August 24, 2016

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

Dear Elise:

Final FY 2017-2021 Proposal Submittal for Long-term Monitoring

17120114-N. Long-term Killer Whale Monitoring

Gulf Watch Alaska, the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC), has finalized our program and project proposals for fiscal years 2017-2021 funding based on comments received from EVOSTC's Science Panel on May 19, 2016. Below is the final budget summary and response to Science Panel comments for the killer whale project.

EVOSTC Funding Requested *(including 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$152,800	$151,300	$142,100	$140,300	$139,500	$725,900

Non-EVOSTC Funding Available

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

Science Panel comment: *There are no project specific comments.*

PI Response:

- The proposal was not revised.

Sincerely,

Mandy Lindeberg
Gulf Watch Alaska Program Lead designate

Attachment: Gulf Watch Alaska: Pelagic Component Project Proposal: 17120114-N—
Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords

EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
PROGRAM PROJECT PROPOSAL SUMMARY PAGE

Project Title

Gulf Watch Alaska: Pelagic Component Project:

17120114-N—Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords

Primary Investigator(s) and Affiliation(s)

Craig Matkin, North Gulf Oceanic Society

Date Proposal Submitted

24 August 2016

Project Abstract

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 (PWS). A primary focus has been on resident killer whales and the recovery of AB pod and the threatened AT1 population of transient killer whales. These groups of whales suffered serious losses at the time of the oil spill and have not recovered at projected rates. Monitoring of all the major pods and their population dynamics, feeding ecology, movements, range, and contaminant levels will help determine their vulnerability to future perturbations and environmental change, including oil spills. The project uses various techniques, as possible and in addition to the core photoidentification monitoring and annual skin and biopsy sampling. These include observations of predation and sampling of prey, remote acoustic monitoring to identify important habitat and seasonal use patterns, time depth tags to investigate feeding ecology, and photographic drones to examine morphometrics, relocating whales for feeding studies. It continues examination of feeding habits prey sampling coupled with innovative chemical techniques. The study will continue to monitor delineate and monitor important habitat and variations in pod specific use patterns using observation as well as non-invasive remote acoustic monitoring. We will continue to examine the role of both fish eating and mammal eating killer whales in the near-shore ecosystem and their interaction with prey species. 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)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$152.8	$151.3	$142.1	$140.3	$139.5	$725.9

Non-EVOSTC Funding Available

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

1. Executive Summary

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 natural variability in affected animal populations. The main problem for assessing impacts on pelagic species was that long-term baseline data were largely absent. As a result, managers struggled to make informed decisions regarding estimation of damages and recommendations for recovery. Ten years after the spill it became widely recognized that there had been a major climatic regime shift (from colder to warmer than average) that altered the marine ecosystem prior to the spill, including marine birds, marine mammals, groundfish, and the shared forage species they all consumed. As we begin to close the second decade of the 2000s we are experiencing anomalous ocean warming events driven by changing atmospheric conditions at both inter-decadal (i.e. Pacific Decadal Oscillation) and shorter (e.g. El Niño Southern Oscillation) time scales. These changes may have profound effects on pelagic ecosystems such as unusual mortality events, harmful algal blooms, and fishery closures.

During the first five years of the Gulf Watch Alaska program, the pelagic component research team addressed two main questions: 1) What are the population trends of key pelagic species groups in Prince William Sound, and, 2) How can forage fish population trends in PWS be monitored most effectively? To answer these questions, five projects focused on species that play a pivotal role in the pelagic ecosystem as trophic indicators for short and long-term ecosystem change: forage fish, marine birds, humpback whales and killer whales. Monitoring of killer whales and marine birds benefitted from having pre-existing long-term data sets as a result of the damage assessment process following the EVOS (>25-year time series).

Moving forward for the next five years, the pelagic research team re-evaluated their primary objectives. The group's primary goal — to determine the long-term population trends of key pelagic species groups in PWS — will remain the same. The second primary objective was fundamentally different: Develop a means to effectively monitor forage fish. Based on knowledge gained in the first five years of the pelagic program, we have developed a broader focus that includes an integrated study of forage fish using marine bird and mammal predators as samplers of the forage base. In addition to providing a means to effectively monitor indices of forage fish trends, our integrated approach will also enhance our understanding of predator-prey relationships and help us identify some mechanisms of change in populations. Ultimately, the integrated surveys along with information from the GWA Environmental Drivers Program will provide a way to evaluate climate variability and climate change on the PWS pelagic ecosystem.

Thus, the two over-arching questions for the pelagic component to answer in the next five years are:

1. *What are the population trends of key upper trophic level pelagic species groups in Prince William Sound – killer whales, humpback whales, marine birds, and forage fish?*

2. *How do predator-prey interactions, including interannual changes in prey availability, contribute to underlying changes in the populations of pelagic predators in Prince William Sound and Middleton Island?*

The pelagic component research team is proposing to continue monitoring key pelagic species groups in PWS using the same five projects focused on killer whales, humpback whales, forage fish, and marine birds. However, modifications have been made to some projects for greater integration, increased precision of information, and achieving new goals. Ultimately this will provide more information to the EVOS Trustee Council, agency resource managers, non-governmental organizations, and the public.

Killer Whale Monitoring

Both resident ecotype (AB pod) and transient ecotype (AT1 population) killer whales suffered significant mortalities following EVOS. AB pod is recovering after 26 years but has still not reached pre-spill numbers. The AT1 population is not recovering and may be headed toward extinction (Matkin et al. 2008). This project has determined that killer whales are sensitive to perturbations such as oil spills, but has not yet determined the long term consequence (which may include extinction) or the recovery period required. As an apex predator, this species (both fish and mammal eating types) has important role in the ecosystem; additionally, they are a primary focus of viewing by a vibrant tour boat industry in the region. Data from this project is used by tour boats to enhance viewers experience and understanding of the local environment and fauna. Unlike many cetaceans, killer whales can be closely monitored and for resident (fish eating) killer whales detailed population dynamics monitored (Matkin et al. 2014). The AT1 transient population can be directly monitored by individual, and the wide ranging Gulf of Alaska transients (mammal eating) population monitored for trends (Matkin et al. 2012). We also contribute all photoidentification data for the offshore form of killer whale to a coast-wide data base at the Pacific Biological Station (Nanaimo, BC, Canada). This project is a unique opportunity to continue a comprehensive monitoring program for a keystone marine species, with three ecotypes, that was initiated in the early 1980s. The importance of long-term killer whale monitoring has been borne out by companion studies other regions such as Puget Sound and British Columbia.

The core project is the photoidentification based monitoring of population parameters, annual monitoring of contaminants, feeding, and trophic changes using blubber biopsy sampling and observation of predation and prey sampling. In addition, we will develop remote acoustic techniques that will allow monitoring geographic and temporal use patterns of resident killer whales. We have pioneered this type of work in Alaska in the past (Yurk et al. 2010) but will now employ new technologies. Additionally, when not compromising the core project, we will use time/depth/location tags to examine details of feeding ecology (Olsen et al. in prep) and explore the use of morphometrics obtained from drone captured, low altitude photos (Durban et al. 2010) to develop an annual index of individual and population health and possibly determine pregnancy rates.

Analysis includes population dynamics and modeling (Matkin et al. 2014), genetic sequencing as necessary for determination of population affiliation, stable isotope analysis of skin and chemical analysis of blubber, acoustic analysis of remote hydrophone data, and as possible morphometric analysis of drone captured overhead photographs and analysis and interpretation of time/depth/location tag data. Although we will focus on the southern Alaska resident and AT1 transient populations which were impacted by EVOS, the study also includes the other two recognized populations in the region, the Gulf of Alaska transients and offshore killer whales and contributes substantially to the National Marine Fisheries Service (NMFS) killer whale stock assessments.

Data will be collected during a minimum 50-day field season from May through October from the R/V Natoa, although opportunistic photographic data is contributed from other collaborating vessels. This is the continuation of a long-term project spanning 33 years and has benefited from continued support of mariners and the coastal communities of the north Gulf coast of Alaska.

2. Relevance to the Invitation for Proposals

This project is relevant in terms of restoration of species impacted by EVOS. It is of continued interest and importance as it provides a continuation of one of the longest running databases of a spill impacted and a keystone marine species in PWS and the North Gulf Coast. The following chart (Figure 1) depicts changes in oil impacted AB pod and AT1 population and continued tracking of these and the other pods/populations in the region is essential in the continued documentation of long term impacts and restoration of key species for which a long time series is available.

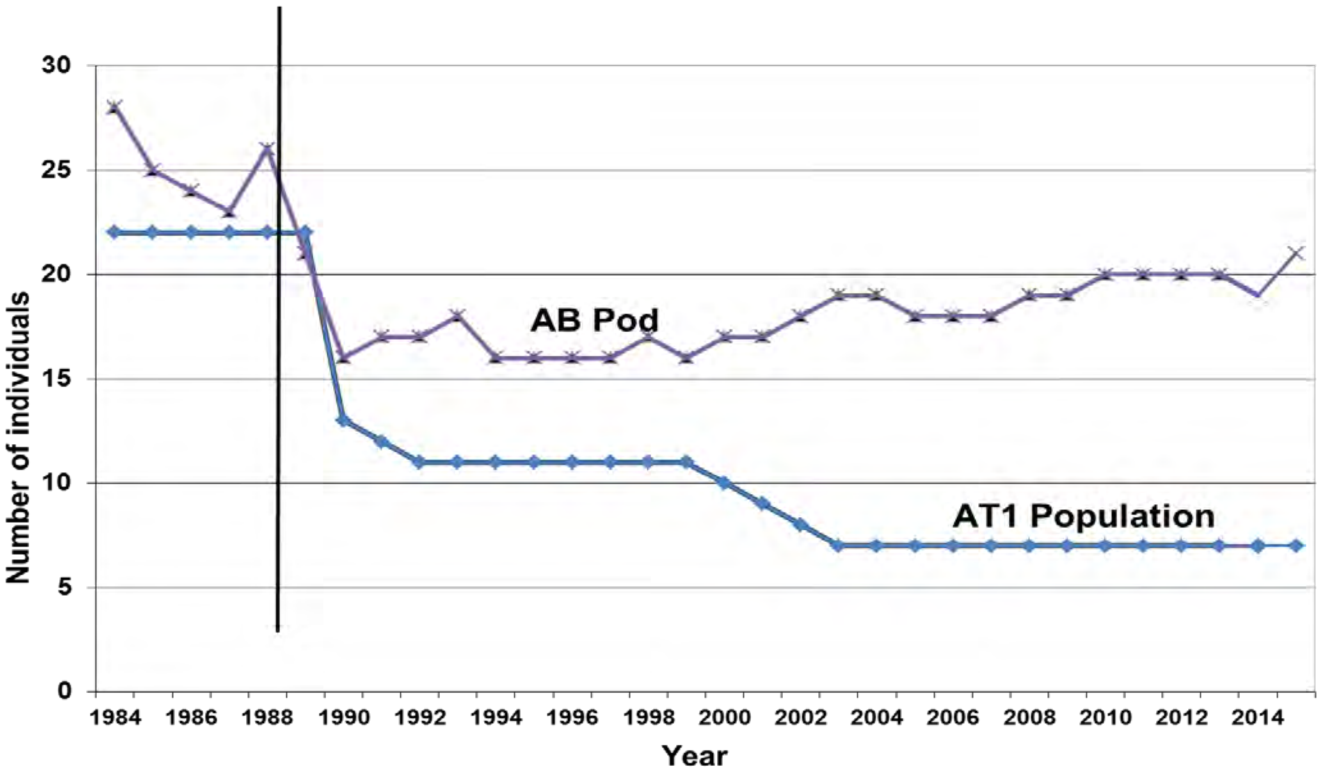

Figure 1. Numbers of whales in AB pod and AT1 population 1984-2015.

It is also relevant to the invitation as it ties in a key upper trophic level predator to the pelagic component as described in the Invitation. It uses proven monitoring techniques to provide detailed population level data and basic feeding and trophic level data on killer whales. These data will provide a baseline to interpret changes due to long-term oceanographic or climatic change or sudden perturbations. The project continues to develop and use other techniques that include drone borne cameras, remote acoustic recorders, and time/depth location tags to better track and understand killer whale movements, feeding ecology, and body condition over extended the years.

We expect to have detailed population and trend data for several populations of killer whales in the region that can be used by managers (in particular the NMFS) to maintain stock assessments as required for this species. It will add an upper level predator to the monitored species in the pelagic component of the Invitation. It will provide valued and requested information to the tour boat industry and general public regarding basic biology latest research results, and specific identities of animals that have become the most sought after for viewing.

3. Project Personnel

CRAIG O. MATKIN, B.A., M.S.
North Gulf Ocean Society Executive Director
3430 Main St. Suite B1
Homer, Alaska 99603
(907) 299-0677 (cell)
(907) 235-6590 (office)
comatkin@gmail.com
www.whalesalaska.org

Please see 2 page CV at end of this document

4. Project Design

This project continues a 33 year population monitoring and population dynamics program for southern Alaska resident and AT1 transient killer whales and monitoring of trends for the Gulf of Alaska transient population (Matkin et al. 2008, Matkin et al. 2012, Matkin et al. 2014). It has provided data for population and trend estimation for humpback whales (Terlink et al. 2014). It has also provided an assessment of killer whale interaction with prey (salmon for transients and marine mammals for transients) and will continue to contribute to this understanding and changes in these relationships.

The core project will continue monitoring of individual killer whales through photoidentification and maintain individual life histories that will allow continued development of population parameters and, in the case of resident whales, a population dynamics model. The project continues monitoring of blubber chemistry that regularly assesses contaminant levels and changes in dietary habits and is coupled with field sampling of prey remains (tissue, fish scales) and as possible, fecal material. Additionally, we will develop remote acoustic monitoring with semi- annual replacement and retrieval of submerged recording devices in key locations. This will yield specific information on timing and duration of use of key areas previously determined by tagging studies and long term encounter data. Although tagging data has been valuable to determine overall use patterns of key pods and identify important habitat, the invasive nature, costs involved, and the relatively short duration of tags makes acoustic monitoring a good choice for continued monitoring use patterns and to important habitat both spatially and temporally.

In addition to the core objectives and as time allows we will develop repeatable morphometric measurements for individual whales and groups using drone based aerial photogrammetry and assess body condition over time and possibly determine pregnancy rates, a missing parameter from our population model. Finally, as time and situations permit we will examine feeding ecology using time/depth/location tags coupled with concurrent prey sampling during feeding aggregations.

A. Objectives

1. Photo-identification of all major resident pods and AT1 transient groups that use PWS/Kenai Fjords on an annual basis. Realistically, all pods are completely documented only on a biennial basis, despite annual field effort. Extension of individual histories, identification catalogues of individuals and an annual update of population model are products of these data (**Core Objective**).

2. Collection of blubber samples for chemical monitoring of polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethanes (DDTs) and polybrominated diphenyl ethers (PBDEs), lipids /fatty

acids and stable isotope values to gauge changes in contaminant loads as well as feeding habit changes. Most analytical costs are borne by NMFS (**Core objective**).

3. Collection of fish scale samples and marine mammal tissue from kill sites to monitor potential changes in feeding habits.

4. Using remotely deployed submerged sonic recorders to track killer whales using calls. This will provide use patterns information for areas already identified as most important for killer whales using tagging and encounter data during previous work (**Core objective**).

5. Collection of genetic tissue samples when necessary to determine population/ecotype affiliations (**Core objective**).

6. Use photogrammetry to develop morphometrics for individuals and groups to assess body condition over time and develop measures to determine pregnancy rate as an additional important population parameter (**secondary objective, completed as possible**).

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

B. PROCEDURAL AND SCIENTIFIC METHODS

Our core work depends on accurate photo-identification of each individual in each pod/group that regularly uses the Sound, 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 and to continue to examine feeding ecology, which are the core elements of this study.

Methods proposed to obtain photographic data necessary to meet core monitoring objectives will be similar to those used by the North Gulf Oceanic Society in PWS/Kenai Fjords for the past 32 years with improvements due to significant technological advancements. 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 very high frequency (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.

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 shapefiles on a daily basis. This format facilitates geographic information system (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 a 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.

All digital photographs will be examined on an expanded screen Apple MacPro computer using Photomechanic 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. Photographic negatives will be analyzed using a photographic database that spans 32 years. Data products include a frame by frame analysis of all digital images, with individual identifications digitally recorded and attached to the photo as well as summarized in separate spread sheets for each encounter listing the identities of the whales in each frame. Improvement 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. ARGOS tracklines are also placed in GIS format and initial analysis, including mapping and measures of effort completed on an annual basis.

Field observations of feeding will be made and prey parts collected when possible. Scales are retrieved from fish predations events and read for species and age at the Pacific Biological Station in Nanaimo, British Columbia, where a scale laboratory has been established and certified for over 25 years. The recent development of a genetic scale library, for Chinook salmon in particular, that now spans the waters of Washington, British Columbia, and southern Alaska has allowed identification of the rivers of origin for Chinook prey. Chinook are a species of high conservation concern with potential impacts involving both humans and killer whales. If mammal prey species cannot be identified visually, then genetic analysis will be conducted if bits of prey remains are collected. The University of British Columbia, Department of Zoology and Northwest Fisheries Science Center (NWFSC)/National Marine Mammal Laboratory (NMML) genetics laboratories maintain reference collections of genetic markers for each marine mammal species and Kim Parsons (NWFSC/NMML) will conduct species identification analysis.

Biopsy samples 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 analysis completed at the NWFSC). Specifically, each biopsy sample was analyzed for their skin carbon and nitrogen stable isotope (SI) ratios, blubber fatty acids (FAs), and persistent organic pollutants (POPs).

Measurements of skin SIs will be conducted following the procedure described in Herman et al. (2005). In essence, the procedure will involve freeze-drying ~50-200 mg of wet skin tissue, removing lipid by accelerated solvent extraction (ASE) using methylene chloride, pulverizing the lipid-free skin to a powder in a micro ball mill, loading ~500ug of powder into tin cups and combusting the powder in a Costech elemental analyzer attached to a Thermo-Finnigan Delta Plus Isotope Ratio Mass Spectrometer. Carbon (13C) and nitrogen (15N) isotope ratios will be measured relative to Vienna Pee Dee Belemnite and atmospheric nitrogen, respectively.

Blubber fatty acids will be analyzed following the procedure described in Herman et al. (2005). Prior to analysis, all blubber biopsy samples are sub-sampled by performing two lateral cuts, the first ~1mm from the inside edge of the epidermis tissue and a second cut exactly 20mm from the epidermis-blubber interface. Because FAs are highly stratified in killer whale blubber tissues it is necessary to standardize all blubber samples in this fashion in order to represent a constant blubber depth. Blubber persistent organic pollutants will be analyzed using a method that involves clean-up of half or more of the lipid extract described in Herman et al. (2005) for the analysis of FAs (which also contains POPs) on a silica/alumina column to remove polar extraneous compounds, separation of the POPs from all lipids by High Performance Size Exclusion Chromatography (HPSEC), and finally separation and analysis on a 60m DB-5 capillary GC column equipped with a quadrupole mass spectrometer operated in the selected ion mode. PCB profile data are expressed on a wt % composition basis by dividing the lipid-normalized concentration of each individual PCB congener by the sum of the lipid-normalized concentrations of all congeners measured in the sample.

A new addition to our core program will be the use of autonomous submerged recording devices that will record calls of killer whales, particularly the vocal residents, for periods of up to 6 months and which we will attempt to redeploy at 6 month intervals to create a full year-long measure of habitat use. This will replace the location only satellite tagging that was developed to explore habitat use in the previous 5-year project. It has the distinct advantage of being more cost effective in the long run, able to assess year round patterns, and is non-invasive. We have used remote transmitting hydrophones in the past but these have required monitoring and placement that allowed transmission to a nearby town (Yurk et al. 2010).

We intend to use the SoundTrap 300 STD recorder, with the additional external battery housing (http://www.oceaninstruments.co.nz/product/st300b-external-battery-pack/). We will use a recording sample rate of around 16kHz for an effective bandwidth of ~8kHz. Intially we intend to employ a simple grapple style mooring. The recorder (attached to a float, i.e., Dragger ball) is tethered to a pier block with an eyebolt. Then we attach two 160ft polysteel lines extending opposite directions from the block, each ending at a 5 or 10kg bruce anchor. This set-up restricts device to relatively shallow (~20fathoms) areas with soft bottom, which can be limiting and induces more surface noise than deeper deployments. Alternatively we will investigate using a small scale acoustic release system such as the Desert Star Systems model (http://desertstar.com/product/arc-1xd/).

Placement locations will be Hinchinbrook Entrance and Montague Strait, the two major entrances to PWS and known seasonal focal areas for killer whales. A third site at the mouth of Resurrection Bay will be employed if time and expense allow. A recording sample rate of around 16 kHz will be used for an effective bandwidth of ~8 kHz. This will detect most discrete calls although it is not broadband enough to capture echolocation signals unless the whales are fairly close.

As an additional project (not part of our core objectives) and to be completed and developed as time and monies allow with personnel assistance from Southwest Fisheries Science Center (SWFSC)/NMFS (Dr. John Durban), we intend to use a small, unmanned hexacopter (APH-22; Aerial Imaging Solutions) as a method for collecting aerial photographs to measure killer whales at sea. There has been good initial success with this program in photographing the endanged Southern Resident Killer whales and our project would be for comparative purposes. We will deploy and retrieved the hexacopter by hand from the upper deck of the R/V Natoa boat, utilizing the aircraft's vertical takeoff and landing (VTOL) capability. The hexacopter is quiet and stable in flight, and therefore can be flown at relatively low altitudes without disturbing whales. The payload will be a Micro Four-Thirds system camera or similar that obtains still images from an altitude of 35–40 m above the whales. Tests have indicated a ground-resolved distance of <1.4 cm across the full extent of a flat and undistorted field of view, and an onboard pressure altimeter enabled measurements in pixels to be scaled to true size with an average accuracy of 5 cm. The images that were obtained in Southern Resident killer whale work were sharp enough to differentiate individual whales using natural markings (77 whales in total) and preliminary estimates resolved differences in whale lengths ranging from 2.6 to 5.8 m. Various measures of body size and shape indicate a good index of condition (body fat) and possibly pregnancy can be resolved.

Although we are completing and publishing our location only tracking work using remotely deployed satellite tags, we will, as possible after completing core objectives, use time/depth/location tags to look at diving behavior as it relates to feeding ecology coupled with concurrent sampling of prey. Tags are attached to the whale using an air rifle (Danjet air rifle) and fastened small barbed posts that attach to the dorsal fin of the whale. The satellite transmitter that we are proposing to deploy is approximately 3.8 cm in diameter in a half dome shape, with a maximum height of 2.2 cm. The transmitting antenna is approximately 1.5 mm in diameter and 17 cm long sticking out of the center of the half dome. On the flat side, opposite the point of the antenna protrusion will be one or two barbed attachment post that will be 5 cm long and 0.6 cm in diameter. Attachments will be made from distances of approximately 6-8 meters. Uplink schedules are set prior to tagging and data received through the Argos satellite system.

C. Data analysis and statistical methods

Because photographic and observational data are being collected in the same basic format as during the past 32 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 monitor population parameters such as age at first reproduction, mortality and survival rates and use population modeling as a heuristic tool for comparison with observed population dynamics. 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 this GWA program, and will include an annual summary of the pods and individuals encountered, photographed and a status report on 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. To fully quantify uncertainty about unknown parameters a Baysian approach to model fitting and inference will be used, where estimates are presented as full probability distributions.

Feeding data will be summarized annually. This includes updating the database for scale samples in the case of resident killer whales and their fish prey and summarizing field observations and genetic data from prey of transient killer whales and their marine mammal prey. We will determine genetic population markers for Chinook salmon scale samples when possible. Trends in these data will be viewed in conjunction with the contaminant/fatty acid/stable isotope data collected from skin and blubber biopsy samples to examine of killer whale feeding habits (see Herman et al. 2005, Krahn et al. 2007 for detailed methodologies). We will statistically compare chemical markers indicative of diet between pods and from between different years and at different times of year (late winter/spring and late summer/fall).

Genetic analysis of killer whale tissues, when appropriate to determine population affiliation or sex, will be conducted using the methods detailed in Parsons et al. (2013) and will include mtDNA and nuclear DNA analysis. All multivariate and univariate analyses of the chemical marker data obtained in this study will be conducted using either JMP Statistical Discovery Software (PC professional edition version 5.01) or Primer-E Software (version 6.16).

We will use an automated detector for cetacean calls that has been developed by the Sea Mammal Research Institute (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 that we determine to contain killer whales in order to identify the whales vocalizing (to population, clan, subclan, pod, etc., as is possible).

Killer whale presence will be measured as the number of monthly days that killer whales are detected. Duration of calling bouts will be calculated when possible to indicate whether whales are remaining in the area or transiting. This is accomplished by calculating 'encounter duration', the length of time over which killer whales are calling 'continuously' without a gap of more than 2-4 hours (this may differ based on location of the recorder). Eventually, we will examine diversity of group detections over a months or years to differentiate between areas used regularly by only one group, from an area that a much larger proportion of the population uses regularly. If pod identities are possible, then estimates of actual numbers of whales present can be made (Yurk et al. 2010). We will also attempt to link concurrent behavioral observations from the field with recordings to "ground truth" and provide context to our interpretations of recordings.

If morphometrics work can be completed, we will use aerial photo data measurements to estimate whale body length L where the whale was in an apparently "flat" position and we can measure from tip of the rostrum and to the fluke notch, defined this as Lm (m = "measured"). Measurements in pixels will be converted to a true measurement on the sensor using information on the real sensor width of the camera and the number of pixels comprising this width. Measurements will then scaled to true lengths using the measured altitude and the lens focal length (scale = altitude / focal length). Two indices will be used to evaluate body shape: head width (HW = the width at 15% of the distance between the blowhole and anterior insertion of the dorsal fin) and breadth (B = the width at the anterior insertion of the dorsal fin); both were measured in pixels and expressed as a proportion of the total pixels in the same image. For all metrics, we will require a minimum of at least three estimates in order to include an individual in the subsequent data analyses.

If we can collect data from time/depth/ location tags that are deployed, it will be analyzed with the latest version of the Wildlife Computers Data Analysis Program (currently DAP 3.0.292). Data will be separated into deeper diving bouts that denote feeding and the shallower dives that denote resting or surface time. Time, depth and duration of dives, and location of dives will all be plotted and presented in a GIS format coupled with dive profiles. Dive data will be linked, as possible with onsite sampling of prey.

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 (Figure 2). However, the funding specifically requested in this proposal will be used primarily in western Prince William Sound and Kenai Fjords where likelihood of encountering the focal whales is most likely. We cannot predict the specific locations where encounters will occur.

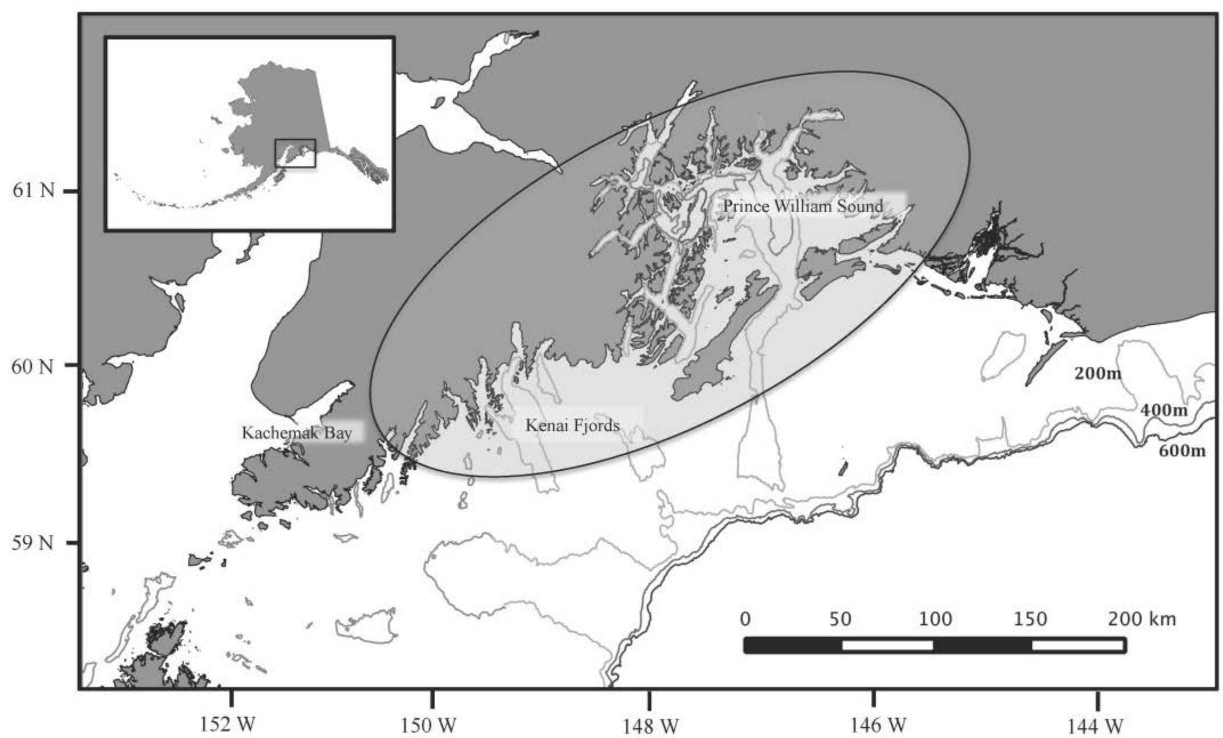

Figure 2. The survey area: Kenai Fjords and Prince William Sound, Alaska

5. Coordination and Collaboration

Within the Program

We 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. We are also working with Rob Campbell of the Oceanographic Conditions in Prince William Sound project (Environmental Drivers) who will fit his mid Sound mooring with recording hydrophones that will be used by this project to record vocalizations that may be used to determine how different pods of killer whales use the Hinchinbrook Entrance and mid Sound. The hydrophones will be serviced by Campbell and data passed on to our project. Campbell also will assist in developing battery packs for extended deployments and fabricating hydrophone mounts on the moorings. The Nearshore program (Dan Monson) will opportunistically provide killer whale identification photographs to our project as will the forage fish project (Mayumi Arimitsu).

With Other EVOSTC-funded Programs and Projects

There is no planned coordination with other EVOS projects outside of the GWA program at this time.

With Trustee or Management Agencies

We will annually provide our data to the NMFS/NMML (Paul Wade) to update the killer whale stock assessments for Alaska and we will provide a review of current Alaska stock assessments, in part based on data collected in this project. Our genetic/contaminant/ and lipid and fatty acid data that spans two decades and will continue is housed at the NWFSC Contaminant Laboratory (Gina Ylitalo) where it will continue to be used in various projects and publications. Genetic samples/ data generated by this project are housed at NWFSC but subsamples are also provided to Southwest Fisheries Science Center (Phil Morin) for examination of worldwide killer whale stock structure and become part of a larger killer whale genetic database maintained at that facility.

With Native and Local Communities

Regular presentations will be given in many local communities including Cordova, Homer, Seward, and Anchorage and include 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. 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.

As is possible, we will provide presentations at the Chenega native village school as we have in the past. Chenega is the only village within our study area and we make opportunistic visits there during field to discuss our work.

6. Schedule

PROJECT MILESTONES

- **Task 1**
  To annually prepare for and launch field collection of core project data including: identification photos, observation of predation and sampling of prey scales/tissue and fecal material (when possible) and collect annual biopsy samples for feeding habits/contaminants/genetics. Prepare and deploy acoustic recorders for year round monitoring of whale movements. Secondarily prepare for possible deployment of time depth tags to investigate details of feeding ecology as time and situations permit.

- **Task 2**
  Conduct analysis of identification photos, skin and blubber samples, scale samples and fecal samples, skin samples, and plot results of tagging efforts. Conducted annually, completion date for all laboratory analysis is February 2022.

- **Task 3**
  Annual update photographic catalogue, Argos tracking data displayed and analyzed, and population dynamics updated. Statistical analysis and compilation of data from all years of the project to be included in final report and/or other publication (draft by April 2022).

MEASURABLE PROJECT TASKS

Measurable project tasks are presented by fiscal year and quarter graphically in Table 1 and descriptively below.

Table 1. Project tasks and activities by fiscal year and quarter, beginning February 1, 2017.

Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Task 1 Collection																				
Field prep	X				X				X				X				X			
Field surveys		X	X			X	X			X	X			X	X			X	X	
Task 2 Data																				
Data summary/analysis				X	X			X	X			X	X			X	X			X
Hydrophone deployments		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Upload previous FY data					X				X				X				X			
Task 3 Reporting																				
Annual Reports					X				X				X				X			
Annual PI meeting				X				X				X				X				X
FY Work Plan (DPD)			X				X				X				X					

FY 2017 (Year 6)

FY17, 1st quarter (February 1, 2017 - April 30, 2017)
Finalize report/paper for first five years funding. Update photo catalogue and population dynamics database. All field preparation completed and boat outfitted for season, with photo equipment, GIS systems and computers, biopsy rifle and supplies, remote and boat based hydrophones, prey/fecal sampling nets and supplies, tagging rifle and supplies.

FY17, 2nd quarter (May 1, 2017 - July 31, 2017)
Initiate field season in early May with intensive field work lasting until early July. Deploy hydrophones. Vessel resupplied at 10-14 day intervals. Trips led by either Craig Matkin or Dan Olsen. Daily outreach through Facebook. In July the R/V Natoa will be on standby in Kenai Fjords to respond to unique encounters, however no scheduled trips.

FY17, 3rd quarter (August 1 2017 - October 31, 2017)
Intensive fieldwork begins again in late August and continues in September-early October. Retrieve hydrophones All field equipment will be cleaned and stored and data analysis will begin by mid-October. Samples will be sent to appropriate laboratories.

FY17, 4th quarter (November 1, 2017 - January 31, 2018)
Analysis continues along with preparation for annual GWA meeting in November and for Alaska Marine Science Symposium in January. Frame by frame photoidentification completed. Begin annual report, summarize annual results including outreach. Work on journal papers.

FY 2018 (Year 7)

FY18, 1st quarter (February 1, 2018 - April 30, 2018)
Complete annual report. Continue analysis, update identification catalogue and distribute. Complete annual update of databases and upload previous years data onto GWA site. Preparation of journal papers. All field preparation completed and boat outfitted for season, with photo equipment, GIS systems and computers, biopsy and tagging rifle and supplies, remote and boat based hydrophones, prey/fecal sampling nets and supplies.

FY18, 2nd quarter (May 1, 2018 - July 31, 2018)
Initiate field season in early May with intensive field work lasting until early July. Deploy hydrophones. Vessel resupplied at 10-14 day intervals. Trips led by either Craig Matkin or Dan Olsen. Daily outreach through Facebook. In July the R/V Natoa will be on standby in Kenai Fjords to respond to unique encounters, however no scheduled trips.

FY18, 3rd quarter (August 1, 2018 - October 31, 2018)
Intensive fieldwork begins again in late August and continues in September-early October. Redeploy hydrophones. All field equipment will be cleaned and stored and data analysis will begin by mid-October. Samples will be sent to appropriate laboratories.

FY18, 4th quarter (November 1, 2018 - January 31, 2019)
Analysis continues along with preparation for annual GWA meeting in November and for Alaska Marine Science Symposium in January. Frame by frame photoidentification completed. Begin annual report, summarize annual results including outreach. Work on journal papers.

FY 2019 (Year 8)

FY19, 1st quarter (February 1, 2019 - April 30, 2019)
Complete annual report. Continue analysis, update identification catalogue and distribute. Complete annual update of databases and upload previous years data onto GWA site. Preparation of journal papers. All field preparation completed and boat outfitted for season, with photo equipment, GIS systems and computers, biopsy and tagging rifle and supplies, remote and boat based hydrophones, prey/fecal sampling nets and supplies.

FY19, 2nd quarter (May 1, 2019 - July 31, 2019)
Initiate field season in early May with intensive field work lasting until early July. Redeploy hydrophones Vessel resupplied at 10-14 day intervals. Trips led by either Craig Matkin or Dan Olsen. Daily outreach through Facebook. In July the R/V Natoa will be on standy in Kenai Fjords to respond to unique encounters, however no scheduled trips.

FY19, 3rd quarter (August 1, 2019 - October 31, 2019)
Intensive fieldwork begins again in late August and continues in September-early October. All field equipment will be cleaned and stored and data analysis will begin by mid-October. Redeploy hydrophones. Samples will be sent to appropriate laboratories.

FY19, 4th quarter (November 1, 2019 - January 31, 2020)
Analysis continues along with preparation for annual GWA meeting in November and for Alaska Marine Science Symposium in January. Frame by frame photoidentification completed. Begin annual report, summarize annual results including outreach. Work on journal papers.

FY 2020 (Year 9)

FY20, 1st quarter (February 1, 2020 - April 30, 2020)
Complete annual report. Continue analysis, update identification catalogue and distribute. Complete annual update of databases and upload previous years data onto the GWA site. Preparation of journal papers. All field preparation completed and boat outfitted for season, with photo equipment, GIS systems and computers, biopsy and tagging rifle and supplies, remote and boat based hydrophones, prey/fecal sampling nets and supplies.

FY20, 2nd quarter (May 1, 2020 - July 31, 2020)
Initiate field season in early May with intensive field work lasting until early July. Redeploy hydrophones. Vessel resupplied at 10-14 day intervals. Trips led by either Craig Matkin or Dan Olsen. Daily outreach through Facebook. In July the R/V Natoa

will be on standy in Kenai Fjords to respond to unique encounters, however no scheduled trips.

FY20, 3rd quarter (August 1, 2020 - October 31, 2020)
Intensive fieldwork begins again in late August and continues in September-early October. Redeploy hydrophones All field equipment will be cleaned and stored and data analysis will begin by mid-October. Samples will be sent to appropriate laboratories.

FY20, 4th quarter (November 1, 2020 - January 31, 2021)
Analysis continues along with preparation for annual GWA meeting in November and for Alaska Marine Science Symposium in January. Frame by frame photoidentification completed. Begin annual report, summarize annual results including outreach. Work on journal papers. Preparation of budget proposal for next five year (FY22-FY26 period).

FY 2021 (Year 10)

FY21, 1st quarter (February 1, 2021 - April 30, 2021)
Complete annual report. Continue analysis, update identification catalogue and distribute. Preparation of proposal for next 5-year funding period (FY22-FY26 period). Complete annual update of databases and upload previous years' data onto GWA site. Preparation of journal papers. All field preparation completed and boat outfitted for season, with photo equipment, GIS systems and computers, biopsy and tagging rifle and supplies, remote and boat based hydrophones, prey/fecal sampling nets and supplies.

FY21, 2nd quarter (May 1, 2021 - July 31, 2021)
Initiate field season in early May with intensive field work lasting until early July. Redeploy hydrophones. Vessel resupplied at 10-14 day intervals. Trips led by either Craig Matkin or Dan Olsen. Daily outreach through Facebook. In July the R/V Natoa will be on standy in Kenai Fjords to respond to unique encounters, however no scheduled trips.

FY21, 3rd quarter (August 1, 2021 - October 31, 2021)
Intensive fieldwork begins again in late August and continues in September-early October. Final pickup of hydrophones. All field equipment will be cleaned and stored and data analysis will begin by mid-October. Samples will be sent to appropriate laboratories.

FY21, 4th quarter (November 1, 2021 - January 31, 2022)
Analysis continues along with preparation for annual GWA meeting in November and for Alaska Marine Science Symposium in January. Frame by frame photoidentification completed. Begin annual report, summarize annual results including outreach. Work on journal papers.

FY 2022 (Year 11)

FY22, 1st quarter (February 1, 2022 - April 30, 2022)
Preparation of final report/publications for second 5-year funding period. Final database/catalogue update and upload for second 5-year funding period. If a third 5-year period is approved, then preparation of vessel/equipment for fieldwork.

7. Budget

Budget forms (Attached)

Completed budget forms are attached.

Sources of additional funding

The NMFS/Northwest Fisheries Science Center/Environmental Contaminant Lab will provide $8,000 annually in analysis and consulting.

The North Gulf Oceanic Society will provide approximately 12,000 in donated vessel time and personnel time to extend the field season.

The Norcross Foundation and other small donors will contribute approximately $5,000 annually to provide Equipment for the project.

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Parsons, K., 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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PROJECT DATA ONLINE

Publicly available data from this project are available online at the following link:
http://portal.aoos.org/gulf-of-alaska.php#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project/files

CRAIG O. MATKIN, B.A., M.S.
(907) 299-0677 (cell) (907) 235-6590 (office)
3430 Main St. Suite B1 Homer, Alaska 99603 comatkin@gmail.com
www.whalesalaska.org

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

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, UA, Kenai Peninsula College, Kachemak Bay Campus, Homer, Alaska (1999-present)

Teaching of marine mammal classes and guest lectures on marine topics

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.

RELATED EXPERIENCE
Mr. Matkin has conducted research on marine mammals in southern Alaska since 1977 when he initiated photo-identification work of killer whales and humpback whales in Prince William Sound in. Since 1982 he has worked as executive director of the North Gulf Oceanic Society, acted as principal investigator on numerous contracts from the National Marine Mammal Laboratory, National Marine Fisheries Service; the U.S. Fish and Wildlife Service; Sea Grant Marine Advisory Program; Alaska Council on Science and Technology, U.S. Marine Mammal Commission; Hubbs Sea World Research Institute, the *Exxon Valdez* Trustee Council, the North Pacific Universities Marine Mammal Research Consortium, and the Alaska Sea Life Center. He has directed the NGOS long-term photo-identification project examining killer whale population dynamics in Alaska since 1984. He has conducted population/distribution/genetics research on humpback whales from southeast Alaska to the Aleutian Islands and western Alaska, most recently as a regional supervisor for the SPLASH program. He has specialized in biopsy sampling of various cetaceans including killer whales, humpback whales, fin whales and sperm whales. Using the biopsy sampling technique he has investigated population genetics and environmental contaminant levels in killer whales and humpback whales, and most recently, feeding habits using stable isotopes and lipid/fatty acids. With collaborators he has developed small telemetry packages for remote attachment to killer whales and other cetaceans and applied tags and used ARGOS satellite systems to track killer whales and monitor diving behavior. He has supervised a killer whale research program that extends from southeastern Alaska to the Eastern Aleutians. For the past 29 years (1989-present) contracted by the and National Marine Fisheries Service he has directed work assessing the long-term impacts of the *Exxon Valdez* Oil Spill on killer whales under the aegis of the *Exxon Valdez* Oil Spill Trustee Council. Recently he reviewed the status of the Cook Inlet beluga whale and was a member of the Cook Inlet Beluga Recovery Team organized by the National Marine Fisheries Service.

Selected recent publications:

Saulitis, E., L.A Holmes, **C. Matkin,** K. Wynn, D. Ellifrit, and C. St. Amand. 2015. Bigg's killer whale (*Orcinus Orca*) predation on subadult humpback whales (*Megaptera novaeangliae)* in Lower Cook Inlet and Kodiak, Alaska. 2015. Aquatic Mammals 41(3), 341-344, Doi: 10.1578/AM.41.3.2015.341.

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Terlink, S.F., O. von Ziegesar, J.M. Straley, T.J. Quinn II**, C.O. Matkin,** and E.L. Saulitis. 2014. First time series of estimated humpback whale (*Megaptera novaeangliae*) abundance in Prince William Sound. Environ. Ecol. Stat. Doi: 10.1007/s10651-014-0301-8.

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Matkin, C.O., J.W. Durban, E.L. Saulitis, R. D. Andrews, J.M. Straley, D.R. Matkin, and G.M. Ellis. 2012. Contrasting abundance and residency patterns of two sympatric populations of transient killer whales (*Orcinus orca*) in the northern Gulf of Alaska. Fish. Bull. 110:143–155.

Collaborators (not previously listed as coauthors):

Russ Andrews, Alaska Sea Life Center, Seward, Alaska; Manolo Casellote, NGOS/NMML; Rob Campbell, PWS Science Center; Dave Herman, Northwest Fisheries Science Center Seattle, WA; John Moran, NOAA, Auke Bay Lab, Juneau, Alaska; Gina Ylitalo, Northwest Fisheries Science Center, Seattle, WA

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$41.0	$41.0	$42.2	$42.2	$42.2	$208.5	
Travel	$3.2	$3.2	$3.5	$3.5	$3.5	$16.8	
Contractual	$49.5	$50.5	$52.3	$52.3	$54.0	$258.6	
Commodities	$33.8	$31.6	$20.6	$19.1	$16.7	$121.6	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*10%*)	$ 13	$ 13	$ 12	$ 12	$ 12	$ 61	
SUBTOTAL	$140.2	$138.8	$130.3	$128.7	$128.0	$666.0	
General Administration (9% of subtotal)	$12.6	$12.5	$11.7	$11.6	$11.5	$59.9	N/A
PROJECT TOTAL	$152.8	$151.3	$142.1	$140.3	$139.5	$725.9	
Other Resources (Cost Share Funds)	$25.0	$25.0	$25.0	$25.0	$25.0	$125.0	

COMMENTS:

FY17-21

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

NON-TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Craig Matkin	P.I. Field Biologist	3.0	6.0		18.0
Field Assistant	Field Assistant/Data analysis	2.5	3.8		9.5
Dan Olsen	Field Biologist/Data analysis	3.0	4.5		13.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	14.3	0.0	
				Personnel Total	$41.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting	1.1	1	3	0.2	1.6
Attend annual Alaska Marine Science Symposium	1.1	1	3	0.2	1.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.2

FY17

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel lease (R/V Natoa--50 days @ $600/day)	30.0
NWFSC Environmental Contaminant Lab Analytical Fees	5.0
GIS/Statistical Analysis	4.0
Photidentification Catalogue	6.5
Data input/Analysis	4.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$49.5

Commodities Costs: Description	Commodities Sum
Acoustic recorders and moorings	21.6
Field Food ($60/day for 50 days)	3.0
Fuel ($120/day for 50 days)	5.0
Misc electronic, photo supplies (memmory cards, hard drives, etc)	1.2
Field Communication, Tracking, Shipping, and Misc supplies	1.0
Camera body	2.0
Commodities Total	$33.8

FY17

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
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
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY17

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Craig Matkin	P.I. Field Biologist	3.0	6.0		18.0
Field Assistant	Field Assistant/Data analysis	2.5	3.8		9.5
Dan Olsen	Field Biologist/Data analysis	3.0	4.5		13.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	14.3	0.0	
				Personnel Total	$41.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting	1.1	1	3	0.2	1.6
Attend annual Alaska Marine Science Symposium	1.1	1	3	0.2	1.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.2

FY18

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel Lease (R.V. Natoa/ 50 days @600/day)	30.0
NWFSC Environmental Contaminant Lab, Analytical Fees	5.0
GIS/Statistical Analysis	4.0
Photoidentification/Catalogue	6.5
Data input/Analysis	5.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$50.5

Commodities Costs: Description	Commodities Sum
Time Depth tags	3.2
Acoustic recorders and moorings	17.2
Field Food ($60/day for 50 days)	3.0
Fuel ($120/day for 50 days)	6.0
Misc electronic, photo supplies (memmory cards, hard drives, etc)	1.2
Field Communication, Tracking, Shipping, and Misc supplies	1.0
Commodities Total	$31.6

FY18

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B 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
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY18

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
Craig Matkin	P.I. Field Biologist	3.0	6.0		18.0
Field Assistant	Field Assistant/Data analysis	2.5	3.9		9.8
Dan Olsen	Field Biologist/Data analysis	3.0	4.8		14.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	14.7	0.0	
				Personnel Total	$42.2

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					
Attend annual Gulf Watch PI meeting	1.1	1	4	0.2	1.7
Attend annual Alaska Marine Science Symposium	1.1	1	4	0.2	1.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.5

FY19

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel Lease (R.V. Natoa/ 50 days @650/day)	32.5
NWFSC Environmental Contaminant Lab, Analytical Fees	5.0
GIS/Statistical Analysis	4.0
Photoidentification/Catalogue	6.8
Data input/Acoustic Analysis	4.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$52.3

Commodities Costs: Description	Commodities Sum
Time Depth tags	3.1
Acoustic recorders and moorings	3.3
Field Food ($60/day for 50 days)	3.0
Fuel ($140/day for 50 days)	7.0
Misc electronic, photo supplies (memmory cards, hard drives, etc)	1.2
Field Communication, Tracking, Shipping, and Misc supplies	1.0
Camera body	2.0
Commodities Total	$20.6

FY19

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B 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
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY19

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Craig Matkin	P.I. Field Biologist	3.0	6.0		18.0
Field Assistant	Field Assistant/Data analysis	2.5	3.9		9.8
Dan Olsen	Field Biologist/Data analysis	3.0	4.8		14.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	14.7	0.0	
				Personnel Total	$42.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting	1.1	1	4	0.2	1.7
Attend annual Alaska Marine Science Symposium	1.1	1	4	0.2	1.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.5

FY20

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel Lease (R.V. Natoa/ 50 days @650/day)	32.5
NWFSC Environmental Contaminant Lab, Analytical Fees	5.0
GIS/Statistical Analysis	4.0
Photoidentification/Catalogue	6.8
Data input/ Acoustic Analysis	4.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$52.3

Commodities Costs: Description	Commodities Sum
Time Depth tags	3.1
Acoustic recorders and moorings	1.8
Field Food ($60/day for 50 days)	3.0
Fuel ($140/day for 50 days)	7.0
Misc electronic, photo supplies (memmory cards, hard drives, etc)	1.2
Field Communication, Tracking, Shipping, and Misc supplies	1.0
Camera body	2.0
Commodities Total	$19.1

FY20

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
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
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY20

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Craig Matkin	P.I. Field Biologist	3.0	6.0		18.0
Field Assistant	Field Assistant/Data analysis	2.5	3.9		9.8
Dan Olsen	Field Biologist/Data analysis	3.0	4.8		14.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	14.7	0.0	
				Personnel Total	$42.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Attend annual Gulf Watch PI meeting	1.1	1	4	0.2	1.7
Attend annual Alaska Marine Science Symposium	1.1	1	4	0.2	1.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.5

FY21

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Vessel Lease (R.V. Natoa/ 50 days @650/day)	32.5
NWFSC Environmental Contaminant Lab, Analytical Fees	5.0
GIS/Statistical Analysis	4.0
Photoidentification/Catalogue	7.0
Data input/Analysis	3.0
Acoustic analysis	2.5
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$54.0

Commodities Costs: Description	Commodities Sum
Time Depth tags	3.3
Acoustic recorders and moorings	1.2
Field Food ($60/day for 50 days)	3.0
Fuel ($140/day for 50 days)	7.0
Misc electronic, photo supplies (memmory cards, hard drives, etc)	1.2
Field Communication, Tracking, Shipping, and Misc supplies	1.0
Commodities Total	$16.7

FY21

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B 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
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY21

Project Title: Long-term killer whale monitoring in PWS & Kenai Fjords
Primary Investigator: Craig Matkin

FORM 3B
EQUIPMENT DETAIL