EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
FY21 (YEAR 10) CONTINUING PROJECT PROPOSAL SUMMARY PAGE

Project Number and Title

Gulf Watch Alaska: Pelagic Component Project

21120114-N—Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

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Project Abstract

This project is a continuation of the long-term photo-identification based program that has continuously monitored killer whale populations in Prince William Sound since 1984. A primary focus has been on resident killer whales and the recovery of AB pod and the threatened AT1 population of transient killer whales. These two groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Assessment of population dynamics, feeding ecology, movements, range, and contaminant levels for all major pods in the area will help determine their vulnerability to future perturbations and environmental change, including oil spills. In addition to population dynamics from annual photo-identification, this project uses other techniques to determine the health and trends of the population. These techniques have included biopsy/skin sampling to compare genetics between populations, occasional biopsy/blubber to investigate contaminants, prey sampling of flesh, fish scales, and whale scat to investigate diet, behavioral observation, and remote acoustic monitoring to determine important off-season habitat. During FY18 - FY20 remote recording hydrophones have been recovered and redeployed in Montague Strait, Hinchinbrook Entrance, and Kenai Fjords. We are using results of the acoustic monitoring and its indication of presence of whales over the year to adjust our field surveys. Between our surveys and contributed photos, we were able to confirm that 5 and likely all 7 of the remaining Threatened AT1 transient population have survived to 2020. AB pod has been at least partially photographed in 2020, although not traveling in a discreet pod and detailed photo analysis has not occurred. It appears there are no new AB pod calves. We were scheduled to begin an optional morphometrics and body condition element to our program, but COVID 19 travel considerations have delayed this work. We are not proposing any major changes to this project for FY21.

EVOSTC Funding Requested* *(must include 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$152,800	$151,300	$142,100	$140,300	$139,500	$726,100

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$25,000	$25,000	$25,000	$25,000	$25,000	$125,000

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. Thus, the two overarching 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?

Killer Whale Monitoring

Both resident ecotype (AB pod) and transient ecotype (AT1 population) killer whales suffered significant mortalities following the *Exxon Valdez* oil spill in 1989. AB pod is recovering after 26 years but has still not reached pre-spill numbers. The AT1 population is not recovering and may be headed toward extinction (Matkin et al. 2008) (Fig. 1). This project has determined that killer whales are sensitive to perturbations such as oil spills but has not yet determined the long-term consequence (which may include extinction) or the recovery period required. As an apex predator, this species (both fish and mammal eating types) has an important role in the ecosystem. Additionally, they are a primary focus of viewing by a vibrant tour boat industry in the region. Data from this project are used by tour boats to enhance viewers experience and understanding of the local environment and fauna.

Unlike many cetaceans, killer whales can be closely monitored, and for resident (fish eating) killer whales detailed population dynamics can also be monitored (Matkin et al. 2014).

The AT1 transient population can be directly monitored for each individual, and the wide-ranging Gulf of Alaska transients (mammal eating) population monitored for trends (Matkin et al. 2012). We also contribute all photo identification data for the offshore form of killer whale to a coast-wide database at the Pacific Biological Station (Nanaimo, BC, Canada). This project is a unique opportunity to continue a comprehensive monitoring program for a keystone marine species with three ecotypes that was initiated in the early 1980s. The importance of long-term killer whale monitoring has been borne out by companion studies in other regions such as Puget Sound and British Columbia.

COVID-19 Disruptions: The optional body condition work using drones was canceled for this year despite obtaining funding due to inability of crew to travel and infection with virus among crew. Also, outreach was limited by inability to hold meetings and provide talks. Regular fieldwork has continued as planned.

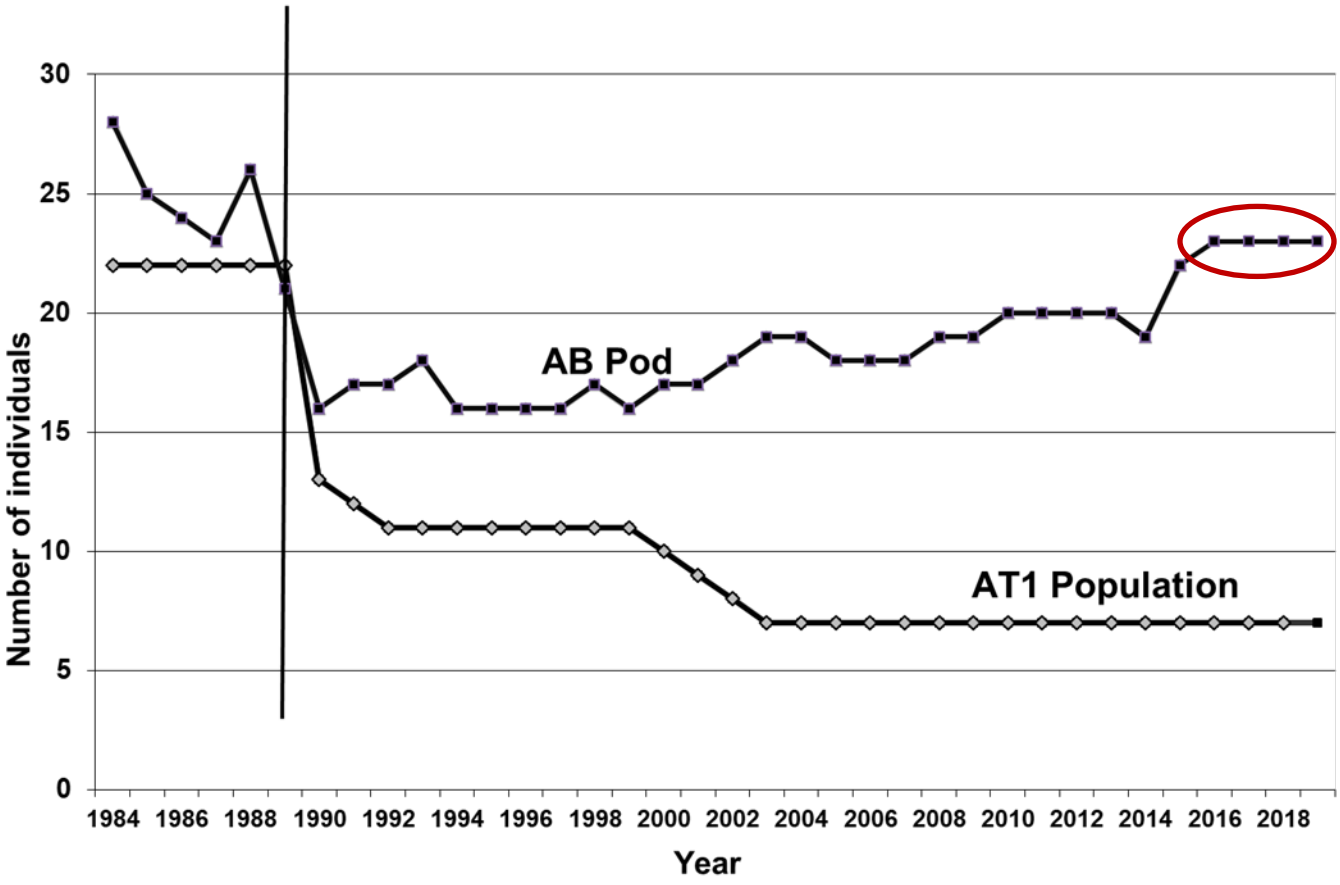

Figure 1. Number of whales in AB pod and AT1 population by year. Note: past four years total for AB pod (circled) does not take into account three missing matrilines (AB17, AB22, and AB14).

The core objective of this project is the monitoring of population parameters based on photo identification. Annual prey sampling and fecal sampling are used to investigate feeding habits and trophic changes. Remote acoustic stations have been placed to monitor of temporal and geographic use patterns of resident killer whales, particularly in winter. We have pioneered this type of acoustic work in Alaska in the past (Yurk et al. 2010) but now employ more comprehensive technologies. Sampling for stable isotope and contaminant analysis has been completed and reanalysis of stable isotope trends is being conducted by Northwest Fisheries Science Center for publication.

Analysis includes population dynamics and modeling at appropriate intervals, genetic sequencing as necessary for determination of population affiliation, and acoustic analysis of remote hydrophone data. Genetic analysis of scats and of predation samples is conducted at the Northwest Fisheries Science Center, Seattle and Pacific Biological Station, Nanaimo, B.C. Although we will focus on the southern Alaska resident and AT1 transient populations which were impacted by the *Exxon Valdez* oil spill, the study also includes the other two recognized populations in the region, the Gulf of Alaska transients and offshore killer whales and the project contributes annually to the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service killer whale stock assessments.

Data will be collected during a minimum 50-day field season from May through October from the R.V. Natoa, although opportunistic photographic data is contributed from other collaborating vessels. This is the

continuation of a long-term project spanning 34 years and has benefited from continued support of mariners and the coastal communities of the north Gulf of Alaska coast.

FY20 Accomplishments and Highlights

During the 2020 reporting period of February to July, we completed 40 field days and had 39 encounters with killer whales. This rate of encounter was very high compared to the long-term average for number of encounters per field day, particularly for those days in Prince William Sound. We completely photo-identified a number of the major resident pods including AD8, AD11, AD16, AK6, AK2, AE2, and AE5, all of which are southern resident haplotype pods. In addition, we photographed all of AJ pod, most of the matrilines in AJ8 pod and likely all the whales in the AB25 and AI pods which are all northern resident. Most of the AB pod matrilines were documented for the first time in several years; however, the AB 17 matriline was still missing. This is the best coverage of northern haplotype whales in the early season that we have had in a number of years. Because whales were in large mixed groups, there is still sorting and ID work to be done with photographs to determine demographic changes.

Between our surveys and contributed photos, as of mid-field season, it is confirmed that at least 5 of the 7 and likely all seven of remaining threatened AT1 transient population have survived into 2020. There are no new calves in the group.

During 2020 fieldwork we have collected 45 scale or flesh samples during predation events by resident killer whales and also collected 38 scat samples. This is the most productive sampling in the early season that we have ever recorded. Most exciting were the number of samples of both scales/flesh and of scat that were obtained in Prince William Sound where our success has been limited in the past. This will be a boost to our long-term study of resident killer whale feeding ecology. Our most recent results from previous scat analysis, indicate the primary importance of Chinook and chum salmon in the diet, with minor contributions from other species (including sockeye salmon, halibut, and arrowtooth flounder). The data support the accuracy of scale and flesh (predation) analysis that was questioned in the previous final report. In particular, the at times ubiquitous pink salmon have not been found in the predation samples (scales and flesh collected at predation sites) or in the scat.

Remote recording SoundTrap hydrophones have been recovered and redeployed in Montague Strait, Hinchinbrook Entrance, and Kenai Fjords in spring 2020. The machines all recorded for the entire previous 6 months (winter season). Additional acoustic data were downloaded from a hydrophone placed on the mid-Sound mooring by Rob Campbell (environmental drivers project 20120114-G). Data from this location has proven not as valuable due to background noise and other issues. We are discontinuing the mid-Sound hydrophone and installing one in Kachemak Bay in a cooperative arrangement with the Brenda Konar and the Nearshore monitoring group who will install and maintain it. Heather Myers our acoustics PhD student will supervise and conduct analysis. We have collected 60 months' worth of data so far from Montague Strait, Hinchinbrook, and Kenai Fjord and 40 months of data so far from Naked Island/Center Sound buoy. Detection rates (% of days per month) are 16-23% in Hinchinbrook and 25-90% in Montague Strait. Analysis will be ongoing this fall and winter under direction of Hannah Meyers at University of Alaska Fairbanks (UAF).

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 task progress by fiscal year and quarter, beginning February 1, 2017. C = completed, X = planned or not completed, V = cancelled due

to COVID-19, P = partially completed, due to constraints of COVID-19. Fiscal year quarters: 1 = Feb 1 – April 30; 2 = May 1 – July 31; 3 = Aug. 1 – Oct. 31; 4 = Nov. 1 – Jan. 31.

	FY17				FY18				FY19				FY20				FY21			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone 1: Collection																				
Field prep	C				C				C				C				X			
Field surveys		C	C			C	C			C	C			C	X			X	X	
Retrieve and re-deploy hydrophones		C	C			C	C			C	C			C	X			X	X	
Milestone 2: Data																				
Data summary/analysis				C	C			C	C			C	C			X	X			X
Review hydrophone data				C	C			C	C			C	C			X	X			X
Photo-identification analysis				C	C			C	C			C	C			X	X			X
Analysis of predation samples				C	C			C	C			C	C			X	X			X
Upload previous FY data					C				C				C				X			
Milestone 3: Reporting																				
Annual Reports					C				C				C				X			
Annual PI meeting				C				C				X				X				X
FY Work Plan (DPD)			C				C				C				C					

In addition to the primary project deliverables in Table 1, during the past year we led or contributed to 5 oral presentations. One manuscript is in review with Marine Mammal Science and another is in preparation for submission (See Section 7). We anticipate completing FY20 and FY21 milestones and tasks as planned.

B. Explanation for not completing any planned milestones and tasks

All sampling, milestones, and tasks for 2019 and the first two quarters of 2020 were completed in accordance with our proposal and with sampling protocols available on the GWA Research Workspace. There were no disruptions to the primary goals of this project due to COVID-19. Two exceptions were optional aspects of the project that were not pursued: 1) morphometrics and body condition, and 2) an outreach opportunity.

C. Justification for new milestones/tasks

No new milestones/tasks proposed.

3. PROJECT COORDINATION AND COLLABORATION

A. Within an EVOSTC-funded Program

Gulf Watch Alaska

As part of the Gulf Watch Alaska program we collaborate at annual meetings and regular teleconferences that include all members of the program. We collaborate directly with John Moran and Jan Straley (project 20120114-O, humpback whales) by sharing photographic and observational data. We have collaborated with Rob Campbell (project 20120114-G) in placing remote hydrophones on oceanographic buoys. We are beginning a collaboration this year with Brenda Konar and the Nearshore project (20120114-H) placing a Soundtrap hydrophone in Kachemak Bay.

Herring Research and Monitoring

This project coordinates with the herring research and monitoring program by sharing data and discussion of relevant trends, as well as collaborating on reports and publications.

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 project will coordinate with other *Exxon Valdez* Oil Spill Trustee Council-funded projects as appropriate by providing data, discussing the relevance and interpretation of data, and collaborating on reports and publications. At this time no such collaborations are in process.

C. With Trustee or Management Agencies

Data are supplied annually and upon request to Janice Waite, NOAA National Marine Mammal Laboratory in Seattle, Washington for application to marine mammal stock assessments, which are reviewed regularly. We also collaborate with Dr Brad Hanson, Candice Emmons, and Gina Ylitalo on papers and journal articles with the NOAA Northwest regional office that conducts long-term research on the endangered Southern Resident killer whale population. Currently we are preparing a paper on stable isotope and contaminant comparisons between Southern Residents and Southern Alaska Residents. We also collaborate directly with Dr. Kim Parsons a geneticist at the NOAA Northwest Fisheries Science Center in genetic examination of killer whale fecal samples. In an international program related to killer whale management, we collaborate with Brianna Wright at the Pacific Biological Station in identification and genetic examination of scale and flesh samples from killer whale and comparison with Northern and Southern Resident killer whales.

4. PROJECT DESIGN

A. Overall Project Objectives

Objective 1

Photo-identification of all major resident pods and AT1 transient groups that use Prince William Sound/Kenai Fjords. Extension of individual histories, identification catalogues of individuals and an annual update of population model are products of these data.

Objective 2

Collect fish scale samples and marine mammal tissue from predation sites to monitor potential changes in feeding habits.

Objective 3

Collect fecal samples from resident killer whales for comparison with results of fish scale/tissue collection (Objective 2).

Objective 4

Use remotely deployed submerged acoustic recorders to track killer whales year-round using calls.

Objective 5

Collect genetic tissue samples when necessary to determine population/ecotype affiliations.

B. Changes to Project Design and Objectives

As stated in our FY18 workplan, we are 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, and are replacing it with a program of feces collection and analysis, as suggested in review of our FY12-16 final report. The chemical data on feeding habits are being reanalyzed by NOAA Northwest Region and a publication is in process (see Section 7 Matkin et al. in prep). This paper and analysis have been delayed due to restrictions on NOAA employees due to COVID-19

The following secondary objectives (optional projects suggested in FY17-21 proposal) will not be implemented at this time:

Objective 6

Use photogrammetry to develop morphometrics for individuals and groups to assess body condition over time and develop measures to determine pregnancy rate as an additional important population parameter (secondary objective, completed as possible). Initial funding to begin this optional segment of project was obtained, but the COVID 19 situation will delay initiation until 2021

Objective 7

Use time/depth/location satellite tags coupled with prey sampling to examine feeding ecology during fall and/or spring feeding aggregations (secondary objective, completed as possible).

Funding was obtained to explore the use of morphometrics obtained from drone captured, low altitude photos to develop an annual index of individual and population health and possibly determine pregnancy rates. Unfortunately, COVID-19 considerations and travel restrictions will prevent inception of this project until 2021. Satellite tagging will be pursued only if less invasive techniques are developed that will reduce risk of infection. Infection that resulted in a killer whale death in Puget Sound was directly linked to tag attachment and resulting infection.

5. PROJECT PERSONNEL – CHANGES AND UPDATES

A new graduate student, Hannah Myers, at the University of Alaska, Fairbanks (Brenda Konar, major professor) has joined our group in 2020 and will be heading up acoustic analysis as she completes her PhD. Dr John Durban

is scheduled to be employed by North Gulf Oceanic Society in November 2020 and he will assume some analytical/report duties from Craig Maktin and Dan Olsen.

6. PROJECT BUDGET

A. Budget Forms (See GWA FY20 Budget Workbook)

Please see project budget forms compiled for the program.

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM

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	
Travel	$3.2	$3.2	$3.5	$0.0	$3.5	$13.3	
Contractual	$49.5	$50.5	$52.3	$59.7	$54.0	$266.0	
Commodities	$33.8	$31.6	$20.6	$15.1	$16.7	$117.7	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*10%*)	$12.7	$12.6	$11.9	$11.7	$11.6	$60.6	
SUBTOTAL	$140.2	$138.8	$130.4	$128.7	$128.0	$666.1	$0.0
General Administration (9% of	$12.6	$12.5	$11.7	$11.6	$11.5	$59.9	N/A
PROJECT TOTAL	$152.8	$151.3	$142.1	$140.3	$139.5	$726.0	
Other Resources (Cost Share	$25.0	$25.0	$25.0	$25.0	$25.0	$125.0	

B. Changes from Original Project Proposal

The overall cost of this project for FY19-21 has not changed. We seek to reallocate funds between categories in FY21. In this budget we request movement of $3.5K from Travel and $3.0K from Commodities to Contractual in FY21 to cover increased acoustic and other analytical costs. We are asking to discontinue funds going to Northwest Fisheries Science Center ($2K) which will be used for other analysis under Contractual. Personnel amount remains unchanged from the original proposal; however, the allocation within the category has changed.

C. Sources of Additional Project Funding

We continue to receive in kind support from Northwest Fisheries Science Center (Kim Parsons) for genetic analysis of scats and from Pacific Biological Station (Briana Wright) for analysis of predation samples. This amounts to an estimated $22K per year as indicated in budget workbook. Also see attached email (pdf).

7. FY17-20 PROJECT PUBLICATIONS AND PRODUCTS

Publications

Chasco, B., I. Kaplan, A.C. Thomas, A. Acevedo-Gutierrez, D.P. Noren, M.J. Ford, M.B. Hanson, J.J. Scordino, S.J. Jeffries, K.N. Marshal, A.O. Shelton, C. Matkin, B.J. Burke, and E.J. Ward. 2017. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. Scientific Reports 7:15439 DOI: 10.1038/s41598-017-14984-8

Danishevskaya, A.V., O. Filatova, F.I.P. Samarra, P.J.O. Miller, J.K.B. Ford, H. Yurk, C.O. Matkin, and E. Hoyt. 2018. Crowd intelligence can discern between repertoires of killer whale ecotypes. Bioacoustics. DOI: 10.1080/09524622.2018.1538902

Matkin, C.O., and D. Olsen. 2018. Long term killer whale monitoring in Prince William Sound / Kenai Fjords. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-N.

Matkin, C.O., and D. Olsen. 2019. Long term killer whale monitoring in Prince William Sound / Kenai Fjords. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-N.

Matkin, C., D. Olsen, G. Ellis, G. Ylitalo, R. Andrews. 2017. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-M), North Gulf Oceanic Society Homer, Alaska.

Matkin, C.O., G.M. Ylitalo, P. M. Chittaro, M. B. Hanson, C. Emmons C., et al. In prep. Chemical tracer changes in tissues of two eastern North Pacific killer whale (*Orcinus orca*) populations: Ecosystem flux or changing diet?

Olsen D.W., and C.O. Matkin. 2017. Behavioral changes during multi-pod aggregations of southern Alaska resident killer whales (*Orcinus Orca*). 2017 Society for Marine Mammalogy Biennial Conference.

Olsen, D.W., C.O. Matkin, R.D. Andrews, and S. Atkinson. 2018. Seasonal and pod-specific differences in core use areas by resident killer whales in the Northern Gulf of Alaska. Deep-Sea Research Part II 147:196-202. DOI:10.1016/j.dsr2.2017.10.009

Olsen, D.W., C.O. Matkin, F.J. Mueter, and S. Atkinson. 2020. Social behavior increases in multipod aggregations of southern Alaska resident killer whales (*Orcinus orca*). Marine Mammal Science. DOI: 10.1111/mms.12715

Published and updated datasets

DataONE Published Datasets

Matkin, C.O. 2017. Acoustic Recordings of Killer Whales in Prince William Sound and Kenai Fjords, 2012 to 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/rw1k1f.

Matkin, C.O. 2017. Acoustic Kenai Fjords and Prince William Sound Long-Term Photographic Monitoring of Killer Whales, 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/rw1k1s.

Matkin, C.O. 2017 Prince William Sound Killer Whale Satellite Telemetry Data, 2004 to 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/rw1k1g.

Matkin, C.O. 2017. Behavior and Feeding Summaries for Killer Whales in Alaska, 2012-2016. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace. https://doi.org/10.24431/rw1k1r.

Gulf of Alaska Data Portal Datasets

Olsen, D.W. 2017. Acoustic Recordings of Killer Whales in Prince William Sound and Kenai Fjords, 2012 to 2016, Gulf Watch Alaska Pelagic Component

Olsen, D.W. 2017. Kenai Fjords and Prince William Sound Long-Term Photographic Monitoring of Killer Whales, 2012-2016, Gulf Watch Alaska Pelagic Component

Olsen, D.W. 2017. Killer Whale Biopsy Genetic and Chemical Data from Southern Alaska, 1994 to 2016, Gulf Watch Alaska Pelagic Component

Olsen, D.W. 2017 Database of Southern Alaska Killer Whale Surveys and Encounters, 2001 to 2016, Gulf Watch Alaska Pelagic Component.

Research Workspace

2017-18. Acoustic Recordings. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

2017-18. Genetics, Prey. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

2017-18. Photographic encounters. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

2017-18. Hydrophone data. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

Presentations

2017

Olsen, D.W. 2017. Kenai Fjords National Park Interpretive guide training. Oral Presentation. May 5.

Olsen, D.W. 2017. Killer whales. Oral Presentation. Seward public science night, Resurrect Art Coffee House. May 16.

Olsen, D.W. 2017. Killer Whales. Oral presentation to Kenai Fjords National Park Interpretive guide training. May.

Olsen D.W. 2017. Killer whales. Presentation. Seward public science night, Resurrect Art Coffee House. May.

Olsen, D.W., et al. 2017. Behavioral changes during multi-pod aggregations of Southern Alaska Resident Killer Whales (Orcinus orca). Oral Presentation. Society of Marine Mammalogy Conference, Halifax, Nova Scotia, November.

2018

Matkin C.O. 2018. Life history and social structure of Alaskan killer whales, 2018. **Oral Presentation** to Kenai Peninsula College, October.

Matkin C.O., D.W. Olsen, and G. Ellis. 2018. Southern Alaska resident killer whales may be dependent on more than Alaska salmon: some initial stream of origin genetic data from prey samples. **Poster Presentation.** Alaska Marine Science Symposium, Anchorage Alaska. January.

Olsen, D.W. 2018. Zegrahm Expeditions, Killer whales of the world. **Oral Presentation** to Zegrahm Expeditions May.

Olsen, DW. 2018. Mom knows best: Killer whale culture in Prince William Sound. **Oral Presentation**. Kenai Fjords National Park naturalist training May.

Olsen, D.W. 2018. Mom knows best: Killer whale culture in Prince William Sound. **Oral Presentation**. Prince William Sound Science Center Brown Bag May.

Olsen, D.W. 2018. Mom knows best: Killer whale culture in Southern Alaska. **Oral Presentation** to Public / naturalists / Captains, Seward, May.

Olsen, D.W. 2018. Mom knows best: Killer whale culture in Southern Alaska. **Oral Presentation**. Kayak Adventures guide training, May.

Olsen, D. 2018. Killer whales of Alaska. Kenai Fjords National Park interpretive guide training. **Oral Presentation**. May.

Olsen, D. 2018. Mother knows best: Killer whale culture in Alaska. Annual Kenai Fjord Tourboat Operators and Boaters meeting. **Oral Presentation**. May.

Olsen, D. 2018. Killer whales of the world. Zegrahm Expeditions, Antarctica. **Oral Presentation**. January.

Olsen, D. 2018. Killer whales of Prince William Sound. Prince William Sound Science Center Brown Bag presentation. **Oral Presentation**. May.

Olsen, D.W. 2018. Killer whales of the world. **Oral Presentation** to Zegrahm Expeditions July.

Olsen, D.W. 2018. Life of the killer whale. **Oral Presentation** to Seabourne Sojourn August.

Olsen, D.W. 2018. Mom knows best: Killer whale culture in Prince William Sound. **Oral Presentation** to Kenai Peninsula College. November.

2019

Matkin, C.O., D.W. Olsen, and G. Ellis. 2019. An unfortunate legacy: Continuing effects of the *Exxon Valdez* oil spill on killer whales. Alaska Marine Science Symposium, Anchorage Alaska. **Poster Presentation**

Olsen, D. 2019. Killer whales of Kenai Fjords. Seward naturalists and boat operators, Seward, Alaska. **Oral Presentation**. May.

Olsen, D. 2019. Killer whales of Kenai Fjords. Kayak Adventures Worldwide guide training, Seward, Alaska. **Oral Presentation**. May.

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

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

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

Olsen, D.W. 2019. Killer whales of Prince William Sound. **Oral Presentation** to Chenega Village School. September.

Olsen, D.W. 2019. Marine Mammal Acoustics. **Oral Presentation** to Kenai Peninsula College. November.

2020

Myers, H., D. Olsen, C. Matkin, and B. Konar. 2020. Killer whale spatial use in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage Alaska. **Poster Presentation**

Olsen, D.W. 2020. Killer whales of the world. **Oral Presentation** to Zegrahm Expeditions. February.

Olsen, D.W. 2020. Killer whales of Kenai Fjords. **Oral Presentation** to Kayak Adventures naturalists. Online. May.

Olsen, D.W. 2020. Killer whales of Prince William Sound. **Online Oral Presentation** to Whittier Naturalists, US Fish and Wildlife Service. Online. May.

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. Alaska Marine Science Symposium, Anchorage Alaska. **Poster Presentation**

Outreach

Matkin, C.O. 2017. Tracking whales with hydrophones. Delta Sound Connections, Prince William Sound Science Center. March 10.

Matkin, C. 2018. A Sense of What Is. Interview in: Pillsbury, R.A. Guided by Whales. Duende Press.

Matkin, C. 2018. Beyond Delta Sound Connections. Delta Sound Connections. Prince William Sound Science Center. http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdfOlsen, D. 2019. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation. January.

North Gulf Oceanic Society. 2017. Updates to Facebook page during field season with descriptions of field activities. https://www.facebook.com/NorthGulfOceanicSociety/

North Gulf Oceanic Society. 2018. Updates to Facebook page during field season with descriptions of field activities. https://www.facebook.com/NorthGulfOceanicSociety/

North Gulf Oceanic Society. 2019. Updates to Facebook page during field season with descriptions of field activities. https://www.facebook.com/NorthGulfOceanicSociety/

North Gulf Oceanic Society. 2020. Updates to Facebook page during field season with descriptions of field activities. https://www.facebook.com/NorthGulfOceanicSociety/

Olsen, D. 2020. Updates to Twitter feed for North Gulf Oceanic Society.

Olsen, D. 2020. Regular informational killer whale emails to Seward naturalist email group.

8. LITERATURE CITED

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Kim M Parsons Jul 18, 2019, 1:30 PM

to me

Hi Craig -

I estimate that the cost for processing the 2016 & 2017 samples last year (extracting DNA, genotyping, and genetic prey ID) was probably ~$22k (including the cost of my time invoiced to the NOAA contracts).

Let me know if you want a more specific breakdown.

Best,

Kim.

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Costs for 2020 and 2021 will be about double this 22K per year due to doubling of number of samples