpback whales. Both encounters were recorded directly south of Knowles Bay, near Port Gravina. One flock consisted of approximately 209 marine birds, including black-legged kittiwakes (n = 170), glaucous-winged gulls (n = 20), common murre (n = 15), loons (n = 2), and pomarine jaegers (n = 2). The other forage flock consisted of 72 marine birds, including common murre (n = 55), black-legged kittiwakes (n = 14), Pacific loon (n = 1), and unidentified gulls (n = 2).

October ADFG survey between year comparison. This was our second year conducting marine bird surveys in October concurrent with the ADF&G spot shrimp survey. The design of the shrimp survey involves repeated visits to the same study sites year after year, thus the survey routes were relatively consistent spatially (Oct. 2013: 303 km surveyed; Oct. 2014: 349 km surveyed) and provided broad-scale coverage of PWS (Fig. 5A). These two surveys were consistent temporally, as well: both the 2013 and 2014 spot shrimp surveys were conducted over the same time span (October 12–23 both years). Due to the high spatial and temporal overlap, we completed a preliminary comparative analysis of community structure between these two surveys.

For species richness and diversity analyses, we removed all unidentified individuals from the dataset (with the exception of *Brachyramphus* murrelets, which were pooled). For each survey, we calculated the Menhinick's species richness index (Magurran 2004), which accounts for variation in sample size. Species diversity indices measure the degree to which the overall sample of observed birds is dominated by few species (lower diversity) or by a more even mix of species (higher diversity). We used the Shannon-Weiner index (Shannon and Weaver 1949) to quantify total species diversity for each survey and for each 3-km segment of surveyed trackline from each survey. For the latter analysis, unidentified birds and birds not assigned to a taxonomic group were excluded. We then mapped the 3-km segment diversity values to compare spatial patterns between October 2013 and October 2014.

Average marine bird densities were higher (Table 3) and relatively more broadly distributed in 2014 than in 2013 (Fig. 5B). In 2013, observations were recorded primarily in the northeastern and southwestern portions of PWS. After eliminating unidentified birds from the dataset, 572 birds were recorded in 2013 and 1013 birds in 2014. Despite the difference in total number of marine bird observations, the same number of species was observed in both surveys ($n = 21$). The species richness index was 0.88 in 2013 and 0.66 in 2014 and the species diversity index was 2.062 in 2013 and 1.701 in 2014. Rank abundance curves provide further insights into differences in community structure between 2013 and 2014 (Fig. 6). In October 2014, the community was dominated primarily by gulls and murres, with black-legged kittiwakes making up over 50% of all observations. In October 2013, dominance in the observations was shared by a mix of murres, gulls, goldeneyes, and storm-petrels. In 2013 the spatial distribution of diversity was concentrated primarily along the eastern side of PWS (Fig. 7). Conversely, in 2014 the spatial distribution of species diversity was scattered, with concentrations in the eastern, northern, and southwestern portions of the Sound (Fig. 7). Therefore, although birds were observed in greater densities and frequencies in 2014, the community structure recorded in 2013 was generally richer and more diverse.

With only two years of data, it is difficult to determine the reasons (biological or sampling variation) for differences in observed community structure between the two surveys. However, with continued collaboration with ADF&G on this survey, we will gain the opportunity to explore the effects of explanatory variables on the community structure of marine birds in PWS.

Analyses of 2007/2008 – 2013/2014 survey data

In spring 2014 we hired Dr. Ali Arab of Quanticipate Consulting to assist with modeling habitat associations for the first seven winters of data. While this work is still in progress, here we provide our rationale and some of the preliminary results of this analysis.

Previously we modeled habitat associations using a two-stage hurdle model (Zuur et al. 2012; Dawson et al. *in press*). A major assumption of the hurdle model is that all zeros are instances of absence, i.e. they are "true zeros". Detection is not a perfect process, particularly in the case of sampling animals; therefore, the probability of detection given presence is nearly always <1. In order to incorporate imperfect detection into our estimates of occupancy and relative abundance we transitioned to a modeling framework that allows us to incorporate some detection-level covariates into an explanation of a portion of the zero values. We use zero-inflated Poisson (ZIP) models to incorporate zeros that we suspect are due to lack of detection of birds that were present. One drawback, however, is that the interpretation of the probabilities becomes more complicated because zeros arise from more than one process including unsuitable habitat, non-detection of birds that are present, or simply part of the stochastic process (i.e. habitat, etc. was suitable but no bird was present). However, the focus of the analyses is not on the value of parameter estimates, per se, but is on changes in distribution predicted by the models.

Our exploratory analyses using the ZIP models found that of the detection covariates, glare is significantly associated with the probability of an excess zero for most species groups (Table 4) and is a significant predictor of all groups' count distributions. Bin (distance from the observer) is also consistently significant in explaining the probability of excess zeros across species groups and is significant in the count portion of the model for most groups. Our exploratory analyses also showed that of the temporal covariates, the variables winter (survey year) and day of the season were consistently significant in driving bird distributions. Of the environment-derived covariates, the variable marine habitat type was significant in nearly all cases. Distance to shore, SST, bathymetry, and slope were not consistent across species groups, likely expressing complicated or non-linear relationships with bird distributions. Spatial variables latitude and longitude were significant for most species groups.

Deliverable/Milestone	Status
Complete fall/winter surveys	6 fall/winter surveys completed, 1 summer survey completed with NOAA/USGS collaboration
Attend annual meetings and workshops	Dr. Bishop attended the annual meeting, AMSS program meeting, and the EVOSTC joint science workshop in addition to two program conference calls.
Complete data summaries and reports	Year 4 workplan submitted in August, 2014 and approved. Research summaries for synthesis report completed. This report constitutes year 3 annual report

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

8.A. Between GWA projects and programs:

Coordination and collaboration is critical to this project as <u>all</u> our surveys require placing an observer on vessel charters associated with other projects. During FY14 we placed an observer on EVOS-sponsored *Gulf Watch Humpback Whale Systematic Surveys* (July, September, December) and *PWS Herring Research & Monitoring* program (November), as well as the Alaska Department of Fish and Game spot shrimp survey (October) and Ocean Tracking Network annual maintenance cruise (February, Table 1).

The pilot July and September 2014 surveys around Montague Strait and the southwest passages marked the first attempt to integrate Gulf Watch forage fish acoustic surveys (USGS) and HRM acoustic validation (PWSSC) with Gulf Watch humpback whale (NOAA) and our Gulf Watch marine bird surveys.

Item 8.C.

Finally, when not conducting daytime marine bird surveys, the bird observer assists the other projects when possible. During the past year, assistance has included helping set and pick shrimp pots with the ADFG survey and process their contents, helping process the catches from plankton and fish trawls, and jigging for forage fish samples (GWA forage fish project).

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

<u>Data:</u>

Datasets and associated metadata through December 2014 have been uploaded to the Gulf Watch portal.

<u>Publications:</u>

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

Dawson, N., M.A. Bishop, K. Kuletz and A. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coast Alaska. *Northwest Science*. *In press*. Accepted October 2014.

Bishop, M.A. 2014. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. Pages 3:70-78 in T. Neher et al. Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Science Synthesis Report for the Gulf Watch Alaska Program.

Popular Press:

Bishop, M.A. 2014. At-sea seabird surveys. *Delta Sound Connections* (circulation ~15,000). This annual newspaper published about the natural history of PWS and the Copper River Delta is distributed each May to airports and tourist areas in southcentral Alaska.

Meetings

Bishop participated in the Gulf Watch meeting for Principal Investigators in November 2014, Anchorage and attended the Gulf Watch meeting during January 2015 at AMSS via teleconference. Bishop also attended the quarterly teleconference meetings of GulfWatch principal investigators.

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

No issues were raised by the most recent EVOSTC review.

11. Budget: *See*, Reporting Policy at III (C) (11).

The contract cost of Dr. Ali Arab of Quanticipate Consulting for conducting the habitat association analyses is coming out of money originally designated for personnel since it was not initially budgeted for. Travel to the annual PI meeting in November 2014 was charged to the project although it was not initially budgeted for.