ATTACHMENT B. Annual Project Report Form (Revised 11.21.19)

1. Project Number:

19120114-N

2. Project Title:

Long-term Killer Whale Monitoring in Prince William Sound/Kenai Fjords

3. Principal Investigator(s) Names:

Craig O. Matkin and Dan Olsen, North Gulf Oceanic Society

4. Time Period Covered by the Report:

February 1, 2019-January 31, 2020

5. Date of Report:

March 2020

6. Project Website (if applicable):

www.gulfwatchalaska.org

7. Summary of Work Performed:

We completed 65 survey days in 2019 with timing and geographic components of effort similar to all other years of the Gulf Watch Alaska program (Fig. 1). The total nautical miles surveyed was 2,955 with 645 spent in company of whales (Fig. 2). We had 46 total encounters, 39 with resident ecotype killer whales, 5 with AT1 or Chugach transients, and 2 with Gulf of Alaska transients (Fig. 2). There were no encounters with offshore ecotype killer whales; however, we did receive contributed photos that indicated offshore killer whales were present at times in Kenai Fjords.

In 2019, all 7 of the AT1 (Chugach) transients were identified. Ages within the group are now estimated between 34 and 53 years. The youngest female is estimated to be 45 years old, which is likely beyond reproductive age. No new calves were documented. A total of 32 different Gulf of Alaska transient killer whales were documented, primarily from contributed photographs. This is the most extensive coverage of the Gulf of Alaska transients that we have had in a number of years.

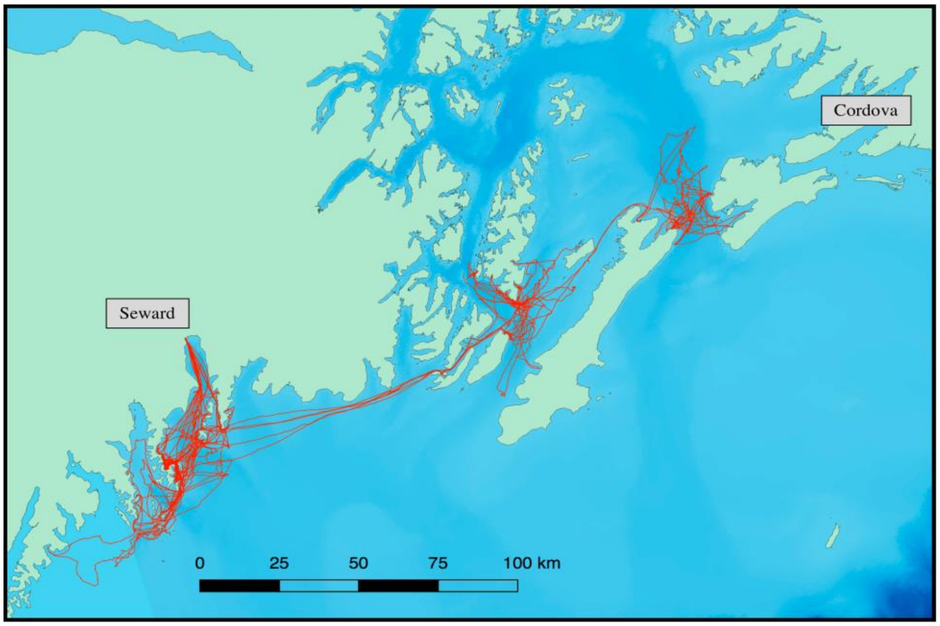

Figure 1. Killer whale effort tracks in Prince William Sound and Kenai Fjords, 2019.

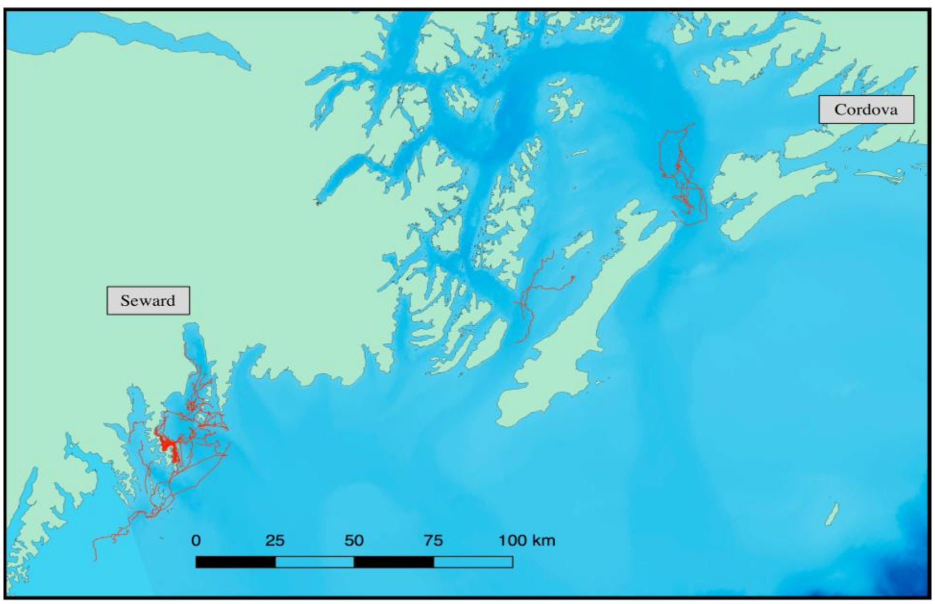

Figure 2. Killer whale encounter tracks in Prince William Sound and Kenai Fjords, 2019.

We had encounters with most of the major resident pods that are monitored for our population dynamics work, with the notable exception of AB pod. In addition to the three matrilines that contain all adult males and their mothers (the AB14, AB17, and AB 22 matrilines) only 8 of the 16 members of the other AB matrilines were photographed. The AB14, AB17 and AB22 matrilines have not been photographed since 2016, while the other matrilines were completely photographed in 2018. The only bright spot was that AB 60 had her first calf. We are uncertain of the total number of whales in

AB pod and this is reflected in Fig. 3 which has not been updated for 2019 because of poor coverage. The "optimistic" number for the past several years is circled but are growing less confident in that number as the three matrilines missing since 2016 fail to appear. Although we had a birth this year, we have no way of knowing if there have been mortalities in the missing matrilines although some mortalities are likely to have occurred due to the ages of matriarchs as well as the ages their sons.

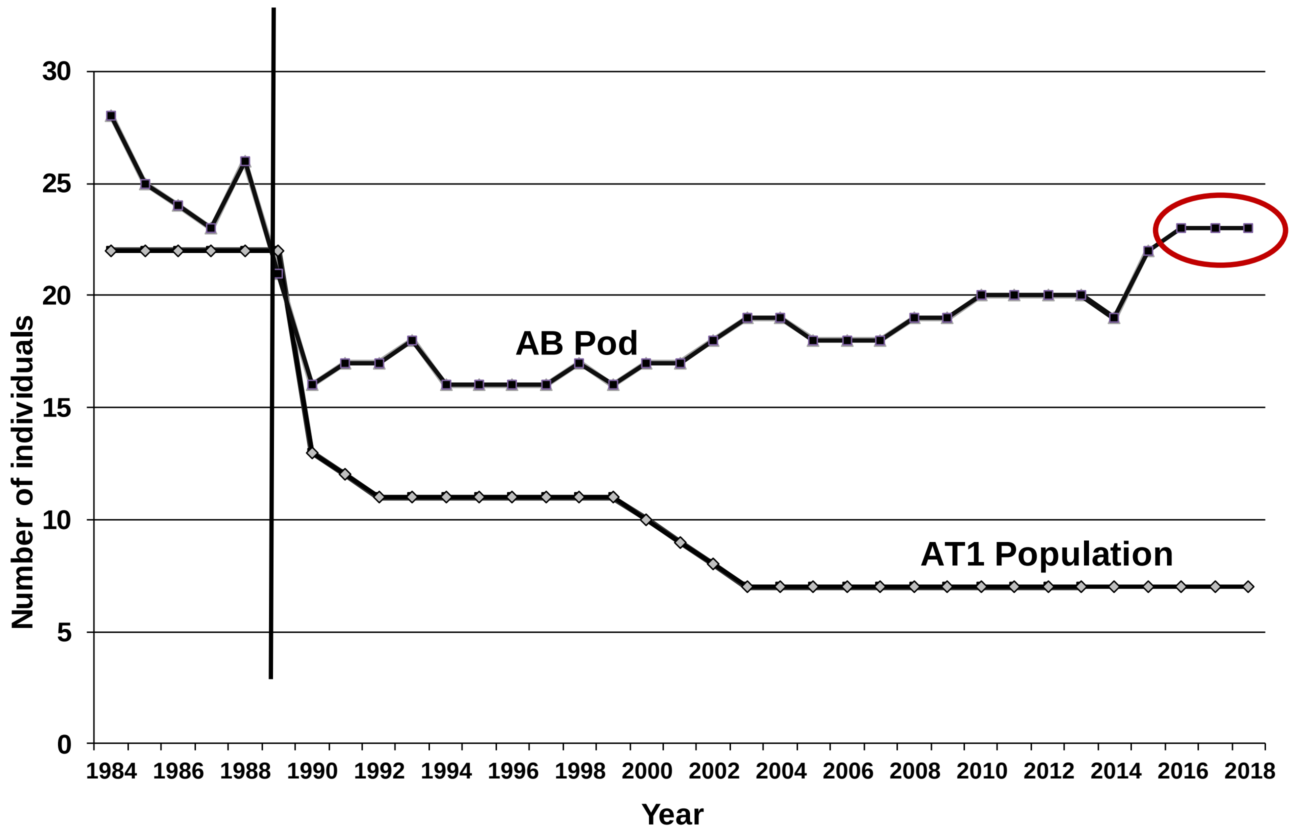

Figure 3. Number of whales in AB pod and AT1 population by year. The graph is not extended to 2019 due to poor coverage. Possible total for AB pod (circled) remains the same but does not take into account three missing matrilines (AB17, AB22, and AB14).

The trend toward splitting of pods on either a temporary or permanent basis has continued along the same maternal lines as in recent years. This may reflect a more challenging feeding environment (e.g., fewer numbers of fish/smaller school size) that favors hunting in smaller groups. It is occurring while population growth has slowed or stopped. In recent decades, the southern Alaska resident killer whale population (except for AB pod) has grown steadily. This trend may be changing. In 2019, of the 145 killer whales photographed from 17 matrilines from our original core pods there were an estimated three new calves and three apparent mortalities. In 2018, from the 148 core group whales photographed it appeared that three calves were recruited and there were three apparent mortalities. In 2017, for the 155 whales from our core groups that were photographed, there were four calves recruited and 8 apparent mortalities. These are not all confirmed mortalities and there may be additional calves or mortalities in matrilines that were not encountered. However, a trend of zero or negative growth appears to be developing in the southern Alaska killer whale population. This will require more in-depth quantitative examination at the end of this 5-year work period. A similar population trend coupled with the splitting of pods has been observed in the British Columbia northern resident population in recent years. Declines in North Pacific Chinook salmon size and abundance coupled with a previously increasing resident killer whale population may have brought these fish-eating whales to a level at or above carrying capacity. This possibility will be more closely examined in the project final report.

Previous research using vessel surveys and satellite transmitters, which has been completed primarily in the summer months, has shown that resident killer whale pods have distinct temporal preferences for certain areas. As a non-invasive and year-round alternative to tagging individuals, we have established acoustic monitoring stations in areas important to southern Alaska resident killer whales during the previous vessel surveys and tagging studies (Fig. 4). The three primary areas monitored are Montague Strait (Little Bay station), Hinchinbrook Entrance (Zaikof Bay station) and outer Resurrection Bay (Pony Cove station).

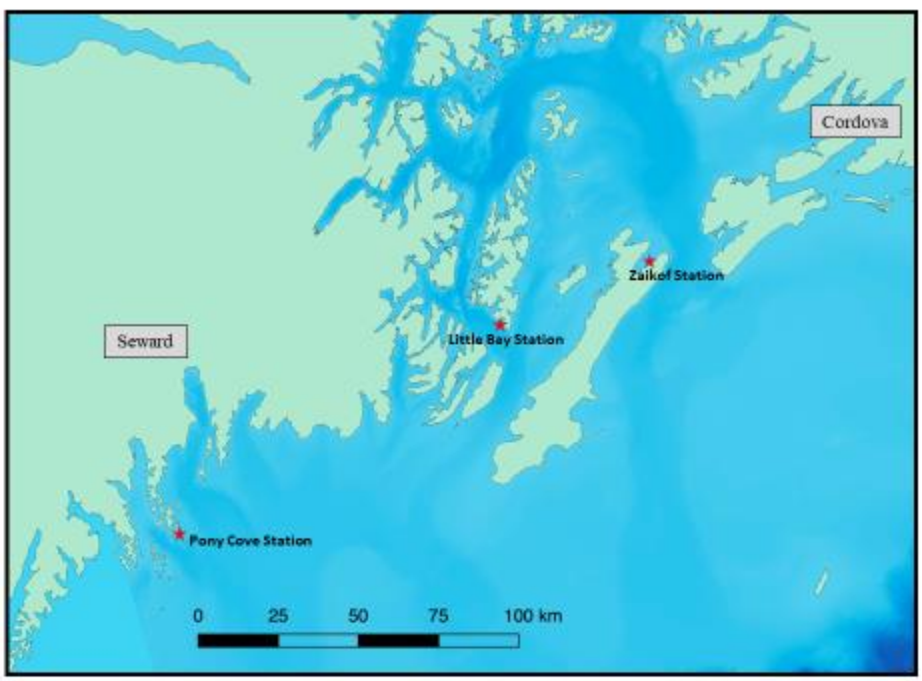

Figure 4. Location of remote hydrophone stations operated by North Gulf Oceanic Society. A mid-Sound station operated by the Prince William Sound Science Center is not shown or reported on here.

The stations monitoring Hinchinbrook Entrance and Montague Strait have operated since 2016 and the outer Resurrection Bay station was first deployed in 2017. In Fig. 5 we summarize the frequency of use (days with killer whale calls) determined since each station was established. The Montague Strait hydrophone was not functional from May to September 2017 and the Pony Cove hydrophone non-operational during November 2017 through April 2018.

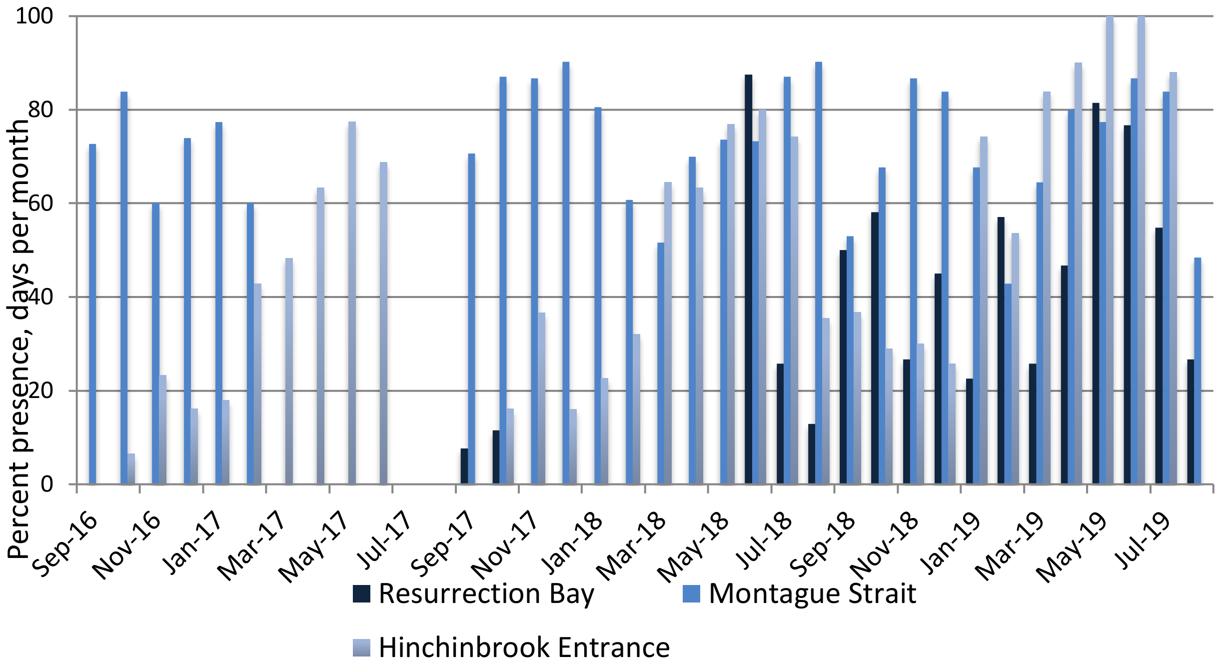

Figure 5. Killer whale presence in Resurrection Bay, Montague Strait, and Hinchinbrook Entrance, measured as the percent days per month that killer whale vocalizations were recorded.

In the several years that our remote hydrophones have been operating, patterns of killer whale use have emerged. Hinchinbrook Entrance is most important April through July but has low levels of use in fall and winter. Montague Strait is the most consistently used area, mid-late winter months. Resurrection Bay use peaks in the May and June period which mirrors our survey experience. To obtain better estimates of actual numbers of whales present we will develop a call catalogue matching discrete calls from field recordings with photographically identified pods and matrilines. Also, we will estimate the number of animals present in autonomous acoustic recordings using measures of call diversity and calling rates and then compare to individual counts using the call catalogue.

We continue to collect both scales and flesh from sites of predation by resident killer whales in addition to collecting fecal samples when possible. A total of 26 prey samples and 27 fecal samples were collected in 2019, primarily during the May-June period in Kenai Fjords. Initial results from fecal sampling in 2016 and 2017 were received from 14 independent fecal samples collected in the months of May, June, and September (Fig. 6). DNA from five fish species; Chinook, chum, and sockeye salmon, Pacific halibut, and arrowtooth flounder were detected in quantities greater than 8% (lower quantities may represent secondary prey). An additional 40 samples have been collected and prepared for analysis and will broaden our understanding of resident feeding habits.

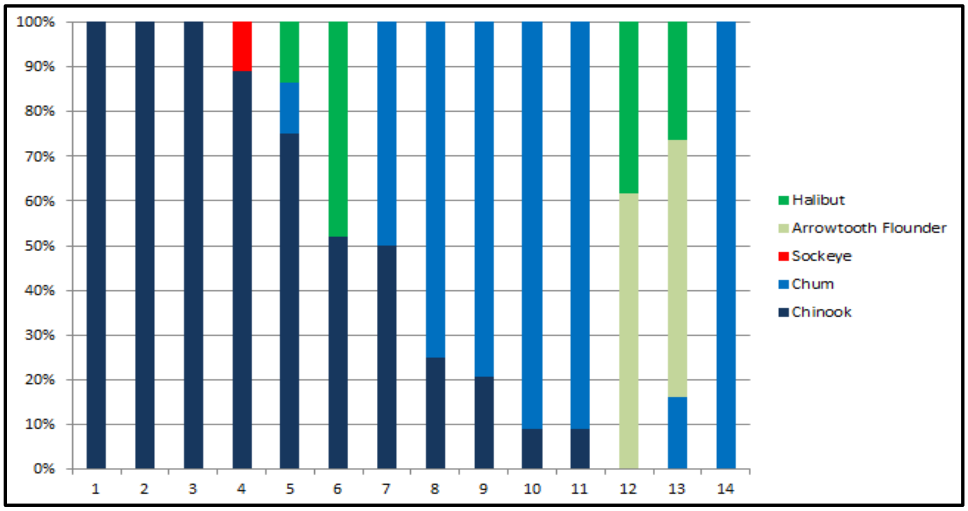

Figure 6. DNA percentage of prey from fourteen fecal samples taken in 2016 and 2017

The initial fecal results, although from a small number of samples, suggest Chinook and chum salmon as important prey during the May, June, and September months when these collections were made. Although halibut has been identified as rare prey item from field observations in the past, arrowtooth flounder is an addition to the known diet of these resident killer whales. Coho salmon is conspicuously missing from this small sample but has been known as an important prey generally in late summer months, August through October, which were not sampled here (Fig. 7). This is too small a sample size to derive any major conclusions regarding feeding ecology but indicates fecal sampling will be a valuable component and complement to our scale and flesh sampling from predation sites.

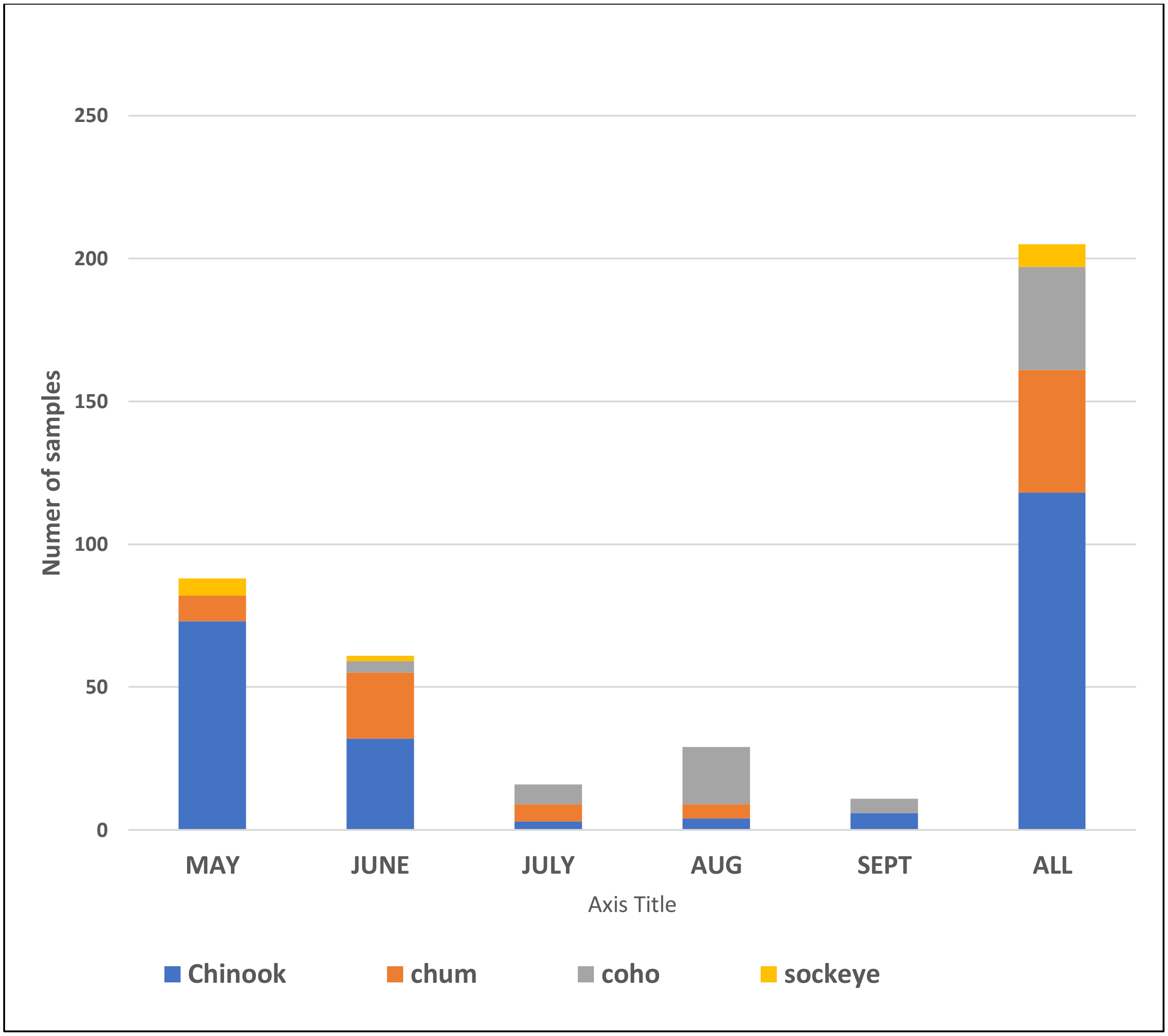

Figure 7. Number of samples collected by month and by species from collection of scales and prey remains from killer whale predation sites 1991-2018.

Sampling from predation sites conducted over the past two decades indicates the importance of Chinook in early season (May) where most sampling is in Kenai Fjords with an increase of chum salmon in the diet in June. July and August show an increasing percentage of coho salmon and in September the Chinook again increases in the sample although sample sizes are relatively small. Overall, Chinook is the largest component of prey samples with chum and coho also very significant at particular times of year. Sockeye salmon a relatively small component found in spring.

8. Coordination/Collaboration:

A. Long-term Monitoring and Research Program Projects

Within the Pelagic Component of Gulf Watch Alaska, we collect humpback whale identification photos and provide data on distribution and abundance of humpback whales (encounter data) as possible during our surveys. This resulted in 28 encounters where up to 10 humpback whales were identified. The raw data are provided to the humpback whale project (PIs Moran and Straley, project 18120114-O) and to the Happywhale project (https://happywhale.com/home) examining population and distribution of humpback whales in the North Pacific.

We work cooperatively with PI Rob Campbell (Prince William Sound Science Center, project 181204114-G) to deploy a Soundtrap hydrophone on his oceanographic moorings as additional data for our killer whale acoustic monitoring efforts.

We contributed data to Chapter 4 (Suryan et al. 2019) of the GWA science synthesis report assessing the GOA ecosystem response to the Pacific marine heatwave.

1. Across Programs

a. Herring Research and Monitoring

No coordination/collaborations for this reporting period.

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.

B. Individual Projects

No coordination/collaborations for this reporting period.

C. With Trustee or Management Agencies

We directly interface and collaborate with research conducted on the endangered Southern Resident killer whale population in Washington State waters. Collaborations include sharing costs of genetic fecal analysis directed by Kim Parsons, and a comparison of polychlorinated biphenyl (PCB) and stable isotope trends with Gina Ylitalo, Brad Hanson, and Candace Emonds, all with the National Oceanic and Atmospheric Administration Northwest Fisheries Science Center (NWFSC), Seattle, WA. In 2020 we are scheduled to initiate a collaborative effort with John Durban and Holly Fernbach of Southhall Environmental Associates, Seattle, WA to compare condition of individuals using body condition indices.

All population data are supplied to the NMFS Alaska Fisheries Science Center Marine Mammal Laboratory, Seattle, WA for incorporation into Alaska marine mammal stock assessment reports and use in management applications.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

1. Peer-reviewed Publications

Olsen, D.W, C.O. Matkin, F.J. Mueter, and S Atkinson. In press. Mating Opportunities? Social Behavior Increases in Multi-Pod Aggregations of southern Alaska Resident Killer Whales (*Orcinus orca*). Marine Mammal Science.

2. Reports

Matkin, C.O. and D. W. Olsen. 2019. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 18120114-N), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Suryan, R.M., M. Arimitsu, H. Coletti, R.R. Hopcroft, M.R. Lindeberg, S. Batten, M.A. Bishop, R. Brenner, R. Campbell, D. Cushing, S. Danielson, D. Esler, T. Gelatt, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, D. Kimmel, B. Konar, K. Kuletz, B. Laurel, J.M. Maniscalco, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, S. Pegau, J. Piatt, L. Rogers, A. Schaefer, J. Straley, K. Seeeney, M. Szymkowiak, B. Weitzman, J. Bodkin, and S. Zador. 2019. Chapter 4 Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. In R.M. Suryan, M.R. Lindeberg, and D.R. Aderhold, eds. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

3. Popular articles

Bernton, H., and L. Mapes. 2019. It’s been 30 years since the *Exxon Valdez* oil spill. Here’s what we’re still learning from that environmental debacle. Seattle Times, March 20 (Section based on killer whale project).

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

1. Conferences and Workshops

Arimitsu, M., M.A. Bishop, D. Cushing, S. Hatch, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaeffer, and J. Straley. 2020. Changes in marine predator and prey population in the Northern Gulf of Alaska: Gulf Watch Alaska Pelagic update 2019. Poster Presentation. Alaska Marine Science Symposium, Anchorage, AK. 27-31 January.

Meyers, H., D. Olsen, C. Matkin, and B. Konar. 2020. Resident killer whale (*Orcinus orca*) spatial use in the Gulf of Alaska. January. Poster presentation at AMSS, Anchorage, Alaska, January.

Olsen, D., C. Matkin, and K. Parsons. 2020. Characterization of killer whale (*Orcinus orca*) diet in the Northern Gulf of Alaska through genetic analysis of fecal samples. Poster presentation AMSS, Anchorage, Alaska, January.

2. Public presentations

Olsen, D. 2019. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation. February 2019.

Olsen, D. 2019. Killer whales of Southern Alaska. Seward naturalists and boat operators, Seward, Alaska. Oral presentation. May 2019.

Olsen, D. 2019. Mom knows best: Killer whale culture in Southern Alaska. Kayak Adventures Worldwide guide training, Seward, Alaska. Oral presentation. May 2019.

Olsen, D. 2019. Killer whales of Kenai Fjords. Kenai Fjords National Park interpretive staff training, Seward, Alaska. Oral presentation. May 2019.

Olsen, D. 2019. Killer Whale Acoustic Identification. Kenai Fjords National Park staff and general Seward naturalists. Seward, Alaska. Oral presentation. June 2019.

Olsen, D. 2019. Killer whales of Alaska. Lindblad Expeditions, Southeast Alaska. Oral presentation. July 2019.

Olsen, D. 2019. Killer whales of Prince William Sound. Chenega School, Chenega, Alaska. Oral presentation. September 2019.

Olsen, D. 2019. Acoustics of killer whales and other marine mammals. Kenai Peninsula College, Homer, Alaska. Oral presentation. November 2019.

Matkin, C. 2019, Cetaceans of Southern Alaska. UAA course: Series of Oral Presentations May 20-June 5.

Matkin, C. 2019. Killer whales in Prince William Sound and continuing effects of the *Exxon Valdez* oil spill. Oral presentation. Kenai Penninsula College, September 2019.

Matkin, C. 2019. Killer whales and research in Alaska. Film production to be shown on Princess Cruises in Alaska. Mike Valente, Faculty NY, producer. April, Anchorage, Alaska.

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

No new contributions for this reporting period.

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

All required data sets have been updated on the Gulf of Alaska Data Portal (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/files). The photographic and Soundtrap acoustic files are very large and cannot be uploaded and accessed with a browser easily, and we supplied the data to Axiom via a hard drive. Currently, data from 2012-2019 (Gulf Watch Alaska time period) have been published by Axiom, which include the following:

- Shipboard acoustic recordings, 2012-2018 (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/folder_metadata/2689596)
- Biopsy data, 1994-2018, including results of chemical tracer analysis (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/folder_metadata/24158)
- Database of surveys and encounters, 2001-2019 (includes Access database: https://workspace.aoos.org/project/4682/folder/2824129/database-of-surveys-and-encounters-2017-2021)
- Prey sampling, 1991-2018 (https://workspace.aoos.org/project/4682/folder/2529812/prey-genetics)
- Soundtrap (remote hydrophone) data through 2019 have been delivered to Axiom for publication (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/folder_metadata/2689596)
- Field identification photos through 2019 were posted by Axiom to a separate site on the Research Workspace because of their large size (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/folder_metadata/2689692)

Discussions are underway within Axiom to determine how to deal with datasets with the number of files or sheer volume make it impractical to access through a browser.

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comment (FY20): *The Science Panel appreciates the work that comes out of this project and is pleased to see the involvement of a graduate student in this project. The Panel has no specific comments or questions.*

PI Response (FY20): Thank you for your comments. We appreciate the positive feedback.

Science Panel Comment (FY19): *We agree with the Science Coordinator [see below] that the diet analysis and understanding killer whale feeding ecology is important. It behooves the PI to locate another lab to process the biopsy samples and continue the work. We would like to know if the PI has any publications planned for the future.*

> *[Science Coordinator comment for reference] From the FY12-16 Final Report, it is apparent that biopsy sampling provided important results in regards to contaminants and stable isotope*

analyses (i.e., probable changes in diet, contaminant levels supports this change in diet). However, the PI is deemphasizing the collection of biopsy samples for examination of feeding habits due in part to the retirement of the chemist at NOAA Northwest Region who led the project. The biopsy sampling and data are one of the more intriguing aspects of this work at this stage.

PI Response (FY19): We are in the process of finalizing and submitting a manuscript:

Ylitalo, G.M., C.O. Matkin, P.M. Chittaro, M.B. Hanson, C.K. Emmons. In prep. Chemical tracer changes in tissues of two eastern North Pacific killer whale populations: ecosystem flux or changing diet? To be submitted to Science of the Total Environment.

At the moment we do not have the funding or commitment from NWFSC or others to continue the chemical tracer sampling and analytical work as conducted in the past. As a special project there could be some continuation of this work at intervals, but that avenue is not apparent at this time. Personnel and priorities are changing at NWFSC and collaboration with our project is primarily based on the interface and comparisons with endangered Southern resident killer whale population. On that note, funding has been secured for a pilot project examining body condition of Southern Alaska residents using drone technology. Data from this aspect of the project will be compared with ongoing studies in Puget Sound on Southern residents. This was listed in our original proposal as an "optional" component of the 5-year plan and we are pleased to add it to our program without additional cost to this project.

11. Budget:

Please see provided program workbook. In evaluating the project budget at the close of FY19, we realize the need to shift funds among categories within the project. Additional funds are needed for analysis due to the amount of data generated by acoustic stations and the complexity of analyses of these data. In contrast, we have found other means to fund much of our travel and lodging and do not need as much for acoustic equipment as initially projected. We anticipate shifting funds from travel and commodities categories to fund additional analytical costs. There will be no change in overall funding request.

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$41.0	$41.0	$42.2	$42.2	$42.2	$208.6	$126.8
Travel	$3.2	$3.2	$3.5	$0.0	$3.5	$13.3	$4.6
Contractual	$49.5	$50.5	$52.3	$55.7	$54.0	$262.0	$147.3
Commodities	$33.8	$31.6	$20.6	$19.1	$16.7	$121.7	$76.1
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (*10%*)	$ 13	$ 13	$ 12	$ 12	$ 12	$ 61	$34.3
SUBTOTAL	$140.2	$138.8	$130.4	$128.7	$128.0	$666.1	$389.1
General Administration (9% of subtotal)	$12.6	$12.5	$11.7	$11.6	$11.5	$60.0	N/A
PROJECT TOTAL	$152.8	$151.3	$142.1	$140.3	$139.5	$726.1	
Other Resources (Cost Share Funds)	$25.0	$25.0	$25.0	$25.0	$25.0	$125.0	