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-H. Nearshore Ecosystems in the Gulf of Alaska

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 Nearshore project.

EVOSTC Funding Requested *(including 9% GA)*

FY17	FY18	FY19	FY20	FY21	TOTAL
$401,900	$452,700	$411,400	$402,200	$402,800	$2,071,000

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$410,000	$410,000	$410,000	$392,000	$392,000	$2,014,000

Science Panel comment: *The Panel has no project specific comments.*

PI Response:

- The proposal was not revised.

Sincerely,

Mandy Lindeberg
Gulf Watch Alaska Program Lead designate

Attachment: Gulf Watch Alaska: Nearshore Component Project Proposal: 17120114-H—Nearshore Ecosystems in the Gulf of Alaska

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

Project Title

Gulf Watch Alaska: Nearshore Component Project:

17120114-H—Nearshore ecosystems in the Gulf of Alaska

Primary Investigator(s) and Affiliation(s)

Heather Coletti, National Park Service

Dan Esler, U.S. Geological Survey, Alaska Science Center

Brenda Konar, University of Alaska Fairbanks

Katrin Iken, University of Alaska Fairbanks

Kim Kloecker, U.S. Geological Survey, Alaska Science Center

Dan Monson, U.S. Geological Survey, Alaska Science Center

Ben Weitzman, U.S. Geological Survey, Alaska Science Center

Date Proposal Submitted

24 August 2016

Project Abstract

Nearshore monitoring in the Gulf of Alaska (GOA) provides ongoing evaluation of the status and trend of more than 200 species, including many of those recovering from the 1989 *Exxon Valdez* oil spill (EVOS). The monitoring design includes spatial, temporal and ecological features that support inference regarding drivers of change through testing of alternative hypotheses. Examples of the application of the monitoring design include assessment of change in sea otter populations related to EVOS recovery and density dependent factors; and assessment of the relative roles of static versus dynamic drivers in structuring benthic communities. Continued monitoring will allow for a better understanding of variation in the nearshore ecosystems across the GOA and a more thorough evaluation of the status of spill injured resources. This information will be critical for anticipating and responding to ongoing and future perturbations in the region, as well as providing for global contrast.

EVOSTC Funding Requested (must include 9% GA)

FY17	FY18	FY19	FY20	FY21	TOTAL
$401.9	$452.7	$411.4	$402.2	$402.8	$2,071.0

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
$410.0	$410.0	$410.0	$392.0	$392.0	$2,014.0

1. Executive Summary

Nearshore marine ecosystems face significant challenges at global and regional scales, with threats arising from both the adjacent lands and oceans. An example of such threats was the 1989 grounding of the T/V *Exxon Valdez* in Prince William Sound (PWS). An important lesson arising from this event, as well as similar events around the world, was that understanding the structure and function of the ecosystem and the composition and abundance of species is essential when responding to and managing present and anticipated threats.

The nearshore is broadly recognized as highly susceptible and sensitive to a variety of natural and human disturbances on a variety of temporal and spatial scales (reviewed in Valiela 2006, Bennett et al. 2006, Dean and Bodkin 2006). For example, observed changes in nearshore systems have been attributed to such diverse causes as global climate change (e.g., Barry et al. 1995, Sagarin et al. 1999, Hawkins et al. 2008, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012), earthquakes (e.g., Baxter 1971, Noda et al., 2015), oil spills (e.g., Peterson 2001, Peterson et al. 2003, Bodkin et al. 2014), human disturbance and removals (e.g., Schiel and Taylor 1999, Crain et al. 2009, Fenberg and Roy 2012), and influences of invasive species (e.g., Jamieson et al. 1998, O'Connor 2014). Nearshore systems are especially good indicators of change because organisms in the nearshore are relatively sedentary, accessible, and manipulable (e.g., Dayton 1971, Sousa 1979, Peterson 1993, Lewis 1996). In contrast to other marine habitats, there is a comparatively thorough understanding of mechanistic links between species and their physical environment (e.g., Connell 1972, Paine 1974, 1977, Estes et al. 1998, Menge and Menge 2013, Menge et al. 2015) that facilitates understanding causes for change. Many of the organisms in the nearshore are sessile or have relatively limited home ranges, providing a geographic link to sources of change. Nearshore habitats will likely have detectable levels of change in the future, and we will continue to be able to detect relatively localized sources of change, tease apart human induced from naturally induced changes, and, provide suggestions for management actions to reduce human induced impacts.

The Nearshore Component of the Gulf Watch Alaska (GWA) long-term monitoring project investigates and monitors the nearshore environment of the greater *Exxon Valdez* oil spill (EVOS) area, with focus on selected elements of the nearshore food web. Our overarching goal is to understand drivers of variation in the Gulf of Alaska (GOA) nearshore ecosystem. The foundational hypotheses of the Nearshore Project include: (1) What are the spatial and temporal scales over which change in nearshore ecosystems is observed? (2) Are observed changes related to broad-scale environmental variation, or local perturbations? (3) Does the magnitude and timing of changes in nearshore ecosystems correspond to those measured in pelagic ecosystems? The design features of the nearshore monitoring program include a rigorous site selection process that allows statistical inference over various spatial scales (e.g., GOA and regions within the GOA) as well as the capacity to evaluate potential impacts from more localized sources, and especially those resulting from human activities, including lingering effects of EVOS. In addition to detecting change at various spatial scales, design features incorporate both static (e.g., substrate, exposure, bathymetry) and dynamic (e.g., variation in oceanographic conditions, productivity, and predation) drivers as potential mechanisms responsible for change. More than 200 species dependent on nearshore habitats, many with well recognized ecological roles in the nearshore food web, are monitored annually within four regional blocks in the GOA. Evaluation of change in those species over time in relation to well defined static and dynamic drivers will allow accurate and defensible measures of change and support management and policy needs addressing nearshore resources both within the GOA and globally.

Harnessing the power of long-term datasets, the first years of the GWA Nearshore Component, were combined with preceding time series, totaling over 50 years. Building on this legacy has resulted in many important insights and management-relevant findings. As an example, data on sea otter population dynamics have revealed that patterns of changes in abundance differ among regions. Changes in sea otters are driven largely by local conditions, although drivers may vary (e.g., recovery from the EVOS in PWS, recolonization following fur harvest in Katmai and Kachemak Bay, and prey availability in Kenai Fjords). As another example, data on rocky intertidal communities indicate that static physical attributes do not differ markedly across regions, neither do intertidal biota; this indicates that our design is well-suited to document temporal variation and whether it is synchronous across regions. Many additional examples are provided by the reports and publications listed in Section 2 of this proposal.

Our goals for the second phase of the long-term nearshore monitoring program are to continue to document the status of the nearshore system by continuing time series, some of which date more than five decades, and many that were initiated after the 1989 spill. This information will be synthesized with other components of GWA in order to identify potential causes of change, including those related to EVOS and climate change. We will continue to use existing and new information from this second phase to address our overarching hypotheses in communities across the GOA and to communicate those findings to the public and resource managers.

2. Relevance to the Invitation for Proposals

This project proposal addresses the EVOS Trustee Council's (EVOSTC's) request for long-term monitoring plans for the nearshore benthic ecosystem directly impacted by EVOS. It is a continuation of the first 5-year phase of the GWA program, which is built on previous projects: 15120114-R Nearshore Benthic Systems in the Gulf of Alaska and 12120114-L, Ecological Trends in Kachemak Bay.

A restoration and ecosystem monitoring plan for the nearshore marine ecosystems affected by the EVOS in the GOA (Dean and Bodkin 2006) recognized that (1) restoration efforts for resources injured by the spill will benefit from information on the status and trends of those resources on a variety of spatial scales within the Gulf, and (2) changes independent of the oil spill are likely to occur in the GOA during the 21st century, and are likely to result from a number of different agents (e.g. normal environmental stochasticity, global climate change, and shoreline development and associated inputs of pollutants). Further, to restore injured resources it is essential to separate EVOS-related effects from other sources of change. The long-term GWA monitoring program initiated in 2011 supports the accomplishment of these goals.

We anticipate that global climate change may result in a gradual transition in the nearshore community that occurs over decades and has impacts over the entire GOA. Conversely, it is possible that climate change will lead to tipping points in the community where sudden changes or collapses can be observed over large spatial scales (Alley et al. 2003, Lenton et al. 2008). In contrast, impacts from shoreline development or other human activities will likely be more episodic and localized. Thus, a suitable monitoring program needs to be designed to detect ecological impacts on these various spatial and temporal scales. To this end, the conceptual framework for monitoring in the nearshore that was implemented over the last decade was designed with the following elements:

1. Synoptic sampling of specified physical parameters (e.g., temperature and salinity) over the entire GOA. This synoptic nearshore sampling is complemented by offshore measurements in the GOA through the Environmental Drivers component of the GWA program.

2. Sampling of a variety of specified biological parameters (e.g. abundance and growth of intertidal organisms, abundance of selected birds and marine mammals) within select areas spread throughout the GOA. Monitoring includes many resources that were injured by the EVOS, allowing perspective on natural variation relative to oil-spill injury.
3. The hierarchical sampling design allows us to test patterns on various spatial scales. For example, rocky intertidal communities are sampled with replicates along various tidal strata at multiple sites within a region, and across four regions (western PWS [WPWS], Katmai National Park [KATM], Kenai Fjords National Park [KEFJ], and Kachemak Bay [KBAY]).
4. The components of the design are centered around the nearshore food web, where primary productivity originates largely in the kelps, other macroalgae and seagrass, is transferred to benthic invertebrates, and then to higher trophic levels (Figure 1).
5. Coordination with externally-funded, short-term (2-5 years) studies aimed at identifying important processes regulating or causing changes within a given system or subsystem. For example, a National Park Service (NPS) funded study examining the reliance of sea otters on a variable prey resource, *Mytilus trossulus*, and how that variability may affect sea otter population status.

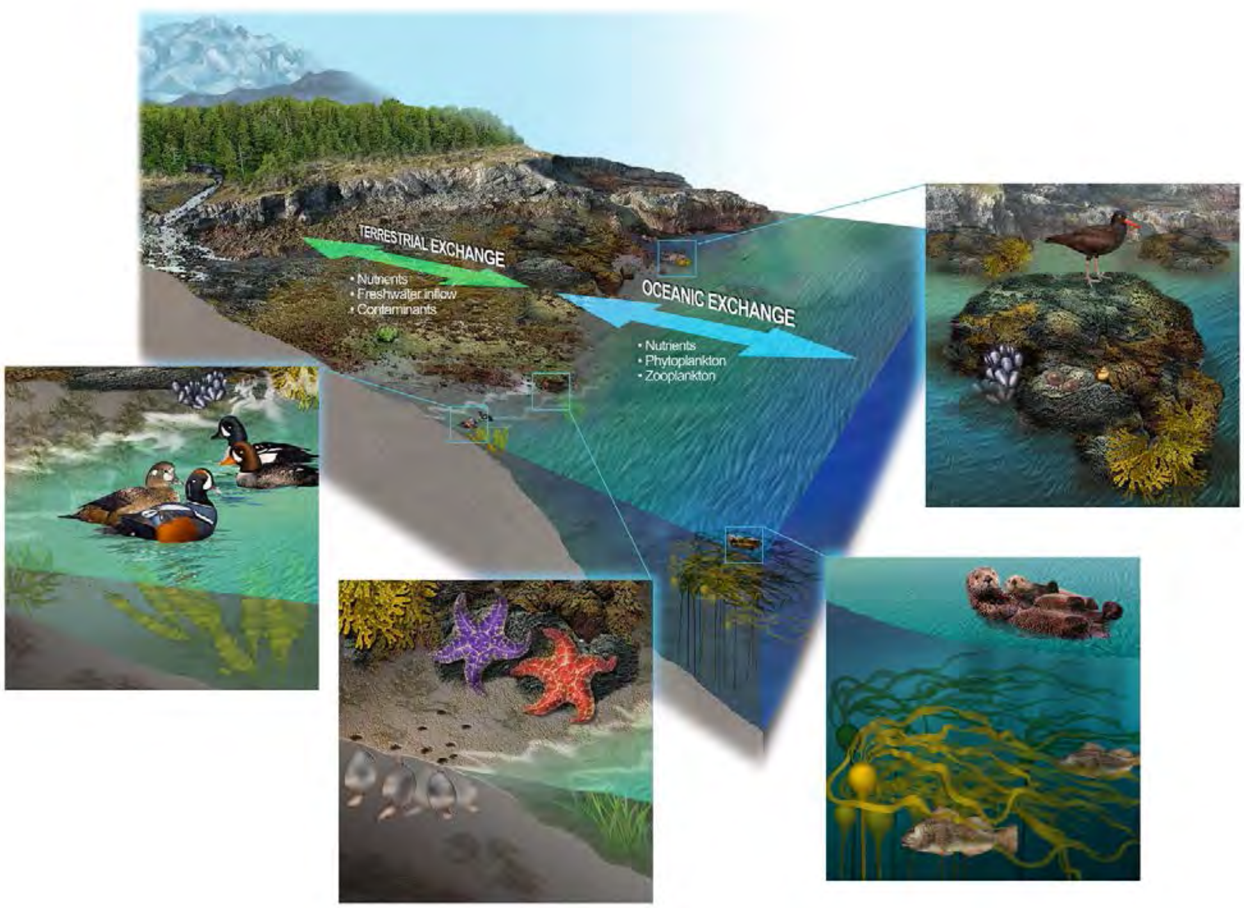

Figure 1. Conceptual model of the nearshore food web with terrestrial and oceanic influences illustrated. In this model, sea otters, black oystercatchers, sea ducks and sea stars act as the top level consumers in a system where primary productivity originates mostly from the macroalgae and sea grass and moves through to the benthic invertebrates to the top level consumers.

Potential Benefits and Recipients of GWA Nearshore Project: We expect our existing monitoring design will continue to have the capacity to track the status and trend of select EVOS injured resources (Monson et al. 2011, Ballachey et al. 2014a, b, Bodkin et al. 2014, Esler 2013, Bowen et al. 2015). We also expect that our monitoring will continue to contribute to detection of differences in status and trend among nearshore populations, and to differentiate potential causes for those differences (Miles et al. 2012, Newsome et al. 2015, Tinker 2015, von Biela et al. in press, Coletti et al. in review). Similarly, our monitoring of static and dynamic drivers is helping to elucidate what controls biological communities in the GOA (Konar et al. submitted). The work cited above demonstrates the value of the nearshore monitoring program to date and exemplifies, in the peer reviewed literature, the contributions to restoration, conservation, and management of nearshore resources in the GOA and across the north Pacific.

The nearshore program also continues to provide valuable data and recommendations to management of nearshore resources in near real time. For example, monitoring data on sea otter abundance and diet has been transmitted to the Department of Interior, U.S. Fish and Wildlife Service (USFWS) related to the status and trend of the southwest Alaska stock of sea otters listed under the Endangered Species Act. The nearshore program has provided distribution and abundance data on nearshore species to state and federal resource managers responding to environmental threats from contaminant spills and potential resource extraction proposals. In several instances, the nearshore program provided some of the only recent reference points available in the region when environmental perturbations seemed imminent. The KATM coast has experienced at least two vessel groundings since the implementation in 2006 of long-term monitoring, both of which our data was used as baseline prior to contamination. In 2009, the KATM and Lake Clark coastlines were threatened by a potential large oil spill from the Drift River terminal during the eruption of Mt. Redoubt. Nearshore monitoring data was used to highlight particularly sensitive areas and help plan spill response. In 2014 and 2015 we adopted additional sampling protocols to contribute to the understanding on the spatial and temporal magnitude of the west coast sea star decline. Below we provide two examples of additional monitoring results with broad scale relevance to resource managers, policy makers and the public.

Since 2006 we have documented Gulf wide declines in mussel (*Mytilus trossulus*) abundance (Figure 2). These declines, and subsequent recovery in some regions, have varied in both extent and magnitude. This variation in a prey resource has likely impacted top level predators, such as sea otters and shorebirds. Long-term impacts of this decline are still unknown. However, complementary data indicate that recovery of mussels is likely driven by local factors affecting survival and not exclusively recruitment. Associated high-intensity studies are proposed to improve our understanding of causes of population change in this keystone intertidal species.

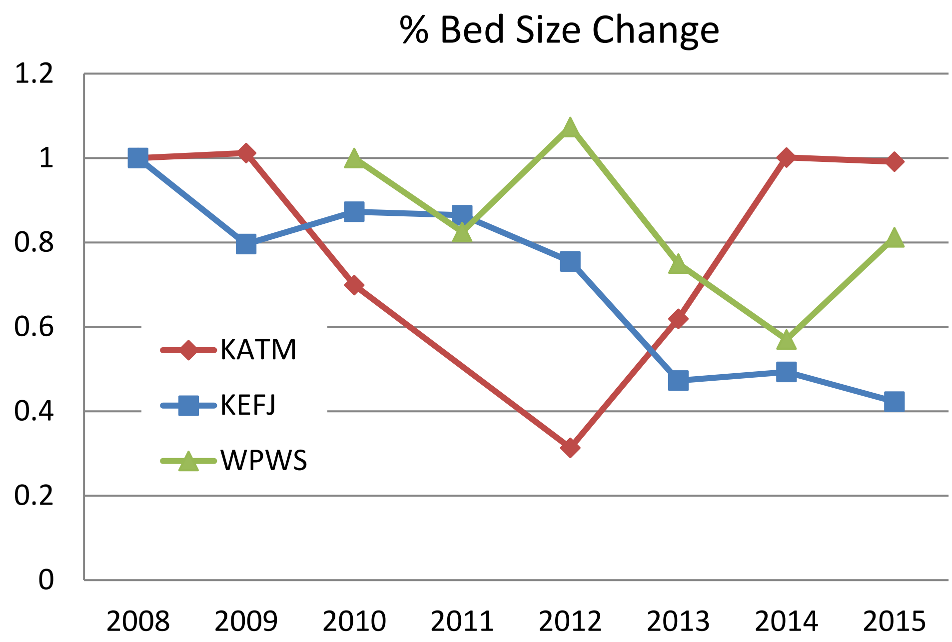

Figure 2. Percent change in mussel bed from size when sampling was initiated. Error bars were omitted for clarity of divergent trends.

We have documented anomalous events in collaboration with the pelagic component such as the sea bird die-off in 2015. We observed large increases in common murres during the summer of 2015 relative to previous years (Figures 3 and 4). This increase was particularly evident in KATM where there are no murre colonies and densities of murres are generally low. This increase in numbers is most likely a function of changed distribution. In poor nutritional conditions, these long-lived birds will readily defer breeding, therefore they are not tied to colonies and thus ended up nearshore, likely searching for food. KEFJ does have common murre colonies, however we still have evidence of an increase of these birds moving into coastal areas not associated with colonies. Our documentation of unusual murre distributions correspond to observations of large die-offs of murres throughout the north Pacific in winter 2015-2016. We speculate that high water temperature may have disrupted prey abundance or availability, leading to changes in murre distribution, behavior, condition, and mortality rates. Our results contribute to observations across GWA components that demonstrate that 2015 was an anomalous year.

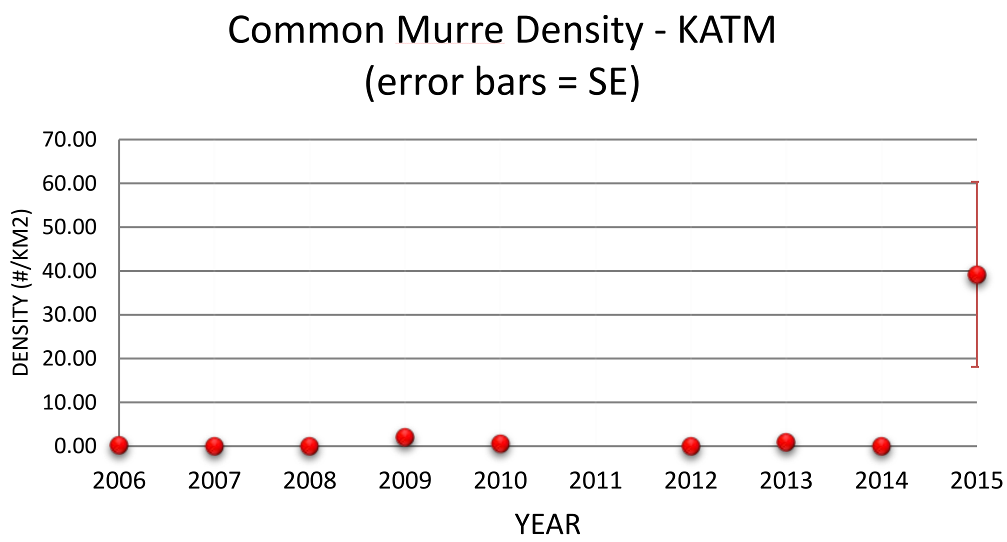

Figure 3. Common murre density estimates in KATM from 2006-2015. 2011 was not surveyed.

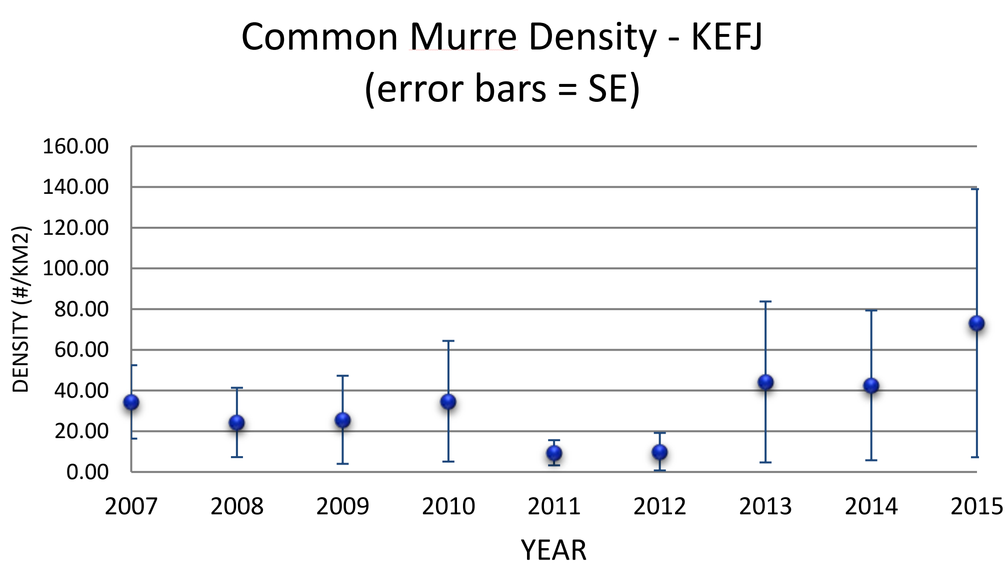

Figure 4. Common murre density estimates in KEFJ from 2007-2015.

The nearshore program continues to benefit from the spatial and ecological linkages explicit in the monitoring design. We anticipate, over time, our understanding of those linkages will increase and allow us to provide increasingly relevant and valuable data and insight.

3. Project Personnel

Overall project management will be the responsibility of H. Coletti, D. Esler, B. Konar and K. Iken. CVs for each of these principal (PIs) are included at the end of this proposal, including full contact information.

We anticipate that T. Dean, J. Bodkin, B. Ballachey, D. Monson, K. Kloecker, G. Esslinger and B. Weitzman with support from M. Lindeberg, A. Miller and additional U.S. Geological Survey (USGS) and NPS scientific staff, will continue the data collection and sampling (all components) in PWS, Kenai and Katmai, and that B. Konar and K. Iken will have responsibility for the Kachemak Bay site, with support from A. Doroff for sea otter foraging observations and additional support from the USFWS for sea otter surveys and carcass collections. This team of scientists has an extensive background of research efforts in coastal marine areas of Alaska. H. Coletti has worked in the GOA since 2000, and has been dedicated to the NPS nearshore monitoring program since 2006. D. Esler leads the Nearshore Marine Ecosystem Research Program at USGS, Alaska Science Center, and has decades of experience working in coastal systems of the north Pacific, including extensive work addressing effects of EVOS. B. Konar and K. Iken both have extensive experience working in various coastal areas of Alaska, and are currently conducting the nearshore monitoring in Kachemak Bay. They both have been PIs on previous EVOS studies and the Census of Marine Life with ecological work in Kachemak Bay. B. Ballachey and T. Dean have both been PIs on previous EVOS studies, with a primary focus on PWS studies, since 1989, and currently are conducting the monitoring of nearshore areas in PWS. J. Bodkin and T. Dean have been central in development and implementation of both the NPS and the USGS/EVOS nearshore monitoring programs. D. Monson of the USGS joined the project in the summer of 2012, and brings over two decades of experience working in PWS and other areas of coastal Alaska. B. Weitzman joined the project in 2012, with seven years of working and managing field efforts in the GOA, and has worked in all four regions to measure and ensure consistency within GWA data streams. A. Miller of the NPS is in charge of the long-term monitoring program in the Kenai and Katmai parks. We anticipate a team approach to the overall field work effort, with shared personnel across areas wherever possible, to ensure consistency of data collection and enhance our understanding of comparisons and contrasts across areas. We will attend an annual meeting of the larger group of scientists involved in the overall long-term monitoring; but also expect that we will continue to work closely together as a sub-group and to meet less formally as required throughout each year.

4. Project Design

The monitoring protocols implemented in 2012 at the onset of the GWA program are based on past work of the PIs and collaborators, allowing the continuation of valuable time series information about critical nearshore habitats in the GOA. Sampling protocols originally developed for the nearshore environment that included sea otters, nearshore marine birds, intertidal kelps, seagrasses and invertebrates in PWS in 2003 were adopted by the NPS's Vital Signs Long-Term Monitoring Plan, and implemented in KATM in 2006 and in KEFJ in 2007. In 2010, EVOS Project 10100750 (J. Bodkin and T. Dean, PIs) was funded to implement the long-term nearshore monitoring plan in WPWS. Nearshore monitoring of rocky intertidal and seagrass habitats in KBAY was initiated in 2003 through the Census of Marine Life program (K. Iken and B. Konar, PIs). In 2011, the GWA program was initiated to continue and expand these long-term nearshore monitoring programs, in combination with studies of pelagic systems and environmental drivers; the work described and proposed herein is a continuation of the nearshore benthic monitoring effort of the GWA project.

We propose to continue long-term restoration and ecosystem monitoring program at four locations across the GOA. Much of the effort to be funded by the EVOSTC program is concentrated in WPWS, but we will integrate with existing monitoring efforts on the Katmai coast and the Kenai Peninsula to cost-effectively monitor other areas of the spill-affected region and provide better information and reference for recovery and restoration of injured resources. The sampling design follows that initially put forward in the first GWA phase in 2010, and consists of four primary sampling locations in nearshore habitats in the central GOA region: KATM, WPWS, KEFJ and KBAY. We propose to continue sampling these regions on an annual basis through 2021. Monitoring includes physical measurements, and abundance estimates of kelps, other macroalgae, seagrasses, marine invertebrates, birds, and mammals, with a focus on species that were injured as a result of the EVOS (EVOSTC 2006). In addition to taxon-specific resources, monitoring includes recognized important ecological relations that include predator-prey interactions, measures of nearshore ecosystem productivity, and stable isotope and contaminant analyses. The nearshore monitoring program will also continue to utilize physical data collected in PWS, along the GOA shelf and in Cook Inlet, by the Environmental Drivers component of the proposed long-term monitoring program. Contrasts between the Nearshore and Pelagic components of Gulf Watch will facilitate understanding how various drivers influence these two important food webs.

A. Objectives

1. To determine status and detect patterns of change in a suite of nearshore species and communities.
2. Identify temporal and spatial extent of observed changes.
3. Identify potential causes of change in biological communities, including those related to climate change.
4. Communicate these to the public and to resource managers to preserve nearshore resources.
5. Continue restoration monitoring in the nearshore in order to evaluate the current status of injured resources in oiled areas and identify factors potentially affecting present and future trends in population status.

B. Procedural and Scientific Method

The *Nearshore Restoration and Ecosystem Monitoring Program* (Dean and Bodkin 2006) and the *National Park Service SWAN Nearshore Monitoring Program* (Dean et al. 2014) include protocols that provide justification, background, objectives, goals, an overview of the monitoring and sample design, the fundamental analytical approach, and description of operational requirements. The Protocol Narrative for Nearshore Monitoring in the Gulf of Alaska (Dean et al.2014) is located at https://workspace.aoos.org/group/4601/project/4650/folder/26475/protocol-narrative and is summarized briefly below.

Standard operating procedures (SOPs) for all data collection have been fully developed and reviewed as part of the preparation and implementation of nearshore monitoring in KATM, KEFJ, and WPWS and are located on the GWA Workspace at https://workspace.aoos.org/group/4601/project/4650/folder/26476/sops. The SOPs provide the details of each data collection procedure, their relations to one another, and how they can be integrated to provide understanding of causes of change that will be detected. The sites in KBAY have been using Census of Marine Life protocols (Konar 2007, Rigby et al. 2007) since 2002 but have revised these to be more comparable with the entire nearshore program. These revisions include increasing the quadrat replicate size from five to ten and extending the transect lengths from 30 m to 50 m. We will continue to evaluate and assess data streams to ensure consistency and comparability, within and between programs.

Nearshore Monitoring Design

The Nearshore Monitoring protocol focuses on sampling of several key components of the nearshore system in the GOA that are both numerically and functionally important to the system's health and on several key environmental drivers. These are termed "vital signs" and include kelps (and other marine algae) and seagrasses, marine intertidal invertebrates, marine birds, black oystercatchers *(Haematopus* *bachmani*), sea otters (*Enhydra lutris)*, and marine water chemistry and quality. The rationale for focusing on these vital signs is given in Bennett et al. 2006 and is summarized here.

Kelp, other seaweeds, and seagrass are "living habitats" that serve as a nutrient filter, provide understory and habitat for planktivorous fish, clams, urchins, and a physical substrate for other invertebrates and algae. Kelps and other seaweeds are the major primary producers in the marine nearshore and because they are located in shallow water they could be significantly impacted by human activities. These include spills of oil or other contaminants, dredging and disturbance from anchoring of vessels, and increased turbidity caused by runoff of sediments or nutrients.

Marine Intertidal Invertebrates provide critical food resources for shorebirds, ducks, fish, bears, sea otters, and other marine invertebrate predators, as well as spawning and nursery habitats for forage fish and juvenile crustaceans. Benthic invertebrates and algae are ecologically diverse in terms of habitat and trophic requirements; have a wide range of physiological tolerances; are relatively sedentary, and have varied life-histories. As a result, they are good biological indicators of both short-term (e.g., annual) and long-term (e.g., decadal scale) changes in environmental conditions.

Marine Birds are predators near the top of marine nearshore food webs. Marine birds are long-lived, conspicuous, abundant, widespread members of the marine ecosystem and are sensitive to change. Because of these characteristics marine birds are good indicators of change in the marine ecosystem. Many studies have documented that their behavior, diets, productivity, and survival changed when conditions change. Public concern exists for the welfare of seabirds because they are affected by human activities like oil pollution and commercial fishing.

Black Oystercatchers are well suited for inclusion into a long-term monitoring program of nearshore habitats because they are long-lived; reside and rely on intertidal habitats; consume a diet dominated by mussels, limpets, and chitons; and provision chicks near nest sites for extended periods. Additionally, as a conspicuous species sensitive to disturbance, the black oystercatcher would likely serve as a sentinel species in detecting change in nearshore community resulting from human or other disturbances.

Sea Otters are keystone species that can dramatically affect the structure and complexity of their nearshore ecological community. They cause well described top-down cascading effects on community structure by altering abundance of prey (e.g., sea urchins) which can in turn alter abundance of lower trophic levels (e.g., kelps)**.** Sea otters generally have smaller home ranges than other marine mammals; eat large amounts of food; are susceptible to contaminants such as those related to oil spills; and have broad appeal to the public. Recent declines in sea otters have been observed in the Aleutian Islands. Currently declines are documented in areas to the western edge of our study area. As a result of these declines, the Western Alaska stock of sea otters (which includes populations in Katmai National Park and Preserve as well as Aniakchak National Monument and Preserve), was federally listed as threatened on September 2005 under the Endangered Species Act.

Marine Water Chemistry and Water Quality including temperature and salinity, are critical to intertidal fauna and flora and are likely to be important determinants of both long-term and short-term fluctuations in the intertidal biotic community. Basic water chemistry parameters provide a record of environmental conditions at the time of sampling and are used in assessing the condition of biological assemblages. Water quality (including water temperature, salinity, and levels of contaminants such as heavy metals and organic pollutants) are also critical in structuring nearshore marine ecosystems and can cause both acute and chronic changes in nearshore populations and communities.

Specific questions and objectives for each of the vital signs are:

Kelp, other seaweeds, and seagrass

Objective:

- Estimate short-term and long-term trends in abundance and distribution of kelp, other seaweeds, and eelgrass at various spatial scales.

Question:

- What are the large-scale (GOA-wide, over decades) trends in the relative abundance and distribution of canopy forming kelps, other seaweeds, and eelgrass?
- What are annual trends in the abundance of canopy forming kelps, intertidal algae, and eelgrass?
- How do inter-annual changes in relative abundance of eelgrass, algae and kelp communities differ among locations?
- What environmental and biological variables are driving the observed temporal and spatial trends and patterns?

Marine Intertidal Invertebrates

Objectives:

- Monitor short-term and long-term trends in species composition and abundance of invertebrate species at various locations.
- Document how the size distributions of limpets (*Lottia persona*), mussels (*Mytilus trossulus*), and clams are changing annually at various locations.

Questions:

- How are the composition and relative abundance of intertidal algae and invertebrates changing annually?
- How do inter-annual changes in relative abundance of intertidal algae and invertebrates differ among locations?
- What environmental and biological variables are driving the observed temporal and spatial trends and patterns?

Marine Birds

Objective:

- Estimate long-term trends in the seasonal abundance of seabirds and seaducks at various locations.

Questions:

- How is the species composition and abundance of birds (and especially those closely linked to the nearshore, such as harlequin ducks and Barrow's goldeneye) changing annually during summer and winter?

- How do inter-annual changes in the number of bird species present and the relative abundance of birds differ among locations?

Black Oystercatcher

Objectives:

- Estimate long-term trends in relative density and nest site productivity of black oystercatchers at various locations.
- Estimate long-term trends in black oystercatcher diet through collection of prey remains at various locations.

Questions:

- How are the relative density (pairs per linear kilometer of shoreline) of black oystercatcher nests and the nest site productivity (number of chicks or eggs per nest) changing annually?
- How is the composition of prey provisioned to black oystercatcher chicks changing over time?
- How do inter-annual changes in density of black oystercatchers and composition of prey provisioned to chicks differ among locations?

Sea Otter

Objectives:

- Estimate long-term trends in sea otter abundance and spatial distribution.
- Estimate and compare age-specific survival rates of sea otters among regions within the GOA.
- Estimate diet composition of sea otters at various locations.

Questions:

- How is abundance and spatial distribution of sea otters changing over time?
- How is age-specific survival of sea otters changing annually?
- How is the diet of sea otters changing annually?
- How do inter-annual changes in abundance, survival, and diet differ among areas?

Marine Water Chemistry and Quality

Objectives:

- Document daily, seasonal, and annual variability in temperature and salinity at various intertidal sampling sites.
- Monitor status and trends in the concentration of metals, polycyclic aromatic hydrocarbons (PAHs; polycyclic aromatic hydrocarbons often associated with petroleum contamination), polychlorinated biphenyls (PCBs), pesticides, and metals in the tissues of mussels collected from various intertidal sampling sites over time.
- Explore other water quality parameters (such as turbidity, dissolved oxygen, carbon system variables, etc.) and disturbance events to help understand changes at intertidal sampling sites over time.

Questions:

- What is the daily, seasonal, and annual variation in intertidal water temperature (including variation in the duration of minimum and maximum temperatures) and salinity and how are these changing over time?
- How is the concentration of contaminants in mussel tissue (an integrated index of contaminant concentrations in water) changing over time?
- How do inter-annual changes in water chemistry and contaminant levels differ among locations?

Sampling Areas

The design focuses on examining these vital signs in KATM, KEFJ, WPWS, and KBAY (Figure 2). Due to logistical constraints, not all vital signs are collected in all regions (see below).

Most vital sign metrics are evaluated on an annual basis, for some metrics less frequent sampling occurs. Sampling frequency was determined based on the expected extent of inter-annual variation for a given metric as well as cost and logistical constraints. For example, the species distribution and abundance of intertidal invertebrates that are known to exhibit high inter-annual variation are sampled either annually or bi-annually whereas less variable contaminant levels in mussel tissue are monitored every 7 to 10 years.

The number and location of sampling units differ among metrics, but in general the design calls for sampling at multiple sites within each region. The number of sampling locations and the rationale for this are specified in vital sign specific SOPs, but in general were guided by preliminary estimates of effort required to detect ecologically meaningful levels of change (Dean and Bodkin 2006). Sampling sites were selected to provide a random, spatially balanced distribution. The design allows for detection of large temporal or spatial-scale changes (e.g., changes that may occur over the entire region over time or among blocks). For some metrics (e.g. contaminants in mussels) the design will also allow for detection of changes that may occur on a more localized scale (e.g., at a site of heavy human influence).

Sampling method overview

Sampling in the core sampling regions (KATM, KEFJ, and WPWS; and except where noted in KBAY) will consist of:

- <u>Surveys of eelgrass and kelp canopy</u> – The area covered by canopy forming kelps and eelgrass will be evaluated based on region-wide aerial surveys (Harper and Morris 2004), expected to be repeated on a ten to twelve-year frequency. Changes in percent cover by eelgrass will also be evaluated in randomly selected eelgrass beds on an annual basis. Sites (5 in KATM KEFJ and WPWS, 4 in KBAY) will be areas of historical eelgrass cover (as documented by previous ShoreZone mapping conducted by Harper and Morris 2004) that are nearest to sites where intertidal algae and invertebrates are sampled. Metrics will include the percent cover, density and, bed size. The boundaries of each bed will be located (either visually or using a fathometer and underwater camera) and positions recorded using a global positioning system (GPS).

- <u>Sampling of intertidal algae and invertebrates on sheltered rocky shores</u> - Randomly selected sites on sheltered rocky shores will be sampled annually to estimate the abundance and distribution of intertidal invertebrates and algae. Five sites will be sampled within each block (6 within KBAY because of historical sampling). Metrics will include number of kelp and mobile invertebrate species identified to the lowest possible taxa, percent cover of algal and sessile invertebrate taxa and size distributions of limpets (*Lottia persona*).

- Sampling of bivalves in gravel / mixed-sand gravel shores - Sampling of bivalves will be conducted every other year at five gravel/mixed sand-gravel sites in each block. Sampling will focus on bivalves that are relatively large, long-lived, and common (Lees and Driskell 2006). Metrics obtained will include abundances of selected bivalve species and size distributions of several dominant species. Sediment samples will be obtained from gravel / sand-gravel site for determination of grain size distribution.
- Sampling of Pacific blue mussels in mussel beds – The density and size distribution of mussels will be measured annually in 5 mussel beds in each region. Metrics of mussel bed size, density, and size structure are obtained using a combined sampling technique (Bodkin et al. 2016). While the focus is on larger mussels that are important prey for sea otters, sea ducks, and black oystercatchers, mussels are also sampled in such a way that all sizes are targeted in order to get an accurate view of their entire size frequency distribution. The selected mussel beds will be the nearest beds to sheltered rocky intertidal sampling sites.
- Sampling marine bird and mammal abundance – Marine bird and mammal abundance will be estimated via boat annually in summer in KATM and KEFJ. Sampling in PWS will be done under a separate contract to the USFWS. In addition, winter sampling will be conducted in KATM and KEFJ every two to three years, funded by NPS. There are no current marine bird and mammal surveys in KBAY. Counts will be made along shoreline transects using the methods of Irons et al. (2000). The focus will be on estimating the abundance of birds closely linked to the nearshore including harlequin ducks, Barrow's goldeneyes, and black oystercatchers (Webster 1941, Goudie and Ankney 1986, Andres 1998). Surveys will be conducted in summer and winter so that abundance estimates can be obtained for birds with different seasonal patterns (e.g., harlequin ducks that are more abundant in winter and black oystercatchers that are more abundant in summer).
- Sampling of black oystercatcher nest site density and oystercatcher chick provisioning - The number of black oystercatcher nest sites will be surveyed annually along shoreline transects in KATM, KEFJ and WPWS. The number of eggs and/or chicks present will be counted as an index of nest productivity. The species composition and relative abundance of oystercatcher prey provided to chicks will be evaluated by sampling prey remains at oystercatcher nesting sites (Webster 1941, Andres 1998).
- Aerial surveys of sea otter abundance - Sea otter abundance will be estimated within each region (KATM, KEFJ or WPWS) in the summer of every third year using aerial survey methods described by Bodkin and Udevitz (1999). These methods have been used to conduct annual surveys to estimate the abundance of sea otters in PWS since 1993 (Bodkin et al. 2002), and on a less frequent basis elsewhere in the GOA. The metric obtained will be numbers of sea otters per block.
- Sampling of sea otter diets - The species composition and relative abundance of sea otter prey will be estimated annually using direct observation of sea otter feeding (Calkins 1978, Estes et al. 1981, Dean et. al 2002). These observations will provide an assessment of foraging efficiency (energy obtained per hour of feeding) as well as the composition of prey being consumed by sea otters (Tinker 2015). The latter will provide an indirect measure of the composition and relative abundance of representative intertidal and subtidal invertebrates that are difficult to sample directly.
- Coastline surveys for collection of sea otter carcasses - Specified beach segments will be walked annually for collection of sea otter skulls in KATM, KEFJ and WPWS. The segments will be in areas

where sea otter carcasses accumulate and will be based on preliminary surveys. KBAY carcasses are collected opportunistically year-round. A tooth will be extracted from each skull and sectioned to estimate the age of the sea otter (Bodkin et al. 1997). The data on the age distribution of dead sea otters will be used to evaluate changes in age-specific survival and to develop age-specific survival estimates based on an age-structured demographic model (Monson et al. 2000, 2011; Bodkin et al. 2002).

- Sampling of water/air temperature, salinity, and contaminants in mussels- Intertidal water/air temperature will be measured at each of the sheltered rocky intertidal sites. Temperature recording devices will be fixed at the 0.5 m tidal elevation in the intertidal zone and will record temperature every hour on a year round basis. Initially, salinity will be measured at one to two sites in KBAY. It is anticipated that more sites will be added if instruments prove reliable. The concentration of contaminants will be measured in mussels collected from rocky intertidal sites once every seven to ten years in KATM, KEFJ and WPWS. KBAY mussels are collected and analyzed for contaminants under the National Oceanographic and Atmospheric Administration (NOAA) Mussel Watch Program. When feasible, we will explore other water quality and disturbance variables (ice scour, storm surges) that may also be contributing to site variation and changes over time.

Design Considerations

In the process of developing the NPS Southwest Alaska Network (SWAN) and EVOS nearshore monitoring programs we investigated most, if not all of the active nearshore monitoring programs along the west coast of North America (e.g., PISCO, MARINe, LIMPET, NAGISA, PSP, NOAA mussel watch). Where feasible we adopted and designed species and location specific procedures that would facilitate comparison of common metrics among existing and prior programs. For example, we employ point contact methods to estimate percent cover of intertidal invertebrates and algae that are similar to PISCO and MARINe methods and will facilitate comparison. We also estimate densities of large motile invertebrates (e.g., stars), that will be comparable to estimates from PISCO, MARINe, and other programs employing comparable techniques. In many instances species differences existed between existing nearshore monitoring programs in the contiguous US and Alaska requiring modification to available procedures. Where appropriate we adopted widely used and published methods to estimate marine bird densities (Irons et al. 2000) black oystercatcher abundance and diet (Andres 1998, Webster 1941) and sea otter abundance (Bodkin and Udevitz 1999), diet (Calkins 1978, Estes et al. 1981), and survival (Monson et al. 2000).

There are, however, fundamental differences between some of the objectives of the GOA nearshore monitoring program described here and other nearshore monitoring programs. These include a GOA program objective to allow statistical inference to the entire region and therefore required a random component to site selection, rather than focusing on specific selected sites. An exception to this random site selection occurred in KBAY. Here, four of the initial sites that were chosen to be monitored (starting in 2002 with another program) were chosen on the south side of the bay because of their large spatial extent and high species diversity. When KBAY joined the GOA monitoring team, we added two addition sites on the north side of the bay to better represent the region. Compared to other existing programs, many GOA sites are remotely located and access is difficult and costly. As a result, our sampling frequency is generally equal to or greater than one year (with a few exceptions such as water quality), with limited ability to detect within year variation or trends. Furthermore, there are additional location-specific factors (e.g. a large tidal prism and high degree of disturbance due to ice and storms) that led us to different sampling designs than employed by other programs. Perhaps most importantly, the GOA program attempts to encompass all major elements of the nearshore trophic web: kelps and seagrasses as primary producers, benthic invertebrates as primary consumers, and the birds and mammals as apex predators (i.e., black oystercatchers, sea ducks and the sea otter). We know of no other nearshore monitoring program that incorporates this breadth of trophic interaction that will allow both "bottom-up" and "top-down" perspectives on causes of change in the nearshore marine ecosystem. This approach required adapting existing procedures where available and appropriate, and developing new ones as needed.

Selection of sampling regions

As indicated above, sampling will be largely restricted to the Katmai, Kenai Peninsula and Prince William Sound coastlines, and will be concentrated in four regions (KATM, KEFJ, WPWS, and KBAY) (Figure 5). There are a wide variety of habitats within these regions. For the purpose of the GWA monitoring program, we intend to restrict sampling of intertidal invertebrates and algae to sheltered-rocky shores and to gravel and mixed sand-gravel beaches. We selected these habitats because they represent over half (about 58%) of the shorelines within the region (Ford et al. 1996); are biologically diverse; harbor both hard bottom (epibenthic) and soft bottom (infaunal) organisms; are tractable to sample, and have a wealth of historical data relative to other habitats. Thus, they provide excellent indicators of change. Sampling of nearshore birds and mammals will include the full range of nearshore habitats.

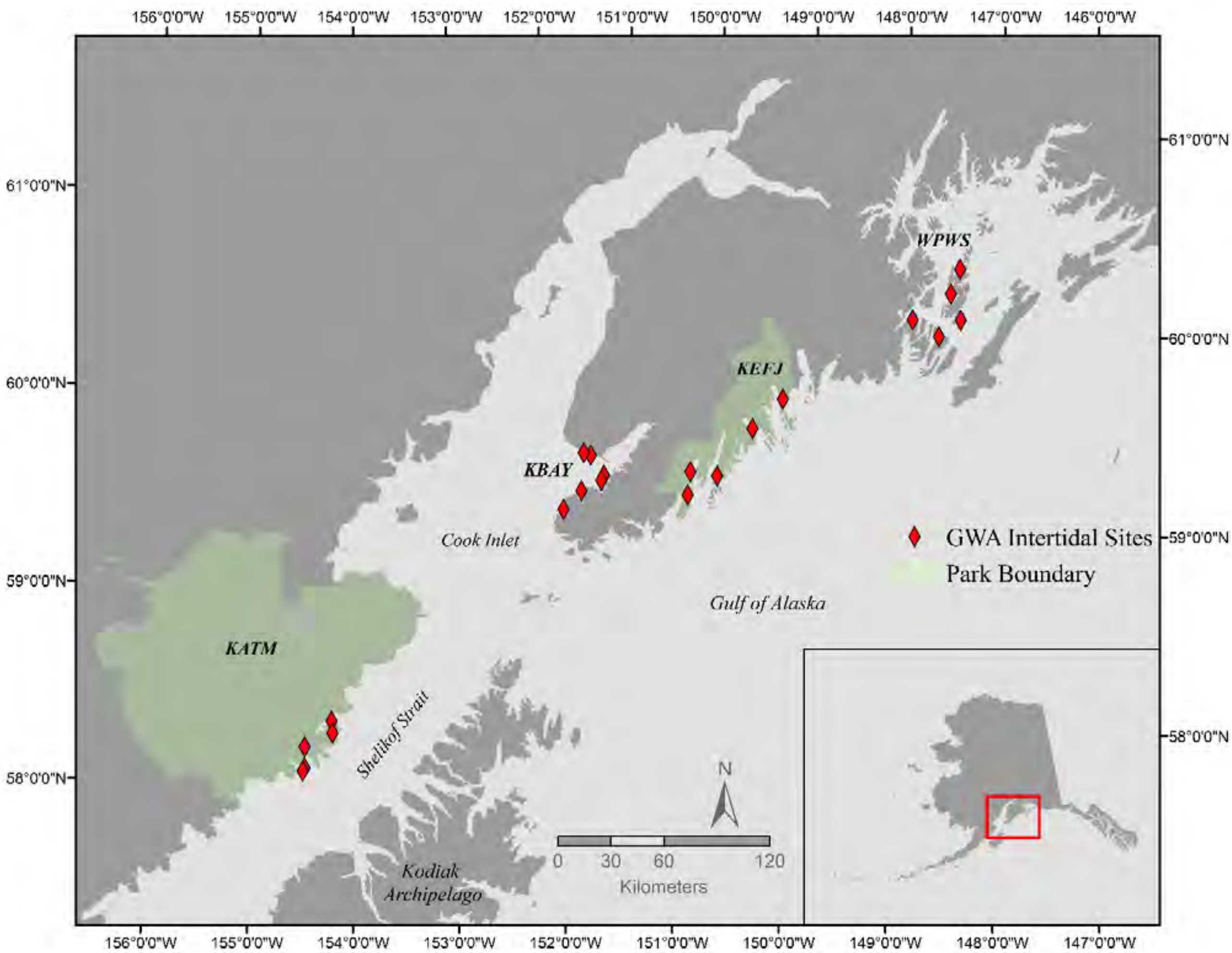

Figure 5. Map showing study sites within KATM, KEFJ, KBAY and WPWS. The red diamonds represent rocky intertidal sites that act as a central point to establish monitoring sites or transects of several other marine nearshore vital signs.

Sampling Site Locations

In KBAY, sites were selected based on location of historical data (from the Census of Marine Life Project and others) or to ensure good representation of the bay. For the rocky sheltered/mixed gravel cobble sites, four were historical sites and two were chosen to better represent the area). For the seagrass sites, two had historical data and two were chosen to ensure better spatial coverage. For all but the KBAY sites, discrete sampling sites used to sample intertidal invertebrates and algae on sheltered rocky shorelines were selected using a generalized random tessellation stratified (GRTS) sampling scheme (Stevens and Olsen, 2004). This design provided a random yet spatially balanced distribution of sites within region. A GRTS design also allows for expansion or contraction of the number of sites to be sampled over time by pre-selecting a large number of sites that were ordered with respect to priority. Thus, sampling sites could be added or deleted without compromising the statistical or spatial integrity of the design.

Rocky intertidal sampling sites were selected using S-Draw, a windows-based GRTS sampling software program (GRTS for the Average Joe: A GRTS Sampler for Windows; http:// http://west-inc.com/reports/grts.pdf). Potential shorelines representing sheltered rocky or gravel/mixed sand gravel geomorphologic types were identified using Geographic Information System (GIS) software from Environmentally Sensitive Index (ESI) maps produced for each region (RPI, 1983a, 1983b, 1985, 1986). The S-Draw software was then used to produce an ordered list of 100 potential sampling sites within each block. Water quality metrics (contaminants in mussels, temperature, and salinity) are to be measured at sites identified for sampling of intertidal invertebrates on rocky shores. Subsequent site selection for other vital signs were based on proximity to the location of the stratified random sample of sheltered rocky sites within each region.

Selection of the size and number of sampling units

The size and number of sampling units to be included for evaluation of each metric within a given sampling period are described in detail in specific SOPs. A sampling unit is defined as the smallest unit for which a particular metric is measured and expressed. For example, the number of sea stars will be counted within a 200 m^2 area and expressed as number per 100 m^2. For each metric, the size of the sampling unit and number of sampling units varies dependent largely on the behavior of the species of interest. In estimating abundance of larger, more motile species that have large and variable home ranges that can cover large portions of a region (e.g. sea otters), sampling will be conducted along relatively large random or systematically placed transects of several hundred meters or more that cover the entire region. For sessile species or ones with a limited home range (e.g., many invertebrates) sampling will be conducted at discrete, permanently established sites within each region. A site is defined as an approximately 50 to 100-m section of coastline and the water directly adjacent to it. For these smaller, less motile species, sampling will be conducted within quadrats or transects ranging in size from approximately 0.10 to 200 m^2 at each site. The number of transects or quadrats sampled per site will range from one (for larger invertebrates like sea stars) to 24 (divided equally between two vertical strata (or 4 vertical strata as in KBAY)) for smaller invertebrates and algae. The intent is to sample a number of units that will provide sufficient statistical power to detect changes ranging from 20% to 80% (dependent on the metric, see section below). These criteria were selected as ones that were both biologically meaningful and achievable given budgetary and logistical constraints.

Transects used for estimating black oystercatcher density were centered on sites used to sample intertidal invertebrates on rocky shores. Nest productivity is estimated at each nest site located within these transects and prey composition is measured at any nest site where prey are observed.

Sea otter abundance (aerial surveys) is estimated using counts of sea otters along transects within defined sea otter habitat throughout each region that were selected systematically with a random start point.

Sea otter foraging observations are to be made at sites wherever sea otters are seen foraging within a 5 km radius of intertidal sampling sites. This radius roughly corresponds to the annual home range for sea otters. Sampling will be focused as close to the invertebrate sites as possible but will be dependent on the presence of sea otters required to obtain the minimum sample of 50 forage bouts per year.

Carcasses of sea otter skulls are collected from wherever skulls are found within each region, but will focus on specific locations where large numbers of sea otter carcasses have been found in the past.

C. Data Analysis and Statistical Methods

Power and the levels of detectable change

As indicated above, the objective of the sampling program is to assess how various metrics change over time and how those changes vary with respect to location and one another. The levels of change that we can expect to detect and the time and spatial scales over which they are to be detected vary with metric. The spatial scales over which trends will be examined range from a region (for large motile species like sea otters) to a site (for smaller, less motile species like mussels). In general, the goal for most biological metrics (e.g., abundance of sea otters, harlequin ducks, or dominant intertidal invertebrates like mussels) is to detect levels of change that are deemed to be of ecological importance (see Protocol Narrative for a discussion of determination of levels of change that are deemed ecologically important for each metric). In general, we intend to detect changes ranging from 20 to 80% (depending on the metric) at a given region (e.g., KATM or PWS). The ability to detect change can be expressed as power, the probability that a given level of change could be detected given the sampling design employed. Power analyses can also be used as a planning tool, to determine the sampling effort required to detect a given level of change with a prescribed power. It is anticipated that one of the primary methods used to detect change will conceptually take the form of mixed-model analyses (McCulloch et al. 2008) that examine, at a minimum, time (year) and location as the primary factors. The location factor consists of blocks (and in some cases sites nested within each block) with replicate samples within the block. Various mixed models would examine the extent of variation for a particular metric that could be attributed to location (e.g., region or sites within a block), time, and the interaction between these factors.

It is reasonable to assume that the power to detect a given level of change will increase over time as the number of surveys increases. This stresses the need for conducting periodic power analyses to suggest modifications to sampling designs over time and to ensure efficiency in the sampling. The power to detect a given level of change also depends on biases associated with a particular sampling regime (Tyre et al. 2003, Earnst et al. 2005). For example, these might include biases introduced by using different observers in aerial surveys of sea otters or birds or those associated with the inability to detect all individuals present. When possible, we will account for these biases in our analyses.

Data analyses and statistical methods that will be used to evaluate changes in the nearshore environment are detailed in Dean and Bodkin (2006) and Dean et al. (2014). In general, we will examine trends in each metric over time within each location, differences among locations over time, and interactions between time and locations (i.e., the extent to which changes within each location track changes across locations over time) through regression and information-theoretic (IT) criteria (Burnham and Anderson 2002, 2004). Competing hypotheses (models) will be selected a priori and those models will be ranked based on their relative support (AIC values). These analyses will help to sort out effects of small scale sources of change (e.g., effects of oil in PWS or other location specific impacts such as logging activities) from larger scale sources of change (e.g., those due to climate change that are occurring over the entire GOA).

To illustrate that the current nearshore design is capable of assessing how various metrics change over time and how those changes vary with respect to location and one another, here we provide a brief overview of two publications that utilize data collected through the integrated design. A recent submission to an Ecosphere special issue (Coletti et al. in review) analyzed sea otter abundance, energy recovery rates and age at death data across KATM, KEFJ and WPWS. Because the monitoring design allows broad spatial inference and has direct food web linkages, we demonstrated the ability of our data to simultaneously detect change and examine potential mechanisms underlying that change. Specifically, our analysis of recent sea otter abundance at these three locations in the GOA indicates populations with divergent trajectories, including growth (WPWS), stability (KEFJ) and perhaps most recently, decline (KATM), although additional surveys will be required to verify findings. This spatial contrast among locations, one of the key design features of our monitoring program, suggests that mechanisms influencing sea otter abundance and trend can differ at relatively small scales. Further, these data suggest that sea otter abundance in the GOA currently is not being driven by Gulf-wide factors. The divergent trends in sea otter abundance allow us to evaluate those regional trends independently, using the diet and mortality data collected concurrently within each region.

In another example, a paper recently accepted by Estuaries and Coasts (Konar et al. submitted) tested hypotheses that rocky intertidal community structure is less similar at the local scale compared with the regional scale, coinciding with static drivers being less similar on smaller scales (sites within regions) than larger scales (across larger geographic regions). It also was hypothesized that static attributes mainly drive local biological community structure. For this, we examined multiple static variables (distance to freshwater, tidewater glacial presence, exposure to wave energy, fetch, beach slope, and substrate composition) to determine their importance in influencing biological communities at specific sites and across regions. Our results suggest that generally, biological communities in the northern GOA are not strongly influenced by the local static attributes measured in this analysis. An alternative is that the static attributes among our regions are not different enough to manifest a change in the biological communities. This lack of evidence for a strong driver associated with static attributes may be a result of the site selection process, which targeted sheltered rocky habitats, and may not have varied greatly in their static characteristics. If true, this suggests that our rocky sheltered sites may be well positioned to examine the influence of dynamic drivers, including those resulting from climate change (i.e., temperature, salinity). We have concluded that a longer term study at our monitoring sites should be able to tease apart the interactions of static and dynamic drivers. Hence, continuing data collection and analyses will focus on drivers of these communities.

These analyses enhance our understanding of system dynamics and illustrate the ability of the integrated design to detect change and infer cause. Because of this, we expect our results to promote conservation and improve management of natural resources.

D. Description of Study Area

Locations (see Figure 5)**:**

Western PWS (5 intensive sites): This study area was funded by EVOSTC (Projects 10100750 and 12120114-R, covering data collection during 2010-2016. We are requesting funds to continue monitoring the study sites long-term, including 2017–2021.

Katmai and Kenai National Parks (5 intensive sites each park): These study areas have been funded primarily by NPS, with data collection at Katmai ongoing since 2006, and at Kenai since 2007. We request funding for support of sea otter aerial surveys at KATM, KEFJ and WPWS areas (alternate years each location), for the charter vessel to Katmai for annual sampling, and for continuing support of personnel who will be involved in data collection, analysis and management across all study locations, 2017-2021.

Kachemak Bay (6 intensive sites): Monitoring of intertidal invertebrates, algae and seagrass beds in nearshore areas of Kachemak Bay has been ongoing for over a decade, along with extensive sea otter surveys, shellfish surveys, and oceanographic measurements. Intertidal survey methods have followed slightly different but overall comparable protocols to those used in the other proposed nearshore study areas. We implemented modified sampling protocols in 2012 that made sampling more consistent with other areas. We also conducted a comparison of protocols between KBAY and the other regions in 2015 and found them to be similar (in Konar et al. submitted). We request support for continued work in 2017-2021.

5. Coordination and Collaboration

Within the Program

The nearshore component of GWA is a highly coordinated effort involving multiple PIs with expertise on various aspects of nearshore ecosystems; the overall design and coordination are critical for drawing inference about factors affecting the nearshore. Since 2012 under GWA, there have been two nearshore projects (15120114-R Nearshore Benthic Systems in the GOA and 12120114-L, Ecological Trends in Kachemak Bay). The two projects have worked closely in the past five years to ensure that data collected in Kachemak Bay are comparable with those from other nearshore sites across the GOA and provide another window into the causative factors and spatial extent of changes in nearshore systems. For example, we collaborated with Drs. Konar and Iken to combine data sets for analyses presented in the 2014 GWA Science Synthesis report, which is in prep to be submitted to a peer reviewed journal. In addition, for 2017-2021, we have proposed to integrate the two nearshore projects into a single program to further our collaboration.

An educational collaboration also exists within this project There are two University of Alaska field courses that are taught by Konar and Iken at the Kasitsna Bay Lab that assist with the data collection used in this program. Students will get valuable experience and training from participating in this project and the project will benefit from having these students. In addition, the KBAY portion of this project provides summer funding for one graduate student who can then dedicate more time to assist in the sampling and sample processing.

We have worked closely with the other GWA components (Environmental Drivers and Pelagic) over the previous five years to identify data sets that can be shared. For example, Environmental Drivers data were used extensively in our analysis of mussel trends across the Gulf of Alaska, presented in the GWA Science

Synthesis report (Monson et al. 2015). For the next five years, we hypothesize that productivity in the nearshore is strongly influenced by physical oceanographic processes. It will be a priority to evaluate whether or not changes that may be noted in the nearshore systems are reflected in either oceanographic conditions or in synchronous changes in pelagic species and conditions. The geographic scale of our study (GOA-wide) will provide greater ability to discern both potential linkages across these diverse components, as well as among the study areas within the nearshore, allowing us to evaluate relations and changes in the nearshore resources. We will incorporate data on annual and seasonal patterns measured in the Environmental Drivers component of the overall study as well as data from the Pelagic study components.

In July 2015, during our fieldwork in KATM, we coordinated with the GWA Environmental Drivers component (Doroff and Holderied) to collect phytoplankton and mussel samples in light of the harmful algal bloom documented in 2015. These samples are still being analyzed. With oceanographic conditions continuing to change, we anticipate further collaboration with the Environmental Drivers group to collect relevant physical and biological data.

As productivity in the nearshore is strongly influenced by physical oceanographic processes, it will be a priority to evaluate whether or not changes that may be noted in the nearshore systems are reflected in either oceanographic conditions or in synchronous changes in pelagic species and conditions. The geographic scale of our study (GOA-wide) will provide greater ability to discern both potential linkages across these diverse components, as well as among the study areas within the nearshore, allowing us to evaluate relations and changes in the nearshore resources. We will incorporate data on annual and seasonal patterns measured in the Environmental Drivers component of the overall study as well as data from the Pelagic study components. For example, we have documented synchronicity at various time and spatial scales in the abundance of mussels in the Gulf of Alaska with cascading effects to upper trophic levels (Monson et al. 2015). Continued monitoring focused on identifying mechanisms of change (e.g., recruitment versus adult survival) may be needed to identify the ultimate driver of the observed synchrony. One component of the overall LTM of particular importance to the nearshore is surveys of nearshore marine birds, which will be accomplished in PWS through the Marine Bird Population Trends monitoring component (representing a further long-term data set; see Irons et al. 2000) and at Kenai Fjords and Katmai by the NPS SWAN program. Contrasting the changes occurring in the pelagic and nearshore environments during the recent years when GOA waters have warmed by several degrees in 2014 and 2015 (https://alaskapacificblob.wordpress.com/2016/02/09/subsurface-warmth-persists/) may be particularly illuminating.

We have been working with Tuula Hollmen and Lisa Sztukowski of the Alaska SeaLife Center (ASLC) on a nearshore conceptual model, leading from variation in prey to variation in behavioral and demographic responses in consumers such as sea otters and sea ducks.

Finally, data collected by the nearshore component are relevant for understanding ecosystem recovery with respect to the Lingering Oil component (e.g., sea otter abundance, energy recovery rate, and age-at-death data) have all been used to evaluate population recovery to this point (Ballachey et al. 2014b).

WITH OTHER EVOSTC-FUNDED PROGRAMS AND PROJECTS

The Nearshore Component of GWA historically has been closely linked with the Lingering Oil component, given that lingering oil occurs in nearshore habitats and affects nearshore species. Although the EVOSTC has indicated that Lingering Oil will be treated as a separate program in the upcoming 5 years, those conceptual and collaborative linkages remain. In 2016, a Lingering Oil proposal will be submitted by L. Bowen, K. Miles, B. Ballachey, J. Bodkin and colleagues to address exposure and effects of hydrocarbons in mussels. If funded, extensive collaboration and synergies will occur between programs, including sample collection, logistical support, conceptual considerations, and shared analysis of relevant data streams.

Also, an associated "above-ceiling" proposal is being submitted, which would (1) establish high-intensity sites for asking critical directed questions that inform ongoing monitoring and (2) address factors leading to variability in population dynamics of mussels. As indicated above, mussels are a key element of nearshore communities. While we have the ability to accurately describe variation in mussels at a number of spatial and temporal scales, our annual monitoring cannot elucidate the underlying mechanisms leading to observed changes. Therefore, the proposed work will look closely at the relative importance of bottom-up and top-down effects on mussels, and how that changes over time and space. This work would be done with a high degree of collaboration with Nearshore and Environmental Drivers Components of GWA. It also would provide insights on processes that affect results of mussel monitoring, which in turn make the findings most useful for managers as they anticipate change in marine ecosystems.

WITH TRUSTEE OR MANAGEMENT AGENCIES

In addition to the logistical, administrative, and in-kind support that the NPS, USGS, NOAA and University of Alaska Fairbanks (UAF) has provided to ensure the success of the GWA Nearshore component, there are several additional projects with trustee and management agencies that the nearshore component of GWA has collaborated with. Below are several recent examples. We expect to continue these projects.

<u>NPS sea otters in KEFJ</u>

In 2013, building on GWA findings indicating that sea otters in KEFJ consume mussels at much higher frequencies than at other areas, we initiated a study of annual patterns in mussel energetics and sea otter foraging at KEFJ, funded by NPS and USGS. That study is to be completed in 2016. Initial results indicate that mussel energy density varies seasonally, likely corresponding to spawning condition. Further, we found that mussel consumption by otters varied slightly seasonally in association with varying mussel energy density, but overall mussel consumption was high in KEFJ across seasons.

<u>NPRB sea otter study</u>

Our GWA nearshore data from KATM contributed to USGS and North Pacific Research Board (NPRB) studies of the status of the southwest Alaska stock of sea otters, which is listed as threatened under the Marine Mammal Protection Act. These data are shared with the USFWS, Marine Mammals Management, who is responsible for sea otter management. NPRB Project 717 Final Report, Estes, Bodkin and Tinker 2010.

<u>NPS Changing Tides</u>

Nearshore GWA PIs (Ballachey, Bodkin, Coletti, and Esler) worked with NPS on the 'Changing Tides' Project. This study examines the linkages between terrestrial and marine ecosystems and is funded by the National Park Foundation. Field work was initiated in July 2015 with in-kind support from our KATM vessel charter. National Parks in Southwest Alaska are facing a myriad of management concerns that were previously unknown for these remote coasts, including increasing visitation, expanded commercial and industrial development, and environmental changes due to natural and anthropogenic forces. These are concerns because of their potential to significantly degrade and potentially impair resources in coastal systems. The project has three key components: (1) brown bear fitness and use of marine resources, (2) health of bivalves (clams and mussels), and (3) an integrated outreach program. We (GWA nearshore component) assisted with the collection of a variety of bivalve species from the coast of Katmai National Park and Preserve. Several specimens were kept live in small aquarium-like containers, and condition and performance metrics were assessed in the laboratory by ASLC collaborators Tuula Hollmen and Katrina Counihan. Others are being used to perform genetic transcription diagnostics (gene expression) to measure the physiologic responses of individuals to stressors, in collaboration with Liz Bowen and Keith Miles of USGS. This project will increase our understanding of how various stressors may affect both marine intertidal invertebrates and bear populations at multiple spatial and temporal scales.

BOEM Nearshore community assessments

Nearshore component PIs (Coletti, Iken, Konar and Lindeberg) have been working on development of recommendations to the Bureau of Ocean Energy Management (BOEM) for nearshore community assessment and long-term monitoring. The BOEM Proposed Final Outer Continental Shelf (OCS) Oil and Gas Leasing Program 2012-2017 includes proposed Lease Sale 244 in the Cook Inlet Planning Area in 2017. An OCS Cook Inlet Lease Sale National Environmental Policy Act (NEPA) analysis has not been undertaken since 2003. Updated information is needed to support an analysis associated with the planned lease sale. The overall objective of this study is to provide data on habitats and sensitive species to support environmental analyses for NEPA documents, potential future Exploration Plans, and Development and Production Plans. The goal was to utilize existing protocols already developed thorough GWA when possible to ensure data comparability. The project will be ongoing through 2019 and all data are being provided to the Alaska Ocean Observing System data portal.

With Native and Local Communities

We have no plans for local or native community involvement at this time.

6. Schedule

Program Milestones

Deliverable/Milestone	***Status***
Field Work (multiple trips, multiple tasks per trip to collect data on series of nearshore metrics); KATM, KEFJ, WPWS, KBAY	Completed, April - July, Annually
Upload Data To Project Website	To be Completed 1 Year After Collection
PI's Attend Annual Program Meeting	To be Completed Annually
Meet All Program Reporting Requirements	To be Completed Annually

Measurable Program Tasks

The projected schedule of tasks for the nearshore benthic component is outlined in Table 1.

1. Annual Collection of sea otter skulls for determination of age-at-death.
2. Annual collection of sea otter diet and energy recovery rate data.
3. Aerial surveys of sea otter abundance.
4. Sampling of intertidal invertebrates and algae.
5. Sampling of sea grasses.
6. Sampling diet and productivity of black oystercatchers.
7. Sampling marine bird and mammal density (summer).
8. Sampling marine bird and mammal density (winter).
9. Stable isotope analysis of selected nearshore species.
10. Contaminants analysis
11. All reporting

Table 1. Schedule of Measurable Program Tasks

Task	FY17				FY18				FY19				FY20				FY21			
	Quarter (EVOSTC FY beginning Feb. 1)																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Task 1 - Collection of sea otter skulls for determination of age-at-death	X	X			X	X			X	X			X	X			X	X		
Task 2 - Annual collection of sea otter diet and energy recovery rate data		X				X				X				X				X		
Task 3 - Aerial surveys of sea otter abundance (alternating between KATM, KEFJ and WPWS)		X				X				X				X				X		
Task 4 - Sampling of intertidal invertebrates and algae		X				X				X				X				X		
Task 5 - Sampling of sea grasses and subtidal kelps		X				X				X				X				X		
Task 6 - Diet and productivity of black oystercatchers		X				X				X				X				X		
Task 7 – Marine bird and mammal surveys (summer KATM and KEFJ)		X				X				X				X				X		
Task 8 - Marine bird and mammal surveys (winter KATM or KEFJ, alternate years)	X				X				X											
Task 9 - Stable isotope analysis of selected nearshore species		X				X				X				X				X		
Task 10 - Contaminant analysis						X														
Task 11 - Reporting																				

Task	FY17				FY18				FY19				FY20				FY21			
	Quarter (EVOSTC FY beginning Feb. 1)																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Published data sets available			X				X				X				X				X	
Annual Rpts	X				X				X				X				X			
Annual PI meeting				X				X				X				X				X
FY Work Plan (DPD)			X				X				X				X					

FY 17 (Year 6)

FY17, 1st quarter (February 1, 2017 - April 30, 2017)

Submit year 5 (2016) annual reports (Feb. 1)

PI data compliance – prior year available to public

Field work includes collection of sea otter skulls for age-at-death determination during April in PWS (task 1) and winter (March) marine bird and mammal surveys in either KATM or KEFJ, depending on NPS priority (NPS funded)

Continue to prepare for upcoming field season (all logistics including staff, timing, equipment, vessel contracts and travel)

FY17, 2nd quarter (May 1, 2017 - July 31, 2017)

All field tasks initiated and completed in all three regions (KBAY, KATM, KEFJ and WPWS) (May, June and July)

WPWS sea otter aerial survey (June)

Open submissions for GWA Special Issue (July 1, 2016)

FY17, 3rd quarter (August 1 2017 - October 31, 2017)

Annual workplan completed

Datasets from current year posted on the internal Ocean Workspace

End Special Issue submission period (Sept. 30, 2016)

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

Begin annual report, summarize annual results including outreach as well as publications

----

FY 2018 (Year 7)

FY18, 1st quarter (February 1, 2018 - April 30, 2018)

Submit year 1 annual reports (Feb. 1)

PI data compliance – prior year available to public

Field work includes collection of sea otter skulls for age-at-death determination during April in PWS (task 1) and winter (March) marine bird and mammal surveys in either KATM or KEFJ, depending on NPS priority (NPS funded)

Continue to prepare for upcoming field season (all logistics including staff, timing, equipment, vessel contracts and travel)

FY18, 2nd quarter (May 1, 2018 - July 31, 2018)
All field tasks initiated and completed in all three regions (KBAY, KATM, KEFJ and WPWS) (May, June and July)

KATM sea otter aerial survey (July)

Samples collected for contaminant analyses in all regions

FY18, 3rd quarter (August 1, 2018 - October 31, 2018)
Annual workplan completed

Datasets from current year posted on the internal Ocean Workspace

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

Begin annual report, summarize annual results including outreach as well as publications

----

FY 2019 (Year 8)

FY19, 1st quarter (February 1, 2019 - April 30, 2019)
Submit year 2 annual reports (Feb. 1)

PI data compliance – prior year available to public

Field work includes collection of sea otter skulls for age-at-death determination during April in PWS (task 1) and winter (March) marine bird and mammal surveys in either KATM or KEFJ, depending on NPS priority (NPS funded)

Continue to prepare for upcoming field season (all logistics including staff, timing, equipment, vessel contracts and travel)

FY19, 2nd quarter (May 1, 2019 - July 31, 2019)
All field tasks initiated and completed in all three regions (KBAY, KATM, KEFJ and WPWS) (May, June and July)

KEFJ sea otter aerial survey (June)

FY19, 3rd quarter (August 1, 2019 - October 31, 2019)
Annual workplan completed

Datasets from current year posted on the internal Ocean Workspace

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

Begin annual report, summarize annual results including outreach as well as publications

----

FY 2020 (Year 9)

FY20, 1st quarter (February 1, 2020 - April 30, 2020)
Submit year 3 annual reports (Feb. 1)

PI data compliance – prior year available to public

Field work includes collection of sea otter skulls for age-at-death determination during April in PWS (task 1) and winter (March) marine bird and mammal surveys in either KATM or KEFJ, depending on NPS priority (NPS funded)

Continue to prepare for upcoming field season (all logistics including staff, timing, equipment, vessel contracts and travel)

FY20, 2nd quarter (May 1, 2020 - July 31, 2020)
All field tasks initiated and completed in all three regions (KBAY, KATM, KEFJ and WPWS) (May, June and July)

WPWS sea otter aerial survey (June)

FY20, 3rd quarter (August 1, 2020 - October 31, 2020)
Annual workplan completed

Datasets from current year posted on the internal Ocean Workspace

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

Begin annual report, summarize annual results including outreach as well as publications

----

FY 2021 (Year 10)

FY21, 1st quarter (February 1, 2021 - April 30, 2021)
Submit year 4 annual reports (Feb. 1)

PI data compliance – prior year available to public

Field work includes collection of sea otter skulls for age-at-death determination during April in PWS (task 1) and winter (March) marine bird and mammal surveys in either KATM or KEFJ, depending on NPS priority (NPS funded)

FY21, 2nd quarter (May 1, 2021 - July 31, 2021)

All field tasks initiated and completed in all three regions (KBAY, KATM, KEFJ and WPWS) (May, June and July)

KATM sea otter aerial survey (July)

FY21, 3rd quarter (August 1, 2021 - October 31, 2021)
Annual workplan completed

Datasets from current year posted on the internal Ocean Workspace

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

Begin annual report, summarize annual results including outreach as well as publications

----

FY 2022 (Year 11)

FY22, 1st quarter (February 1, 2022 - April 30, 2022)
Submit year 5 final reports (Feb. 1)

7. Budget

Budget forms (Attached)

Completed budget forms are attached.

Sources of additional funding

Annual in-kind contributions consist of staff time (USGS = $92K; NPS = $130k; NOAA = $10k), reduced charter costs (USGS = $45K; NPS= $25K), winter bird surveys (NPS=$18K through 2019), use of equipment such as rigid-hull inflatable, inflatables/outboards, GPSs, spotting scopes, field laptops, sounding equipment (USGS = $40K; NPS = $40K) and commodities (USGS = $5k; NPS = $5K). NPS budgets are projected to decline over time based on agency 5-year planning.

Literature Cited

Alley, R.B., Marotzke, J., Nordhaus, W.D., Overpeck, J.T., Peteet, D.M., Pielke, R.A., Pierrehumbert, R.T., Rhines, P.B., Stocker, T.F., Talley, L.D. and Wallace, J.M., 2003. Abrupt climate change. Science 299(5615):2005-2010.

Andres, B.A. 1998. Shoreline habitat use of black oystercatchers breeding in Prince William Sound, Alaska. Journal of Field Ornithology 69(4): 626-634.

Ballachey, B. E., J. L. Bodkin, D. Esler, and S. D. Rice. 2014a. Lessons from the 1989 *Exxon Valdez* oil spill: A biological perspective. Pages 181-197 *in* Alford, J. B., M. S. Peterson, and C. C. Green (eds.), Impacts of Oil Spill Disasters on Marine Habitats and Fisheries in North America. CRC Press, 320 p.

Ballachey, B. E., D. H. Monson, G. G. Esslinger, K. Kloecker, J. Bodkin, L. Bowen, and A. K. Miles. 2014b. 2013 Update on sea otter studies to assess recovery from the 1989 Exxon Valdez oil spill, Prince William Sound, Alaska. U.S. Geological Survey Open File Report 1030.

Barry J. P., Baxter C. H., Sagarin R. D., and Gilman S. E. 1995. Climate-related, long-term faunal changes in a California rocky intertidal community. Science 267:672-675.

Baxter R. E. 1971. Earthquake effects on clams of Prince William Sound. In: The great Alaska earthquake of 1964. Report to National Academy of Sciences, Washington, DC. Pp.238-245.

Bennett, A. J., W. L. Thompson, and D. C. Mortenson. 2006. Vital signs monitoring plan, Southwest Alaska Network. National Park Service, Anchorage, AK.

Bodkin J. L., J. A. Ames, R .J. Jameson, A. M .Johnson, and G. M. Matson. 1997. Estimating age of sea otters with cementum layers in the first premolar. J Wildl Management 61:967-973.

Bodkin, J. L. and M. S. Udevitz. 1999. An aerial survey method to estimate sea otter abundance. pg 13-26 In: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds). Marine Mammal Survey and Assessment Methods. Balkema Press, The Netherlands.

Bodkin, J. L., B. E. Ballachey, T. A. Dean, A. K. Fukuyama, S. C. Jewett, L. L. McDonald, D. H. Monson, C. E. O'Clair, and G. R. VanBlaricom. 2002. Sea otter population status and the process of recovery following the 1989 Exxon Valdez oil spill. Mar Ecol Prog Ser. 241:237-253.

Bodkin, J. L., D. Esler, S. D. Rice, C. O. Matkin, and B. E. Ballachey. 2014. The effects of spilled oil on coastal ecosystems: lessons from the *Exxon Valdez* spill. In Maslo, B. and J.L. Lockwood (eds), Coastal Conservation. Cambridge University Press, NY. Pp. 311-346.

Bodkin, J. L., T. A. Dean, H. A. Coletti, and B. E. Ballachey. 2016. Mussel bed sampling: standard operating procedure, v. 1.2, Southwest Alaska Network. Natural Resource Report NPS/SWAN/NRR—2016/1175. National Park Service, Fort Collins, Colorado.

Bowen, L., Miles, A. K., Ballachey, B. E., Bodkin, J. L., and Esler, D. 2015. Gulf Watch Alaska Long-term Monitoring Program - Evaluating Chronic Exposure of Harlequin Ducks and Sea Otters to Lingering Exxon Valdez Oil in Western Prince William Sound. Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 12120114-Q), Pacific Wildlife Foundation and Centre for Wildlife Ecology, Simon Fraser University, Delta, British Columbia, Canada. U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Burnham, K. P. and D. R. Anderson. 2002. Model selection and multimodel inference. 2nd Ed. Springer-Verlag, New York.

Burnham, K.P. and D. R. Anderson. 2004. Multimodel inference: understanding AIC and BIC in model selection. Sociological Methods in Research 33:261-304.

Calkins, D. G. 1978. Feeding behavior and major prey species of the sea otter, *Enhydra lutris*, in Montague Strait, Prince William Sound, Alaska. US Fish Bull 76:125-131

Coletti, H. A., J. L. Bodkin, D. H. Monson, B. E. Ballachey and T. A. Dean. *In review*. Detecting and inferring cause of change in an Alaska marine ecosystem. Ecosphere.

Connell, J.H. 1972. Community interactions on marine rocky intertidal shores. Annual Review of Ecology and Systematics 3:169-92.

Crain, C. M., B. S. Halpern, M. W. Beck, and C.V. Kappel. 2009. Understanding and managing human threats to the coastal marine environment. Annals of the New York Academy of Sciences 1162:39–62.

Dayton P.K. 1971. Competition, disturbance and community organization: the provision and subsequent utilization of space in a rocky intertidal community. Ecological Monographs 41:351-89.

Dean, T. A., J. L. Bodkin, A. Fukuyama, S. C. Jewett, D. H. Monson, C. E. O'Clair, G. R. VanBlaricom. 2002. Food limitation and the recovery of sea otters following the *Exxon Valdez* oil spill. Marine Ecology Progress Series 241:255-270

Dean, T. and J. L. Bodkin. 2006. Sampling Protocol for the Nearshore Restoration and Ecosystem Monitoring (N-REM) Program (Nearshore Restoration and Ecosystem Monitoring Research Project G-050750), US Geological Survey, Alaska Science Center, Anchorage, Alaska. Report submitted to the EVOS Trustee Council. 99 pg. plus appendices.

Dean, T. A., J. L. Bodkin, and H. A. Coletti. 2014. Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska: Version 1.1. Natural Resource Report NPS/SWAN/NRR - 2014/756. Fort Collins, Colorado.

Doney, S. C., Ruckelshaus, M., Duffy, J. E., Barry, J. P., Chan, F., English, C. A., Galindo, H. M., Grebmeier, J. M., Hollowed, A. B., Knowlton, N. and Polovina, J., 2012. Climate change impacts on marine ecosystems. Marine Science 4.

Earnst, S. L., R. A. Stehn, R. M. Platte, W .M. Larned, and E. J. Mallek. 2005. Population size and trend of yellow-billed loons in northern Alaska. The Condor. 107:289-304.

Esler, D. 2013. Long-term monitoring: lingering oil evaluating chronic exposure of harlequin ducks and sea otters to lingering "Exxon Valdez" oil in Western Prince William Sound, "Exxon Valdez" Oil Spill Trustee Council Restoration Project Final Report (Project 12120114). Delta, British Columbia, Canada.

Estes, J. A., R. J. Jameson, and A. M. Johnson. 1981. Food selection and some foraging tactics of sea otters. pp. 606-641 in Worldwide Furbearer Conference Proceedings. J.A. Chapman & D. Pursley, eds. The worldwide furbearer conference proceedings. University of Maryland Press, Bethesda, MD.

Estes, J. A., M. T. Tinker, T. M. Williams, and D. F. Doak. 1998. Killer whale predation on sea otters linking coastal with oceanic ecosystems. Science 282:473-476.

Estes, J. A., J. L. Bodkin, and M. T. Tinker. 2010. Threatened southwest Alaska sea otter stock: delineating the causes and constraints to recovery of a keystone predator in the North Pacific Ocean. NPRB Project 717 Final Report. http://doc.nprb.org/web/07_prjs/717_NPRBFinalReport(Estesetal).pdf

Exxon Valdez Oil Spill Trustee Council. 2006. *Exxon Valdez* Oil Spill Restoration Plan: Update on Injured Resources and Services 2006. 41p.

Fenberg, P.B. and K. Roy. 2012. Anthropogenic harvesting pressure and changes in life history: insights from a rocky intertidal limpet. The American Naturalist, 180(2):200-210.

Ford, R.J., M. L. Bonnell, D. H. Varoujean, G. W. Page, H. P. Carter, B. E. Sharp, D. Heinemann, and J. L. Casey. 1996. Pages 684-711. In: S. D. Rice, R. B. Spies D.A. Wolfe and B. A. Wright (Eds). Proceedings of the Exxon Valdez Oil Spill Symposium. American Fisheries Society Symposium 18.

Goudie, R. I. and C. D. Ankey. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. Ecology 67:1475-1482.

Harper, J. R., and M. C. Morris. 2004. ShoreZone mapping protocol for the Gulf of Alaska (ver 1.0) CORI Project: 02-33 EVOS Project: 030641. Exxon Valdez Trustee Council, Anchorage, AK.

Hawkins, S. J., Moore, P. J., Burrows, M. T., Poloczanska, E., Mieszkowska, N., Herbert, R. J., Jenkins, S. R., Thompson, R. C., Genner, M. J. and Southward, A. J. 2008. Complex interactions in a rapidly changing world: responses of rocky shore communities to recent climate change. Climate Research 37*:*123-133.

Hoegh-Guldberg, O., and J. F. Bruno. 2010. The impact of climate change on the world's marine ecosystems. Science (New York, N.Y.) 328(5985):1523–8.

Irons, D. B., S. J. Kendall, W. P. Erickson, and L. L. McDonald. 2000. Nine years after the Exxon Valdez oil spill: effects on marine bird populations in Prince William Sound, Alaska. Condor 102:723-737.

Jamieson, G. S., E. D. Grosholz, D. A. Armstrong, and R. W. Elner. 1998. Potential ecological implications from the introduction of the European green crab, *Carcinus maenas* (Linneaus), to British Columbia, Canada, and Washington, USA. Journal of Natural History 32:1587-1598.

Konar, B. 2007. Introduction to Rocky Shore Ecology. *In* Y. Shirayama and K, Iken, eds. Handbook for Sampling Coastal Seagrass and Macroalgae Community Biodiversity. Kyoto University Press.

Konar, B., K. Iken, H. Coletti, D. Monson and B. Weitzman. *Submitted*. Influence of static habitat attributes on local and regional rocky intertidal community structure. Estuaries and Coasts.

Lees, D.C. and W.B. Driskell. 2006. Intertidal Reconnaissance Survey to Assess Composition, Distribution, and Habitat of Marine/Estuarine Infauna in Soft Sediments in the Southwest Alaska Network. Final Report. National Park Service-Southwest Alaska Network. Anchorage, AK. 51 pgs.

Lenton, T. M., H. Held, E. Kriegler, J. W. Hall, W. Lucht, S. Rahmstorf and H. J. Schellnhuber. 2008. Tipping elements in the Earth's climate system. Proceedings of the National Academy of Sciences, 105(6):1786-1793.

Lewis, J. 1996. Coastal benthos and global warming: strategies and problems. Marine Pollution Bulletin 32:698-700.

McCulloch, C. E., S. R. Searle, and J. M. Neuhaus. 2008. Generalized, Linear and Mixed Models. Wiley, Hoboken, 384p.

Menge, B.A. and D.N. Menge. 2013. Dynamics of coastal meta-ecosystems: the intermittent upwelling hypothesis and a test in rocky intertidal regions. Ecological Monographs 83(3):283-310.

Menge, B. A., T. C. Gouhier, S. D. Hacker, F. Chan and K. J. Nielsen. 2015. Are meta-ecosystems organized hierarchically? A model and test in rocky intertidal habitats. Ecological Monographs 85(2):213-233.

Miles, A. K., L. Bowen, B. E. Ballachey, J. L. Bodkin, M. Murray, J. A. Estes, R. A. Keister and J. L. Stott. 2012. Variation in transcript profiles in sea otters (*Enhydra lutris*) from Prince William Sound, Alaska and clinically normal reference otters. Marine Ecology Progress Series 451:201–212.

Monson, D. H., D. F. Doak, B. E. Ballachey, A. Johnson, and J. L. Bodkin. 2000. Long-term impacts of the Exxon Valdez oil spill on sea otters, assessed through age-dependent mortality patterns. Proc. Natl. Acad. Sci. USA 97(12): 6562-6567.

Monson, D.H., D. F. Doak, B. E. Ballachey and J. L. Bodkin. 2011. Could residual oil from the Exxon Valdez spill create a long-term population "sink" for sea otters in Alaska? Ecol Appl 21(8)2917–2932.

Monson, D. H., T. A. Dean, M. R. Lindeberg, J. L. Bodkin, H. A. Coletti, D. Esler, K. A. Kloecker, B. P. Weitzman and B. E. Ballachey. 2015. Interannual and spatial variation in Pacific blue mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013. Chapter 4 *in* Quantifying Temporal and Spatial Variability across the

Northern Gulf of Alaska to understand Mechanisms of Change. Science Synthesis Report for the Gulf Watch Alaska Program.

Newsome, S. D., M. T. Tinker, V. A. Gill, Z. N. Hoyt, A. Doroff, L. Nichol, and J. L. Bodkin. 2015. The interaction of intraspecific competition and habitat on individual diet specialization: a near range-wide examination of sea otters. Oecologia. DOI 10.1007/s00442-014-3204-3.

Noda, T., A. Iwasaki and K. Fukaya. 2015. Recovery of rocky intertidal zonation: two years after the 2011 Great East Japan Earthquake. Jnl. Mar. Biol. Assoc. UK. http://dx.doi.org/10.1017/S002531541500212X

O'Connor, N. J. 2014. Invasion dynamics on a temperate rocky shore: from early invasion to establishment of a marine invader. Biological Invasions 16(1):73-87.

Paine, R. T. 1974. Intertidal community structure: experimental studies on the relationship between a dominant competitor and its principal predator. Oecologica 15:93-120

Paine, R. T. 1977. Controlled manipulations in the marine intertidal zone, and their contributions to ecological theory. Pp 245-270. In C.E. Goulden (Ed.) The Changing Scenes in the Natural Sciences. Philadelphia, Academy of Natural Sciences. Philadelphia, PA.

Peterson, C. H. 1993. Improvement of environmental impact by application of principles derived from manipulative ecology: Lessons from coastal marine case histories. Australian Journal of Ecology. 18:21-52.

Peterson, C. H. 2001. The Exxon Valdez oil spill in Alaska: acute, indirect and chronic effects on the ecosystem. Advances in Marine Biology 39:1-103.

Peterson, C. H., S. D. Rice, J. W. Short, D. Esler, J. L. Bodkin, B. E. Ballachey, and D. B. Irons. 2003. Long-term ecosystem response to the *Exxon Valdez* oil spill. Science 302:2082-2086.

Research Planning Institute, Inc (RPI). 1983a. Sensitivity of coastal environments and wildlife to spilled oil, Prince William Sound, Alaska: an atlas of coastal resources. Report to NOAA (National Oceanic and Atmospheric Administration) Office of Oceanography and Marine Services Seattle.

Research Planning Institute, Inc (RPI). 1983b. Sensitivity of coastal environments and wildlife to spilled oil, Shelikof Strait, Alaska: an atlas of coastal resources. Report to NOAA (National Oceanic and Atmospheric Administration) Office of Oceanography and Marine Services Seattle.

Research Planning Institute, Inc (RPI). 1985. Sensitivity of coastal environments and wildlife to spilled oil, Cook Inlet/Kenai Peninsula, Alaska: an atlas of coastal resources. Report to NOAA (National Oceanic and Atmospheric Administration) Office of Oceanography and Marine Services Seattle.

Research Planning Institute, Inc (RPI). 1986. Sensitivity of coastal environments and wildlife to spilled oil, Southern Alaska Peninsula, Alaska: an atlas of coastal resources. Report to NOAA (National Oceanic and Atmospheric Administration) Office of Oceanography and Marine Services Seattle.

Rigby, R., K. Iken, and Y. Shirayama. 2007. Sampling Biodiversity in Coastal Communities. Kyoto University Press.

Sagarin R. D., Barry J. P., Gilman S. E., and Baxter, C. H. 1999. Climate related changes in an intertidal community over short and long time scales. Ecological Monographs 69:465-490.

Schiel, D. R. and D. I. Taylor. 1999. Effects of trampling on a rocky intertidal algal assemblage in southern New Zealand. J. Exp. Mar. Biol. & Ecol. 235:213-235.

Sousa, W. P. 1979. Experimental investigations of disturbance and ecological succession in a rocky intertidal algal community. Ecological Monographs. 49:227-254.

Stevens, D. L. and A. R. Olsen. 2004. Spatially Balanced Sampling of Natural Resources. Journal of the American Statistical Association 99:262-278.

Tinker, M. T. 2015. The use of quantitative models in sea otter conservation. Chapter 10 *in* J. Bodkin, S. Larson and G. VanBlaricom, Eds. Sea Otter Conservation. Elsevier.

Tyre, A. J., B. Tenhumberg, S. A. Field, D. Niejalke, K. Parris, and H. P. Possingham. 2003. Improving precision and reducing bias in biological surveys: estimating false-negative error rates. Ecological Applications 13: 1790-1801.

Valiela, I. 2006. Global Coastal Change. Blackwell Publishing. Malden, MA. 368 p.

von Biela, V., C. E. Zimmerman, G. H. Kruse, F. J. Mueter, B. A. Black, D. C. Douglas, J. L. Bodkin. *In Press.* Influence of basin and local-scale conditions on nearshore production in the northeast Pacific Ocean. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science.

Webster, J. D. 1941. Feeding habitats of the black oyster-catcher. The Condor 43: 175-180.

PROJECT DATA ONLINE

http://portal.aoos.org/gulf-of-alaska.php#metadata/a51209ad-e2fd-4292-b9ef-4e6f45b5f15a/project/files

Heather A. Coletti
National Park Service
4175 Geist Rd., Fairbanks, AK 99709
Phone: 907-455-0675
E-mail: Heather_Coletti@nps.gov

Current position: Marine Ecologist, National Park Service Southwest Alaska Network (SWAN) Inventory and Monitoring (I&M) Program.

Education: Master of Science, Natural Resources: Environmental Conservation, 2006 (University of New Hampshire, Durham, New Hampshire). Bachelor of Science, Zoology, 1997 (University of Rhode Island, Kingston, RI).

Current activities related to the proposed project: Monitoring resources that are explicitly linked to the marine nearshore along regions within the Gulf of Alaska through the NPS SWAN I&M program and Gulf Watch Alaska.

Selected Publications

Ballachey, B.E., J.L. Bodkin, K.A. Kloecker, T.A. Dean, and **H.A. Coletti**. 2015. Monitoring for Evaluation of Recovery and Restoration of Injured Nearshore Resources. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 10100750), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Ballachey, B., J. Bodkin, **H. Coletti**, T. Dean, D. Esler, G. Esslinger, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, D. Monson, M. Shephard, and B. Weitzman. 2015. Variability within nearshore ecosystems of the Gulf of Alaska. In: Quantifying temporal and spatial variability across the northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska Synthesis Report to the Exxon Valdez Oil Spill Trustee Council, Projects 14120114 and 14120120.

Bodkin, J., B. Ballachey, **H. Coletti**, G. Esslinger, K. Kloecker, S. Rice, J. Reed and D. Monson. 2012. Long-term effects of the Exxon Valdez oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. *Marine Ecology Progress Series*.

Bodkin, J. L., B. E. Ballachey, G. G. Esslinger, K. A. Kloecker, D. H. Monson, and **H. A. Coletti**. 2007. Perspectives of an invading predator: Sea otters in Glacier Bay. Pp.133-136 in J. F. Piatt and S. M. Gende (eds.), Proceedings of the Fourth Glacier Bay Science Symposium. U.S. Geological Survey Scientific Investigations Report 2007-5047, 246 p.

Coletti, H.A., J.L. Bodkin, D.H. Monson, B.E. Ballachey and T.A. Dean. In review. Detecting and inferring cause of change in an Alaska marine ecosystem. Ecosphere.

Coletti, H.A. and T.L. Wilson. 2015. Nearshore marine bird surveys: data synthesis, analysis and recommendations for sampling frequency and intensity to detect population trends. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 12120114-F), National Park Service, Anchorage, Alaska.

Coletti, H. A., T. A. Dean, K. A. Kloecker and B. E. Ballachey. 2014. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012. Natural Resource Technical Report NPS/SWAN/NRTR—2014/843. National Park Service, Fort Collins, Colorado.

Coletti, H. A., J. L. Bodkin, T. A. Dean, and K. A. Kloecker. 2013. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2011. Natural Resource Technical Report NPS/SWAN/NRTR—2011/719. National Park Service, Fort Collins, Colorado.

Coletti, H. A. J. L. Bodkin and G. G. Esslinger. 2011. Distribution and density of marine birds and mammals along the Kenai Fjords National Park coastline - March 2010: Southwest Alaska Network Inventory and Monitoring Program. Natural Resource Technical Report NPS/SWAN/NRTR—2011/451. National Park Service, Fort Collins, Colorado.

Coletti, H. A., J. L. Bodkin, and G. G. Esslinger. 2011. Sea otter abundance in Kenai Fjords national Park: results from the 2010 aerial survey: Southwest Alaska Inventory and Monitoring. Natural Resource Technical Report NPS/SWAN/NRTR—2011/417. National Park Service, Fort Collins, Colorado.

Coletti, H. A., J. L. Bodkin, T. A. Dean, and K. A. Kloecker. 2011. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2010. Natural Resource Technical Report NPS/SWAN/NRTR—2011/497. National Park Service, Fort Collins, Colorado.

Coletti, H. 2006. Correlating sea otter density and behavior to habitat attributes in Prince William Sound, Alaska: A model for prediction. MS Thesis, University of New Hampshire, Durham, NH. pp. 99.

Dean, T. A., J. L. Bodkin, and **H. A. Coletti**. 2014. Protocol Narrative for Nearshore Marine Ecosystem Monitoring in the Gulf of Alaska: Version 1.1. Natural Resource Report NPS/SWAN/NRR - 2014/756. Fort Collins, Colorado.

Konar, B, K. Iken, **H. Coletti**, D. Monson, and B. Weitzman. In review. Influence of static habitat attributes on local and regional rocky intertidal community structure. Estuarine Coastal and Shelf Science

Collaborators

Dr. Brenda Ballachey (USGS), Mr. James Bodkin (USGS), Dr. Lizabeth Bowen (USGS), Dr. Katrina Counihan (ASLC), Dr. Thomas Dean, Dr. Dan Esler (USGS), Mr. George Esslinger (USGS), Dr. Allan Fukuyama (FHT Enivironmental), Dr. Tuula Hollmen (ASLC), Dr. Katrin Iken (University of Alaska Fairbanks), Dr. Tahzay Jones (NPS), Mr. Robert Kaler (USFWS), Ms. Kimberly Kloecker, Dr. Brenda Konar (University of Alaska Fairbanks), Ms. Mandy Lindeberg (NOAA), Dr. Daniel Monson (USGS) , Dr. John Piatt (USGS), Dr. Benjamin Pister (NPS), Ms. Susan Saupe (CIRCAC), Ms. Sarah Schoen (USGS)
(Note: full listing of Gulf Watch Alaska PI's not given here; available upon request).

Dan Esler
Alaska Science Center
U.S. Geological Survey
4210 University Drive
Anchorage, Alaska 99508
(907) 331-8115
desler@usgs.gov

Education:

2000 Ph.D. Wildlife Science. Oregon State University, Corvallis, Oregon, USA.
1988 M.Sc. Wildlife Ecology. Texas A&M University, College Station, Texas, USA.
1985 B.Sc. Biology/Outdoor Education. Northland College, Ashland, Wisconsin, USA.

Recent Professional Experience:

August 2013 – present

Project Leader and Research Wildlife Biologist, Nearshore Marine Ecosystem Research Program, Alaska Science Center, U.S. Geological Survey, Anchorage, Alaska. I lead the Nearshore Marine Ecosystems Research Program (NMERP) of the Alaska Science Center, USGS. My program conducts studies to document and understand underlying causes of change in nearshore marine systems.

February 2001 – May 2013

University Research Associate and Adjunct Professor, Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, British Columbia

Responsibilities: I led a research team conducting a broad suite of studies related to wildlife conservation in western North America, particularly marine birds and their prey. This research was designed to generate findings relevant for management of populations and habitats at regional or continental scales.

Relevant Peer-reviewed Publications:

Esler, D., P. L. Flint, D. V. Derksen, J.-P.L. Savard, and J. Eadie. 2015. Conclusions, synthesis, and future directions: understanding sources of population change. *in* J.-P.L. Savard, D. Derksen, D. Esler, and J. Eadie, editors. Ecology and Conservation of North American Sea Ducks. Studies in Avian Biology.

Bodkin, J. L., **D. Esler**, S. D. Rice, C. O. Matkin, and B. E. Ballachey. 2014. The effects of spilled oil on coastal ecosystems: lessons from the Exxon Valdez spill. Pp. 311-346 in B. Maslo and J. L. Lockwood, eds. Coastal Conservation. Cambridge University Press.

Lok, E. K., **D. Esler**, J. Y. Takekawa, S. W. De La Cruz, W. S. Boyd, D. R. Nyeswander, J. R. Evenson, and D. H. Ward. 2012. Spatiotemporal associations between Pacific herring spawn and surf scoter spring migration: evaluating a "silver wave" hypothesis. Marine Ecology Progress Series 457:139-150.

Esler, D., B. E. Ballachey, K. A. Trust, S. A. Iverson, J. A. Reed, A. K. Miles, J. D. Henderson, B. W. Wilson, B. R. Woodin, J. R. Stegeman, M. McAdie, and D. M. Mulcahy. 2011. Cytochrome P4501A biomarker indication of the timeline of chronic exposure of Barrow's goldeneye to residual *Exxon Valdez* oil. Marine Pollution Bulletin 62:609-614.

Esler, D., K. A. Trust, B. E. Ballachey, S. A. Iverson , T. L. Lewis, D. J. Rizzolo, D. M. Mulcahy, A. K. Miles, B. R. Woodin, J. J. Stegeman, J. D. Henderson, and B. W. Wilson. 2010. Cytochrome P4501A biomarker indication of oil exposure in harlequin ducks up to 20 years after the Exxon Valdez oil spill. Environmental Toxicology and Chemistry 29:1138-1145.

Iverson, S. A., and **D. Esler**. 2010. Harlequin duck population dynamics following the 1989 Exxon Valdez oil spill: assessing injury and projecting a timeline to recovery. Ecological Applications 20:1993-2006.

Esler, D., and S. A. Iverson. 2010. Female harlequin duck winter survival 11 to 14 years after the *Exxon Valdez* oil spill. Journal of Wildlife Management 74:471-478.

Lewis, T. L., **D. Esler**, and W. S. Boyd. 2008. Foraging behaviors of Surf and White-winged Scoters in relation to clam density: inferring food availability and habitat quality. Auk 125:149-157.

Kirk, M., **D. Esler**, and W. S. Boyd. 2007. Foraging effort of surf scoters (*Melanitta perspicillata*) wintering in a spatially and temporally variable prey landscape. Canadian Journal of Zoology 85:1207-1215.

Kirk, M., **D. Esler**, and W. S. Boyd. 2007. Morphology and density of mussels on natural and aquaculture structure habitats: implications for sea duck predators. Marine Ecology Progress Series 346:179-187.

Lewis, T. L., **D. Esler**, and W. S. Boyd. 2007. Effects of predation by sea ducks on clam abundance in soft-bottom intertidal habitats. Marine Ecology Progress Series 329:131-144.

Žydelis, R., **D. Esler**, W. S. Boyd, D. Lacroix, and M. Kirk. 2006. Habitat use by wintering surf and white-winged scoters: effects of environmental attributes and shellfish aquaculture. Journal of Wildlife Management 70:1754-1762.

Peterson, C. H., S. D. Rice, J. W. Short, **D. Esler**, J. L. Bodkin, B. A. Ballachey, and D. B. Irons. 2003. Long-term ecosystem response to the *Exxon Valdez* oil spill. Science 302:2082-2086.

Esler, D., T. D. Bowman, K. Trust, B. E. Ballachey, T. A. Dean, S. C. Jewett, and C. E. O'Clair. 2002. Harlequin duck population recovery following the Exxon Valdez oil spill: progress, process, and constraints. Marine Ecology Progress Series 241:271-286.

Recent Collaborators:

Anderson, Eric (British Columbia Institute of Technology), Ballachey, Brenda (USGS retired), Bodkin, James (USGS retired), Bowen, Liz (USGS), Bowman, Tim (USFWS), Boyd, W. Sean (Environment Canada), Coletti, Heather (NPS), Derksen, Dirk (USGS retired), Eadie, John (University of California Davis) Flint, Paul (USGS), Gorman, Kristen (PWSSC), Hogan, Danica (Environment Canada), Hollmen, Tuula (UAF/ASLC), Hupp, Jerry (USGS), Lok, Erika (Environment Canada), Matkin, Craig (North Gulf Oceanic Society), Lindeberg, Mandy (NOAA), Palm, Eric (Ducks Unlimited), Rice, Jeep (NOAA retired), Schmutz, Joel (USGS), Thompson, Jonathan (Golder), Tinker, Tim (USGS/University of California Santa Cruz), Uher-Koch, Brian (USGS), Ward, David (USGS), Willie, Megan (Simon Fraser University), and Ydenberg, Ron (Simon Fraser University)

Kimberly Anne Kloecker
1045 Beech Lane #17
Anchorage Alaska 99501
907.440.4663 kkloecker@usgs.gov

Ms. Kloecker is a marine ecologist who has taken on project and data management tasks. She has over 10 years managing cross-project budgets, logistics, and data and more than 20 years' experience working with agency, university, and private researchers, volunteers, students, and resource managers. Her goals include mentoring the next generation of scientists in data stewardship and rescuing historic or orphaned data sets relevant to the long-term monitoring program.

Education

MS, Marine Sciences, University of California, Santa Cruz, CA, 1993
BS, Biological Science, Michigan State University, E. Lansing, MI, 1989

Professional Experience

USGS Anchorage, AK, *Biologist* 2002 – Present
USGS Anchorage, AK, *Ecologist* 1998 – 2002

Relevant Publications and Technical Reports

Ballachey, B. E., D. H. Monson, G. G. Esslinger, K. A. Kloecker, J. L. Bodkin, L. Bowen, and A. K. Miles. 2014. 2013 update on sea otter studies to assess recovery from the 1989 *Exxon Valdez* oil spill, Prince William Sound, Alaska. USGS Open-File Report 2014-1030, 40 p. doi:10.3133/ofr20141030.

Coletti, H. A., T. A. Dean, K. A. Kloecker and B. E. Ballachey. 2014. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2012. Natural Resource Technical Report NPS/SWAN/NRTR—2014/843. National Park Service, Fort Collins, Colorado.

Coletti, H. A., J. L. Bodkin, T. A. Dean, and K. A. Kloecker. 2013. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks: 2011. Natural Resource Technical Report NPS/SWAN/NRTR—2011/719. National Park Service, Fort Collins, Colorado.

Bodkin, J. L., B. E. Ballachey, H. A. Coletti, G. G. Esslinger, K. A. Kloecker, S. D. Rice, J. A. Reed, and D. H. Monson. 2012. Long-term effects of the *Exxon Valdez* oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. Marine Ecology Progress Series 447:273-287. doi: 10.3354/meps09523.

Coletti, H. A., J. L. Bodkin, T. A. Dean, and K. A. Kloecker. 2009. Nearshore marine vital signs monitoring in the Southwest Alaska Network. NRTR NPS/SWAN/NRTR—2009/252. National Park Service, Fort Collins, Colorado.

Bodkin, J. L., T. A. Dean, H. A. Coletti, and K. A. Kloecker. 2009. Nearshore Marine Vital Signs Monitoring in the Southwest Alaska Network. USGS, Alaska Science Center, Anchorage. 2008 Annual Report to the U.S. National Park Service.

Bodkin, J. L., B. E. Ballachey, K. A. Kloecker, G. G. Esslinger, D. H. Monson, H. A. Coletti. 2007. Perspectives of an invading predator: Sea otters in Glacier Bay. Pp 133-136 in J. F. Piatt and S. M. Gende (eds.), Proceedings of the Fourth Glacier Bay Science Symposium. USGS Scientific Investigations Report 2007-5047, 246 pp.

Bodkin, J. L., B. E. Ballachey, K. A. Kloecker, G. G. Esslinger, D. H. Monson, and H. A. Coletti. 2005. Sea Otter Studies in Glacier Bay. Annual Report 2004. USGS Alaska Science Center, Anchorage AK.

Bodkin, J. L., B. E. Ballachey, K. A. Kloecker, G. G. Esslinger, D. H. Monson, H. A. Coletti and J. A. Estes. 2004. Sea Otter Studies in Glacier Bay. Annual Report 2003. USGS Alaska Science Center, Anchorage AK.

Bodkin, J. L. K. A. Kloecker, G. G. Esslinger, D. H. Monson, H. A. Coletti and J. Doherty. 2003. Sea Otter Studies in Glacier Bay. Annual Report 2002. USGS Alaska Science Center, Anchorage AK.

Bodkin, J. L. K. A. Kloecker, G. G. Esslinger, D. H. Monson, J. D. DeGroot and J. Doherty. 2002. Sea Otter Studies in Glacier Bay. Annual Report 2001. USGS Alaska Science Center, Anchorage AK.

Bodkin, J. L. K. A. Kloecker, H. A. Coletti, G. G. Esslinger, D. H. Monson, and B. E. Ballachey. 2002. Marine predator surveys in Glacier Bay. Annual Report 2001. USGS Alaska Biological Science Center, Anchorage AK. 46 pp.

Bodkin, J. L. K. A. Kloecker, G. G. Esslinger, D. H. Monson, and J. D. DeGroot. 2001. Sea Otter Studies in Glacier Bay. Annual Report 2000. USGS Alaska Biological Science Center, Anchorage AK. 70 pp.

Bodkin, J. L. K. A. Kloecker, H. A. Coletti, G. G. Esslinger, D. H. Monson, and B. E. Ballachey. 2001. Marine Predator Surveys in Glacier Bay. Annual Report 2000. USGS Alaska Biological Science Center, Anchorage AK.

Bodkin, J. L. and K. A. Kloecker. 1999. Intertidal clam diversity, size, abundance, and biomass in Glacier Bay. 1999 Annual Report. USGS Alaska Biological Science Center, Anchorage AK. 22 pp.

Bodkin, J. L., K.A. Kloecker, G. G. Esslinger, D. H. Monson, J. D. DeGroot, and J. Doherty. 2002. Sea Otter Studies in Glacier Bay. 2001 Annual Report. USGS Biological Science Office, Anchorage, AK, 67 pp.

Ballachey, B. E. and K. A. Kloecker. 1997. EVOS State/Federal NRDA Final Reports, USFWS, Anchorage, AK.

- Hydrocarbon Residues in Tissues of Sea Otters Collected from southeast Alaska.
- Hydrocarbon Residues in Tissues of Sea Otters Collected Following the EVOS.
- Hydrocarbons in Hair, Liver, and Intestine of Sea Otters Found Dead Along the Path of the EVOS.

Rebar, A. H., B. E. Ballachey, D. L. Bruden, and K. A. Kloecker. 1996. Hematology and Clinical Chemistry of Sea Otters Captured Following the *Exxon Valdez* Oil Spill. EVOS State/Federal NRDA Final Reports, USFWS, Anchorage, AK.

Collaborators

- USGS: Daniel Esler, Brenda Ballachey, Jim Bodkin, Daniel Monson, George Esslinger, Ben Weitzman, John Paszalek, Vanessa von Biela, Yvette Gillies, Anthony Fischbach, Rose Cunningham, Durelle Smith, Viv Hutchinson, Keith Miles, Shaylyn Storms
- NPS: Southwest Alaska Network: Heather Coletti, Tim Shepherd
- FWS: Marine Mammals Management: Joel Garlich-Miller, Brad Benter; Migratory Bird Management: Rob Kaler, Kathy Kuletz
- NOAA: Auke Bay Lab: Mandy Lindeberg; Emergency Response Division: Gary Shigenaka; Kasitsna Bay Lab: Chris Holderied; National Estuarine Research Reserve: Angela Doroff
- Academic: UCSC: Tim Tinker, Sarah Espinosa; UAA: Jennifer Burns; UC Davis: Liz Bowen
- Private/NGO: Monterey Bay Aquarium: Michelle Staedler, Michael Murray; Hakai Research Institute: Erin Rechsteiner; Cook Inlet RCAC: Sue Saupe

Daniel H. Monson,
Research Wildlife Biologist
US Geological Survey, Alaska Science Center
4210 University Drive, Anchorage, Alaska, 99508
Email: dmonson@usgs.gov phone: 907-786-7161

Research Wildlife Biologist, Alaska Science Center, 1996-present
Biological Technician and Statistical Assistant, Alaska Science Center, 1987-1996
2009 – Ph.D., University of California Santa Cruz, Santa Cruz, CA. (Ecol. & Evol. Biology)
1995 – M.S., University of California Santa Cruz, Santa Cruz, CA. (Marine Science)
1983 – B.A., Luther College, Decorah, Iowa (Biology)

Dan has been involved in the Coastal Ecosystems research program for the Alaska Science Center since 1987. Beginning in 2012, Dan became a PI for the Nearshore component within the GulfWatch Program where his role is to conduct high quality research focused on understanding natural and anthropogenic factors affecting nearshore ecosystems that will be critical for ecosystem-based management of these resources. In particular, the status of sea otter populations provides important insights into the health and function of nearshore systems, and Dan brings more than two decades of experience conducting multi-disciplinary research on sea otters and their environment with collaborators from more than a dozen different agencies, academic and private institutions.

Relevant Publications

Monson, D.H., J. A. Estes, J.L. Bodkin, and D.B. Siniff. 2000. Life history plasticity and population regulation in sea otters. Oikos 90:457-468.

Monson, D.H., D.F. Doak, B.E. Ballachey, A. Johnson, and J.L. Bodkin. 2000. Long-term impacts of the *Exxon Valdez* oil spill on sea otters, assessed through age-dependent mortality patterns. Proceedings of the National Academy of Sciences. 97:6562-6567.

Laidre, K.L., J.A. Estes, M.T. Tinker, J. Bodkin, D. Monson, and K. Schneider. 2006. Patterns of growth and body condition in sea otters from the Aleutian archipelago before and after the recent population decline. J. of Animal Ecol. 75:978–989.

Bodkin, J.L., B.E. Ballachey, T.A. Dean, A.K. Fukuyama, S.C. Jewett, L. McDonald, D.H. Monson, C.E. O'Clair, and G.R. VanBlaricom. 2002. Sea otter population status and the process of recovery from the 1989 'Exxon Valdez' oil spill. Marine Ecology Progress 241:237-253.

Dean, T.A., J.L. Bodkin, A.K. Fukuyama, S.C. Jewett, D.H. Monson, C.E. O'Clair, and G.R. VanBlaricom. 2002. Food limitation and the recovery of sea otters following the 'Exxon Valdez' oil spill. Marine Ecology Progress Series. 241:255-270.

Doak, D.F., J.A. Estes, B.S. Halpern, U. Jacob, D.R. Lindberg, J. Lovvorn, D.H. Monson, M.T. Tinker, T.M. Williams, J.T. Wootton, I. Carroll, M. Emmerson, F. Micheli, and M. Novak. 2008. Understanding and Predicting Ecological Dynamics: Are Major Surprises Inevitable? Ecology 89:952-961.

Newsome, S.D., M.T. Tinker, D. Monson, O.T. Oftedal, K. Ralls, M.M. Staedler, M.L. Fogel, and J.A. Estes. 2009. Using stable isotopes to investigate individual diet specialization in California sea otters (*Enhydra lutris nereis*). Ecology 90:961-974.

Monson, D.H., Daniel F. Doak, Brenda E. Ballachey, and James L. Bodkin. 2011. Effect of the *Exxon Valdez* oil spill on the sea otter population of Prince William Sound, Alaska: Do lingering oil and *source-sink* dynamics explain the long-term population trajectory? Ecological Applications 21(8):2917-2932.

Bodkin, J.L B.E. Ballachey, H.A. Coletti, G. G. Esslinger, K.A. Kloecker, S.D. Rice, J. A. Reed, and D. H. Monson. 2012. Long-term effects of the *Exxon Valdez* oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. Marine Ecology Progress Series 447:273-287.

Ballachey, B.E., J.L. Bodkin and D.H. Monson. 2013. Quantifying long-term risks to sea otters from the 1989 'Exxon Valdez' oil spill: Reply to Harwell & Gentile (2013). Marine Ecology Progress Series 488: 297–301.

Ballachey, B.E., D.H. Monson, G.G. Esslinger, K. Kloecker, J. Bodkin, L. Bowen, and A.K. Miles. 2014. 2013 update on sea otter studies to assess recovery from the 1989 *Exxon Valdez* oil spill, Prince William Sound, Alaska: U.S. Geological Survey Open-File Report 2014-1030, 40 p., http://dx.doi.org/10.3133/ofr20141030.

Esslinger, G.G., J.L. Bodkin, A. Brenton, J.M. Burns, and D.H. Monson. 2014. Temporal patterns in the foraging behavior of sea otters in Alaska. Journal of Wildlife Management 78:689-700.

Monson, D.H. and L. Bowen. 2015. Evaluating the Status of Individuals and Populations: Advantages of Multiple Approaches and Time Scales. In: *Sea Otter Conservation,* S.E. Larson, J.L. Bodkin and G.R. VanBlaricom (eds). Elsevier, London. Pp. 63-88.

Monson, D.H., T.A. Dean, M.R. Lindeberg, J.L. Bodkin, H.A. Coletti, D. Esler, K.A. Kloecker, B.P. Weitzman and B.E. Ballachey. 2015 Pacific blue mussel (*Mytilus trossulus*) abundance in the Gulf of Alaska: synthesis of gulf watch data (2006-2013) and a consideration of major recruitment events (1989-2013). Report to the EVOS Trustee Council, Anchorage, AK 39 pp.

Recent collaborators:
Dr. B. Ballachey, (emeritus) Alaska Science Center, USGS, Anchorage, AK, Mr. J. Bodkin, (emeritus) Alaska Science Center, USGS, Anchorage, AK, Dr. L. Bowen, Western Ecological Research Center, USGS, Davis, CA, Ms. H. Coletti, National Park Service, Fairbanks, AK, Dr. T. Dean, Coastal Resources, Carlsbad, CA, Dr. D. Esler, Alaska Science Center, USGS, Anchorage, AK, Dr. J. Estes, Univ. of California Santa Cruz, Santa Cruz, CA Dr. D. Doak, Univ. of Colorado, Boulder, CO, Mr. J. Garlich-Miller, US Fish & Wildlife Service, Anchorage, AK Dr. M. Horning, Alaska SeaLife Center, Seward, AK , Dr. B. Konar, Univ. of Alaska, Fairbanks, AK, Dr. T. Klinger, Univ. of Washington, Seattle, WA, Dr. S. Larson, Seattle Aquarium, Seattle, WA, Ms. M. Lindeberg, Auke Bay Laboratory, NOAA/NMFS, Juneau, AK, Dr. S. Newsome, Univ. of New Mexico, Albuquerque, NM Dr. M. T. Tinker, Western Ecological Research Center, USGS, Santa Cruz, CA, Dr. T. Wootton, Univ. of Chicago, Chicago, IL

Benjamin Weitzman
Wildlife Biologist
Phone : 907-406-3181
Email: bweitzman@usgs.gov

Alaska Science Center	Western Ecological Research Center
Nearshore Marine Ecosystem Research	Santa Cruz Field Station
4210 University Dr.	100 Shaffer Rd.
Anchorage, AK 99508	Santa Cruz, CA 95060

Education

2015-present **Ph.D. Marine Biology *University of Alaska Fairbanks***
Advisors: Dr. Brenda Konar & Dr. Daniel Esler
2010-2013 M.A. Ecology & Evolutionary Biology *University of California, Santa Cruz*
Advisors: Dr. M. Tim Tinker, Dr. James A. Estes, James L. Bodkin, Dr. Laurel Fox, & Dr. Pete Raimondi
2004-2008 B.Sc. Marine Biology. *University of California, Santa Cruz*
Advisor: Dr. Terrie M. Williams

Professional Experience

February 2013 – Present *Wildlife Biologist*: US Geological Survey: Western Ecological Resource Center, Santa Cruz, CA & Alaska Science Center, Anchorage, AK

- Duties include conducting variety of specialized surveys of nearshore organisms in the North Pacific, responsible for data management and analysis in contribution to summaries, reports, and publication. Extensive experience in coordinating field logistics, leading dynamic projects, compilation and synthesis of large data sets, public speaking/outreach on natural history and nearshore ecology (see presentations), and coordination of collaborative intra- and inter-agency projects.
- Supervisors: Dr. Tim Tinker (current, WERC), Dr. Daniel Esler (current, ASC), Dr. Brenda Ballachey (previous, ASC), & George Esslinger (previous, ASC).

April 2010 – February 2013 *Graduate Student Researcher/Biologist.* US Geological Survey: Western Ecological Resource Center & Alaska Science Center

- Similar to current position, Supervisor: Dr. Tim Tinker (current, WERC) & George Esslinger (ASC)

March 2008 – April 2010 *Scientific Aide.* California Dept. Fish & Game, Santa Cruz, CA

- Contributed to field data collections, necropsies, environmental sampling, data management, and laboratory experiments relating to sea otters and nearshore ecosystems. Supervisor: Jack Ames (retired) & Dr. Dave Jessup (retired))

Publications, Reports, & Outreach

- Presented at over 20 conferences, workshop, public lecture, and outreach events between 2010-2015
- Weitzman, B.P., Esslinger, G.G., Bodkin, J.L., Kloecker, K.K., Tinker, M.T., Monson, D.H., Estes, J.A., Esler, D. (*in progress) Changes in unconsolidated benthic ecosystems following the recolonization and growth of sea otters in Glacier Bay, Alaska.*
- Esslinger, G.G., Weitzman, B.P., Bodkin, J.L., Monson, D.H., Tinker, M.T., Kloecker, K.K., Estes, J.A., Esler, D. (*in progress) Dietary patterns associated with the recolonization and growth of sea otters in a soft-sediment*

ecosystem.

- Tinker, M. T., *et al.* (2015, *in progress*) *Sea Otter Population Biology at Big Sur and Monterey California: Investigating the Consequences of Resource Abundance and Anthropogenic Stressors for Sea Otter Recovery.* Open File Report. pp. 1-246.
- Weitzman, B.P., Esslinger, G.G. (2015) *Aerial Sea Otter Abundance Surveys – Prince William Sound, Alaska, Summer 2014*. Administrative report for USFWS Region 7, pp 1-9.
- Tinker, M.T., *et al.* (2014) *Southern Sea Otters in Elkhorn Slough and Sea Otter Recovery Outreach and Education Program, Year-End Report, June 2014*. Annual report to California Coastal Conservancy. pp 1-16.
- Weitzman, B.P., Esslinger, G.G., Bodkin, J.L., (2013) *Using a Diver-operated Suction Dredge to Evaluate the Effects of a Top-predator on Subtidal Soft-sediment Infaunal Bivalve Communities*, in Stellar, D., Lobel, L., eds., Proceedings of the American Academy of Underwater Sciences 31st Symposium, September 24-29, 2012. Monterey, CA: Diving for Science 2012. pp. 103-109.
- Tomoleoni, J.A., Weitzman, B.P., Young, C., Harris, M., Hatfield, B.E., Kenner, M. (2013) *Closed-Circuit Diving Techniques for Wild Sea Otter Capture*, in Stellar, D., Lobel, L., eds., Proceedings of the American Academy of Underwater Sciences 31st Symposium, September 24-29, 2012. Monterey, CA: Diving for Science 2012. pp. 193-199.
- Esslinger, G.G., Bodkin, J.L., Weitzman, B.P. (2013) *Sea otter Population Abundance and Distribution in Glacier Bay, Alaska*. Administrative Report for USFWS Region 7, pp. 1-11.
- Coletti, H. A., Esslinger G.G., and Weitzman, B.P. (2013) *Sea Otter Abundance in Katmai National Park and Preserve: Results from the 2012 Aerial Survey,* Southwest Alaska Network Inventory and Monitoring Program. Natural Resource Technical Report. National Park Service, Fort Collins, Colorado.

Collaborators:

Brenda Konar (UAF), Katrin Iken (UAF), James Estes (UCSC), Michael Kenner (UCSC), Tim Tinker (USGS/UCSC), Daniel Esler (USGS), Kristy Kroeker (UCSC), Doug Rasher (Univ. of Maine), Bob Steneck (Univ. of Maine), Allan Fukuyama (FHT Enivironmental), Gary Shigenaka (NOAA), Tom Dean (CRA), Michelle Staedler (Monterey Bay Aquarium), Angela Doroff (UAA), Nicole Thometz (UCSC), Zach Randell (OSU), George Esslinger (USGS), Kim Kloecker (USGS), Daniel Monson (USGS), Joe Tomoleoni (USGS), Brian Hatfield (USGS), Colleen Young (CDFW), Michael Harris (CDFW), Matt Edwards (SDSU), Genoa Sullaway (SDSU), Scott Gabara (SDSU)

Brenda Konar
Professor
School of Fisheries and Ocean Sciences, University of Alaska Fairbanks
P.O. Box 757220, Fairbanks, Alaska 99775
e-mail: bhkonar@alaska.edu, phone: 907-474-5028 / fax: 907-474-5804

Academic Preparation

San Jose State University, San Jose, CA	Zoology	B.A. 1986
Moss Landing Marine Laboratories, CA	Marine Sciences	M.S. 1991
University of California, Santa Cruz	Biology	Ph.D. 1998

Appointments

2014-Present	Associate Dean, School of Fisheries and Ocean Sciences (SFOS), University of Alaska Fairbanks (UAF)
2014-present	Director, Coastal Marine Institute, SFOS, UAF
2012-2014	Academic Program Head, Graduate Program in Marine Sciences and Limnology, UAF
2009-Present	Professor, SFOS, UAF
2006-Present	Science Director. Kasitsna Bay Laboratory
2004-2009	Associate Professor. SFOS, UAF
2000-2004	Assistant Professor, SFOS, UAF
1999-2000	Research Assistant Professor, SFOS, UAF

Example of Recent Publications (* denotes students)

*Ravelo AM, B Konar and BA Bluhm. 2015. Spatial variability of epibenthic communities on the Alaska Beaufort Shelf. Polar Biology DOI 10.1007/s00300-015-1741-9

*Stewart N, B Konar. MT Tinker. 2015. Testing the nutritional-limitation, predator-avoidance, and storm-avoidance hypotheses for restricted sea otter habitat use in the Aleutian Islands, Alaska. Oecologia 177:645-655

Konar B, M Edwards, *T Efird. 2015. Local habitat and regional oceanographic influence on fish distribution patterns in the diminishing kelp forests across the Aleutian Archipelago. Environmental Biology of Fishes. DOI: 10.1007/s10641-015-0412-6.

* Stewart N, B Konar, A Doroff. 2014. Sea otter (*Enhydra lutris*) foraging habitat use in a heterogeneous environment in Kachemak Bay off Alaska. Bulletin of Marine Science. 90:921-939.

*Schuster M, B Konar. 2014. Foliose algal assemblages and deforested barren areas: Phlorotannin content, sea urchin grazing and holdfast community structure in the Aleutian dragon kelp, *Eualaria fistulosa*. Marine Biology 161:2319-2332.

Konar B, M Edwards, JA Estes. 2014. Biological interactions maintain the boundaries between kelp forests and urchin barrens in the Aleutian Archipelago. Hydrobiologia 724:91-107.

*Efird T, B Konar. 2013. Habitat characteristics can influence fish assemblages in high latitude kelp forests. Environmental Biology of Fishes 97:1253-1263.

Konar B. 2013. Lack of recovery from disturbance in high-Arctic boulder communities. Polar Biology 36:1205-1214.

*Deiman M, K Iken, B Konar. 2012. Susceptibility of *Nereocystis luetkeana* (Laminariales, Ochrophyta) and *Eualaria fistulosa* (Laminariales, Ochrophyta) spores to sedimentation. Algae 27:115-123

Konar B, K Iken, JJ Cruz-Motta, L Benedetti-Cecchi, A Knowlton, G Pohle, P Miloslavich, M Edwards, T Trott, E Kimani, R Riosmena-Rodriguez, M Wong, S Jenkins, A Silva, I Sousa Pinto, Y Shirayama. 2010. Current patterns of macroalgal diversity and biomass in northern hemisphere rocky shores. PLoS ONE 5:e13195.

Synergistic Activities

Development of Curricular Materials (courses not previously taught at UAF):

Field Topics in Marine Biology, Kelp Forest Ecology, Scientific Diving, and several seminars including Macroalgae, Controversies in Science, and Professional Development

Development of Curricular Materials (Book Chapter and teaching publication):

Pearse JS, MH Carr, CH Baxter, JM Watanabe, MS Foster, DL Steller, JA Coyer, **B Konar,** DO Duggin and PK Dayton. 2013: Kelpbeds as classrooms: Perspectives and lessons learned. *In*: Research and Discoveries: The revolution of science through scuba, Lang M (ed). Smithsonian Contributions to the Marine Science 39.

Konar B, K Iken, G Pohle, P Miloslavich, JJ Cruz-Motta, L Benedetti-Cecchi, E Kimani, A Knowlton, T Trott, T Iseto and Y Shirayama. 2010. Surveying nearshore biodiversity. In: AD McIntyre (ed) Life in the World's Oceans: Diversity, Distribution, and Abundance Blackwell Publishing Ltd. (Oxford). pp 27-41.

Committee examples:

International: Natural Geography Inshore Areas (NaGISA) Steering Committee (past co-PI)
National: National Research Council Study Committee for the North Pacific Research Board (past)
State: Kachemak Bay National Research Reserve Advisory Council (current)

Examples of Outreach:

K-12 presentations at 16 different schools, Alaska native community presentations at 10 different communities in Alaska, multiple media interactions.
Worked with PolarTREK teachers in the Arctic and Antarctic.

Collaborators

Dr. Brenda Ballachey (USGS), Dr. Lisandro Benedetti-Cecchi (University of Pisa, Italy), James Bodkin (USGS), Dr. J Byrnes (University of Massachusetts Boston), Dr. Mark Carr (University of California Santa Cruz), Heather Coletti (National Park Service), Dr. Lee Cooper (University of Tennessee), Dr. Juan J. Cruz (Simon Bolivar University, Venezuela), Dr. Ken Dunton (University of Texas), Dr. Matt Edwards (San Diego State University), Dr. Dan Esler (USGS), Dr. James Estes (University of California Santa Cruz), Dr. Jackie Grebmeier (University of Tennessee), Dr. Kris Holderied, (NOAA), Dr. Katrin Iken (University of Alaska Fairbanks), Mandy Lindeberg (NOAA), Dr. Patricia Miloslavich (Simon Bolivar University, Venezuela), Dr. Brenda Norcross (UAF), Dr. John Pearse (University of California Santa Cruz), Dr. Gerhard Pohle (The Huntsman Marine Science Centre, Canada), Dr. Yoshihisa Shirayama (Seto Marine Biological Lab, Kyoto University, Japan), Dr. Tim Tinker (University of California Santa Cruz), Dr. John Trefry (Florida Institute of Technology)

Katrin B. Iken
Professor in Marine Biology
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
Fairbanks, AK 99775-7220
kbiken@alaska.edu, **office phone: 907-474-5192**

Professor in Marine Biology, University of Alaska Fairbanks, 2002-present
1999 - 2001 Postdoctoral Research Fellow, University of Alabama at Birmingham
1996 - 1999 Postdoctoral Research Fellow, Alfred Wegener Institute, Germany
1995 Ph.D. Alfred Wegener Institute for Polar and Marine Research, Germany
1991 M.S. University of Bayreuth, Germany
1987 B.S. University of Düsseldorf, Germany

Dr. Katrin Iken is a Professor in Marine Biology at UAF and a benthic ecologist with research interests in the Arctic and in nearshore regions of Alaska. Her main research focus is on community structure, biodiversity, and food web structure and energy flow through ecosystems. She spends considerable time every year in the field conducting intertidal, nearshore subtidal and ship-based work. She currently is the project lead or co-PI of 12 externally funded research projects. She also teaches at UAF and advises several graduate students involved in her research programs.

Relevant Peer-Reviewed Publications (out of 83 total)
(* denotes student author)

Duffy JE, Reynolds PL, Boström C, Coyer JA, Cusson M, Donadi, S, Douglass GJ, Eklöf JS, Engelen AH, Eriksson BK, Fredriksen S, Gamfeldt L, Gustafsson C, Hoarau G, Hori M, Hovel K, **Iken K,** and 11 others (2015) Biodiversity mediates top–down control in eelgrass ecosystems: a global comparative-experimental approach. Ecol Lett 18: 696-705

Divine LM*, **Iken K**, Bluhm B (2015) Regional benthic food web structure on the Alaska Beaufort Sea shelf. Mar Ecol Prog Ser 531: 15-32, doi: 10.3354/meps11340

Iken K, Bluhm BA, Søreide JE (2013) Arctic benthic communities. Arctic Report Card Update for 2013. http://www.arctic.noaa.gov/reportcard/benthic_communities.html

Miloslavich P, Cruz-Motta JJ, Klein E, **Iken K**, Weinberger V, Konar B, and 13 others (2013) Large-scale spatial distribution patterns of gastropod assemblages in rocky shores. PLoS One 8(8): e71396. doi:10.1371/journal.pone.0071396

Murphy M*, **Iken K** (2013) Larval brachyuran crab timing and distribution in relation to water properties and flow in a high-latitude estuary. *Estuaries and Coasts* 37: 177-190. DOI 10.1007/s12237-013-9668-2

Spurkland T*, **Iken K**. (2012) Seasonal growth patterns of *Saccharina latissima* in a glacially-influenced subarctic estuary. *Phycological Research* 60: 261-275. DOI 10.1111/j.1440-1835.2012.00657.x

Deiman M*, **Iken K**, Konar B (2012) Susceptibility of *Nereocystis luetkeana* (Laminariales, Ochrophyta) and *Eualaria fistulosa* (Laminariales, Ochrophyta) spores to sedimentation. *Algae* 27: 115-123

Iken K (2012) Grazers on benthic seaweeds. In: Wiencke C, Bischof K (eds) Seaweed Biology: Novel Insights into Ecophysiology, Ecology and Utilization. Ecological Studies, Springer Verlag, Berlin, pp 157-176.

Dubois A*, **Iken K** (2012) Seasonal variation in kelp phlorotannins in relation to grazer abundance and environmental variables in the Alaskan sublittoral zone. *Algae* 27: 9-19. DOI 10.4490/algae.2012.27.1.001

1987 Spurkland T*, **Iken K** (2011) Salinity and irradiance effects on growth and maximum quantum yield of photosynthesis of subarctic *Saccharina latissima* (Laminariales, Laminariaceae). *Botanica Marina* 54: 355-365, doi:10.1515/BOT.2011.042

1988 Spurkland T*, **Iken K** (2011) Kelp bed dynamics in estuarine environments in subarctic Alaska. *Journal of Coastal Research* 27: 133-143. doi:10.2112/JCOASTRES-D-10-00194.

Pohle G, **Iken K**, Clarke KR, Trott T, Konar B, and 11 others (2011) Aspects of benthic decapod diversity and distribution from rocky nearshore habitat at geographically widely dispersed sites. *PLoS One* 6(4): e18606. doi:10.1371/journal.pone.0018606

Cruz-Motta JJ, Miloslavich P, Palomo G, **Iken K**, Konar B, Pohle G, and 15 others (2010) Patterns of spatial variation of assemblages associated with intertidal rocky shores: a global perspective. *PLoS One* 5(12): e14354

Iken K, Konar B, Benedetti-Cecchi L, Cruz-Motta JJ, and 14 pothers (2010) Large-scale spatial distribution patterns of echinoderms in nearshore rocky habitats. *PLoS One* 5(11): e13845

Konar B, **Iken K**, Cruz-Motta JJ, Benedetti-Cecchi L, and 13 others (2010) Global patterns of macroalgal diversity and biomass in rocky nearshore environments. *PLoS One* 5(10): e13195

Konar B, **Iken K**, Pohle G, Miloslavich P, Cruz-Motta JJ, and 6 others (2010) Surveying Nearshore Biodiversity. In: AD McIntyre (ed) Life in the World's Oceans: Diversity, Distribution, and Abundance. Blackwell Publishing Ltd. (Oxford), pp 27-41

Konar B, **Iken K,** Edwards M (2009) Depth-stratified community zonation patterns on Gulf of Alaska rocky shores. *Marine Ecology* 30: 63-73

Konar B, **Iken K** (2009) Influence of taxonomic resolution and morphological functional groups in multivariate analyses of macroalgal assemblages. *Phycologia* 48: 24-31

Hondolero DE*, Konar B, **Iken K,** Chenelot H (2007) Variation in low Intertidal Communities: Submerged vs. Emerged. In: Rigby P.R. and Shirayama Y. (eds) Selected Papers of the NaGISA World Congress 2006, Publications of the Seto Marine Biological Laboratory, Special Publication Series Vol. VIII. pp 29-36

Chenelot HA, **Iken K,** Konar B, Edwards M (2007) Spatial and Temporal Distribution of Echinoderms in Rocky Nearshore Areas of Alaska In Rigby P.R. and Shirayama Y. (eds) Selected Papers of the NaGISA World Congress 2006, Publications of the Seto Marine Biological Laboratory, Special Publication Series Vol. VIII. pp 11-28

Rigby R, **Iken K,** Shirayama, Y (2007) *Sampling biodiversity in coastal communities.* Kyoto University Press. pp. 145

Collaborators (other than co-PIs of this proposal and co-authors listed above)

C. Amsler (UAB), C. Ashjian (WHOI), P. Archambault (UQR, Canada), B. Baker (USFS), S. Budge (Dalhousie), M. Blicher (Greenland IMR), R.E. Collins (UAF), L. Cooper (UM), N. Denisenko (RAS, Russia), E. Duffy (VIMS), K. Dunton (UT Austin), N. Foster (UAF), R. Gradinger (UAF), J. Grebmeier (UM), M. Hoberg (UAF), K. Holderied (NOAA-NCCOS), K. Kuletz (USFWS), J. McClintock (UAB), S. Moore (NOAA), S. Saupe (CIRCAC), K. Stafford (UW-APL), C. Wiencke (AWI, Germany)

Brenda E. Ballachey
Scientist Emeritus
6 Varbay Place NW, Calgary, Alberta T3A 0C8
beballachey@gmail.com 403/397-3073 (cell phone)

EDUCATION

Oregon State University, Corvallis, Oregon - Ph.D., 1985
Colorado State University, Fort Collins, Colorado - M.S., 1980
Colorado State University, Fort Collins, Colorado - B.S. with distinction, 1974

PROFESSIONAL EXPERIENCE

USGS Emeritus, Alaska Biological Science Center, USGS, Anchorage, AK
December 2015, ongoing

Research Physiologist, Alaska Biological Science Center, USGS, Anchorage, AK,
(formerly U.S. National Biological Service; U.S. Fish & Wildlife Service)
July 1990 to November 2015 (retired November 2015): Research on marine nearshore ecosystems, with emphasis on studies of long-term effects of the *Exxon Valdez* oil spill on the sea otters and nearshore communities.

General Biologist, Alaska Fish and Wildlife Research Center, USFWS, Anchorage, AK,
November 1989 to July 1990: Research on sea otters, with emphasis on studies of acute effects of the *Exxon Valdez* oil spill on the sea otters.

Staff Officer, Board on Agriculture, National Research Council, Washington, DC, USA,
March 1987 to November 1989: Worked with the Committee on Managing Global Genetic Resources on conservation of genetic diversity in agricultural species, encompassing crops, livestock, forests and fisheries.

Research Associate, Department of Chemistry, South Dakota State University, Brookings.
January 1986 to March 1987: Post-doctoral appointment to conduct research on the relation between stability of DNA in spermatozoa and male fertility, using flow cytometry to evaluate DNA.

SELECTED PUBLICATIONS

Bowen, L., A.K. Miles, B. **Ballachey**, S. Waters and J. Bodkin. In review. Gene transcript profiling in sea otters post-*Exxon Valdez* oil spill: A tool for marine ecosystem health assessment. J. Mar. Sci. Eng.

Coletti, H.A., J.L. Bodkin, D.H. Monson, B.E. **Ballachey** and T.A. Dean. In review. Engaging form and function to detect and infer cause of change in an Alaska marine ecosystem. Ecosphere.

Ballachey, B.E., J.L. Bodkin, D. Esler and S.D. Rice. 2015. Lessons from the 1989 *Exxon Valdez* oil spill: a biological perspective. Chapter 9 in: J.B. Alford, M.S. Peterson and C.C. Green, Eds. Impacts of Oil Spill Disasters on Marine Habitats and Fisheries in North America. CRC Marine Biology Series.

Ballachey, B.E. and J.L. Bodkin. 2015. Challenges to sea otter recovery and conservation. Chapter 4 in J. Bodkin, S. Larson and G. VanBlaricom, Eds. Sea Otter Conservation Elsevier.

Ballachey, B.E., J.L. Bodkin, K.A. Kloecker, T.A. Dean, and H.A. Coletti. 2015. Monitoring for Evaluation of Recovery and Restoration of Injured Nearshore Resources. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 10100750), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Bowen, L., Miles, A.K., **Ballachey**, B.E., Bodkin, J.L., and Esler, D. 2015. Gulf Watch Alaska Long-term Monitoring Program - Evaluating Chronic Exposure of Harlequin Ducks and Sea Otters to Lingering Exxon Valdez Oil in Western Prince William Sound. Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 12120114-Q), Pacific Wildlife Foundation and Centre for Wildlife Ecology, Simon Fraser University, Delta, British Columbia, Canada. U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Ballachey, B.E., D.H. Monson, G.G. Esslinger, K. Kloecker, J. Bodkin, L. Bowen and A.K. Miles. 2014. 2013 update on sea otter studies to assess recovery from the 1989 *Exxon Valdez* oil spill, Prince William Sound, Alaska: US Geological Survey Open-File Report 2014-1030, 40p. http://dx.doi.org/10.3133/ofr20141030.

Bodkin, J.L., D. Esler, S.D. Rice, C.O. Matkin, and B.E. **Ballachey**. 2014. The effects of spilled oil on coastal ecosystems: lessons from the *Exxon Valdez* spill. In: B. Maslo and J.L. Lockwood, Eds. Coastal Conservation. Cambridge University Press. Pp. 311-346.

Ballachey, B.E., J.L. Bodkin and D.H. Monson. 2013. Quantifying long-term risks to sea otters from the 1989 'Exxon Valdez' oil spill: Reply to Harwell & Gentile (2013). Mar Ecol Prog Ser 488: 297-301.

Bodkin, J.L, B.E. **Ballachey**, H.A. Coletti, G.G. Esslinger, K.A. Kloecker, S.D. Rice, J.A. Reed, and D.H. Monson. 2012. Long-term effects of the *Exxon Valdez* oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. Mar Ecol Prog Ser 447:273-287.

Bowen, L. A.K. Miles, M. Murray, M. Haulena, J. Tuttle, W. Van Bonn, L. Adams, J.L. Bodkin, B.E. **Ballachey**, M. T. Tinker, R. Keister, and J.L. Stott. 2012. Gene Transcription in Sea Otters (*Enhydra lutris*); Development of a diagnostic tool for sea otter and ecosystem health. Molec Ecol Res 12: 67-74

Miles , A.K., L. Bowen, B E. **Ballachey**, J.L. Bodkin, M. Murray, J.A. Estes, R.A. Keister and J.L. Stott. 2012. Gene transcription in sea otters (*Enhydra lutris*) two decades post *Exxon Valdez*. Mar Ecol Prog Ser 451:201-212.

Monson, D.H., D.F. Doak, B.E. **Ballachey** and J.L. Bodkin. 2011. Could residual oil from the *Exxon Valdez* spill create a long-term population “sink” for sea otters in Alaska? Ecol Appl 21(8)2917–2932.

Esler, D., K.A. Trust, B.E. **Ballachey**, S.A. Iverson, T.L. Lewis, D.J. Rizzolo, D.M. Mulcahy, A.K. Miles, B.R. Woodin, J.J. Stegeman, J.D. Henderson, and B.W. Wilson. 2010. Cytochrome P4501A biomarker indication of oil exposure in harlequin ducks up to 20 years after the *Exxon Valdez* oil spill. Environ Toxicol Chem 29(5):1138-1145.

Peterson, C.H., S.D. Rice, J.W. Short, D. Esler, J.L. Bodkin, B.E. **Ballachey**, and D.B. Irons. 2003. Long-term ecosystem response to the Exxon Valdez oil spill. Science 302:2082-2086.

Bodkin, J.L., B.E. **Ballachey**, T.A. Dean, S. Jewett, L. McDonald, D. Monson, C. O’Clair, and G. VanBlaricom. 2002. Recovery of sea otters in Prince William Sound following the *Exxon Valdez* oil spill. Mar Ecol Prog Ser 241:237-253.

COLLABORATORS

Bodkin, J., USGS; Bowen, L., USGS/UC Davis; Coletti, H., NPS; Esslinger, G., USGS; Dean, T., Coastal Resources Associates; Doroff, A., ADF&G/UAA; Counihan, K., Alaska SeaLife Center; Esler, D., USGS; Holdried, K., NOAA Kasitsna Bay Lab; Hoffman, K., PWSSC, Cordova; Hollmen, T., Alaska SeaLife Center; Howlin, S., West Ecosystems Technology; Kloecker, K., USGS; Larson, S., Seattle Aquarium; Lipscomb, T., DVM. Diplomate ACVP; Lindeberg, M., NOAA; Matkin, C., North Gulf Oceanographic Society; McCammon, M., AOOS, Anchorage; Miles, A.K., USGS; Mohr, F.C., UC Davis; Monson, D., USGS; Murray, M., Monterey Bay Aquarium; Newsome, S., UNM; Rice, S., NOAA retired; Speckman, S., USFWS; Von Biela, V., USGS; Weitzman, Ben, USGS. (Note: full listing of Gulf Watch Alaska PI’s not given here; available upon request).

James L. Bodkin,
Scientist Emeritus
Alaska Science Center, US Geological Survey
92 West Vancouver Dr. Port Townsend, WA 98368
jldbodkin@gmail.com cell 917-873-2799

Research Wildlife Biologist, Alaska Science Center, 1991-2013
1985 - MS, California Polytechnic State University, San Luis Obispo, CA. (Wildlife Biology)
1976 - BS, Long Beach State University (Biology), Long Beach, CA

Jim led the Coastal Ecosystems research program for the Alaska Science Center, US Geological Survey from 1991 until his retirement in 2013. At that time he accepted an emeritus position and continues to pursue his research interests in coastal marine ecology and long term ecological monitoring. As project leader Jim supervised and managed all activities associated with a complex and diverse array of research projects internal to the Alaska Science Center and collaborated with at least 14 agencies, academic or private institutions on cooperative, multi-disciplinary projects.

Relevant Publications

Ricca, M.A., A.K.Miles, B.E. Ballachey, J.L. Bodkin, D.E. Esler, and K.A. Trust. 2010. PCB exposure in sea otters and harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. Marine Pollution Bulletin.

Monson, D.H., Daniel F. Doak, Brenda E. Ballachey, and James L. Bodkin. 2011. Effect of the *Exxon Valdez* oil spill on the sea otter population of Prince William Sound, Alaska: Do lingering oil and *source-sink* dynamics explain the long-term population trajectory? Ecological Applications 21(8):2917-2932.

Bodkin, J.L., B.E. Ballachey, and G.G. Esslinger. 2011, Trends in sea otter population abundance in western Prince William Sound, Alaska: Progress toward recovery following the 1989 *Exxon Valdez* oil spill: U.S. Geological Survey Scientific Investigations Report 2011-5213 14 p.

Bodkin, J.L B.E. Ballachey, H.A. Coletti, G. G. Esslinger, K.A. Kloecker, S.D. Rice, J. A. Reed, and D. H. Monson. 2012 Long-term effects of the Exxon Valdez oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. Marine Ecology Progress Series 447:273-287.

Bowen, L. A.K. Miles, M. Murray, M. Haulena, J. Tuttle, W. Van Bonn, L. Adams, J.L. Bodkin, B.E. Ballachey, M. T. Tinker, R. Keister, and J.L. Stott. 2012 Gene transcription in sea otters (*Enhydra lutris*); Development of a diagnostic tool for sea otter and ecosystem health. Molecular Ecology Resources 12: 67-74

Miles , A.K., L Bowen, B E. Ballachey, J.L. Bodkin, M. Murray, J.A. Estes, R.A. Keister and J.L. Stott. 2012. Variation in transcript profiles in sea otters (*Enhydra lutris*) from Prince William Sound, Alaska and clinically normal reference otters. Marine Ecology Progress Series 451:201-212.

Ballachey, B.E., J.L. Bodkin and D.H. Monson. 2013. Quantifying long-term risks to sea otters from the 1989 'Exxon Valdez' oil spill: Reply to Harwell & Gentile (2013). Marine Ecology Progress Series 488: 297–301.

Bodkin, J.L., D. Esler, S.D. Rice, C.O. Matkin, and B.E. Ballachey. 2014. The effects of spilled oil on coastal ecosystems: lessons from the Exxon Valdez spill. In Maslo, B. and J.L. Lockwood (eds), Coastal Conservation. Cambridge University Press, NY. Pp. 311-346.

L. Bowen, A. K. Miles, C. A. Kolden, J.A. Saarinen, J. L. Bodkin, M. Murray, M. T. Tinker. 2015. Effects of wildfire on sea otter (*Enhydra lutris*) gene transcript profiles Marine Mammal Science 31:1: 191-210.

Ballachey, B. E., J. L. Bodkin, D. Esler, and S. D. Rice. 2014. Lessons from the 1989 *Exxon Valdez* oil spill: A biological perspective. Pages 181-197 *in* Alford, J. B., M. S. Peterson, and C. C. Green (eds.), Impacts of Oil Spill Disasters on Marine Habitats and Fisheries in North America. CRC Press, 320 p.

Larson, S.E, J.L. Bodkin and G.R. VanBlaricom (eds). 2015. Sea Otter Conservation. Elsevier, London. 468 pages.

Larson, S.E and J.L. Bodkin. 2015. The conservation of sea otters: a prelude. In: *Sea Otter Conservation,* S.E. Larson, J.L. Bodkin and G.R. VanBlaricom (eds). Elsevier, London. Pp. 2-15.

Ballachey, B.E. and J.L. Bodkin. 2015. Challenges to sea otter recovery and conservation. In: *Sea Otter Conservation,* S.E. Larson, J.L. Bodkin and G.R. VanBlaricom (eds). Elsevier, London. Pp. 63-88.

Recent collaborators:
Dr. B.E. Ballachey, Alaska Science Center, US Geological Survey
Dr. L. Bowen, Western Ecological Research Center, US Geological Survey
Dr. D.E. Esler, Alaska Science Center, US Geological Survey
Dr. J. A. Estes, Univ. CA, Santa Cruz
Dr. D. Doak, Univ. Colorado
Dr. C. Kolden, Univ. Idaho
Dr. S. Larson, Seattle Aquarium
C. Matkin, North Gulf Oceanic Society
Dr. K. Miles, Western Ecological Research Center, US Geological Survey
Dr. M. Murray, Monterey Bay Aquarium
Dr. S. Newsome, Univ. New Mexico
Dr. J.A. Saarinen, Univ. Michigan
Dr. S.D. Rice, Auke Bay Lab, NOAA
Dr. M.Tinker, Western Ecological Research Center, US Geological Survey
Dr. G. VanBlaricom, Washington Cooperative Fish and Wildlife Research Unit, USGS

George G. Esslinger
U.S. Geological Survey
4210 University Drive
Anchorage, AK 99508
907-786-7044 (Office)
gesslinger@usgs.gov

Education

2011 - Master of Science, Biological Sciences, University of Alaska, Anchorage, AK
1993 - Bachelor of Science, Wildlife, Humboldt State University, Arcata, CA

Work experience

11/98 – present	Zoologist, U.S. Geological Survey, Anchorage, AK
10/96 – 11/98	Fish and Wildlife Biologist, U.S. Geological Survey, Anchorage, AK
04/95 – 10/96	Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Anchorage, AK
04/93 – 04/95	Biological Science Technician, U.S. Fish and Wildlife Service, Anchorage, AK

Professional licenses and memberships

Member, USGS Diving Safety Board, 2010-present, Anchorage, AK
Research Vessel Manager, U.S. Geological Survey, 2006-present, Anchorage, AK
Oxygen Rebreather Diver, Aqua Lung, 2006, Vista, CA
Master 50-100 ton License, U.S. Coast Guard, 1999-present, Anchorage, AK
Motorboat Operator Instructor, Department of Interior, 1997, Lake Mead, NV
Divemaster, NOAA Dive Program, 1996, Seattle, WA
Working Diver, NOAA Dive Program, 1994, Seattle, WA

Publications

Monk, M. H., G.G. Esslinger, V. A. Gill, M. Mangel, and M.T. Tinker. In prep. Abundance and carrying capacity of the Southeast Alaska stock of northern sea otters. Ecological Applications.

Esslinger, G.G., B. P. Weitzman, J.L. Bodkin, D.H. Monson, K.A. Kloecker, M.T. Tinker, J.A. Estes, D. Esler. In prep. Dietary patterns associated with the colonization and growth of sea otters in a soft-sediment ecosystem. Marine Ecology Progress Series.

Weitzman, B.P. , Esslinger, G.G. , J.L. Bodkin, D.H. Monson, K.A. Kloecker, M.T. Tinker, J.A. Estes, and D. Esler. In prep. Changes in unconsolidated benthic ecosystems following the recolonization and growth of sea otters in Glacier Bay, Alaska.

Esslinger, G.G., B. Ballachey, D. Esler, S. Howlin, and L. Starcevich. 2015. Monitoring population status of sea otters (*Enhydra lutris*) in Glacier Bay National Park and Preserve—Options and considerations. U.S. Geological Survey Open-File Report 2015-1119, 42 p., http://dx.doi.org/10.3133/ofr20151119.

Esslinger, G.G., B.E. Ballachey, and J.L. Bodkin, 2014, Sea otter abundance in Western Prince William Sound, through 2013, pages 5-10 in Ballachey, B.E., Monson, D.H., Esslinger, G.G., Kloecker, K., Bodkin, J., Bowen, L., and Miles, A.K., eds., 2013 Update on sea otter studies to assess recovery from the 1989 Exxon Valdez oil spill, Prince William Sound, Alaska. U.S. Geological Survey Open-File Report 2014-1030, http://dx.doi.org/10.3133/ofr20141030.

Esslinger, G.G., J.L. Bodkin, A.R. Breton, J.M. Burns, D.M. Monson. 2014. Temporal patterns in the foraging behavior of sea otters in Alaska. Journal of Wildlife Management 78(4):689-700.

Bodkin, J.L., B.E. Ballachey, H.A. Coletti, G.G. Esslinger, K.A. Kloecker, S.D. Rice, J.A. Reed, and D.H. Monson. 2012. Long-term effects of the Exxon Valdez oil spill: Sea otter foraging in the intertidal as a pathway of exposure to lingering oil. Marine Ecology Progress Series 447:273-287.

Bodkin, J.L., B.E. Ballachey, and G.G. Esslinger. 2011. Trends in sea otter population abundance in western Prince William Sound, Alaska: Progress toward recovery following the 1989 *Exxon Valdez* oil spill. U.S. Geological Survey Scientific Investigations Report 2011–5182, 14 p.

Esslinger, G. G. 2011. Temporal patterns in the behavior and body temperature of sea otters in Alaska. M.S. Thesis, Department of Biological Sciences, University of Alaska, Anchorage. 74 pp.

Jewett, S. C., J. L. Bodkin, H. Chenelot, G. G. Esslinger, and M. K. Hoberg. 2010. The Nearshore Benthic Community of Kasatochi Island, One Year after the 2008 Volcanic Eruption. Arctic, Antarctic, and Alpine Research 42(3):315-324. DOI:10.1657/1938-4246-42.3.315

Esslinger, G.G., and J.L. Bodkin. 2009. Status and Trends of Sea Otter Populations in Southeast Alaska, 1969-2003. U.S. Geological Survey Scientific Investigations Report 2009–5045, 19 p.

Bodkin, J. L., D. H. Monson, and G. G. Esslinger. 2007. Activity budgets derived from time-depth recorders in a diving mammal. Journal of Wildlife Management 71(6):2034-2044.

Bodkin, J. L., B. E. Ballachey, G. G. Esslinger, K. A. Kloecker, D. H. Monson, and H. A. Coletti. 2007. Perspectives on an invading predator, Sea otters in Glacier Bay. Pages 133-136 *in* J. F. Piatt and S. M. Gende, eds., Proceedings of the Fourth Glacier Bay Science Symposium, 2004, October 26-28, 2004: U.S. Geological Survey Scientific Investigations Report, Anchorage, AK.

Bodkin, J. L., G. G. Esslinger, and D. H. Monson. 2004. Foraging depths of sea otters and implications to coastal marine communities. Marine Mammal Science 20(2):305-321.

Collaborators:

Dr. Brenda Ballachey (USGS), Mr. James Bodkin (USGS), Mr. Michael Bower (NPS), Dr. McCrea Cobb (USFWS), Ms. Heather Coletti (NPS), Dr. Dan Esler (USGS), Dr. James Estes (University of California Santa Cruz), Ms. Verena Gill (BOEM), Ms. Kim Kloecker (USGS), Dr. Daniel Monson (USGS) , Dr. Mevin Hooten (USGS), Dr. John Piatt (USGS), Dr. Tim Tinker (USGS), Dr. Perry Williams (Colorado State University), Mr. Ben Weitzman (USGS), Dr. Jamie Womble (NPS).

Thomas A. Dean, Ph. D.
Coastal Resources Associates Inc.
5190 El Arbol Dr.
Carlsbad, CA 92008
Phone: (760) 207-0985
Email: tomdean@coastalresources.us

Education

University of Delaware, Ph.D., Biology	1977
East Carolina University, M.A., Biology	1973
Gettysburg College, B.A., Biology	1970

Professional Experience

President 1988 to Present
Coastal Resources Associates, Inc.

Associate Research Biologist 1978 to 1987
University of California, Santa Barbara

Senior Staff Ecologist 1976 to 1978
E.H. Richardson Associates

Selected Publications

Bowyer, R.T., G.M. Blundell, M. Ben-David, S.C. Jewett, T.A. Dean, L.A. Duffy. 2003. Effects of the *Exxon Valdez* oil spill on river otters: injury and recovery of a sentinel species. Wildlife Monographs 67:1-53.

Dean, T.A., J.L. Bodkin, A. Fukuyama, S.C. Jewett, D.H. Monson, C.E. O'Clair, G.R. VanBlaricom. 2002. Food limitation and the recovery of sea otters following the *Exxon Valdez* oil spill. Marine Ecology Progress Series 241:255-270

Deysher, L.E., T.A. Dean, R. Grove, A. Jahn. 2002. Design considerations for an artificial reef to grow giant kelp (*Macrocystis pyrifera*) in Southern California. ICES J. Mar Sci. 217:17-24

Bodkin, J.L., B. Ballachey, T.A. Dean, F.K. Fukuyama, S.C. Jewett, L.L. McDonald, D.H. Monson, C.E. O'Clair, and G.R. Van Blaricom. 2002. Sea otter population status and the process of recovery following the 1989 *Exxon Valdez* oil spill. Marine Ecology Progress Series 241:237-253

Golet, H.G., P.E. Seizer, A.D. McGuire, D.D. Roby, J.B. Fischer, K.J. Kuletz. D.B. Irons, T. A. Dean, S.C. Jewett, and S.H. Newman. 2002. Long-term direct and indirect effects of the the *Exxon Valdez* oil spill on pigeon guillemots in Prince William Sound, Alaska. Marine Ecology Progress Series 241:287-304

Esler, D., T.D. Bowman, K.A. Trust, B.E. Ballachey, T.A. Dean, S.C. Jewett, C.E. O'Clair. 2002. Harlequin duck population recovery following the *Exxon Valdez* oil spill: Progress, process, and constraints. Marine Ecology Progress Series 241: 271-286

Jewett, S.C., T.A. Dean, B.R. Woodin, M.K. Hoberg, and J.L. Stegeman. 2002. Exposure to hydrocarbons ten years after the *Exxon Valdez* oil spill: evidence from cytochrome P4501A expression and biliary FACs in nearshore demersal fishes. Marine Environmental Research. 54:21-48.

Dean, T.A., S.C. Jewett. 2001. Habitat specific recovery of shallow subtidal communities following the *Exxon Valdez* oil spill. Ecological Applications 11:1456-1471.

Esler, D., T.D. Bowman, C.E. O'Clair, T.A. Dean, L.L. McDonald. 2000. Densities of Barrow's Goldeneyes during winter in Prince William Sound, Alaska, in relation to habitat, food, and history of oil contamination. Water Birds 23:423-429

Esler, D., T.D. Bowman, T.A. Dean, C.E. O'Clair, S.C. Jewett, L.L. McDonald. 2000. Correlates of harlequin duck densities during winter in Prince William Sound, Alaska: Condor 102:920-926

Dean T.A., J.L. Bodkin, S.C. Jewett, D.H. Monson, D. Jung. 2000. Changes in sea urchins and kelp following reduction in sea otter density as a result of the *Exxon Valdez* oil spill. Marine Ecology Progress Series 199:281-291

Dean T.A., L. Haldorson, D.R. Laur, S.C. Jewett, A. Blanchard. 2000. The distribution of nearshore fishes in kelp and eelgrass communities in Prince William Sound, Alaska: associations with vegetation and physical habitat characteristics. Environmental Biology of Fishes 57: 271-287

Jewett, S.C., T.A. Dean, R.O. Smith, A. Blanchard. 1999. The *Exxon Valdez* oil spill: Impacts and recovery in the soft-bottom benthic community in and adjacent to eelgrass beds. Mar Ecol Prog Ser 185:59-83

Dean, T.A., K. Thies, S. Lagos. 1989. Survival of juvenile giant kelp: The effects of demographic factors, competitors, and grazers. Ecology 70:483-495

Dean, T.A., F. Jacobsen, K. Thies, S. Lagos. 1988. Differential effects of grazing by white sea urchins on recruitment of brown algae. Mar Ecol. Prog. Series 48:99-102

Dean, T.A., F. R. Jacobsen. 1986. Nutrient-limited growth of juvenile kelp, *Macrocystis pyrifera* during the 1982-1984 "El Nino" in southern California. Mar. Biol. 90:597-601

Dean, T.A. 1985. The temporal and spatial distribution of underwater quantum irradiation in a southern California kelp forest. Estuar. Coast. Shelf Sci. 21:835-601

Dean, T.A., S. Schroeter, J. Dixon. 1984. Effects of grazing by two species of sea urchins (*Strongylocentrotus franciscanus* and *Lytechinus anamesus*) on recruitment and survival of two species of kelp (*Macrocystis pyrifera* and *Pterygophora californica*). Mar. Biol. 78: 301-313

Collaborators:
Dr. B. Ballachey, (emeritus) Alaska Science Center, USGS, Anchorage, AK, Mr. J. Bodkin, (emeritus) Alaska Science Center, USGS, Anchorage, AK, Ms. H. Coletti, National Park Service, Fairbanks, AK, Dr. D. Esler, Alaska Science Center, USGS, Anchorage, AK, Dr. B. Konar, Univ. of Alaska, Fairbanks, AK, Dr. T. Klinger, Univ. of Washington, Seattle, WA, Ms. M. Lindeberg, Auke Bay Laboratory, NOAA/NMFS, Juneau, AK

MANDY R. LINDEBERG
Fisheries Research Biologist
Auke Bay Laboratories, Alaska Fisheries Science Center, NMFS
17109 Pt. Lena Loop Rd, Juneau, Alaska 99801
Phone: (907) 789-6616
FAX: (907) 789-6094
mandy.lindeberg@noaa.gov

Professional Experience

Leadership

- GWA Pelagic Component Lead (since 2013).
- Research Coordinator for Recruitment, Energetics, and Coastal Assessment Program (2011-current) - NMFS Auke Bay Laboratories (ABL).
- Acting Deputy Director for NMFS Auke Bay Laboratories, half a year (2013).
- Core team member of Habitat and Ecological Processes Program, Alaska Fisheries Science Center (AFSC) - developing RFPs, reviewing proposals for scientific merit, and recommendation for funding.
- Chair for Auke Bay Laboratories Data Coordination Committee and member of AFSC Public Access and Research Results (PARR) workgroup.
- Coordinator for Division FOIA responses – NMFS, Auke Bay Laboratories.

Research
1990 - Present: Mandy has been involved in oil spill research and nearshore habitat studies throughout Alaska's coastline, particularly Prince William Sound, for over 25 years. Her research includes damage assessment and long term monitoring of nearshore flora, fauna, and persistence of oil in the EVOS spill region. Mandy has been an integral part of the Gulf Watch Alaska Program serving as Pelagic Component Lead (2013-16), co-Principle Investigator for the Nearshore component (2011-16), and co-Principle Investigator for the Lingering oil component (2011-16). She has been a core steering committee member and a participant in the Alaska *ShoreZone* habitat mapping project for over 12 years. Mandy has also conducted research on essential fish habitat under the Magnuson-Stevens Act, focusing on nearshore forage fish throughout the state. Her specific scientific expertise lies with coastal ecology and specializes in the taxonomy and ecology of seaweeds. All of these studies have enabled her to not only develop a unique knowledge of Alaskan marine ecosystems but also manage all activities associated with a diverse array of research projects and collaborators.

Education: BS 1989, Marine Biology, Western Washington University, Bellingham, Washington.

Publications:

Research Highlights:

Lindeberg, M.R. and S.C. Lindstrom. 2016 re-print. Field Guide to Seaweeds of Alaska. Alaska Sea Grant College Program, University of Alaska Fairbanks, 192 p.
Lindeberg and Johnson, 2015. Alaska Chapter. Our living oceans: Habitat. Status of the habitat of U.S. living marine resources, 1st edition. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-F/SPO-75.
Lindstrom, S. C., M. R. Lindeberg, and D. A. Guthrie. 2015. Marine Macroalgae of the Aleutian Islands: I. Bangiales. Algae, 30(4): 1-17.

Johnson, S. W., A. D. Neff, and M. R. Lindeberg. 2015. A handy field guide to the nearshore fishes of Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-293, 211 p.
Kawai, H., T. Hanyuda, M.R. Lindeberg, and S.C. Lindstrom. 2008. Morphology and molecular phylogeny of *Aureophycus aleuticus* gen. *et* sp. Nov. (Laminariales, Phaeophyceae) from the Aleutian Islands. J. of Phycol. 44:1013-1021.

EVOS Research Highlights:
Lindeberg, M. R. et al. 2014. Variability within pelagic ecosystems of Prince William Sound: introduction to pelagic ecosystem monitoring. Gulf Watch Alaska Program 3 year synthesis Report, *Exxon Valdez* Trustee Council.
Short, J. W., K. R. Springman, M. R. Lindeberg, L. G. Holland, M. L. Larsen, C. A. Sloan, C. Khan, P. V. Hodson, and S. D. Rice. 2008. Semipermeable membrane devices link site-specific contaminants to effects: Part II – A comparison of lingering *Exxon Valdez* oil with other potential sources of CYP1A inducers in Prince William Sound, Alaska. Mar. Environ. Res. 66:487-498.
Springman, K. R., J. W. Short, M. Lindeberg, and S. D. Rice. 2008. Evaluation of bioavailable hydrocarbon sources and their induction potential in Prince William Sound, Alaska. Mar. Environ. Res. 66:218-220.
Springman, K. R., J. W. Short, M. R. Lindeberg, J. M. Maselko, C. Khan, P. V. Hodson, and S. D. Rice. 2008. Semipermeable membrane devices link site-specific contaminants to effects: Part 1 – Induction of CYP1A in rainbow trout from contaminants in Prince William Sound, Alaska. Mar. Environ. Res. 66:477-486.
Thomas, R.E., M. R. Lindeberg, Patricia M. Harris, and Stanley D. Rice. 2007. Induction of DNA Strand Breaks in the Mussel (*Mytilus trossulus*) and Clam (*Protothaca staminea*) Following Chronic Field Exposure to Polycyclic Aromatic Hydrocarbons from the *Exxon Valdez* Spill. Marine Pollution Bulletin. 54: 726-732.
Short J.W., G. V. Irvine, D. H. Mann, J. M. Maselko, J. J. Pella, M. R. Lindeberg, J. R. Payne, W. B. Driskell, and S. D. Rice. 2007. Slightly weathered *Exxon Valdez* oil persists in Gulf of Alaska beach sediments after 16 years. Environ. Sci. Technol. 41:1245-1250.
Short, J.W., J.M. Maselko, M.R. Lindeberg, P.M Harris, and S.D. Rice. 2006. Vertical distribution and probability of encountering intertidal *Exxon Valdez* oil on shorelines of three embayments within Prince William Sound, Alaska. Environ. Sci. and Technol. Vol. 40, 3723-3729.
Short, J.W., M. R. Lindeberg, Patricia M. Harris, J. Maselko, Jerome J. Pella, and S.D. Rice. 2004. An estimate of oil persisting on beaches of Prince William Sound, 12 years after the *Exxon Valdez* oil spill. Environ. Sci. and Technol. Vol 38: 19-25.
O'Clair, Charles E., M. R. Lindeberg, and Joshua Millstein. 2001. "Mesoscale differences in mussel, *Mytilus trossulus*, population structure in Prince William Sound, Alaska in relation to oiling history and predation intensity." Journal of Experimental Marine Biology and Ecology. 262:155-176.
Highsmith, Raymond C., Rucker, T.L., Stekoll, M.S., Saupe, S.M., Lindeberg, M.R., Jenne, R.N., Erickson, W.P. 1996. Impact of the *Exxon Valdez* Oil Spill on Intertidal Biota. American Fisheries Society Symposium 18:212-237.

Collaborators:
Coon, Catherine (BOEM); Eagleton, Mathew (Alaska Regional Office, NMFS); Iken, Katrin (UAF); Hoffman, Christopher (USACOE); Jones, Tahzay (NPS); Konar, Brenda (UAF); Lewis, Steve (Alaska Regional Office, NMFS); Lindstrom, Sandra (UBC); Lauenstein, Gunnar (NOAA); Robertson, Tim (Nuka Research, Inc.);

Saupe, Sue (Cook Inlet RCAC); Schock, Carl (Coastal and Oceans Research, Inc.); Stickle, William (LSU).

ANGELA M. DOROFF
Kachemak Bay National Estuarine Research Reserve, 2181 Kachemak Drive Homer AK 99603, Day Phone: 907-235-4795; Email: adoroff@uaa.alaska.edu

EDUCATION: M.Sc. in Wildlife Ecology (1988) University of Wisconsin, Madison; B.S. in Biology (1984) University of Minnesota, St. Paul

CURRENT POSITION: Kachemak Bay National Estuarine Research Reserve (Reserve), Research Coordinator since11/2008. I supervise the national monitoring program development for water quality, weather, and salt marsh habitats for the Reserve and specialize in the nearshore marine ecology and biological oceanography. The Reserve is a unique organization composed of research, education, and coastal training sectors that collectively benefit the State of Alaska, National Oceans and Atmospheric Administration (NOAA), and the coastal communities in Southcentral Alaska. We conduct locally and nationally relevant research and communicate the science to the public, coastal decision-makers, and other scientists. I serve as the sea otter representative to the Otter Specialist Group of the International Union for the Conservation of Nature (IUCN). I am an Affiliate Faculty at the University of Alaska, Fairbanks School of Fisheries and Ocean Sciences (2015-2018).

RECENT JOURNAL PUBLICATIONS:

Carrasco, S. E., B. B. Chomel, V. A. Gill, A. M. Doroff, M. A. Miller, K. A. Burek, R. W. Kasten, B. A. Byrne, T. G. Goldstein, J. A. K. Mazet. 2014. Exposure to *Bartonella spp*. is common in Alaskan sea otters. Vector-borne and Zoonotic Diseases. Vol. 14(12) 831.

Stewart, N.L., B. Konar, A. Doroff. 2014. Sea Otter (*Enhydra lutris*) foraging in a heterogeneous environment in Kachemak Bay, Alaska. Bulletin of Marine Science 90:921-939.

Newsome, S. D., M. T. Tinker, V.A. Gill, A.M. Doroff, L. Nichol, and J.L. Bodkin. 2015. The interaction of intraspecific competition and habitat on individual diet specialization. Oecologia DOI 10.1007/s00442-015-3223-8.

Traiger, S., B. Konar, A. Doroff, and L. McCaslin. In review. Sea otters versus sea stars as major clam predators: evidence from foraging pits and shell litter. Submitted: Marine Ecological Progress Series.

Doroff, A., S. Baird, J. Freymeuller, M. Murphy, and S. Buckelew. In review. Assessing coastal habitat changes in a glacially influenced estuary system, Kachemak Bay, Alaska. Submitted: Estuaries and Coasts special issue journal.

RECENT GRANTS AWARDED:

State Wildlife Grants annually 2009-2016: Principal Investigator /Project Manager (145K)University of New Hampshire, Science Collaborative (2010-2013): Principal Investigator (915K)Exxon Valdez Trustee Council, Long-term monitoring (2011-2016): Principal Investigator (700K) NOAA Habitat Focus Area: Kachemak Bay: Principal Investigator (385K)

RECENT COLLABORATORS (EXCLUSIVE OF CO-AUTHORS ABOVE):

Sonia Batten; Rob Campbell; Kris Holderied; Russ Hopcroft; Tom Weingartner; Mark Johnson, Georgina Gibson; Katrin Iken; Jeff Hatrick; Michael Opheim; E. Jamie Trammel; Marcus Geist; Dom Hondelaro; Pat Tester; Wayne Litker; Catie Bursch; Jessica Shepard; Deb Tobin; Kathy Kuletz; Elizabeth Labunski.

Amy E. Miller
Supervisory Ecologist
National Park Service – Inventory & Monitoring Program
240 West 5th Avenue, Anchorage, AK 99501
Email: amy_e_miller@nps.gov; Tel: 907-644-3683

2015-present – Supervisory Ecologist, National Park Service, Anchorage, AK
2004-2015 – Ecologist, National Park Service, Anchorage, AK
2002-2004 – Research Associate, Univesity of California, Santa Barbara, CA
2004 - Ph.D., University of Colorado, Boulder, CO (Biology)
1993 – B.S., Oregon State University, Corvallis, OR (Botany)

Amy leads the Inventory and Monitoring Program for the Southwest Alaska Network (SWAN), a network of five National Park Service units consisting of Kenai Fjords National Park, Lake Clark National Park and Preserve, Katmai National Park and Preserve, Alagnak Wild River, and Aniakchak National Monument and Preserve. She oversees all activities associated with the five program areas of the SWAN: climate, water, terrestrial wildlife, nearshore marine environments, and vegetation. Previously, she served as the terrestrial ecologist for the network, in which she managed a long-term monitoring program examining vegetation and landcover change, and collaborated with more than a dozen university and agency partners. She serves as Affiliate Faculty with the University of Alaska and is a member of the Steering Committee for the Western Alaska Landscape Conservation Cooperative.

RECENT PUBLICATIONS

Csank AZ, Miller AE, Sherriff RL, Berg EE, Welker JM. Tree-ring isotope chronologies reveal drought sensitivity in trees killed by insect outbreaks in Alaska. *Ecological Applications* (in press).
Lindsay C, Zhu J, Miller AE, Kirchner P, Wilson TL. 2015. Deriving snow cover metrics for Alaska from MODIS. *Remote Sensing* 7:12961-12985..
Homyak PM, Sickman JO, Miller AE, Melack JM, Meixner T, Schimel JP. 2014. Assessing nitrogen- saturation in a seasonally dry chaparral watershed: Limitations of traditional indicators of N-saturation. *Ecosystems* 17:1286-1305.
Carlson ML, Lipkin R, Roland C, Miller AE. 2013. New and important vascular plant collections from south-central and southwestern Alaska: a region of floristic convergence. *Rhodora* 115:61-95.
Sherriff RL, Berg EE, Miller AE. 2011. Climate variability and spruce beetle (*Dendroctonus rufipennis*) outbreaks in south-central and southwest Alaska. *Ecology* 92:1459-1470.
Thompson WL, Miller AE, Mortenson DC, Woodward A. 2011. Developing effective sampling designs for monitoring natural resources in Alaskan national parks. *Biological Conservation* 144:1270-1277.
Ashton IW, Miller AE, Bowman WD, Suding KN. 2010. Niche complementarity due to plasticity in resource use: plant partitioning of chemical N forms. *Ecology* 91:3252-3260.
Reed B, Budde M, Spencer P, Miller AE. 2009. Integration of MODIS-derived metrics to assess interannual variability in snowpack, lake ice, and NDVI in southwest Alaska. *Remote Sensing of Environment* 113:1443-1452.
Miller AE, Schimel JP, Sickman JO, Skeen K, Meixner T, Melack JM. 2009. Seasonal variation in nitrogen uptake and turnover in two high-elevation soils: mineralization response is site-dependent. *Biogeochemistry* 93:253-270.

Ashton IW, Miller AE, Bowman WD, Suding KN. 2008. Nitrogen preferences and plant-soil feedbacks as influenced by neighbors in the alpine tundra. *Oecologia* 156:625-636.
Miller AE, Bowman WD, Suding KN. 2007. Plant uptake of inorganic and organic nitrogen: neighbor identity matters. *Ecology* 88:1832-1840.
Miller AE, Schimel JP, Sickman JO, Meixner T, Doyle AP, Melack JM. 2007. Mineralization responses at near-zero temperatures in three alpine soils. *Biogeochemistry* 84:233-245.
Nemergut DR, Anderson SP, Cleveland CC, Martin AP, Miller AE, Seimon A, Schmidt SK. 2007. Microbial community succession in an unvegetated, recently deglaciated soil. *Microbial Ecology* 53:110-122.
Gende SM, Miller AE, Hood E. 2007. The effects of salmon carcasses on soil nutrient pools in a riparian forest of southeast Alaska. *Canadian Journal of Forest Research* 37:1194-1202.

RECENT COLLABORATORS

Rosemary Sherriff, Humboldt State University, Arcata, CA
Edward Berg, U.S. Fish and Wildlife Service, Soldotna, AK (emeritus)
Adam Csank, University of Nevada, Reno/Nipissing University, Ontario, Canada
Jeffrey Welker, University of Alaska, Anchorage, AK
Bruce McCune, Oregon State University, Corvallis, OR
Steffi Ickert-Bond, University of Alaska, Fairbanks, AK
Jiang Zhu, University of Alaska Fairbanks, Fairbanks, AK
Tom Heinrichs, University of Alaska, Fairbanks, AK
Matthew Carlson, University of Alaska, Anchorage, AK
Bradley Reed, U.S. Geological Survey, Reston, VA
Michael Budde, U.S. Geological Survey, Sioux Falls, SD
Andrew Richardson, Harvard University, Cambridge, MA
Robert Kennedy, Boston University, Boston, MA
Andrew Robertson, Saint Mary's University of Minnesota, Winona, MN

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$228.8	$229.1	$229.4	$229.8	$230.1	$1,147.2	
Travel	$17.4	$17.5	$17.6	$17.7	$17.8	$88.0	
Contractual	$83.1	$120.6	$83.1	$83.1	$83.1	$453.0	
Commodities	$23.9	$23.0	$23.0	$23.0	$23.0	$115.9	
Equipment	$5.0	$15.0	$14.0	$5.0	$5.0	$44.0	
Indirect Costs (*will vary by proposer*)	$10.5	$10.2	$10.3	$10.4	$10.5	$51.9	
SUBTOTAL	$368.7	$415.4	$377.4	$369.0	$369.6	$1,900.0	
General Administration (9% of subtotal)	$33.2	$37.4	$34.0	$33.2	$33.3	$171.0	N/A
PROJECT TOTAL	$401.9	$452.7	$411.4	$402.2	$402.8	$2,071.0	
Other Resources (Cost Share Funds)	$410.0	$410.0	$410.0	$392.0	$392.0	$2,014.0	

COMMENTS:
This is the combined budget for the individual Coletti/Esler and Iken/Konar budgets that follow. Coletti is affliated with the National Park Service, A Trustee Agency, Esler is affiliated with the U.S. Geological Survey, a Trustee Agency, and Iken and Konar are affiliated with the University of Alaska Fairbanks, a Non-Trustee Agency. The budgets have been combined by using a Non-Trustee Agency budget reporting form. This form contains the summary information only. Detail by year for each of the Trustee and Non-Trustee Agency PIs can be found in the following two worksheets.

FY17-21

Project Title: Nearshore
Primary Investigators: H. Coletti, D. Esler, K. Iken, & B. Konar

NON-TRUSTEE AGENCY SUMMARY PAGE

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$194.1	$194.1	$194.1	$194.1	$194.1	$970.5	
Travel	$15.5	$15.5	$15.5	$15.5	$15.5	$77.5	
Contractual	$80.9	$118.4	$80.9	$80.9	$80.9	$442.0	
Commodities	$20.7	$21.5	$21.5	$21.5	$21.5	$106.7	
Equipment	$5.0	$15.0	$14.0	$5.0	$5.0	$44.0	
SUBTOTAL	$316.2	$364.5	$326.0	$317.0	$317.0	$1,640.7	
General Administration (9% of subtotal)	$28.5	$32.8	$29.3	$28.5	$28.5	$147.7	N/A
PROJECT TOTAL	$344.7	$397.3	$355.3	$345.5	$345.5	$1,788.4	
Other Resources (Cost Share Funds)	$410.0	$410.0	$410.0	$392.0	$392.0	$2,014.0	

COMMENTS:
Annual in-kind contributions consist of staff time (USGS = $92K; NPS = $130k; NOAA = $10k), reduced charter costs (USGS = $45K; NPS= $25K), winter bird surveys (NPS=$18K), use of equipment such as rigid-hull inflatable, inflatables/outboards, GPSs, spotting scopes, field laptops, sounding equipment (USGS = $40K; NPS = $40K) and commodities (USGS = $5k; NPS = $5K). NPS budgets are projected to decline over time based on agency 5-year planning.

FY17-21

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
D. Esler (USGS)		1.0	10.5		10.5
G. Esslinger (USGS)		1.0	9.5		9.5
K. Kloecker (USGS)		4.0	9.9		39.6
D. Monson (USGS)		4.0	10.4		41.6
B. Weitzman (USGS)		6.0	6.7		40.2
Tech (USGS or NPS)		6.0	6.7		40.2
Overtime (estimated)		1.0	12.5		12.5
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	66.2	0.0	
				Personnel Total	$194.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Field Travel (NOAA)					2.5
AMSS and LTM PI meetings (Coletti)	0.5	3	15	0.2	4.5
Field travel (NPS)					2.5
Field travel (USGS)					6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$15.5

FY17

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
PERSONNEL & TRAVEL
DETAIL

Contractual Costs: Description	Contract Sum
Vessel Charter (Katmai)	20.0
Aerial Surveys for sea otters - WPWS	17.5
Sea otter carcass tooth cementum age analysis	1.4
Stable Isotope analyses, mussels and POM	6.0
Senior Scientist (T. Dean, J. Bodkin, B. Ballachey)	36.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$80.9

Commodities Costs: Description	Commodities Sum
fuel for skiffs	3.0
field & safety gear	3.0
software	3.0
sampling gear (NOAA)	7.5
equipment maintenance	4.2
Commodities Total	$20.7

FY17

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
data logging instruments			5.0
			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	$5.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Questar spotting scopes & high-power binocs for sea otter forage data collection	5	USGS/NPS
Existing small skiffs for charters (3 skiffs/nearshore trip are needed, more if trips are concurrent)	3	USGS/NPS
Field computers	4	USGS/NPS
Cameras	4	USGS/NPS
GPS units	5	USGS/NPS
Radio units	8	USGS/NPS
25 ft Boston Whaler, if needed for carcass surveys, monitoring work	1	USGS
airplane GPS unit for sea otter surveys	1	USGS

FY17

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
D. Esler (USGS)		1.0	10.5		10.5
G. Esslinger (USGS)		1.0	9.5		9.5
K. Kloecker (USGS)		4.0	9.9		39.6
D. Monson (USGS)		4.0	10.4		41.6
B. Weitzman (USGS)		6.0	6.7		40.2
Tech (USGS or NPS)		6.0	6.7		40.2
Overtime (estimated)		1.0	12.5		12.5
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	66.2	0.0	
				Personnel Total	$194.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Field Travel (NOAA)					2.5
AMSS and LTM PI meetings (Coletti)	0.5	3	15	0.2	4.5
Field travel (NPS)					2.5
Field travel (USGS)					6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$15.5

FY18

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
PERSONNEL & TRAVEL
DETAIL

Contractual Costs: Description	Contract Sum
Vessel Charter (Katmai)	20.0
Aerial Surveys for sea otters - KATM	17.5
Sea otter carcass tooth cementum age analysis	1.4
Stable Isotope analyses, mussels and POM	6.0
Senior Scientist (T. Dean, J. Bodkin, B. Ballachey)	36.0
Contaminant analyses, Mussel Watch, 15 sites * 2.5/site	37.5
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$118.4

Commodities Costs: Description	Commodities Sum
fuel for skiffs	3.0
field & safety gear	3.0
software	3.0
sampling gear (NOAA)	7.5
equipment maintenance	5.0
Commodities Total	$21.5

FY18

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
data logging instruments	1.0	5.0	5.0
field laptops	2.0	5.0	10.0
			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	$15.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Questar spotting scopes & high-power binocs for sea otter forage data collection	5	USGS/NPS
Existing small skiffs for charters (3 skiffs/nearshore trip are needed, more if trips are concurrent)	3	USGS/NPS
Field computers	4	USGS/NPS
Cameras	4	USGS/NPS
GPS units	5	USGS/NPS
Radio units	8	USGS/NPS
25 ft Boston Whaler, if needed for carcass surveys, monitoring work	1	USGS
airplane GPS unit for sea otter surveys	1	USGS

FY18

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
D. Esler (USGS)		1.0	10.5		10.5
G. Esslinger (USGS)		1.0	9.5		9.5
K. Kloecker (USGS)		4.0	9.9		39.6
D. Monson (USGS)		4.0	10.4		41.6
B. Weitzman (USGS)		6.0	6.7		40.2
Tech (USGS or NPS)		6.0	6.7		40.2
Overtime (estimated)		1.0	12.5		12.5
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	66.2	0.0	
				Personnel Total	$194.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Field Travel (NOAA)					2.5
AMSS and LTM PI meetings (Coletti)	0.5	3	15	0.2	4.5
Field travel (NPS)					2.5
Field travel (USGS)					6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$15.5

FY19

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
PERSONNEL & TRAVEL
DETAIL

Contractual Costs: Description	Contract Sum
Vessel Charter (Katmai)	20.0
Aerial Surveys for sea otters - KEFJ	17.5
Sea otter carcass tooth cementum age analysis	1.4
Stable Isotope analyses, mussels and POM	6.0
Senior Scientist (T. Dean, J. Bodkin, B. Ballachey)	36.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$80.9

Commodities Costs: Description	Commodities Sum
fuel for skiffs	3.0
field & safety gear	3.0
software	3.0
sampling gear (NOAA)	7.5
equipment maintenance	5.0
Commodities Total	$21.5

FY19

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
data logging instruments	1.0	5.0	5.0
inflatable skiff for field work w outboard and accessories (Mark II w/ 20hp)	1.0	9.0	9.0
			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	$14.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Questar spotting scopes & high-power binocs for sea otter forage data collection	5	USGS/NPS
Existing small skiffs for charters (3 skiffs/nearshore trip are needed, more if trips are concurrent)	3	USGS/NPS
Field computers	4	USGS/NPS
Cameras	4	USGS/NPS
GPS units	5	USGS/NPS
Radio units	8	USGS/NPS
25 ft Boston Whaler, if needed for carcass surveys, monitoring work	1	USGS
airplane GPS unit for sea otter surveys	1	USGS

FY19

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
D. Esler (USGS)		1.0	10.5		10.5
G. Esslinger (USGS)		1.0	9.5		9.5
K. Kloecker (USGS)		4.0	9.9		39.6
D. Monson (USGS)		4.0	10.4		41.6
B. Weitzman (USGS)		6.0	6.7		40.2
Tech (USGS or NPS)		6.0	6.7		40.2
Overtime (estimated)		1.0	12.5		12.5
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	66.2	0.0	
				Personnel Total	$194.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Field Travel (NOAA)					2.5
AMSS and LTM PI meetings (Coletti)	0.5	3	15	0.2	4.5
Field travel (NPS)					2.5
Field travel (USGS)					6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$15.5

FY20

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
PERSONNEL & TRAVEL
DETAIL

Contractual Costs: Description	Contract Sum
Vessel Charter (Katmai)	20.0
Aerial Surveys for sea otters - WPWS	17.5
Sea otter carcass tooth cementum age analysis	1.4
Stable Isotope analyses, mussels and POM	6.0
Senior Scientist (T. Dean, J. Bodkin, B. Ballachey)	36.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$80.9

Commodities Costs: Description	Commodities Sum
fuel for skiffs	3.0
field & safety gear	3.0
software	3.0
sampling gear (NOAA)	7.5
equipment maintenance	5.0
Commodities Total	$21.5

FY20

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
data logging instruments	1.0	5.0	5.0
			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	$5.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Questar spotting scopes & high-power binocs for sea otter forage data collection	5	USGS/NPS
Existing small skiffs for charters (3 skiffs/nearshore trip are needed, more if trips are concurrent)	3	USGS/NPS
Field computers	4	USGS/NPS
Cameras	4	USGS/NPS
GPS units	5	USGS/NPS
Radio units	8	USGS/NPS
25 ft Boston Whaler, if needed for carcass surveys, monitoring work	1	USGS
airplane GPS unit for sea otter surveys	1	USGS

FY20

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
D. Esler (USGS)		1.0	10.5		10.5
G. Esslinger (USGS)		1.0	9.5		9.5
K. Kloecker (USGS)		4.0	9.9		39.6
D. Monson (USGS)		4.0	10.4		41.6
B. Weitzman (USGS)		6.0	6.7		40.2
Tech (USGS or NPS)		6.0	6.7		40.2
Overtime (estimated)		1.0	12.5		12.5
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	66.2	0.0	
				Personnel Total	$194.1

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Field Travel (NOAA)					2.5
AMSS and LTM PI meetings (Coletti)	0.5	3	15	0.2	4.5
Field travel (NPS)					2.5
Field travel (USGS)					6.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$15.5

FY21

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
PERSONNEL & TRAVEL
DETAIL

Contractual Costs: Description	Contract Sum
Vessel Charter (Katmai)	20.0
Aerial Surveys for sea otters - KATM	17.5
Sea otter carcass tooth cementum age analysis	1.4
Stable Isotope analyses, mussels and POM	6.0
Senior Scientist (T. Dean, J. Bodkin, B. Ballachey)	36.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$80.9

Commodities Costs: Description	Commodities Sum
fuel for skiffs	3.0
field & safety gear	3.0
software	3.0
sampling gear (NOAA)	7.5
equipment maintenance	5.0
Commodities Total	$21.5

FY21

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B CONTRACTUAL & COMMODITIES DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
data logging instruments	1.0	5.0	5.0
			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	$5.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Questar spotting scopes & high-power binocs for sea otter forage data collection	5	USGS/NPS
Existing small skiffs for charters (3 skiffs/nearshore trip are needed, more if trips are concurrent)	3	USGS/NPS
Field computers	4	USGS/NPS
Cameras	4	USGS/NPS
GPS units	5	USGS/NPS
Radio units	8	USGS/NPS
25 ft Boston Whaler, if needed for carcass surveys, monitoring work	1	USGS
airplane GPS unit for sea otter surveys	1	USGS

FY21

Project Title: Nearshore
Primary Investigator: Coletti & Esler
Agency: NPS & USGS

FORM 4B
EQUIPMENT DETAIL

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$34.7	$35.0	$35.3	$35.7	$36.0	$176.7	
Travel	$1.9	$2.0	$2.1	$2.2	$2.3	$10.5	
Contractual	$2.2	$2.2	$2.2	$2.2	$2.2	$11.0	
Commodities	$3.2	$1.5	$1.5	$1.5	$1.5	$9.2	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (25%)	$10.50	$10.17	$10.28	$10.40	$10.52	$ 51.87	
SUBTOTAL	$52.50	$50.9	$51.4	$52.0	$52.6	$259.3	
General Administration (9% of subtotal)	$4.7	$4.6	$4.6	$4.7	$4.7	$23.3	N/A
PROJECT TOTAL	$57.2	$55.4	$56.0	$56.7	$57.3	$282.7	
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS:
-Year 1 will have greater amount of budget for equipment and supplies and travel
-Tuition has a 5-10% yearly increase for student employees.

FY17-21

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

NON-TRUSTEE AGENCY SUMMARY PAGE

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Konar		0.6	15.7		9.9
Iken		0.6	18.5		11.7
Doroff		0.5	12.0		5.5
Student		2.0	3.7		7.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	50.0	0.0	
				Personnel Total	$34.7

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
RT Fairbanks-Kachemak Bay	0.4	2	4	0.3	1.8
Ground transportation	0.1	2			0.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.9

FY17

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Laboratory analyses	2.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$2.2

Commodities Costs: Description	Commodities Sum
Supplies	0.5
Data loggers	2.7
Commodities Total	$3.2

FY17

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

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: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Konar		0.6	16.0		10.1
Iken		0.6	18.5		11.7
Doroff		0.5	12.3		5.7
Student		2.0	3.7		7.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	50.6	0.0	
				Personnel Total	$35.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
RT Fairbanks to Kachemak Bay	0.4	2	4	0.3	1.9
Ground transportation	0.1	2			0.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.0

FY18

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Lab services	2.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$2.2

Commodities Costs: Description	Commodities Sum
Supplies	0.5
Data loggers	1.0
Commodities Total	$1.5

FY18

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

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: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Konar		0.6	16.3		10.3
Iken		0.6	18.5		11.7
Doroff		0.5	12.7		5.8
Student		2.0	3.7		7.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	51.2	0.0	
				Personnel Total	$35.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Travel RT-Fairbanks to Kachemak Bay	0.5	2	4	0.3	2.0
Ground transportation	0.1	2			0.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.1

FY19

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Lab services	2.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$2.2

Commodities Costs: Description	Commodities Sum
Supplies	0.5
Data loggers	1.0
Commodities Total	$1.5

FY19

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

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: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Konar		0.6	16.6		10.5
Iken		0.6	18.5		11.7
Doroff		0.5	13.0		6.0
Student		2.0	3.7		7.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	51.9	0.0	
				Personnel Total	$35.7

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
RT-Fairbanks to Kachemak Bay	0.5	2	4	0.3	2.1
Ground transportation	0.1	2			0.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.2

FY20

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Lab services	2.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$2.2

Commodities Costs: Description	Commodities Sum
Supplies	0.5
Data loggers	1.0
Commodities Total	$1.5

FY20

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

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: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
EQUIPMENT DETAIL

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Konar		0.6	17.0		10.7
Iken		0.6	18.5		11.7
Doroff		0.5	13.3		6.1
Student		2.0	3.7		7.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
		Subtotal	52.5	0.0	
				Personnel Total	$36.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
RT=Fairbanks to Kachemak Bay	0.6	2	4	0.3	2.2
Ground transportation	0.1	2			0.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.3

FY21

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs: Description	Contract Sum
Lab services	2.2
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$2.2

Commodities Costs: Description	Commodities Sum
Supplies	0.5
Data loggers	1.0
Commodities Total	$1.5

FY21

Project Title: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

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: Kachemak Bay Ecology
Primary Investigator: Brenda Konar and Katrin Iken

FORM 3B
EQUIPMENT DETAIL