***Exxon Valdez* Oil Spill Trustee Council**

Long-Term Research and Monitoring, Mariculture, Education and Outreach

Annual Project Reporting Form

Project Number: 23120114-N

Project Title: Long-term killer whale monitoring in Prince William Sound/Kenai Fjords

Principal Investigator(s): John Durban and Craig Matkin, North Gulf Oceanic Society

Reporting Period: February 1, 2023 – January 31, 2024

Submission Date: March 1, 2024

Project Website: https://www.whalesalaska.org/ https://gulfwatchalaska.org/

Please check all the boxes that apply to the current reporting period.

☒ **Project progress is on schedule.**

With caveat of reduced deliverables given cessation of funding after two of the 10 proposed years (see section 4).

☐ **Project progress is delayed.**

☐ **Budget reallocation request.**

☐ **Personnel changes.**

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1. Summary of Work Performed:

Field data collection:

We conducted 32 vessel survey days in 2023 onboard the *R/V Natoa,* a 10.3 m inboard diesel-powered vessel, to collect killer whale (*Orcinus orca*) photo-identifications. The timing and geographic components were similar to previous years (Fig. 1). Specifically, search effort was focused on known killer whale hotspots in the Kenai Fjords in late May and early June, with effort moving to Hinchinbrook Entrance and Montague Strait in Prince William Sound during the second half of June (Fig. 1). There was also opportunistic photo-identification effort in Kachemak Bay. We had 28 encounters when killer whale photo-identifications were collected, including 23 with the resident (fish-eating) ecotype and five with the transient (mammal-eating, also known as Bigg's killer whale) ecotype. There were no AT1 (Chugach transient) encounters on our surveys, but photographs of AT1s were contributed by naturalists on other platforms.

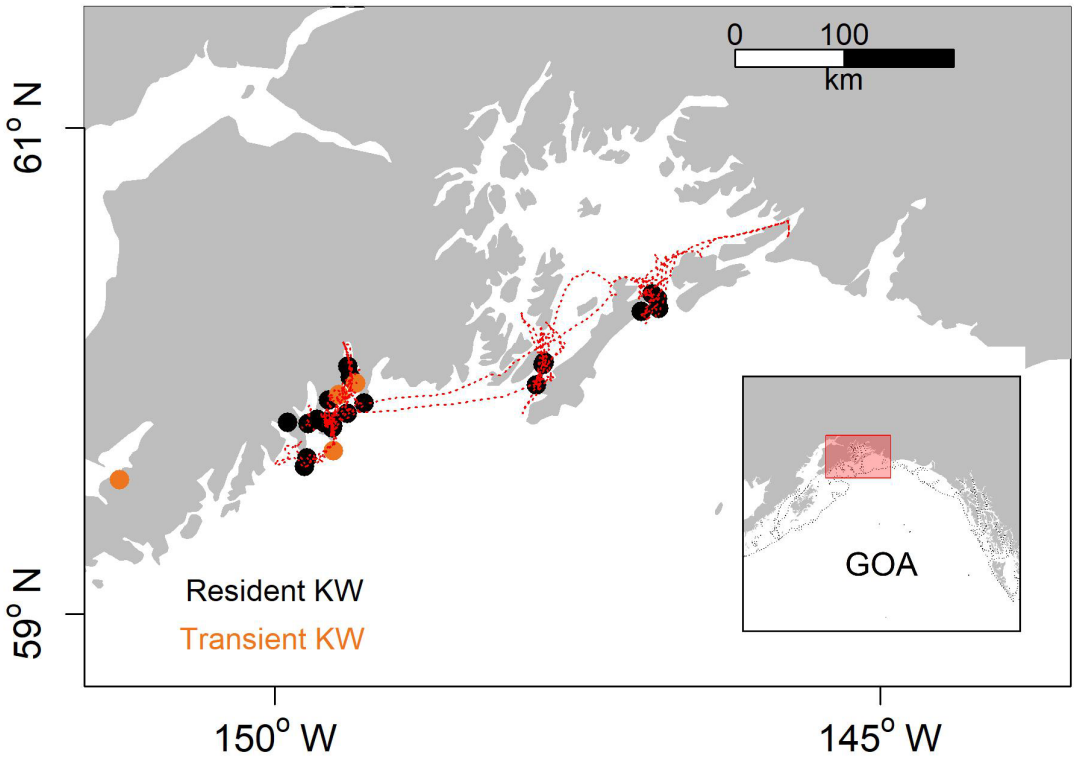

Figure 1. Vessel survey tracks (red broken lines) when searching for killer whales in Prince William Sound and Kenai Fjords in 2023. Solid circles show locations where resident (fish-eating, black) and transient (mammal-eating, orange) killer whales were encountered and photo-identifications collected.

We also collected 11 free-floating scat samples from killer whales, and one sample of fish scales from a killer whale predation event; these will be analyzed genetically for prey preferences if/when funds are secured. Additionally, we continue to maintain five hydrophones recording year-round occurrence of killer whales in the Gulf of Alaska (Fig. 2): Marmot Island, Kachemak Bay, Resurrection Bay, Montague Strait, and Hinchinbrook Entrance. Acoustic recordings will be analyzed to document killer whale presence, at the level of ecotype and pod, if/when funds are secured.

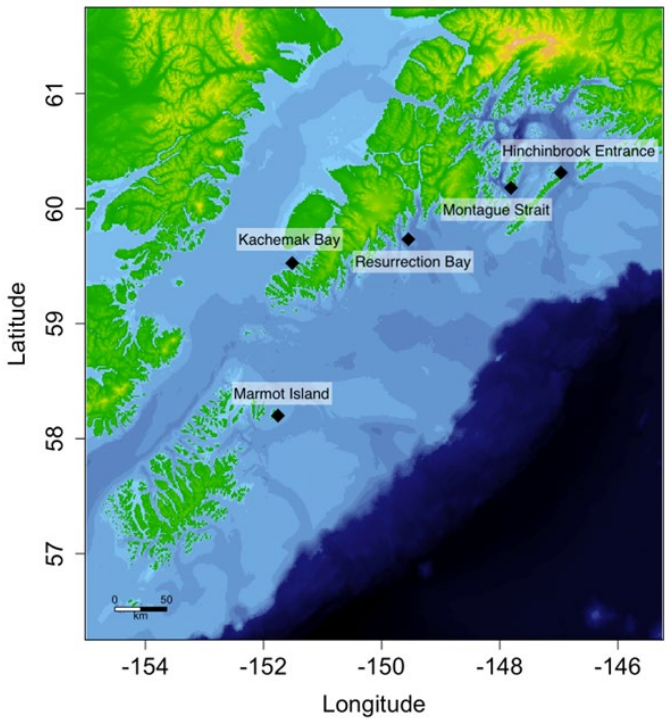

Figure 2. Location of five remote hydrophone stations operated by North Gulf Oceanic Society.

Data analysis:

Frame by frame boat-based photo-identification) analysis (n = 16,175 photos) is complete for the 2023 data. This documented 12 different pods of resident killer whales, including pods from both AB and AD acoustically and genetically distinct clans (Fig. 3). There was notable spatial and temporal stratification of the clans, with AD clan whales typically being encountered around the Kenai Fjords in late May and early June, and AB clan whales typically being encountered in later June in Prince William Sound.

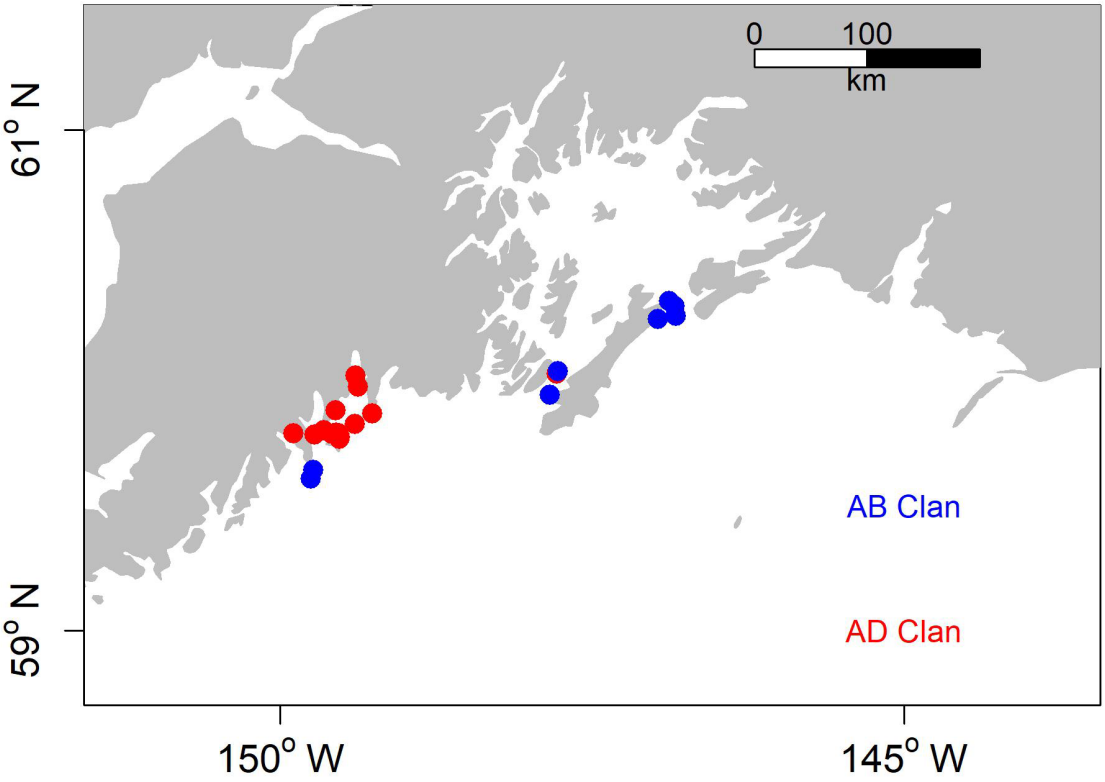

Figure 3. Encounter locations with resident killer whales from the two acoustically and genetically distinct clans. AD clan pods (red) were typically encountered around the Kenai Fjords in late May and early June and AB clan pods (blue) were typically encountered at the entrances to Prince William Sound in later June.

The photographic analysis confirmed that we had encounters with 8/10 index pods of resident killer whales that we are currently monitoring for population dynamics (Matkin et al. 2023), including four pods from each of both AB and AD acoustic clans (Table 1). Although not every matriline was encountered in all pods, photo-identification analyses of the photographed groups indicated general slow growth, with a small number of new calves documented since 2022 and no new deaths. AB pod, which has been documented to have been injured by the *Exxon Valdez* oil spill, was inferred to contain 18 whales in 2023, remaining below the pre-spill high of 27 individuals.

Table 1. Recruitment, likely mortalities, and total number of killer whales in index pods (See Matkin et al. 2023). Shading indicates pods from the AB acoustic clan listed above those pods from the AD acoustic clan.

POD	Total 2022	Calves since 2022	Missing since 2022*	Total 2023
AB**	17	1	0	18
AB25**	26	1	0	27
AJ***	47	0	0	47
AJ08	20	0	0	20
AI	10	NA	NA	NA
AB Clan sum		**2**	**0**	
AE**	18	1	0	19
AK02	20	NA	NA	NA
AK06	11	0	0	11
AD08	10	0	0	10
AD16	15	0	0	15
AD Clan sum		**1**	**0**	

** Missing likely indicates death but may be due to incomplete photo-identification coverage. Photo-identification in future years will help confirm, along with fitting of mark-recapture model to account for matriline-specific capture probabilities when estimating survival.*
*** Not all matrilines in these pods were encountered in 2023; considered constant until more data collected.*
****One whale (AJ73) missing in 2022 was seen in 2023, so 2022 total adjusted from 46 to 47. Not all matrilines in this pod encountered; considered constant until more data collected.*

Six of the seven AT1 transients known to be alive in 2022 were also identified from contributed photographs in 2023. One whale (AT3, an adult male) was missing from photographs in 2023 and future surveys are needed to assess the likelihood of mortality. The youngest female in the AT1s is estimated to be 49 years old, which is likely beyond reproductive age, and therefore the population is inferred to have no reproductive potential. The AT1 population was directly injured by the *Exxon Valdez* oil spill and remains below the pre-spill high of 22 individuals.

To help diagnose the causes of population dynamics, we are continuing to use drone photogrammetry to make quantitative measurements of health. Measurements of body condition will be used to infer nutritional status in the short term and measurements of length will be used to assess the longer-term consequences of any nutritional limitation. New data collection was not supported in 2023. But, with support from other sources we continued photogrammetry analysis of the 32,000 aerial images collected 2021 and 2022 combined. We have identified 112 different

whales from 10851 measurement-quality images, based on their natural markings visible in the aerial photographs. This sample includes whales from nine different pods (AB25, AD5, AD8, AD16, AJ8, AK6, AK2, AX27, one unidentified pod), and from both the AB and AD acoustic clans in the population. Now that measurable images have been selected and assigned to individuals, we are undertaking the task of measuring to quantify lengths and body condition.

References:

Matkin, C. O., J. Durban, D. Olsen, H. Myers, and G. Ellis. 2023. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-M), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

2. Products:

Peer-reviewed publications:

Myers, H. et al. *Submitted*. How much do killer whales call? Quantifying calling rates for passive acoustic density estimation. *Communications Biology*

Olsen, D. et al. *In prep*. Diverse diet of resident killer whales (*Orcinus orca*) in southern Alaska revealed by two complementary sampling methods. *In review with coauthors*. *Will be submitted in the next 6-month reporting period (second half of 2023 grant)*

Van Cise, A. et al. *In prep*. North Pacific resident killer whales exhibit spatial and seasonal differences in preferred fish prey. *In review with coauthors. Will be submitted in the next 6-month reporting period (second half of 2023 grant)*

Reports:

Matkin, C. O., J. Durban, D. Olsen, H. Myers, and G. Ellis. 2023. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-N), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Myers, H. J. 2023. Passive acoustic monitoring of killer whales (*Orcinus orca*) in the northern Gulf of Alaska. Coastal Marine Institute Graduate Student Funding Opportunity Final Report.

Popular articles:

Matkin, C. 2023. Opinion: Red herrings won't help us save Chinook salmon. Anchorage Daily News, November 13. https://www.adn.com/opinions/2023/11/13/opinion-red-herrings-wont-help-us-save-chinook-salmon/.

Matkin, C. 2023. Opinion: Protecting killer whales in the Bering Sea requires following the science. Anchorage Daily News, December 31. https://www.adn.com/opinions/2023/12/31/opinion-protecting-killer-whales-in-the-bering-sea-requires-following-the-science/.

Conferences and workshops:

Arimitsu, M., D. Cushing, J. Durban, S. Hatch, R. Kaler, K. C. Matkin, J. Moran, D. Olsen, S. Pegau, J. Piatt, J. Straley, S. Whelan, and L. Wild. 2024. Changes in marine predator and prey populations in the Northern Gulf of Alaska: Gulf Watch Alaska pelagic update 2023. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Public presentations:

Myers, H. 2023. Killer whale research presentation and bioacoustics class project. Hutchison High School Marine Biology class, Fairbanks, Alaska, April.

Myers, H. 2023. Eavesdropping on killer whales. Invited online talk, University of Alaska Fairbanks College of Fisheries and Ocean Sciences Advisory Council Meeting, April.

Myers, H. 2023. Listening to killer whales. Invited online seminar, Department of Natural Science, College of Coastal Georgia, March.

Olsen, D. 2023. Killer whale research updates. Presentation to marine naturalists working on commercial ecotourism boats in Seward, Alaska.

Matkin, C. 2023. Killer whale life history, behavior, and population dynamics. Lectures to Semester by the Bay Program students, University of Alaska Anchorage, Kenai Peninsula College.

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

An updated analysis of resident killer whale population dynamics, inferred from photo-identification records, is being complied and prepared for submission to a peer-reviewed scientific journal.

An updated analysis of resident killer whale diet, inferred from fecal and scale samples, is being reviewed by coauthors in advance of submission to a peer-reviewed scientific journal.

An analysis of the acoustic calling rates of resident and transient killer whales, inferred from passive acoustic recordings, has been completed and submitted to a peer-reviewed scientific journal (Myers et al., submitted). This is an important component of passive acoustic density estimation.

Data sets and associated metadata:

Data sets have not yet been updated on the Gulf of Alaska Data Portal to include 2023 data. The photographic and acoustic files are very large and cannot be uploaded and accessed with a browser easily, but will be transferred by hard drive to add to the following datasets which have been published online by Axiom Data Science for previous years (https://gulf-of-alaska.portal.aoos.org/#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project):

- Database of surveys and encounters
- Shipboard acoustic recordings
- Remote hydrophone recordings
- Prey sample metadata
- Field identification photographs

Additional Products not listed above:

Nothing to report at this time.

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center

We coordinate closely with the Prince William Sound Science Center (PWSSC) in their role as administrative lead of the Gulf Watch Alaska Long-Term Research and Monitoring program

(GWA-LTRM). This includes managing award contracts, meeting reporting requirements and attending in-person and online meetings arranged by PWSSC.

EVOSTC Long-Term Research and Monitoring Projects

We coordinate closely with the GWA-LTRM program, specifically by providing data for synthesis with the Pelagic component (see Arimitsu et al. poster on 2023 update to Alaska Marine Science Symposium) and broader synthesis efforts across GWA-LTRM components (Rob Suryan, Science Lead for GWA-LTRM). We collect humpback whale identification photos and provide data on distribution and abundance of humpback whales (encounter data) as possible during our surveys. The raw data are provided to the humpback whale project (principal investigators [PIs] Moran and Wild, project 22120114-O). Conversely, the humpback whale project contributes opportunistic killer whale identification photographs to our dataset.

EVOSTC Mariculture Projects

No coordination/collaborations for this reporting period.

EVOSTC Education and Outreach Projects

We are working closely with financial support from a Seward kayak guiding company to provide local education regarding killer whales, humpback whales, porpoise, and the whole Kenai Fjords ecosystem. This includes school visits, tangible wildlife guides and guidelines, naturalist trainings, and social media and website outreach. We have also participated in meetings with members of the CORaL network funded by EVOSTC to evaluate ways the programs can work together on outreach activities.

Individual EVOSTC Projects

We work with the Data Management program to ensure data collected on killer whales are properly reviewed, have current metadata, and are posted to the Gulf of Alaska data portal. We will work with other individually funded EVOSTC projects if collaborative efforts make sense based on data collected.

Trustee or Management Agencies

We directly collaborate with the National Oceanic and Atmospheric Administration's (NOAA's) Northwest Fisheries Science Center (Dr. Kim Parsons), including sharing data for genetic analysis of killer whale fecal samples to infer dietary preference. This is facilitating a

comparison of the diet of southern Alaska resident killer whales and endangered Southern Resident killer whale population in Washington State waters.

Population data on resident and transient killer whales are supplied to the NOAA Alaska Fisheries Science Center (Dr. Paul Wade) for incorporation into Alaska Marine Mammal Stock Assessment Reports and use in management applications.

Native and Local Communities

We have delivered naturalist training, school visits, and other educational opportunities in Seward, Homer and Fairbanks during 2023. Our social media engagement and email information outreach has seen participation from Chenega, Cordova, Valdez, Whittier, Seward, Homer, and Kodiak.

4. Response to EVOSTC Review, Recommendations and Comments:

In January 2024, the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) decided to discontinue funding for this project after the 2023 cycle, which we will spend out during 2024 with no cost extension carryover funds from FY23 (because the NOAA grant is off-cycle from the EVOSTC fiscal year). Specifically, it was decided not to approve continued funding for this project in 2024-2026 cycles as part of a reallocation request from the GWA-LTRM program. As a result, funding has only been made available for the first two years of our original 10-year (FY22-31) proposal. This support will clearly not be long enough to generate the data to support all the deliverables proposed for the ten-year period, specifically the seven proposed papers. At a science level, this will mean we will not be supported to continue to monitor killer whale population dynamics and will not be supported to track changes in killer whale health (photogrammetry) and ecosystem interactions (diet and distribution) to help diagnose the causes of population dynamics. These were all elements that were supported and encouraged by the EVOSTC Science Panel's reviews of our proposal and progress.

Despite not having a multi-year funding commitment, we are on track with proposed annual progress both in field data collection and model-based analysis. As such in FY24, using carryover funds noted above, we anticipate delivering the paper we proposed in the second year of this project (2023 funding cycle), specifically a paper updating population dynamics of Alaska resident killer whales, examining pod-specific demography, quantify correlation between pods and identifying key temporal trends and any abrupt shifts.

With alternative sources of support, we also anticipate being able to deliver the second proposed paper, specifically a manuscript comparing body size and condition of Alaska Resident killer whales to Southern Resident and Northern Resident killer whale populations. However, without dedicated EVOSTC support in 2024, the timing of this delivery will be delayed.

Additional future deliverables will be dependent on additional support.

5. Budget:

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

Budget Category:	Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$0	$0	$0	$0	$0	$0	$0
Travel	$7,200	$3,000	$0	$0	$0	$10,200	$12,364
Contractual	$152,200	$88,500	$0	$0	$0	$240,700	$201,850
Commodities	$18,500	$13,550	$0	$0	$0	$32,050	$18,785
Equipment	$0	$0	$0	$0	$0	$0	$0
Indirect Costs Rate = 10%	$17,790	$10,505	$0	$0	$0	$28,295	$23,300
SUBTOTAL	$195,690	$115,555	$0	$0	$0	$311,245	$256,299
General Administration (9% of subtotal)	$17,612	$10,400	$0	$0	$0	$28,012	N/A
PROJECT TOTAL	$213,302	$125,955	$0	$0	$0	$339,257	
Other Resources (In-Kind Funds)	$76,000	$126,000	$56,000	$56,000	$56,000	$370,000	

Further expenditure of FY23 funds is expected through May 2024 to coincide with the NOAA grant. We do not expect to fully spend out some categories by then because of the late arrival of FY23 funds, so plan some expenditure after 01 June 2024.