September 27, 2021

Shiway Wang, Executive Director
Exxon Valdez Oil Spill Trustee Council
4210 University Drive
Anchorage, AK 99508-4626

Re: Revision of GWA-LTRM Project 22120114-N Long-term killer whale monitoring

Dear Shiway,

We are re-submitting the subject project proposal and budget including revisions you requested. Below, the PIs respond to the EVOTC Science Panel comments and outline what changes were made to the proposal and budget.

In response to reviewer comments in the Draft FY22-FY31 Work Plan (9/21/21) we have revised our project proposal, 22120114-N, submitted under the Long-term Research and Monitoring (LTRM) program focus area of the EVOSTC FY22-31 Invitation. We are proposing the continuation of the long-term killer whale monitoring project, which was initiated in 1984, one of the few time series with pre-spill data for an injured resource.

The reviewers expressed two principal concerns: 1) an apparent lack of attention to developing mechanistic explanations for observations obtained over the course of this study, and 2) a paucity of recent publications. The reviewers further suggested that the valuable data sets this project has acquired over 35+ years are fertile ground for mechanistic analyses and strongly encouraged us to expand our project with more rigorous modelling approaches. A revised proposal and budget were recommended, understanding that our "comparatively low budget" would increase to add this additional component.

In response to these recommendations, we have modified proposal and budget (see attached). To summarize, we are now proposing to add a number of tasks within a new core objective related to mechanistic and integrated modelling. Our diet and distributional data will be used to suggest plausible environmental and trophic covariates for killer whale responses, and the predictive ability of these mechanistic links will be investigated in Bayesian modelling frameworks that will integrate changes in whale body size, body condition and population dynamics. These tasks are modular and cumulative over the course of the study, and their addition will allow us to both continue to provide assessments of long-term trends in population dynamics and provide increased resolution on killer whale responses to environmental changes.

Furthermore, data from this project have been and will continue to be used by the LTRM Synthesis and Modeling Component (P.I. Suryan) efforts and publications. For example, datasets that originated pre-spill are key to the proposed analysis by a new LTRM post-doc, Dr. Bia Dias. Dr. Dias is proposing objectives and hypotheses related to regime shifts and associated drivers that includes updating the Prince William Sound Ecopath/Ecosim model (developed by Okey et al.) to address ecosystem response to changes in frequency of future heatwaves and environmental perturbations. Dr. Dias just started her post-doc two months ago, so specific objectives and exact methods are still underdevelopment.

To develop and apply these cumulative and updating model components over the full term of the proposal, these tasks will be led within NGOS by Dr. John Durban, a senior scientist with over 90 publications to date, who is an expert at quantitative modelling of abundance, population dynamics and photogrammetry data. Dr. Durban's CV is included at the end of the proposal. Dr. Durban will coordinate with the LTRM Synthesis and Modeling Component lead (Dr. Suryan), Dr. Dias, and other postdocs engaged in synthesis and modelling of other Gulf Watch Alaska long-term data sets to investigate killer whale responses to climate scenarios and abundance changes at lower trophic levels. Dr. Durban will also have a leading role in data collection on killer whales, and his knowledge of the data and study population will allow modelling tasks to be conducted efficiently and with considerable cost savings compared to familiarizing and training outside personnel who would require turnover to support the 10-yr study. Furthermore, engaging Dr. Durban on a part-time basis but over the full duration of the project will allow modelling tools to be developed in parallel with our ongoing data collection, rather than waiting until the final data are in hand (the same strategy as the LTRM Synthesis and Modeling Component). These modelling tools will be used to provide updated inference about both killer whale population dynamics and responses to environmental changes during both 5-year phases.

Notably, we are proposing seven manuscripts over the ten-year study as a result of this new core component, with three of these in the first five-year phase. These manuscripts will build on, and extend, similar research that is underway by Dr. Durban and his collaborators in studies of endangered Southern Resident killer whales and Northern Resident killer whales around Vancouver Island. As such, our proposed work plan and manuscripts will both facilitate comparative studies to assess population status of killer whales in PWS and provide significantly increased resolution for monitoring and understanding changes in status as we extend our 37-year time series.

Many thanks for your consideration,
Craig Matkin, Dan Olsen, John Durban, North Gulf Oceanic Society

*** Specific changes to the proposal:

Budget – New rows highlighted in yellow under contractual are in the budget form (Excel file)

- We have also updated the budget summaries in the proposal (p1-2, p22-23).
- The table below shows the change in the total 10-yr cost for the project.

22120114-N	August Budget	Sept Revised Budget	Difference
Total	$ 1,810,600	$ 2,158,393	$ 347,793*
w 9% GA	$ 1,973,554	$ 2,352,648	$ 379,094

** comprable to cost of a postdoc ($120K for 3 yrs = $360K)*

Proposal – Edits are highlighted as track changes

Our main addition is a new section on "Integrated and mechanistic modelling" on p14-16, which details our proposed methods and deliverables (7 papers over 10 years; 3 in the first 5-years). We have made minor changes throughout the document to add and refer to this new component.

Please also note changes to:

- Integration with Synthesis and Modeling Component (p19). Text noting above information and more insight on the 10-year synthesis plan.
- Deliverables, p21. Seven new papers are proposed.
- Durban has updated his CV (p30) with three key papers that demonstrate recent success and experience of using Bayesian modelling approaches for killer whales.

Sincerely,

Mandy Lindeberg
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FY 22-31 *PROJECT* PROPOSAL
LONG-TERM RESEARCH AND MONITORING PROGRAM

Does this proposal contain confidential information? ☐Yes ☒No

Project Number and Title

Long-Term Research and Monitoring Program: Pelagic Ecosystem Monitoring Component

22120114-N Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords

Primary Investigator(s) and Affiliation(s)

Craig Matkin, Dan Olsen, John Durban, North Gulf Oceanic Society

Date Proposal Submitted

August 13, 2021; revised September 27, 2021 (revisions in blue throughout proposal)

Project Abstract (maximum 300 words)

The proposed project is a continuation of the photo-identification based long term killer whale monitoring program that was initiated in 1984 in Prince William Sound. A primary focus has been on resident killer whales and the recovery of resident (fish eating) AB pod and the threatened transient (mammal eating) AT1 population of killer whales. These groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Furthermore, the positive recovery trajectory of the AB pod appears to have suffered a setback to post-spill levels following the recent marine heatwave. Monitoring of all major pods, their population dynamics, feeding ecology, movements, range, and contaminant levels now spans over 35 years; its continuation will assess their vulnerability to future perturbations and environmental change, including oil spills. To ensure continuity of existing data streams and better integrate the killer whale project with the Gulf Watch Alaska - Long-Term Research and Monitoring Pelagic Component goals in the next funding cycle, we are adding a program led by Dr. John Durban to regularly monitor killer whale growth and body condition, including pregnancy status and subsequent calf mortality rates, using camera equipped drones. In combination, these techniques will continue to provide assessment of long-term trends in population numbers and dynamics and provide increased resolution on killer whale responses to environmental changes. Diet and distributional data will be used to suggest plausible environmental and trophic covariates, and the predictive ability of these mechanistic links will be investigated in a Bayesian modelling framework that will integrate changes in body size, body condition and population dynamics. Community based initiatives, educational programs, and programs for tour boat operators will continue to be integrated into the work to help foster restoration by improving public understanding and reducing harassment of the whales.

EVOSTC Funding Requested* (must include 9% GA)

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$213,302	$233,325	$238,601	$215,221	$258,804	$1,159,253
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$240,549	$219,147	$231,917	$225,262	$276,519	$1,193,395
				FY22-31 Total	*$2,352,648*

**If the amount requested here does not match the amount on the budget form, the request on the budget form will considered to be correct.*

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 ONR 20,000 NGOS 15,000 Total: $76,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 ONR 20,000 NGOS 15,000 Total: $76,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $320,000
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $280,000
				FY22-31 Total	*$600,000*

1. EXECUTIVE SUMMARY (maximum ~1500 words, not including figures and tables)

Pelagic Component

In the aftermath of the 1989 *Exxon Valdez* oil spill (EVOS), it was difficult to distinguish between the impacts of the spill and background variability in pelagic populations such as whales, marine birds, and forage fish. The main problem was that long-term baseline data for these groups of species were largely absent. As a result, managers struggled to make informed decisions in their assessment of damages and recommendations for recovery. Ten years after the spill it was widely recognized that there had been a major climatic regime shift that altered the marine ecosystem prior to the spill. Recently, marine heatwaves of unprecedented spatial and temporal scale have led to a large-scale disruption in the pelagic marine food web. Ongoing monitoring is essential for understanding the impacts of natural and anthropogenic stressors on the pelagic marine ecosystem.

The Gulf Watch Alaska Long - Term Research and Monitoring (GWA-LTRM) program's Pelagic Component contains five projects focused on species that play a pivotal role in the pelagic ecosystem as trophic indicators for short and long-term ecosystem change: killer whales, humpback whales, forage fish, and marine birds. The overall goals of the GWA-LTRM Pelagic Component are to (1) determine the population trends of key pelagic species groups in Prince William Sound (PWS) and their abundance in adjacent shelf waters, and (2) improve our understanding of predator – prey relationships and their response to ecosystem changes. The following questions will shape the research of the pelagic team over the next decade:

1. *What are the population trends of key pelagic species groups in PWS - killer whales, humpback whales, marine birds, and forage fish?*

2. *What are indicators of ecosystem flux in these middle- and upper-level predators (e.g., population changes, shifts in distribution or abundance, variation in condition of individuals, changes in predator/prey relationships)?*

3. *How do these indicators interface with environmental drivers and with indicators in nearshore coastal and shelf environments to inform a larger picture of ecosystem change?*

Killer Whale Monitoring

Both resident ecotype (AB pod) and transient ecotype (AT1 population) killer whales suffered significant mortalities following EVOS in 1989. AB pod still has not recovered to pre-spill numbers (Matkin et al. 2008) and in recent years following the Pacific marine heatwave (Di Lorenzo and Mantua 2016) the loss of older females and their older sons has driven numbers down to levels near those following the spill. The AT1 population is not recovering and may be headed toward extinction (Fig. 1; Matkin et al. 2008, Matkin et al. 2012).

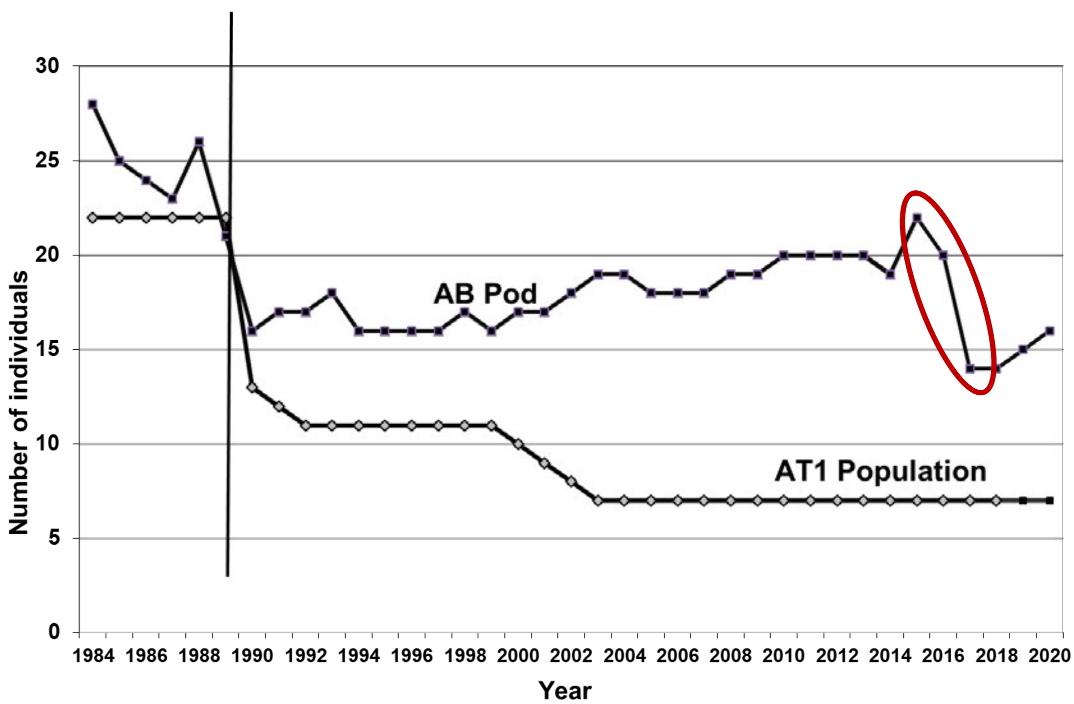

Figure 1. Number of whales in AB pod and AT1 population by year. Red circle highlights the recent mortality of older AB females and their adult sons, following the marine heatwave.

This project has demonstrated that killer whales are sensitive to perturbations such as oil spills and marine heatwaves. However, the potential long-term consequences which may include extinction, or the extended recovery periods, including climate-induced setbacks are being clearly demonstrated over three decades after the spill. This species (both fish and mammal eating ecotypes), as an apex predator, has important roles in the ecosystem. Changes in killer whale numbers and condition signal serious changes in the environment which, in the case of resident killer whales would signal changes in availability of specific Pacific salmon species. Additionally, these whales are a primary focus for viewing by a vibrant regional tour boat industry in the southcentral Alaska region. Over 100,000 annual visitors pass through the Kenai Fjords on tour vessels, and killer whales are a primary viewing objective. Many more visitors and Alaskans view the whales from private vessels and on tour boats in PWS. Our identification catalogues and other data from this project are frequently referenced by tour boats to enhance viewer experience which can lead to a deeper appreciation of the local environment and its fauna.

There are four killer whale populations that use our study area, each with different habits and trajectories. These are the resident (salmon specialists, including AB pod), AT1 or Chugach transients (harbor seal and porpoise predators), Gulf of Alaska transients (sea lion and other marine mammal predators), and offshores (shark specialists). We will monitor all four populations as possible but are focused on the piscivorous residents and the AT1 transients. Killer whales can be reliably resighted and individuals monitored by unique markings. Because of the unique social structure of resident killer whales, detailed population dynamics models can be developed (Matkin et al. 2014). Also, the AT1 transient population can be monitored by individual as they now number only seven whales (Matkin et al. 2008). The wide-ranging Gulf of Alaska transients (mammal eating) population have been examined for trends using Bayesian mark-recapture models in previous years of our study (Matkin et al. 2012). Finally, the very wide-ranging offshore population can be photo-identified by individual and data from encounters with this population are contributed to a coast-wide data base at the Pacific Biological Station (Nanaimo, BC, Canada). The killer whale project, which now spans 35 years of work in PWS and Kenai Fjords, is a unique opportunity to continue a comprehensive monitoring program for this keystone marine species.

This project ties in closely and collaborates with companion killer whale studies that span the west coast of the North Pacific, particularly the endangered Southern Residents of Washington State. The core project is the photo-identification based monitoring of population parameters, developing detailed understanding of feeding ecology, examining year-round distributional changes and habitat use patterns using acoustics, long term monitoring of contaminants, and the recently added tracking of individual growth, body condition and pregnancy rates using aerial photogrammetry (Durban et al. 2015, Fearnbach et al. 2020).

Analysis of data collected during this project includes photo-identification data to inform population dynamics (Matkin et al. 2014), genetic sequencing as necessary for determination of population affiliation (Parsons et al 2013), analysis of prey including identification of scales and flesh left at kill sites and genetic analysis of fecal samples for prey species identity, genetic tracking of salmon prey to river of origin, acoustic analysis of remote hydrophone data, and morphometric analysis of drone data captured in overhead photographs (Durban et al. 2015). These components will be integrated in a modelling framework that aims to develop mechanistic explanations for changes to whale population status. Specifically, diet and distributional data will be used to suggest plausible environmental and trophic covariates for killer whale responses, and the predictive ability of these mechanistic links will be investigated in Bayesian modelling frameworks that will integrate changes in whale body size, body condition and population dynamics (e.g., Stewart et al. 2021). Although we will focus on the oil spill impacted southern Alaska resident and AT1 transient populations, the study also includes the other two recognized populations in the region, the Gulf of Alaska transients and offshore killer whales. This project makes a substantial contribution to the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) killer whale stock assessments.

Data will be collected from the R.V. *Natoa*, during a minimum 55-day field season between May and October, although opportunistic photographic data will be contributed from other collaborating vessels. This is the continuation of a long-term project spanning nearly four decades that benefits from continued support of mariners and the coastal communities across the north Gulf coast of Alaska.

2. RELEVANCE TO THE INVITATION (maximum 300 words)

This project is relevant in terms of restoration of the species impacted by EVOS. Killer whales were injured by EVOS and the impacted groups have not returned to pre-spill numbers. The observed changes in oil impacted AB pod and the AT1 population indicate that oil spill effects were more severe and have had a longer impact than originally anticipated and recent environmental conditions have caused further setbacks (Fig. 1). Moreover, this study demonstrated the importance of long-term monitoring to measure changes in wildlife populations to understand impacts of major perturbations such as EVOS and marine heatwaves. Continued tracking of oil impacted groups and other groups of killer whales is essential for documentation of long-term impacts, restoration time, and trajectory of this key species. The proposed project will use proven monitoring techniques to provide detailed population level data and basic feeding and trophic level data on killer whales. Our photo analysis provides life history parameters and changes in baseline population status over the long (decadal) term. Acoustic monitoring is an excellent tool to observe inter-annual shifts in occurrence, timing, and relative importance of key locations. Additional clarity in diet studies is critical for ecological understanding, but also for comparison with other populations, namely the Endangered Southern Residents.

The innovative drone technologies proposed here will provide a new morphometric analysis, providing population health responses in the short term through trends in body condition and the longer-term through data on individual growth. In combination, our data on killer whales at varied time scales will facilitate linkages to changes in the physical environmental and abundance at lower trophic levels and our modelling frameworks, combined with those of the GWA-LTRM Synthesis and Modeling Component, will formerly examine and identify mechanistic links. This will integrate our project across components and support GWA-LTRM-wide synthesis efforts.

3. PROJECT HISTORY (maximum 400 words)

This is a continuing project that has been funded by the EVOS Trustee Council (EVOSTC) since the inception of the Council (Projects: Damage Assessment [1989-92]MM02 and research projects [95-04]012, [05-10]742, and 21120114-N). Products that have used the data and analysis generated by this long-term killer whale project include over 40 published papers, over a dozen popular articles, numerous newspaper accounts, and two books. There have been more than 60 public presentations made during the project, more than 25 were at scientific conferences. Our research group has worked directly with tour boat operators to develop viewing guidelines sanctioned by the operators and tour boat companies.

In the written and oral products of our photo-identification based studies, we have directly evaluated the impact of EVOS on particular populations and pods of killer whales. These impacts have been substantial and persistent. Research has focused on the threatened AT1 (Chugach) transient population and the southern Alaska resident population and examined in detail the population dynamics of each. Using biopsy sampling we have delineated genetic structure and clearly separated the populations. From these samples we have also examined contaminant levels in the whales and patterns in stable isotopes in the skin and blubber. This has complemented our feeding ecology studies, which examine the remains of predation events and use innovative genetic assessment of fecal samples to examine diet in detail. The social structure and changes in pod structure over the years has been carefully diagrammed and reported to the public in our annually updated catalogue and other publications. Satellite transmitters were employed to reveal movements of the whales over time but have been discontinued due to animal health concerns. The project is now successfully pioneering the use of non-invasive remote acoustic stations to monitor movements and habitat use of killer whales in the region. Similarly, in 2021 we successfully started using remotely controlled drones to collect aerial images of resident killer whales in our study area to use photogrammetry data to assess population health through size at-age and body condition, which will now provide a quantitative basis for future monitoring. Similarly, these quantitative metrics can be compared across identical studies of other populations, namely the Northern and Southern Residents. In the case of the endangered Southern Resident killer whales, growth and body condition parameters for relatively healthy and increasing Alaska resident pods can provide benchmarks for recovery.

4. PROJECT DESIGN

A. Objectives and Hypotheses

This project continues a 37-year population monitoring and population dynamics program for southern Alaska resident and AT1 transient killer whales with the monitoring of trends for the Gulf of Alaska transient population (Matkin et al. 2008, Matkin et al. 2012, Matkin et al. 2014). It also has provided photographic data on Offshore killer whales used to inform catalogues and studies of this unique wide-ranging ecotype. As a byproduct we have participated in the publication of findings on Offshore killer whales (Ford et al. 2011). It has also provided an assessment of killer whale interaction with their prey: salmon and other fishes in the case of residents, marine mammals for the two transient populations, and sharks in the case of offshore type killer whales. The proposed project seeks continuation of these core long term studies and will continue to contribute status and management related data on killer whales in Alaska that can be interfaced with studies conducted in other regions. As another valuable byproduct, this study has provided essential data for humpback whale population and trend estimations in our study region (Teerlink et al. 2014).

The core project will continue photographic monitoring of individual killer whales, focusing on the oil spill impacted pod and population that, after more than three decades, have not recovered from the effects of the spill. Using photo-identification and maintaining individual life histories, the project will continue to develop population parameters, and, in the case of resident whales, a population dynamics model. This will provide a quantitative framework for assessing changes over time and comparing population status to other resident killer whale populations (see Ward et al. 2016). Notably, in the case of the endangered Southern Resident killer whales off Washington State and British Columbia, population dynamics of relatively healthy and increasing Alaska resident pods can provide benchmarks for recovery. Similarly, our mark-recapture estimates will provide quantitative parameters for monitoring the status of transient killer whales in our study area and comparing to adjacent populations (see Durban et al. 2010, Ford et al. 2008). We will continue to assess contaminant levels in blubber at extended intervals to monitor changes that might be indicative of changes in prey and health consequences. Field sampling of prey remains (tissue, fish scales) and fecal sampling to expand our knowledge of feeding ecology will be an emphasis. Additionally, we will examine distribution and movements year-round using remote acoustic monitoring and semi- annual replacement and retrieval of submerged recording devices in key locations. Although tagging data has been valuable to determine overall use patterns of key pods and identify important habitat, tags are invasive, costly, and have a relatively short duration. Thus, acoustic monitoring is a preferred choice for continued monitoring spatial and temporal habitat use patterns. We will add an aerial photogrammetry component that will give us a precise indicator of annual and inter-annual changes in body condition that can map short term effects of changes in environmental conditions and relate these to longer-term population dynamics. These components will be integrated in a modelling framework that aims to update information on whale population dynamics, compare population status with other killer whale populations and develop mechanistic explanations for changes to whale population status.

Objectives:

1) Photo-identification of all major resident pods, the AT1 transient group, and secondarily the Gulf of Alaska transients and Offshore killer whales. The spill affected PWS/Kenai Fjords study area will be our primary focus but contributed photographs from adjacent regions will be used as possible to augment our work. All other objectives are based on this primary objective. The program includes the extension of individual histories, updates of identification catalogues of individuals, and annual updates of population tables and development of long-term population dynamics analysis at appropriate intervals. (**Primary Objective**).

2) Collection of fish scale samples and marine mammal tissue from kill sites and collection of killer whale fecal samples coupled with genetic analysis to understand feeding ecology differences by location, and by season, and between populations. (**Core Objective**).

3) Determine movements and distribution using strategically located remote Soundtrap hydrophone/recorders on submerged moorings. Annual analysis of calls will provide detailed information on patterns of killer whales, specifically the seasonal timing of use by specific pods (**Core Objective**).

4) Use the innovative techniques of aerial photography from a drone platform to determine and compare morphometrics of individuals to assess individual body condition on an annual basis, monitor growth trends and to determine pregnancy rates and contrast those with recruitment rates derived from photo-identification (**Core Objective**).

5) Develop models that integrate changes in body size, body condition and population dynamics to provide more resolution on population status and identify mechanistic links with environmental and trophic covariates. Fit models to provide updates in each 5-year phase on whale population dynamics, compare population status with other killer whale populations and develop mechanistic explanations for changes to whale population status (**Core Objective**).

6) As an option if time allows, obtain genetic skin tissue samples when necessary to determine population/ecotype affiliations and to sample blubber at extended intervals to examine contaminant levels and compare with previous samples. (**Secondary Objective**).

B. Procedural and Scientific Methods

Our core work depends on accurate photo-identification of each individual in each pod/group that regularly uses the Kenai Fjords/PWS, particularly AB pod and the AT1 population. It is important that researchers maximize the time actually spent with resident killer whales (particularly AB pod and other resident whales) to insure thorough identification of all individuals for population analysis. This provides the framework for completion of our other core objectives.

Methods proposed to obtain photographic data necessary to meet core monitoring objectives will be similar to those used by North Gulf Oceanic Society (NGOS) in PWS/Kenai Fjords for the past 10-year funding cycle with improvements due technological advancements in digital camera equipment and computer tools. Searches for whales will not be made on random transects but based on current and historical sighting information. In addition, whales will be located by listening for killer whale calls with a directional hydrophone (calls can be heard up to 10 miles away), or by responding to VHF radio calls from other vessels reporting sightings of whales. We have developed network of cooperating vessel owners and tour boat operators that regularly report whale sightings. In addition, requests for recent killer whale sightings will be made routinely on hailing Channel 16 VHF and working channel 72 (Kenai Fjords tour boat channel).

A vessel log and chart of the vessel track will be kept for each day the research vessels operate. A dedicated GPS unit will record tracklines of vessel searches and whale encounters and will be downloaded and converted to geographic information system (GIS) shapefiles daily. This format facilitates GIS analysis and presentation of the location data. Distances surveyed, distances traveled by the whales and elapsed times are all recorded. Marks (time and location) are also recorded for changes in behavior of the whales and used in spatial behavioral analysis. Weather and sea state noted at regular intervals as they relate to working and observational conditions.

Basic summary data from the field sheets for each survey day and from each killer whale encounter are transcribed into an Access database and all vessel and whale tracks stored in a GIS database. Data recorded will include date, time, duration, and location of the encounter. Summary of the photographic record the estimated number of whales photographed are recorded.

Photographs for individual identification will be taken of the port side of each whale showing details of the dorsal fin and gray saddle patch. Photographs will be taken at no less than 1/1000 sec using Nikon D750 digital cameras or superior and equipped with either a 300 mm f4.5 or 80-200 mm f2.8 zoom auto focus lens with 1.4x Nikon tele-extender. When whales are encountered, researchers will systematically move from one subgroup (or individual) to the next keeping track of the whales photographed. If possible, individual whales will be photographed several times during each encounter to insure an adequate identification photograph. Whales will be followed until all whales are photographed or until weather and/or darkness make photography impractical. Larger pods/groups usually require multiple encounters to insure adequate identification photos.

All digital photographs will be examined on an expanded screen computer using photographic analysis software. All identifiable individuals in each frame will be recorded. When identifications are not certain, they will be noted but not included in further analysis. Unusual wounds or other injuries will be noted. Photographs will be analyzed using a photographic database that spans 32 years. Individual identifications are digitally recorded and attached to the photo as well as summarized in separate spread sheets for each encounter listing the identities of the whales. Updated photos of each individual are selected and placed in appropriate folders and used to update our working catalogue (for NGOS and public access) and provide reference for future identifications. The population dynamics data base that lists data on each individual (including newly recruited calves) is updated annually. This database maintains an annual record for each individual used in our analysis for every year of its life (or since the time we started the focused study 32 years ago). Increasingly, whales that we track were born during the study improving the accuracy of our analysis of population parameters. All vessel and whale encounter tracklines are stored in GIS format, ready for analysis.

Field observations of feeding will be made and prey parts collected when possible. Scales will be retrieved from fish predations events and read for species and age at the DFO Pacific Biological Station in Nanaimo, British

Columbia, where a scale laboratory was established and has been certified for over 30 years. This same laboratory conducts similar studies on the diet of Northern and Southern Resident killer whales, which will facilitate direct comparisons. The recent development of a genetic scale library, for Chinook salmon in particular, now spans the waters of Washington, British Columbia, and southern Alaska. It has facilitated identification of the likely rivers of origin for Chinook salmon prey, as well as for chum salmon in some cases. Chinook are a species of high conservation concern with potential impacts involving both humans and killer whales. Chum and Coho salmon are also highly important in resident killer whale diet in our region. The innovative use of genetic analysis to examine fecal samples will help to resolve questions around the completeness of diet information obtained from prey samples. Fecal sampling will reveal the full spectrum of prey taken, even if consumed at depth where prey sampling is ineffective. Dr. Kim Parsons (National Oceanic and Atmospheric Administration [NOAA] Northwest Fisheries Science Center [NWFSC]) will supervise genetic analysis of fecal samples and subsequent prey identification. She has pioneered these innovative techniques and is a long-term collaborator with our program. This same laboratory conducts similar studies on the diet of Northern and Southern Resident killer whales, which will facilitate direct comparisons

If there is a need to collect biopsy samples, they will be obtained from individually identified whales as described in Barrett Lennard et al. (1996). Samples (skin and blubber) will be stored as wet frozen materials on board vessel at -10C and then at the lab at -80C until analyzed for their chemical tracers. (All analyses will be completed at the NWFSC, Seattle). Specifically, each biopsy sample will be analyzed for their skin carbon and nitrogen stable isotope (SI) ratios (Herman et al. 2005), blubber fatty acids (Krahn et al. 2007), and persistent organic pollutants (Lawson et al. 2020). These will enable updated comparisons to other killer whale populations (e.g., Krahn et al. 2007) and monitor changes over time that might be indicative of changes in prey.

During the previous five-year funding cycle, we initiated and have now standardized the use of autonomous submerged recording devices (Soundtrap) that record calls of killer whales of all ecotypes, but particularly the calls of the vocal resident type (Myers et al. in review). In the new funding cycle, we will continue to collect year-round recordings and increase our resolution of analysis by improving our catalogue of pod specific dialects. In the future we hope to develop data on specific numbers of whales and activity state. This provides data on presence, movements, and activities of the whales not only in summer, but also winter months, when presence data has not been previously available. We have used remote transmitting hydrophones successfully in the past, but with direct transmission to Seward, Alaska (Yurk et al. 2010). The current technology has proven itself to be effective year-round in remote locations with much smaller energy demand, but without a live feed.

We use Soundtrap 300, 500, and 600 recorders with additional batteries for year-round capability (http://www.oceaninstruments.co.nz). We will use a recording sample rate of around 24 kHz for an effective bandwidth of ~12 kHz. We will employ a simple grapple style subsurface mooring. The recorder is attached to a float and is tethered to a pier block with an eyebolt. Attached to this are two 40 m polysteel lines extending opposite directions from the block, each ending at a 7 to 10 kg mushroom type anchor. This arrangement requires relatively shallow (~40 m) areas with soft bottom, which limits location and can induce more surface noise, but reduces mooring and strum noise. In the past five- year program we have had had good success with these moorings once appropriate sites were determined.

Placement locations will be Hinchinbrook Entrance and Montague Strait, covering the two major entrances to PWS. These are known seasonal focal areas for killer whales from examination of tagging data and historic encounter data (Olsen et al. 2018). A third site is located at the mouth of Resurrection Bay in Kenai Fjords where there are spring aggregations of killer whales and a certain degree of year-round use. The sampling rate of 24 kHz/12 kHz will detect most discrete calls and nearby echolocation.

A new innovative core element, the use of drones to measure specific aspects of individual killer whale morphology and health, will be added in the proposed ten-year program. This comes with the addition of protocols and analytical techniques pioneered by Dr. John Durban who is joining our staff and is a recognized expert in data collection and analysis for aerial photogrammetry studies (Durban et al. 2015, 2016; Fearnbach et al. 2018, 2020; Groskreutz et al. 2019). This element will allow investigation of the health changes underpinning population dynamics. For long-lived killer whales, multi-decadal time series of photo-identifications are required to track population dynamics by documenting annual births and deaths (Matkin et al. 2008, 2014). The recent development of non-invasive photogrammetry using drones has demonstrated that health metrics can provide sensitive population indicators, providing quantitative measures of health for large numbers of individuals that expand population data on births and deaths to provide greater power for detecting trends and covariates (Stewart et al. 2021).

Vertical images of killer whales will be collected using either a small hexacopter (22" across APH-22, Aerial Imaging Solutions) or a larger octocopter (36" across APO-36, Aerial Imaging Solutions), both routinely used for cetacean photogrammetry missions by the applicant and collaborators and permitted by National Marine Fisheries Service (NMFS) for photogrammetry flights over killer whales. To operate these proven aircraft, a uniquely experienced flight team (Dr. John Durban & Dr. Holly Fearnbach) will be used for this project, with much of their time provided in kind by NGOS and SeaLife Response-Rehab-Research (SR3), respectively. We will deploy and retrieve the drones by hand from the deck of the R/V *Natoa* boat, utilizing the aircraft's vertical takeoff and landing capability. The drones will be equipped with a mirrorless digital camera and Normal lens to capture flat images with no wide-angle distortion and water-level pixel resolution of <1.5 cm (Durban et al. 2015). A precise laser altimeter (<0.1% error) will enable measurements in pixels to be scaled to real size (e.g., Groskreutz et al. 2019). When whales surface in the frame, the pilot will remotely trigger the camera to record high-resolution still photographs at one-second intervals to maximize the chance of obtaining "flat" images for unbiased photogrammetry measurements. The support boat will be repositioned during flights to maintain a consistent and non-invasive contact distance. Our experience from previous photogrammetry has shown the utility of the larger octocopter to carry a greater payload in the form of a higher-resolution camera (Sony A7R full frame mirrorless camera with 36MP resolution) and the greater visibility of the larger aircraft enables the launch boat to position non-invasively further away from the whales (typically 100-300 yds). As such, an octocopter (provided in kind by NGOS/Durban) will be used as priority, and the hexacopter (provided in kind by SR3) will be used as backup.

During pioneering studies with endangered Southern Resident killer whales in Washington State, Durban and Fearnbach have developed a precise and sensitive annual condition index for each individual whale in the study using drone-based aerial photogrammetry. In our study these same techniques will be used for Southern Alaska resident killer whales. Measurements will be linked to whales of known identity by matching to an established photo-identification catalog (http://www.whalesalaska.org). It has been demonstrated that images taken from the air can be matched to lateral, boat-based photo-identification catalogs using saddle patch pigmentation and scarring patterns (Fig. 2; Fearnbach et al. 2011, Durban et al. 2015). Boat based images taken simultaneously with drone operations will facilitate initial identification matching, and an aerial catalog of individuals will be established to differentiate whales, and to enable us to track the same whales in repeated images across field efforts. Of particular note, individual identities will be linked to known age, gender and social/pod affiliations (e.g., Matkin et al. 1999, C. Matkin unpublished data), in order to permit age and sex stratified analyses of size and body condition.

Figure 2. Aerial images can be matched to photo-identifications of known whales.

Measurements taken will include those that will permit analysis of growth from length-at age relationships (Fig. 3), body condition changes between years and seasons (Fig. 4), and identification of pregnancies (Fig. 5) to track changes in reproductive success within the Southern Alaska resident killer whale population. All data will be comparable with the endangered Southern Resident killer population and Northern Resident killer whales. These health indices are much more instantaneous that population dynamics effects in such a long-lived animals which exhibit very low mortality and reproductive rates. Of great significance, these data will allow additional integration with and synthesis of data from other projects in the GWA-LTRM program that measure or reflect annual or shorter-term variations in environment (see "Integrated and Mechanistic Modelling", section C below). We have performed similar integration linking Southern Resident killer whale condition to abundance of Chinook salmon prey (Stewart et al. 2021).

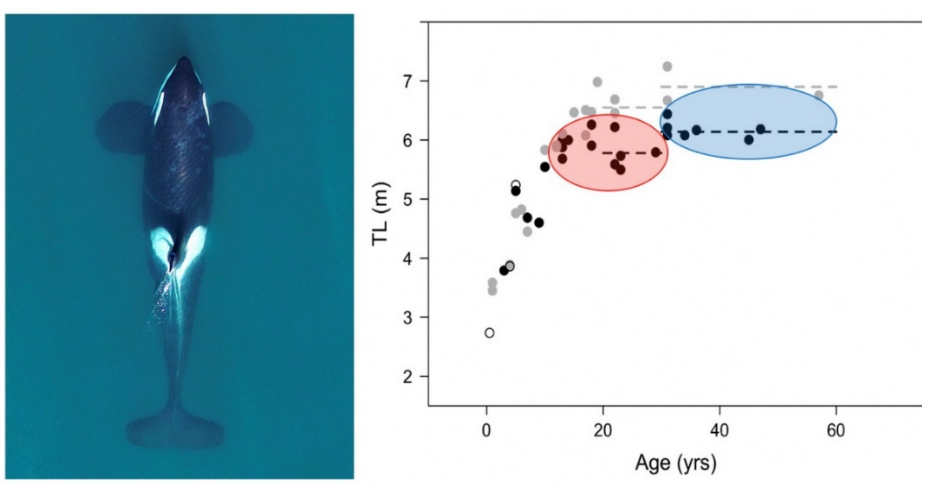

Figure 3. Photogrammetry has been used to measure the length of individual whales (left) and describe the body length-at-age relationship of Southern Resident killer whales (right). Notably, this research has shown that individual Southern Resident killer whales are growing smaller adult sizes in recent decades (Fearnbach et al. 2011).

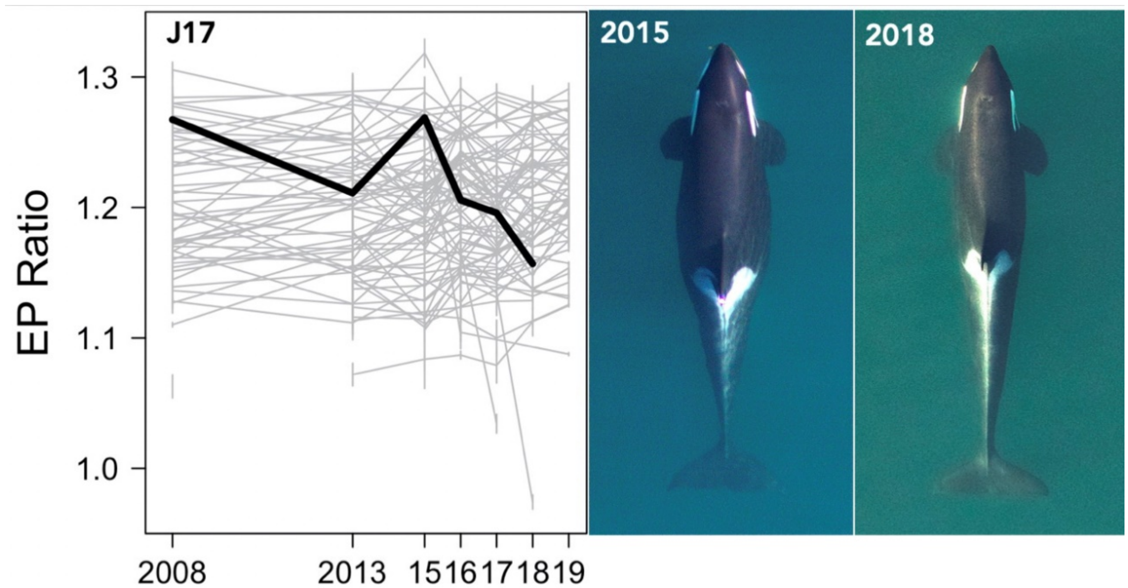

Figure 4. Quantitative measurements of body condition by the eye patch (EP) ratio (Fearnbach et al. 2020) for 99 Southern Resident killer whales from J, K, and L pods between 2008 and 2019. Horizontal lines show changes in the mean annual measurements for each individual and the thick black line highlights adult female J17 that died in early 2019. Aerial photos on the right are of J17 when robust in 2015 and lean in 2018.

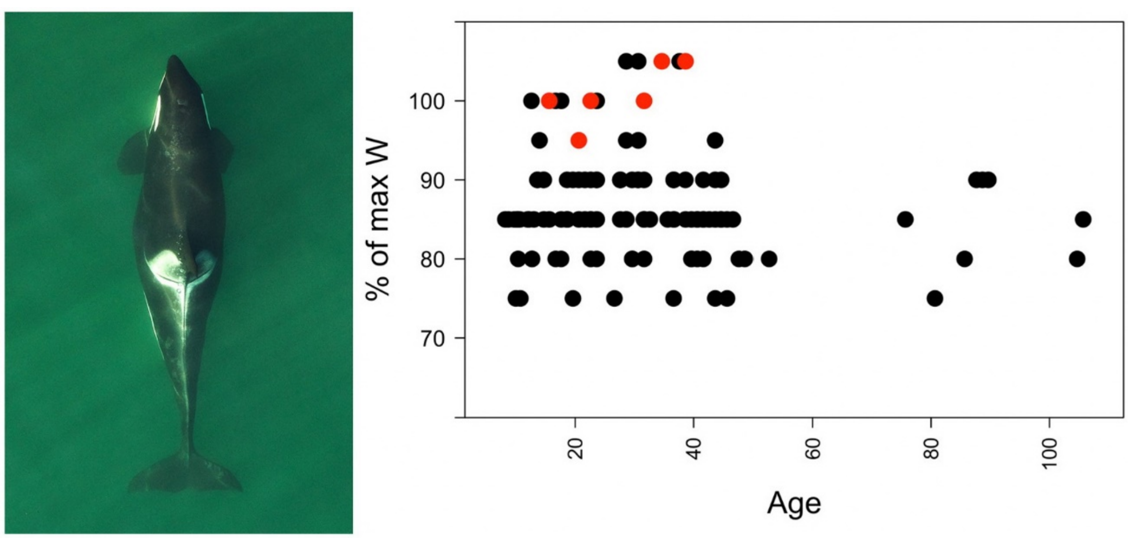

Figure 5. Width profiles measured from aerial images can be used to reliably detect pregnancies. Left shows a pregnant female Southern Resident killer whale (note width at mid-body). Right shows the percentile along the body axis that was measured as the maximum width for Southern Resident killer whale reproductive females (100% represents approximate mid-body); red shows those with successful pregnancies. All those greater than 90% were thought to be pregnant. Plot based on unpublished data.

C. Data Analysis and Statistical Methods

Because photographic and observational data are being collected in the same basic format as during the past 37 field seasons and using the techniques now standardized for studying killer whales, the data will be comparable with other data collected around the North Pacific. Since we identify every individual in each pod of resident killer whales that we use in our population dynamics analysis, and pod membership only changes through death or calf production, we can accurately assess changes in pods/population. Using genealogies, we have made age estimates for those whales born prior to the study, however, most of the population segment we use for population analysis has been born during the study. We estimate population parameters such as age at first reproduction, mortality and survival rates and to monitor population dynamics (see "Integrated and Mechanistic Modelling", below). Comparisons with other resident killer whale populations, such as the endangered Southern Residents of British Columbia, is a key piece of the program. Comparisons will have important management implications.

The report for the monitoring segment will include a summary of all field effort, including that funded outside of the GWA-LTRM program, and will include an annual summary of the pods and individuals encountered and photographed and a status report on the AB pod of resident and the AT1 population of transient killer whales. Changes within AB pod will be examined with consideration for the age and sex structure of the pod and maternal groups within the pod and compared to previous and other population models.

Absolute population numbers for the Gulf of Alaska transient (mammal eating) population are difficult as the matrilines are not necessarily stable over years. Trends in transient killer whale sighting rates and demographics will be determined using mark/recapture models (Durban et al. 2010, Matkin et al. 2012). To fully quantify uncertainty about unknown parameters a Bayesian approach to model fitting and inference will be used, where estimates are presented as full probability distributions.

Feeding data will be summarized annually, including observation of fish predation by resident killer whales and mammal predation by transients. When possible, for residents we will determine river of origin using genetic population markers from scale samples. Analytical data from fecal samples and resulting prey composition will be compiled as summarized as it becomes available. The comparison of predation samples and fecal samples will illustrate limitations of either technique and contribute to a more comprehensive understanding of seasonal, location-specific, and interannual shifts in diet. Diet preferences will be used as hypotheses for examining prey abundance (where data exist) as covariates for changes in body condition, body size, and population dynamics (see "Integrated and Mechanistic Modelling", below).

Genetic analysis of killer whale tissues from biopsy will be used if appropriate to determine population affiliation or sex using the methods detailed in Parsons et al. (2013) and will include mtDNA and nuclear DNA analysis. In the event biopsy samples are collected, contaminant analysis will be conducted, and these data will be examined by using JMP Statistical Discovery Software (PC professional edition version 5.01) or Primer-E Software (version 6.16) or similar.

We will use an automated detector for cetacean calls that has been developed by the Sea Mammal Research Unit (www.smruconsulting.com) and built into PAMGuard, an open-source acoustic analysis software package (www.pamguard.org). We will use the Whistle and Moan Detector, which is a spectrogram-based tonal detector that can be configured to work well with killer whale calls. It works by searching for sounds of a certain size (duration and pixels) that exceed a user defined amplitude threshold. We will run the detector on month-long batches of recordings, and then manually verify all detections to minimize false-positives, effectively bringing the false-positive rate to zero. As possible we will manually go through each of the recordings with killer whales to identify the population, clan, subclan, or pod that is vocalizing.

Killer whale presence will be measured as the percentage of days per month that killer whales are acoustically detected, and relative temporal use of the entrances of PWS will be compared to provide a seasonal use estimate. Duration of calling bouts will be assessed to indicate whether whales are remaining in the area or transiting. Call diversity and calling rates will be used to remotely estimate the number of pods and number of individuals present. Acoustic identification of pods, combined with field behavioral observations and recordings, can refine these estimates and give context to the remote recordings (Yurk et al. 2010).

From our aerial photogrammetry work using drones, measurements in pixels will be converted to real size using a measure of scale (scale= altitude/lens focal length), with altitude measured onboard the drone using laser altimeter with a typical error of ~0.1%, providing the power to detect relatively subtle changes in growth (Dawson et al. 2017). We will aim to capture multiple images of each identified whale, and the longest of the sum of blowhole-dorsal fin and dorsal-fin to fluke measurements will be taken as the most accurate (flattest) surfacing orientation of each whale (Groskreutz et al. 2019). Separate growth curve models will then be fit to whales of each sex to generate quantitative parameters (e.g., age of inflexion, asymptotic size) to describe growth patterns and track changes over time. Whales with anomalous growth will be identified as significant outliers to the fitted growth models. Body condition will be quantified through an eye patch ratio (EPR), which has been shown to be a sensitive indicator of fatness (Fearnbach et al. 2020). When cetaceans become nutritionally stressed, they lose adipose tissue behind the cranium resulting in a "peanut head" appearance. By examining aerial images of emaciated Southern and Northern Resident killer whales prior to their deaths, Fearnbach et al. 2020 developed the EPR to provide a quantitative index of this effect through the ratio of the width (in pixels) between the inside edges of the white eye patches of the whale at 75% of their length compared to the width between their anterior edges. As with previous work on Southern Residents (Stewart et al. 2021) we will assign individuals into body condition states based on their EPR values relative to 20% intervals of the distribution of all EPR values across time for all whales in their age/sex class (1 = poor condition to 5 = comparatively robust). At a population level we can therefore monitor seasonal and inter-annual changes in the proportion of whales in each condition class, stratified by pod, to assess the evidence for seasonal effects, annual effects, or prey effects as hypothesized by our prey studies (e.g., abundance of certain salmon stocks, where data exist).

Pregnancies will be identified by measuring full width profiles at 5% increments along the body length; our previous studies have shown that females in the latter stages of pregnancy (confirmed with new calves in the subsequent year) had anomalous shape profiles (Fig. 5) that could be detected after approximately 9 months of gestation (full term = 17.5 months). Specifically, these pregnant females displayed with a maximum body width posterior to the dorsal fin. Body width at the anterior insertion of the dorsal fin, and the percentile of maximum length, will therefore be used to indicate pregnant whales.

Integrated and mechanistic modelling

We propose a number of modular tasks for quantitative model development and fitting to identify mechanistic links, specifically related to data on whale population dynamics, body condition, size and trophic and/or environmental covariates (e.g., abundance of certain salmon species or stocks, oceanographic indices). The fundamental concept is that environmental conditions and prey abundance will impact whale body condition and growth, which impact demographic rates and therefore population dynamics. These models will be formulated in a Bayesian statistical framework to make inference through intuitive probability statements and to propagate information and uncertainty across levels as model components are added.

1. Population dynamics. This approach will begin by developing a Bayesian mark-recapture framework for inference about population dynamics from photo-identification data. Specifically, this approach will combine modelling of fecundity and survival within an integrated modelling framework that will explicitly incorporate uncertainty associated with imperfect detection (Ward et al. 2016). Latent states will be estimated for whales in years when they are not seen, allowing for probabilistic inference even if pods are imperfectly documented in any given year. This is important when trying to relate population dynamics to annual environmental covariates in later steps.

    Paper (Year 2, 2023): Updating population dynamics of Alaska resident killer whales, examine pod-specific demography, quantify correlation between pods and identify key temporal trends and any abrupt shifts.

2. Body size and condition. As we accumulate data on body size and condition, we will develop Bayesian hierarchical growth curves for describing size-at-age relationships (Stewart et al. 2021b) and multi-state models for assigning individuals to condition states (Stewart et al. 2021). Both frameworks will be extendable and capable of modelling covariate relationships as the time series extend.

    Paper (Year 3, 2024): Manuscript comparing body size and condition of Alaska Resident killer whales to Southern Resident and Northern Resident killer whale populations.

3. Integrating body condition and population dynamics. Because photogrammetry measurements of whale morphometrics will be available for a larger number of individuals each year, compared to a relatively small number of births and deaths, the integration of condition data will provide greater statistical power for identifying changes in population status and mechanistic links to environmental changes. To this end, these model modules will then be combined in a modelling framework that will be integrated to link body condition with population dynamics (Stewart et al. 2021), and in turn assess predictive relationships of environmental covariates. Mechanistic links will be hypothesized by using diet and distributional data to identify plausible environmental driving mechanisms and we will use model selection methods to identify environmental covariates with strong predictive relationships for the whale data. We will update our knowledge of these relationships through quantitative model fitting at the end of years 5 and years 10.

    Paper (Year 5, 2026): Integrating population dynamics and body condition of Alaska Resident killer whales; new methodology to assess mechanistic links to environmental and prey covariates.

    Paper (Year 10, 2031): Updating population dynamics and body condition of Alaska Resident killer whales, a re-evaluation of environmental and prey covariates.

4. There is also likely to be an interaction between environmental and individual effects on demographic rates. Specifically, individual traits like body size are known to impact survival and fecundity of whales

and are likely to be under variable selection pressures because of environmental changes and differences in nutritive resilience conferred by body size differences. As we gather data on the size-at-age of more individuals across the years of this study we therefore also propose to incorporate body size traits into integrated population dynamics models (Plard et al. 2019), to provide a better understanding of individual responses to their environment over the longer term while also monitoring the population dynamics. Not only will this improve forecasting ability, which we propose to test in the latter years of this study but, by quantifying the interacting population dynamics and body size distributions, we can further compare the status of resident killer whales in the Gulf of Alaska to those elsewhere in the North Pacific where similar studies are being undertaken by our team and collaborators (e.g., Fearnbach et al. 2011, Groskreutz et al. 2019)

Paper (Year 7, 2028): Integrating body size into a population dynamics model for Alaska Resident killer whales to assess both individual and population responses to environmental drivers.

Paper (Year 8, 2029): Combining body size and population dynamics to compare the status of killer whales in the North Pacific.

Paper (Year 9, 2030): Comparing observed population dynamics to model predictions for Alaska Resident killer whales: evaluating forecasting performance of models that include environmental covariates and individual traits.

5. Long-term time series data from this project will continue to be used in publications generated by integrated analyses and developing ecosystem models by the GWA-LTRM Synthesis and Modeling Component (see below).

D. Description of Study Area

This project is part of an ongoing killer whale research in PWS and the Kenai Fjords region, Alaska. The overall study area stretches from the Nuka Bay, outer Kenai Peninsula region to Cordova on the eastern edge of PWS (Figs. 6 and 7). However, the funding specifically requested in this proposal will be used primarily in western PWS and Kenai Fjords where likelihood of encountering the focal whales is most likely. We cannot predict the specific locations where encounters will occur but operate from historic patterns in distribution and from data generated by the remote hydrophones.

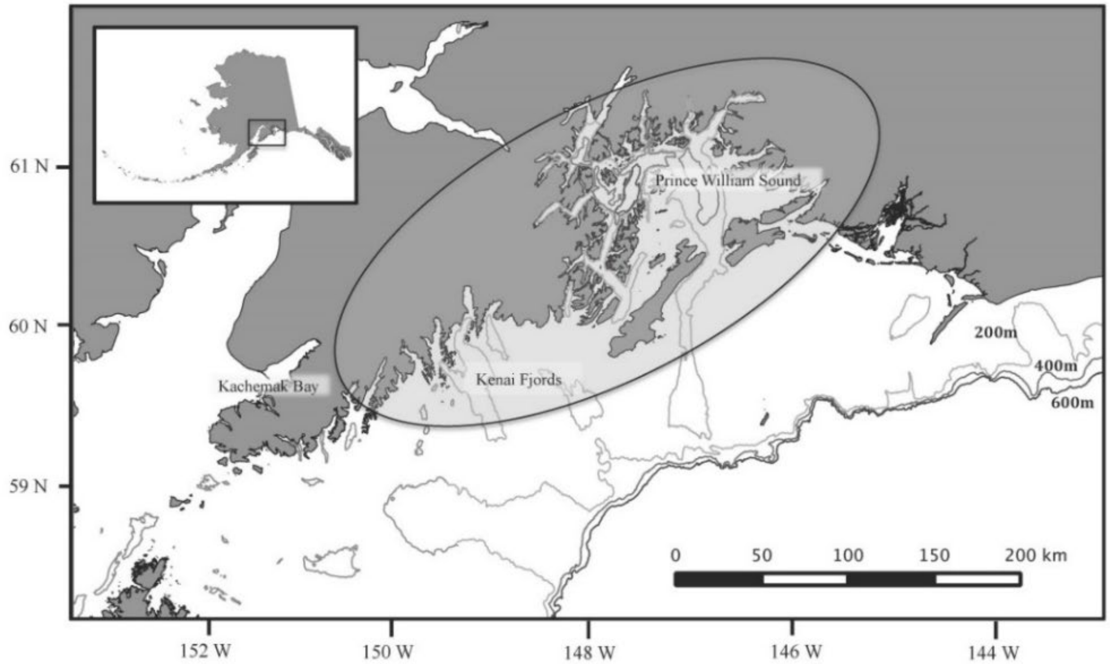

Figure 6. The survey area: Kenai Fjords and Prince William Sound, Alaska.

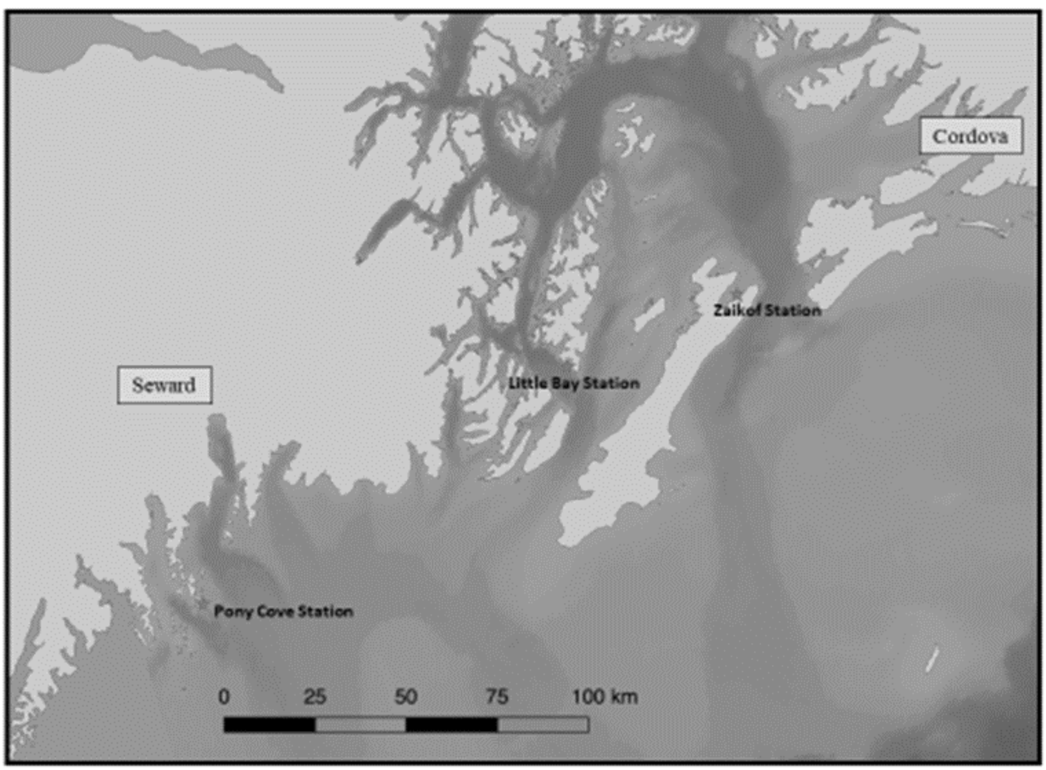

Figure 7. Location of remote hydrophone stations operated by North Gulf Oceanic Society.

5. COORDINATION AND COLLABORATION

A. With the Alaska SeaLife Center or Prince William Sound Science Center

We work directly with the Prince William Sound Science Center (PWSSC) and have received our funds through PWSSC for the past 9 seasons and will continue to do so if this proposal is funded. We deliver talks in their forums and contribute to their popular publication *Delta Sound Connections* on a regular basis. We collaborate directly with related PWSSC projects (see below) as part of GWA and Herring Research and Monitoring programs. The Alaska SeaLife Center supported our work on transient killer whales for many years and we still collaborate and coordinate and have jointly published with Dr. John Maniscalco at the Alaska SeaLife Center (Maniscalco et al 2007). This collaboration will continue with our proposed future killer whale research in Kenai Fjords.

B. Within the EVOSTC LTRM Program

Environmental Drivers Component

We will collaborate closely with Rob Campbell (Oceanographer, PWSSC) in exchanging sighting data during his regular servicing of his moorings. In the past we have placed hydrophones on his mid-Sound moorings and may use the potential Hinchinbrook Entrance mooring as a hydrophone station. We will provide killer whale annual body condition information (proportion of whales in each condition state, by pod) for synthesis discussion with Environmental Drivers component projects and other projects within GWA-LTRM. We will take advice on plausible environmental drivers as covariates to test against whale population data in our proposed integrated and mechanistic modelling. Our acoustic recorders will provide seasonal timing of killer whale presence, which will be compared with timing of basic productivity in key locations like Hinchinbrook Entrance.

Pelagic Monitoring Component

As part of this component our project will collaborate closely with the humpback whale and herring predation project (Moran/Straley). Our field work provides photographic and other data from our observations which have numbered from 20 to 40 encounters with humpback whales annually. We also receive data from all killer whale encounters that they log during their fieldwork. Additionally, we will compare our body condition data (proportion of whales in each condition state, by pod) with annual measurements of condition and survival from other pelagic component projects. We will take advice on plausible pelagic covariates to test against whale population data in our proposed integrated and mechanistic modelling (see above).

Nearshore Monitoring Component

The nearshore component (Dan Monson) will opportunistically provide killer whale identification photographs to our project. We will provide killer whale annual body condition data (proportion of whales in each condition state, by pod) for synthesis discussion with nearshore monitoring component and other projects

Lingering Oil Monitoring Component

Because lingering oil data are collected once in a 5-year period and the oil is not currently bioavailable, we do not anticipate incorporating these data into our project. We look forward to status reports from the Lingering Oil Component.

Herring Research and Monitoring component

We will provide killer whale annual body condition information (proportion of whales in each condition state, by pod) for synthesis discussion with herring research and monitoring component.

Synthesis and Modeling Component

Modeling efforts within this project and among other GWA-LTRM components over the next 10 years will greatly enhance the integration and mechanistic understanding of factors affecting changes in the killer whale population. These efforts are synergistic with the Synthesis and Modeling Component (P.I., R. Suryan). For example, example killer whale encounter rate and number of individuals encountered were used as short-term (annual) response indices to evaluate ecosystem response to the Pacific marine heatwave (Suryan et al. 2021). With the addition to our project of a photogrammetry component to assess killer whale body condition, integration and synthesis with other projects will be greatly expanded. Specifically, our data on the proportion of whales, by pod, in each condition state will provide quantitative metrics on an annual and possibly seasonal basis that can represent key input into models. With the addition of Dr. John Durban, an experienced modeler, to our staff we will have the perspective to implement new approaches to synthesis as our datasets grow. Specifically, we will work closely with the Synthesis and Modeling Component, project PI's, and post-docs involved in analysis of other GWA GWA-LTRM-wide data sets and take advice on plausible covariates to test against whale population data in our proposed integrated and mechanistic modelling (see above). For example, newly hired post-doc, Dr. Bia Dias, will use ours and other long-term datasets to test hypotheses related to regime shifts, associated drivers, and subsequently update the PWS and Gulf of Alaska Ecopath/Ecosim model (developed by Okey et al.) to address ecosystem response to changes in frequency of future heatwaves and other environmental perturbations. These collective efforts will feed into the Pelagic Component post-doc and synthesis efforts to occur during the second 5-year period (FY27-31).

Data Management Project

We will continue to work with the data management component to ensure both raw and processed data are made available as rapidly as possible. We target having all data provided within one year of collection to meet the data management requirements.

C. With Other EVOSTC-funded Projects (not within the LTRM Focus Area)

Current EVOSTC-funded projects not within the LTRM focus area have not intersected with this project so far. As the EVOSTC funds future projects outside the GWA-LTRM program, we will evaluate their applicability to our project and coordinate as appropriate.

D. With Proposed EVOSTC Mariculture Focus Area Projects

We look forward to working with the EVOSTC's Mariculture Program and projects they embark on. We anticipate they will be interested in GWA-LTRM datasets and we expect there will be opportunities for coordination and collaboration.

E. With Proposed EVOSTC Education and Outreach Focus Area Projects

The GWA-LTRM program will develop an outreach plan that includes coordination and collaboration with the Trustee's Education and Outreach Program and projects. We look forward to participating in education and outreach opportunities where our project findings an contribute to a better understanding of the Gulf of Alaska ecosystem by the general public.

F. With Trustee or Management Agencies

We will annually provide our data to the NMFS/National Marine Mammal Laboratory (Janice Waite) to update the killer whale stock assessments for Alaska. We will provide a review of current Alaska stock assessments, in part based on data collected in this project. Feeding ecology data from prey sampling will be analyzed at the Pacific Biological Station, Nanaimo and combined with their extensive data base for Northern and Southern resident killer whales. Genetic samples of feces generated by this project (along with skin/blubber samples for genetics and contaminants) are maintained at NOAA NWFSC where genetic analysis is completed. We collaborate with NWFSC, and specifically with Dr. Kim Parsons, on all genetics and contaminant papers. This collaboration provides a highly important comparison between Southern Alaska Resident killer whales and the Endangered Southern Resident killer whales, found in Washington State.

G. With Native and Local Communities

The GWA-LTRM program and this project are committed to involvement with local and Alaska Native communities. Our vision for this involvement will include active engagement with the Education and Outreach Focus Area (see above), program-directed engagement through the Program Management project (2222LTRM), and project-level engagement. During the first year of the funding cycle (FY22), the GWA-LTRM program will reach out to local communities and Alaska Native organizations in the spill affected area to ask what engagement they would like from us and develop an approach that invites involvement of PIs from each project, including this one. Our intent as a program is to provide effective and meaningful community involvement that complements the work of the Education and Outreach Focus Area and allows communities to engage directly with scientists based on local interests.

In addition, this project will continue engaging with local communities as we have during the first 10 years of the program. Regular presentations will be given in many local communities including Cordova, Homer, Seward, Whittier, Chenega Bay, and Anchorage, with some talks specifically aimed at tour boat and commercial whale watching operators. This outreach provides the double benefit of increasing interest in killer whales and their conservation and in area-wide conservation issues and in stimulating boaters (particularly tour boats) to provide photos that may be important in our identification work. This contribution can also be made by local residents and Native peoples following whale watching guidelines. With the quality of cameras and lenses in use today, photographs can be taken at distances that do not violate marine mammal protection laws and regulations. Viewing regulations and guidelines will be stressed at all presentations/meetings. In meetings that we have initiated as part of previous projects, the Kenai Fjords Tour boat operators have developed their own strict guidelines for viewing marine mammals

We will attempt to make presentations in the Village of Chenega school when possible and in Cordova (Eyak). These are the only villages in the operational area. We will visit other villages (Tatilkek, Nanwalek, Port Graham) as invited and as funds permit. We also regularly discuss sighting data for killer whales with residents of Chenega Village and receive sighting reports from their vessels active in the area.

6. DELIVERABLES

The data sets from each previous year will be updated on the Gulf of Alaska Data Portal (https://portal.aoos.org/gulf-of-alaska#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/files). Metadata will be updated as needed. These data include shipboard acoustic recordings, biopsy data, database of surveys and encounters, and detailed accounting of prey sampling and fecal sampling. The photographic and Soundtrap acoustic files are very large and cannot be feasibly uploaded and accessed with a browser, so these data will be supplied to Axiom via a hard drive. Previous years data will continue to be uploaded annually to the Gulf of Alaska Data Portal and supplied to Axiom as it has been for the previous ten seasons. We will submit annual reports to EVOSTC.

We provide annually updated catalogues of pod associations and other educational materials to enhance the education experience of the over 100,000 visitors that board tour vessels in the region. We offer annual presentations to captains and naturalists in Seward, and opportunistically in Whittier and Homer. Our Facebook page provides consistent, recent, and relevant information about our research field activities, and is accessible by other researchers and contributors. Additionally, we have regular Instagram posts to provide notifications to a younger audience. For Kenai Fjords location-specific information, we started a Naturalist email group years ago that now has 170 recipients. Our outreach program will also include two presentations given annually as part of marine mammal classes at University of Alaska Kachemak Bay Campus. Presentations in conjunction with PWSSC venues will be given biennially. Regular presentations/posters will be presented at the Alaska Marine Science Symposium. As possible presentations will be made at the Biennial Conference on Marine Mammals (funding for this is not covered by this project).

Seven new papers are proposed above as part of our integrated and mechanistic modelling. These will be based on photo-identification and photogrammetry studies to quantify changes in population dynamics, body condition and body size in relation to environmental drives. Additionally, we propose at least one feeding ecology paper, using newly obtained genetic results from fecal sample collection. We will produce at least two acoustics papers, both centered around remote hydrophones. One acoustics paper will focus on using dialects and call types to identify the whales.

7. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

Project milestones and tasks by fiscal year and quarter, beginning February 1, 2022. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

	FY22				FY23				FY24				FY25				FY26			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Field Work																				
Field Prep	X				X				X				X				X			
Vessel surveys		X	X			X	X			X	X			X	X			X	X	
Hydrophones serviced		X	X			X	X			X	X			X	X			X	X	
Data summary and Analysis																				
Data Summary				X	X			X	X			X	X			X	X			X
Analysis				X	X			X	X			X	X			X	X			X
Integrated and mechanistic models	X			X	X			X	X			X	X				X			X
Reporting																				
Annual reports					X				X				X				X			

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Deliverables																				
Facebook/Website update	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Previous year data upload				X				X				X				X				X
Delta Sound Connection article									X								X			

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Field Work																				
Field Prep	X				X				X				X				X			
Vessel surveys		X	X			X	X			X	X			X	X			X	X	
Hydrophones serviced		X	X			X	X			X	X			X	X			X	X	
Data summary and Analysis																				
Data Summary				X	X			X	X			X	X			X	X			X
Analysis				X	X			X	X			X	X			X	X			X
Integrated and mechanistic models	X			X	X			X	X			X	X				X			X
Reporting																				
Annual reports					X				X				X				X			
Final report																				X
Deliverables																				
Facebook/Website update	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Previous year data upload				X				X				X				X				X
Delta Sound Connection article					X								X							

8. BUDGET

A. Budget Forms (Attach)

Please see Gulf Watch Alaska Long-Term Research and Monitoring workbook.

Budget Category:			Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED
Personnel			$0	$0	$0	$0	$0	$0
Travel			$7,200	$7,200	$7,200	$7,200	$7,200	$36,000
Contractual			$152,200	$173,900	$174,300	$158,800	$196,150	$855,350
Commodities			$18,500	$13,500	$17,500	$13,500	$12,500	$75,500
Equipment			$0	$0	$0	$0	$0	$0
Indirect Costs	Rate =	10%	$17,790	$19,460	$19,900	$17,950	$21,585	$96,685
		SUBTOTAL	$195,690	$214,060	$218,900	$197,450	$237,435	$1,063,535
General Administration (9% of subtotal)			$17,612	$19,265	$19,701	$17,771	$21,369	$95,718
		PROJECT TOTAL	$213,302	$233,325	$238,601	$215,221	$258,804	$1,159,253
Other Resources (In-Kind Funds)			$76,000	$76,000	$56,000	$56,000	$56,000	$320,000

Budget Category:		Proposed FY 27	Proposed FY 28	Proposed FY 29	Proposed FY 30	Proposed FY 31	5- YR TOTAL PROPOSED
Personnel		$0	$0	$0	$0	$0	$0
Travel		$7,200	$7,200	$7,200	$7,200	$7,200	$36,000
Contractual		$173,425	$160,975	$167,225	$166,075	$209,825	$877,525
Commodities		$20,000	$14,600	$19,000	$14,600	$13,600	$81,800
Equipment		$0	$0	$0	$0	$0	$0
Indirect Costs	Rate = 10%	$20,063	$18,278	$19,343	$18,788	$23,063	$99,533
	SUBTOTAL	$220,688	$201,053	$212,768	$206,663	$253,688	$1,094,858
General Administration (9% of subtotal)		$19,862	$18,095	$19,149	$18,600	$22,832	$98,537
	PROJECT TOTAL	$240,549	$219,147	$231,917	$225,262	$276,519	$1,193,395
Other Resources (In-Kind Funds)		$56,000	$56,000	$56,000	$56,000	$56,000	$280,000

Budget Category:		TEN YEAR TOTAL
Personnel		$0
Travel		$72,000
Contractual		$1,732,875
Commodities		$157,300
Equipment		$0
Indirect Costs	Rate = 10%	$196,218
	SUBTOTAL	$2,158,393
General Administration (9% of subtotal)		$194,255
	PROJECT TOTAL	**$2,352,648**
Other Resources (In-Kind Funds)		**$600,000**

B. Sources of Additional Funding

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 ONR 20,000 NGOS 15,000 Total: $76,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 ONR 20,000 NGOS 15,000 Total: $76,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $320,000
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $56,000	NWFSC 25,000 PBS, DFO 6,000 SR3 10,000 NGOS 15,000 Total: $280,000
				FY22-31 Total	*$600,000*

<u>All estimates are minimum estimates of costs</u>

NWFSC: Northwest Fisheries Science Center provides genetic analytical services for feces and skin

PBS, DFO: Pacific Biological Station of Fisheries and Oceans Canada provides analysis of prey (scales and tissue)

ONR: Office of Naval Research provides acoustic analytical support monies (may be extended beyond FY23)

SR3 Provides services of Holly Fearnbach for field/drone operation

NGOS provides drone for field operations (5K)

NGOS provides C. Matkin salary for role in reporting and data and project management (10K)

9. LITERATURE CITED

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Durban, J.W., M.J. Moore, G. Chiang, L.S. Hickmott, A. Bocconcelli, G. Howes, P.A. Bahamonde, W.L. Perryman, and D.J. LeRoi. 2016. Photogrammetry of blue whales with an unmanned hexacopter. Marine Mammal Science 32: 1510-1515.

Fearnbach, H., J.W. Durban, D.K. Ellifrit, and K.C. Balcomb III. 2011. Size and long-term growth trends of endangered fish-eating killer whales. Endangered Species Research 13:173-180.

Fearnbach, H., J.W. Durban D.K. Ellifrit, and K.C. Balcomb lll. 2018. Using aerial photogrammetry to detect changes in body condition of endangered southern resident killer whales. Endangered Species Research 35:175-180.

Fearnbach, H., J.W. Durban, L.G. Barrett-Lennard, D.K. Ellifrit, and K.C. Balcomb III. 2020. Evaluating the power of photogrammetry for monitoring killer whale body condition. Marine Mammal Science 36:359-364.

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Parsons, K., J.J.W. Durban, A.M. Burdin, V.N. Burkanov, R.L. Pitman, J. Barlow, L.G. Barrett-Lennard, R.G. LeDuc, K.M. Robertson, C.O. Matkin, and P.R. Wade. 2013 Geographic patterns of genetic differentiation among Killer Whales in the Northern North Pacific. Journal of Heredity. Doi: 10.1093.

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10. PROJECT PERSONNEL

CRAIG O. MATKIN, B.A., M.S.

[redacted]

www.whalesalaska.org

PROFESSIONAL EXPERIENCE

Executive Director, North Gulf Oceanic Society, Homer, Alaska, (1982-present)
Supervise and conduct research on cetaceans, primarily killer whales and humpback whales, oversee stranding network and educational operations, operate and outfit research vessels. Maintain collaborations with numerous institutions and oversee fiscal operations of NGOS.

Adjunct faculty, University of Alaska, Kenai Peninsula College, Kachemak Bay Campus, Homer, Alaska (1999-present)
Teaching of marine mammal classes and guest lectures on marine topics. Instructor in elder hostel program.

Commercial Fisherman, Gulf of Alaska, Alaska (1977-1997)
Outfitting and operation of commercial fishing vessels harvesting, salmon, herring and various species of crab. Participation on boards of various fishing organizations.

EDUCATION

B.A. in Biology, University of California, Santa Cruz (1974)
M.S. in Zoology, University of Alaska Fairbanks (1980)

SELECTED PUBLICATIONS

Maniscalco, J.M., **C.O. Matkin,** D. Maldini, D.G. Calkins, S. Atkinson. 2007. Assessing Killer Whale predation on Steller sea lions from field observations in Kenai Fjords, Alaska. Marine Mammal Science 23(2): 306-321.

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Esler, D, B. Bellachey, **C.O. Matkin**, D Cushing, R. Kaler, J.L. Bodkin, D.H. Monson, G. Esslinger, K. Kloeker. 2017. Timelines and mechanisms of wildlife population recovery following the *Exxon Valdez* oil spill. Deep Sea Research Part II Topical Studies in Oceanography 147 DOI: 10.1016/j.dsr2.2017.04.007

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COLLABORATORS:

Lance Barrett-Lennard Vancouver Public Aquarium, Vancouver, B.C. Canada
Manolo Castellote National Marine Mammal Laboratory, Seattle WA
John Durban, NOAA Southwest Fisheries Science Center, La Jolla, CA
Holly Fernbach NOAA Southwest Fisheries Science Center, La Jolla CA
Kim Parsons, Northwest Fisheries Science Center
Olga Filatova Department of Vertebrate Zoology, Moscow State University, Moscow
Graeme Ellis Pacific Biological Station, Nanaimo, B.C. Canada
John K.B. Ford Pacific Biological Station, Nanaimo, B.C. Canada
Brad Hanson, Northwest Fisheries Science Center, Seattle, WA
Ward Testa, University of Alaska, Anchorage
Jan Straley, University of Alaska Southeast, Sitka, Alaska
Paul Wade National Marine Mammal Laboratory, Seattle, WA
Janice Waite National Marine Mammal Laboratory, Seattle, WA
Briana Wright Pacific Biological Station, Nanaimo, B.C. Canada
Gina Ylitalo, Northwest Fisheries Science Center, Seattle, WA
Harald Yurk Department of Fisheries and Oceans Canada, Vancouver, B.C. Canada

Dan Olsen

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Objective

To contribute to the advancement of science in the field of marine biology. Current projects involve killer whale diet, seasonal distribution, and social behavior.

Education

1992 B.A. Interpersonal Communication, Seattle Pacific University
2017 MSc Fisheries Biology, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks

Relevant Experience

2006-present Field Biologist, North Gulf Oceanic Society. Homer, Alaska.
2005-2015 Captain/naturalist, Kenai Fjords Tours, Seward, Alaska
2008-present Guide/Presenter, Zegrahm and Quark Expeditions, Antarctica

Licenses, Certificates, and Skills

100 ton Near Coastal Master (>1000 days as Captain); Basic and Advanced Marine Firefighting; Basic Safety Training (Maritime); Radar Observer; Open Water Diver/ PADI; First Aid and CPR; Boat driver during permitted research (1000's of hours, 15 years); Photo-identification of cetaceans (1000's of hours, 15 years); Passive acoustics of cetaceans (1000's of hours, 15 years); Fecal and prey remains sampling (1000's of hours, 15 years); Biopsy darting with air rifle (training on non-living targets); Hexacopter pilot training (in process); Scale/tissue and scat sample collection; Trapping and banding hawks, falcons, and eagles; GIS; Statistical coding in R; PAMGUARD audio processing; Acoustic signal identification.

Publications

Olsen, D. W., Matkin, C. O., Andrews, R. D., & Atkinson, S. (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: Topical Studies in Oceanography*, *147*, 196-202.

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Suryan, R. M., M. L. Arimitsu, H. A. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. J. Barbeaux, S. D. Batten, W. J. Burt, M. A. Bishop, J. L. Bodkin, R. E. Brenner, R. W. Campbell, D. A. Cushing, S. L. Danielson, M. W. Dorn, B. Drummond, D. Esler, T. Gelatt, D. H. Hanselman, S. A. Hatch, S. Haught, K. Holderied, K. Iken, D. B. Iron, A. B. Kettle, D. G. Kimmel, B. Konar, K. J. Kuletz, B. J. Laurel, J. M. Maniscalco, C. Matkin, C. A. E. McKinstry, D. H. Monson, J. R. Moran, D. Olsen, W. A. Palsson, W. S. Pegau, J. F. Piatt, L. A. Rogers, N. A. Rojek, A. Schaefer, I. B. Spies, J. M. Straley, S. L. Strom, K. L. Sweeney, M. Szymkowiak, B. P. Weitzman, E. M. Yasumiishi, and S. G. Zador. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports https://doi.org/10.1038/s41598-021-83818-5.

Current Collaborators

Andrews, R (MarEcoTel), Atkinson, S (University of Alaska Fairbanks), Ellis, G (Fisheries and Oceans Canada), Ford, J (Fisheries and Oceans Canada), Matkin C (North Gulf Oceanic Society), Mueter, F (University of Alaska Fairbanks) Myers, H (University of Alaska Fairbanks), Stredulinski, E (Fisheries and Oceans Canada), Parsons, K (NOAA NW Fisheries Science Center), Pilkington, J (Fisheries and Oceans Canada), Towers, J (Fisheries and Oceans Canada), Veirs, S (Orcasound), Wright, B (Fisheries and Oceans Canada).

JOHN WILLIAM DURBAN

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SYNOPSIS

Ph.D. scientist with 26 years of research (>90 publications) on cetacean biology, including studies of both individual health and the population-level consequences. Specific focus on assessing individual health through photogrammetric studies of size, growth and body condition, including pioneering the use of remotely controlled drones for photogrammetry of cetaceans. At the population level, conducts quantitative analyses of abundance, demographics and life history using photographic mark-recapture techniques and the pioneering the application of Bayesian statistical methods.

EDUCATION

1995-1998. B.S. First Class Honors Zoology-Animal Ecology, University of Aberdeen (UK)
1999–2002. Ph.D. Zoology, University of Aberdeen (UK)

CURRENT POSITION

Associate Professor, Department of Fish and Wildlife, Oregon State University
Courtesy appointment
Senior Scientist, North Gulf Oceanic Society
Individual health and population assessment of killer whales in Alaska

EMPLOYMENT HISTORY

2019-2020. Senior Scientist, Southall Environmental Associates, Inc.
2017-2019. Supervisory Marine Biologist, NOAA SW Fisheries Science Center
2016-2017. Research Marine Biologist, NOAA SW Fisheries Science Center.
2009-2016. Research Biologist (contract), NOAA SW Fisheries Science Center
2005-2009. Research Biologist (contract), NOAA Alaska Fisheries Science Center
2003-2005. Post-Doctoral Research Associate, National Research Council.
1994-2002. Research Assistant, Center for Whale Research, Friday Harbor, WA

10 RELEVANT PUBLICATIONS ON PHOTOGRAMMETRY

Durban, J.W. and Parsons, K.M. 2006. Laser-metrics of free-ranging killer whales. Marine Mammal Science 22: 735-743.

Fearnbach, H., Durban, J.W., Ellifrit, D.K. and Balcomb III, K.C., 2011. Size and long-term growth trends of endangered fish-eating killer whales. Endangered Species Research, 13: 173-180.

Durban, J.W., Fearnbach, H., Barrett-Lennard, L.G., Perryman, W.L. and Leroi, D.J., 2015. Photogrammetry of killer whales using a small hexacopter launched at sea. Journal of Unmanned Vehicle Systems 3: 131-135.

Durban, J.W., Moore, M.J., Chiang, G., Hickmott, L.S., Bocconcelli, A., Howes, G., Bahamonde, P.A., Perryman, W.L. and LeRoi, D.J., 2016. Photogrammetry of blue whales with an unmanned hexacopter. Marine Mammal Science 32: 1510-1515.

Durban, J.W., Fearnbach, H., Burrows, D.G., Ylitalo, G.M. and Pitman, R.L., 2017. Morphological and ecological evidence for two sympatric forms of Type B killer whale around the Antarctic Peninsula. Polar Biology 40: 231-236.

Fearnbach, H., Durban, J.W., Ellifrit, D.K. and Balcomb, K.C., 2018. Using aerial photogrammetry to detect changes in body condition of endangered southern resident killer whales. Endangered Species Research 35: 175-180.

Groskreutz, M. J., J. W. Durban, H. Fearnbach, L. G. Barrett-Lennard, J. R. Towers, J. K. B. Ford. 2019. Decadal changes in adult size of salmon-eating killer whales in the eastern North Pacific. Endangered Species Research 40: 183-188.

Stewart, J.D., Durban, J.W., Fearnbach, H., Barrett-Lennard, L.G., Casler, P.K., Ward, E.J. and Dapp, D.R. 2021. Survival of the fattest: linking body condition to prey availability and survivorship of killer whales. Ecosphere 12: p.e03660.

Stewart, J.D., Durban, J.W., Knowlton, A.R., Lynn, M.S., Fearnbach, H., Barbaro, J., Perryman, W.L., Miller, C.A. and Moore, M.J. 2021. Decreasing body lengths in North Atlantic right whales. Current Biology 31: 3174-3179.

Durban, J.W., Fearnbach, H., Paredes, A., Hickmotte, L.S. and LeROi, D.J. 2021. Size and body condition of sympatric killer whale ecotypes around the Antarctic Peninsula. Marine Ecology Progress Series DOI: https://doi.org/10.3354/meps13866.

FIVE ADDITIONAL PUBLICATIONS

Parsons, K.M., Balcomb III, K.C., Ford, J.K.B. and Durban, J.W. 2009. The social dynamics of southern resident killer whales and conservation implications for this endangered population. Animal Behaviour 77: 963-971.

Durban, J., Ellifrit, D., Dahlheim, M., Waite, J., Matkin, C., Barrett-Lennard, L., Ellis, G., Pitman, R., LeDuc, R. and Wade, P. 2010. Photographic mark-recapture analysis of clustered mammal-eating killer whales around the Aleutian Islands and Gulf of Alaska. Marine Biology 157: 1591-1604.

Matkin, C.O., Durban, J.W., Saulitis, E.L., Andrews, R.D., Straley, J.M., Matkin, D.R. and Ellis, G.M., 2012. Contrasting abundance and residency patterns of two sympatric populations of transient killer whales in the northern Gulf of Alaska. Fishery Bulletin 110: 143-155.

Durban, J.W. and Pitman, R.L., 2012. Antarctic killer whales make rapid, round-trip movements to subtropical waters: evidence for physiological maintenance migrations? Biology Letters 8: 274-277.

Fearnbach, H., Durban, J.W., Ellifrit, D.K., Waite, J.M., Matkin, C.O., Lunsford, C.R., Peterson, M.J., Barlow, J. and Wade, P.R. 2014. Spatial and social connectivity of fish-eating “Resident” killer whales in the northern North Pacific. Marine biology 161: 459-472.

CURRENT COLLABORATORS

Apprill A (Woods Hole Oceanographic Institution), Ainley D (HT Harvey and Associates), Balcomb K (Center for Whale Research, WA), Barrett-Lennard L (Vancouver Aquarium), Calambokidis J (Cascadia Research Collective), Christiansen F (Aarhus University), Corkeron P (New England Aquarium), Ellifrit D (Center for Whale Research), Fearnbach H (SeaLife Response, Rehab and Research), Foote A (Norwegian University of Science and Technology), Ford J (University of British Columbia), Friedlaender A (UC Santa Cruz), Groskreutz M (NOAA SW Fisheries Science Center), Guazzo R (UC San Diego), Hooper R (Uppsala University), Joyce T (NOAA SW Fisheries Science Center), Kellar N (NOAA SW Fisheries Science Center), Knowlton A (New England Aquarium), Leslie M (Swarthmore College), Miller C (Woods Hole Oceanographic Institution), Matkin C (North Gulf Oceanic Society), Moore M (Woods Hole Oceanographic Institution), Nykanen M (University College Cork), Perryman W (NOAA SW Fisheries Science Center), Pirotta E (Washington State University), Pitman R (Oregon State University), Scharf H (San Diego State University), Schick R (Duke University), Southall B (Southall Environmental Associates), Stewart J (NOAA SW Fisheries Science Center), Thomas L (University of St. Andrews), Towers J (Fisheries and Oceans Canada), Tyack P (University of St. Andrews), Visser, F (University of Amsterdam), Wade P (NOAA AK Fisheries Science Center), Wellard B (Curtin University) Weller R (NOAA SW Fisheries Science Center)

NORTH GULF OCEANIC SOCIETY
3430 Main Street Suite B1 Homer, Alaska 99603

20 July 2021

To: Mandy Lindeberg - NOAA, GWA-LTRM Program Lead
Katrina Hoffman - PWSSC, President and CEO
Shiway Wang, EVOSTC Executive Director

Re: Letter of Commitment

We are pleased to provide this letter of commitment for the proposed project 22120114-N Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords led by principal investigator (PI), Craig Matkin. This proposal was drafted by the PI in response to the EVOSTC's FY22-31 Invitation for Proposals and subsequent request for final submission on August 13, 2021. The cost for this project over a ten-year period will be $1,810 K (without EVOSTC GA). This includes some non-EVOSTC funds that are in-kind contributions we support totaling an estimated $600 K for the life of the project (e.g., some analytical costs and drone lease).

This project proposal is part of the larger multi-agency Gulf Watch Alaska Long-Term Research and Monitoring (GWA-LTRM) program proposal package. This package represents a continued commitment of the successful long-term research and monitoring projects supported by the EVOSTC and various agencies and organizational investments since the initiation of the Trustee Council.

Sincerely,

Craig Matkin
Executive Director
Authorized Representative of North Gulf Oceanic Society
comatkin@gmail.com, 907-202-2579

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	
Travel		$7,200	$7,200	$7,200	$7,200	$7,200	$36,000	
Contractual		$152,200	$173,900	$174,300	$158,800	$196,150	$855,350	
Commodities		$18,500	$13,500	$17,500	$13,500	$12,500	$75,500	
Equipment		$0	$0	$0	$0	$0	$0	
Indirect Costs	Rate = 10%	$17,790	$19,460	$19,900	$17,950	$21,585	$96,685	
SUBTOTAL		$195,690	$214,060	$218,900	$197,450	$237,435	$1,063,535	
General Administration (9% of subtotal)		$17,612	$19,265	$19,701	$17,771	$21,369	$95,718	N/A
PROJECT TOTAL		$213,302	$233,325	$238,601	$215,221	$258,804	$1,159,253	
Other Resources (In-Kind Funds)		$76,000	$76,000	$56,000	$56,000	$56,000	$320,000	

COMMENTS:
Cost share includes analytical costs for scat analysis borne by the Northwest Fisheries Science Center ($25K) and Pacific Biological Station ($6K). Field time and analytical time is covered by SR3 for Holly Fearnbach ($10K) and by ONR for Hannah Myers ($20K in FY22,23). ONR money only committed through FY23. Drone ($5K) and C. Matkin salary for management and report/analysis asisstance ($10K) provided in kind by NGOS.

Budget revised September 2021 per Science Panel direction to add integrated and mechanistic modeling. See highlighted cells in budget detail.

FY22-26

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

NON-TRUSTEE AGENCY SUMMARY PAGE

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY22

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 300/day/55 days	$16,500
Field Assistants 150/day/55days	$8,250
Field Biologist Photogrammetry 20 days	$8,000
Data input and organization/GIS (Olsen)	$8,000
Photoidentification (Ellis)	$7,000
Population dynamics/reporting/publication (Durban)	$4,000
Food Habits analysis/publication (Olsen)	$8,000
Photogrammetry Analysis/reporting (Durban)	$25,000
Acoustic Analysis	$800
Integrated and mechanistic modelling (Durban)	$20,000
Reports/Permits/Catalogue (Olsen/Durban)	$9,500
Outreach (Olsen))	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$152,200

Commodities Costs: Description	Commodities Sum
Acoustic recorders and moorings	$5,000
Field Food ($60/day for 55 days)	$3,300
Fuel ($120/day for 55 days)	$6,600
Misc electronic, batteries, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$18,500

FY22

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY22

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY23

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 300/day/55 days	$16,500
Field Assistants 150/day/55 days	$8,250
Field Biologist Photogrammetry 20 days	$8,500
Data input and organization//GIS	$8,500
Photoidentification	$7,000
Population dynamics/reporting/publication	$4,000
Food Habits analysis/publication	$8,000
Photogrammetry Analysis/reporting	$25,000
Acoustic Analysis	$4,000
Integrated and mechanistic modelling (Durban)	$40,000
Reports/Permits/Catalogue) Olsen/Durbin	$7,000
(Outreach (Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$173,900

Commodities Costs: Description	Commodities Sum
Field Food ($60/day for 55 days)	$3,300
Fuel ($120/day for 55 days)	$6,600
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$13,500

FY23

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY23

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY24

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 300/day/55 days	$16,500
Field Assistants 150/day/55 days	$8,250
Field Biologist Photogrammetry 20 days	$8,500
Data input and organization//GIS	$8,500
Photoidentification	$7,100
Population dynamics/reporting/publication	$4,000
Food Habits analysis/publication	$9,000
Photogrammetry Analysis/reporting	$25,000
Acoustic Analysis	$3,500
Integrated and mechanistic modelling (Durban)	$40,000
Reports/Permits/Catalogue (Osen/Durban)	$7,000
Outreach (Olsen)	$1,200
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$174,300

Commodities Costs: Description	Commodities Sum
Acoustic recorders and moorings	$5,000
Field Food ($60/day for 55 days)	$3,300
Fuel ($120/day for 55 days)	$6,600
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$1,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$17,500

FY24

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY24

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY25

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 320day/55 days	$17,600
Field Assistants 150/day/55 days	$8,250
Field Biologist Photogrammetry 20 days	$8,500
Data input and organization//GIS	$8,500
Photoidentification	$7,100
Population dynamics/reporting/publication	$4,100
Food Habits analysis/publication	$7,000
Photogrammetry Analysis/reporting	$26,000
Acoustic Analysis	$6,800
Integrated and mechanistic modelling (Durban)	$20,000
Reports/Permits/Catalogue (Olsen/Durban)	$8,000
Outreach (Olsen)	$1,200
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$158,800

Commodities Costs: Description	Commodities Sum
Field Food ($60/day for 55 days)	$3,300
Fuel ($120/day for 55 days)	$6,600
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$13,500

FY25

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY25

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY26

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 300/day/55 days	$16,500
Field Assistants 150/day//55 days	$8,250
Field Biologist Photogrammetry 20 days	$8,750
Data input and organization//GIS	$8,750
Photoidentification	$7,200
Population dynamics/reporting/publication	$10,000
Food Habits analysis/publication	$8,000
Photogrammetry Analysis/reporting	$24,000
Acoustic Analysis	$8,800
Covariate data identification (Olsen)	$8,750
Integrated and mechanistic modelling (Durban)	$40,000
Reports/Permits/Catalogue (Durban/Olsen)	$10,000
Outreach (Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$196,150

Commodities Costs: Description	Commodities Sum
Field Food ($60/day for 55 days)	$3,300
Fuel ($120/day for 55 days)	$6,600
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$1,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$12,500

FY26

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY26

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Budget Category:	Proposed FY 27	Proposed FY 28	Proposed FY 29	Proposed FY 30	Proposed FY 31	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$0	$0	$0	$0	$0	$0	
Travel	$7,200	$7,200	$7,200	$7,200	$7,200	$36,000	
Contractual	$173,425	$160,975	$167,225	$166,075	$209,825	$877,525	
Commodities	$20,000	$14,600	$19,000	$14,600	$13,600	$81,800	
Equipment	$0	$0	$0	$0	$0	$0	
Indirect Costs Rate = 10%	$20,063	$18,278	$19,343	$18,788	$23,063	$99,533	
SUBTOTAL	$220,688	$201,053	$212,768	$206,663	$253,688	$1,094,858	
General Administration (9% of subtotal)	$19,862	$18,095	$19,149	$18,600	$22,832	$98,537	N/A
PROJECT TOTAL	$240,549	$219,147	$231,917	$225,262	$276,519	$1,193,395	
Other Resources (In-Kind Funds)	$56,000	$56,000	$56,000	$56,000	$56,000	$280,000	

COMMENTS:
Cost share includes analytical costs for scat analysis borne by the Northwest Fisheries Science Center ($25K) and Pacific Biological Station ($6K). Field time and analytical time is covered by SR3 for Holly Fearnbach ($10K). Drone lease is provided in kind ($5K).

Budget revised September 2021 per Science Panel direction to add integrated and mechanistic modeling. See highlighted cells in budget detail.

FY27-31

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

NON-TRUSTEE AGENCY SUMMARY PAGE

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY27

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $650/day)	$35,750
Vessel Operator/Field Biologist 320/day/55 days (Olsen/Matkin)	$17,600
Field Assistants 160/day/55 days	$8,800
Field Biologist Photogrammetry 20 days	$9,000
Data input and organization/GIS (Olsen)	$9,500
Photoidentification (Ellis)	$7,200
Population dynamics/reporting/publication (Durban)	$4,000
Food Habits analysis/publication (Olsen)	$6,500
Photogrammetry Analysis/reporting (Durban)	$25,000
Acoustic Analysis	$8,800
Integrated and mechanistic modelling (Durban)	$31,875
Reports/Permits/Catalogue (Olsen/Durban)	$8,000
Outreach (Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$173,425

Commodities Costs: Description	Commodities Sum
Acoustic recorders and moorings	$5,400
Field Food ($70/day for 55 days)	$3,850
Fuel ($130/day for 55 days)	$7,150
Misc electronic, batteries, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$20,000

FY27

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY27

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY28

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $6750/day)	$37,125
Vessel Operator/Field Biologist 330/day/55 days (Olsen/Matkin)	$17,600
Field Assistants 160/day/55 days	$8,800
Field Biologist Photogrammetry 20 days	$9,250
Data input and organization/GIS (Olsen)	$9,750
Photoidentification (Ellis)	$9,000
Population dynamics/reporting/publication (Durban)	$3,000
Food Habits analysis/publication (Olsen)	$6,500
Photogrammetry Analysis/reporting (Durban)	$20,000
Acoustic Analysis	$8,800
Integrated and mechanistic modelling (Durban)	$21,250
Reports/Permits (Olsen/Durban)	$8,500
Outreach (Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$160,975

Commodities Costs: Description	Commodities Sum
Field Food ($70/day for 55 days)	$3,850
Fuel ($130/day for 55 days)	$7,150
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$14,600

FY28

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY28

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY29

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description		Contract Sum
Vessel lease (R/V Natoa--55 days @ $675/day)		$37,125
Vessel Operator/Field Biologist 320/day/55 days (Olsen/Matkin)		$17,600
Field Assistants 160/day/55 days		$8,800
Field Biologist Photogrammetry 20 days		$9,250
Data input and organization/GIS (Olsen)		$10,500
Photoidentification (Ellis)		$8,000
Population dynamics/reporting/publication (Durban)		$4,000
Food Habits analysis/publication (Olsen)		$7,000
Photogrammetry Analysis/reporting (Durban)		$25,000
Acoustic Analysis		$8,800
Integrated and mechanistic modelling (Durban)		$21,250
Reports/Permits/Catalogue (Olsen/Durban)		$8,500
Outreach Olsen)		$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required.	**Contractual Total**	$167,225

Commodities Costs: Description		Commodities Sum
Acoustic recorders and moorings		$5,400
Field Food ($70/day for 55 days)		$3,850
Fuel ($130/day for 55 days)		$7,150
Misc electronic, photo supplies (memmory cards, hard drives, etc)		$1,200
Field Communication, Tracking, Shipping, and Misc supplies		$1,400
	Commodities Total	$19,000

FY29

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY29

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY30

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ /day)	$37,125
Vessel Operator/Field Biologist 330/day/55 days (Olsen/Matkin)	$18,150
Field Assistants 160/day/55 days	$8,800
Field Biologist Photogrammetry 20 days	$9,250
Data input and organization/GIS (Olsen)	$10,500
Photoidentification (Ellis)	$8,300
Population dynamics/reporting/publication (Durban)	$3,000
Food Habits analysis/publication (Olsen)	$6,000
Photogrammetry Analysis/reporting (Durban)	$25,000
Acoustic Analysis	$8,800
Integrated and mechanistic modelling (Durban)	$21,250
Reports/Permits/Catalogue (Olsen/Durban)	$8,500
Outreach (Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$166,075

Commodities Costs: Description	Commodities Sum
Field Food ($70/day for 55 days)	$3,850
Fuel ($130/day for 55 days)	$7,150
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$2,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$14,600

FY30

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY30

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Subtotal	0.0	0.0	
				Personnel Total	$0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting (Olsen)	700.0	1	4	200.0	$1,500
Attend annual Alaska Marine Science Symposium (Olsen)	700.0	1	4	200.0	$1,500
Durban/Fearnback Field transport	2100.0	2			$4,200
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
				Travel Total	$7,200

FY31

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

PERSONNEL & TRAVEL DETAIL

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

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--55 days @ $675/day)	$37,125
Vessel Operator/Field Biologist 330/day/55 days (Olsen/Matkin)	$18,150
Field Assistants 160/day/55 days	$8,800
Field Biologist Photogrammetry 20 days	$9,250
Data input and organization/GIS (Olsen)	$10,500
Photoidentification (Ellis)	$8,000
Population dynamics/reporting/publication (Durban)	$6,000
Food Habits analysis/publication (Olsen)	$6,000
Photogrammetry Analysis/reporting (Durban)	$25,000
Acoustic Analysis	$12,800
Covariate data selection (Olsen)	$9,300
Integrated and mechanistic modelling (Durban)	$42,500
Reports/Permits/Catalogue (Olsen/Durban)	$15,000
Outreach Olsen)	$1,400
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$209,825

Commodities Costs: Description	Commodities Sum
Field Food ($70/day for 55 days)	$3,850
Fuel ($130/day for 55 days)	$7,150
Misc electronic, photo supplies (memmory cards, hard drives, etc)	$1,200
Field Communication, Tracking, Shipping, and Misc supplies	$1,400
Commodities Total	$13,600

FY31

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
		New Equipment Total	$0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY31

Project Number: 22120114-N
Project Title: Killer Whale Monitoring
PI(s): Matkin, Olsen, & Durban (NGOS)

EQUIPMENT DETAIL

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

Budget Category:		TEN YEAR TOTAL
Personnel		$0
Travel		$72,000
Contractual		$1,732,875
Commodities		$157,300
Equipment		$0
Indirect Costs	Rate = 10%	$196,218
	SUBTOTAL	$2,158,393
General Administration (9% of subtotal)		$194,255
	PROJECT TOTAL	**$2,352,648**
Other Resources (In-Kind Funds)		**$600,000**

22120114-N
Killer Whale

FY22-31
NON-TRUSTEE AGENCY
SUMMARY TABLE