FY16 PROJECT PROPOSAL SUMMARY PAGE
Continuing, Multi-Year Projects

Project Title: Gulf Watch Alaska: Nearshore Systems in the Gulf of Alaska

Project Period: February 1, 2016 – January 31, 2017

Primary Investigator(s): H. Coletti, National Park Service; B. Ballachey, J. Bodkin, D. Esler, K. Kloecker, D. Monson, B. Weitzman, US Geological Survey; T. Dean, Coastal Resource Associates; M. Lindeberg, NOAA; A. Doroff, Kachemak Bay Research Reserve.

Study Location: Gulf of Alaska: Prince William Sound, Kenai Fjords National Park, Katmai National Park and Preserve

Project Website: http://www.gulfwatchalaska.org
http://science.nature.nps.gov/im/units/swan/monitor/nearshore.cfm
http://alaska.usgs.gov/science/biology/nearshore_marine/lt_monitoring.php

Abstract*: This project is a component of Gulf Watch Alaska: Integrated Long-Term Monitoring of Marine Conditions and Injured Resources and Services. For the Nearshore ecosystem component, we have implemented a long-term monitoring program at five locations across the GOA, including sampling areas in Western, Northern and Eastern Prince William Sound (PWS), Kenai Fjords National Park, and Katmai National Park and Preserve. Additional nearshore sampling as part of Gulf Watch Alaska is ongoing in Kachemak Bay (Project 12120114-L) and is closely coordinated with this project. The Gulf Watch Alaska nearshore program is integrated with nearshore monitoring implemented in 2006 by the National Park Service to cost-effectively monitor nearshore ecosystems across the central and western Gulf of Alaska, including spill-affected areas, and provide information on recovery and restoration of injured resources. We propose to (1) continue sampling Katmai NPP, Kenai Fjords NP, and Western PWS in 2016 (all 3 areas previously sampled in multiple years starting in 2006), and (2) sample Eastern PWS in 2016 (previously sampled in 2012 and 2014). We will continue to coordinate with the ongoing nearshore monitoring program in Kachemak Bay. Monitoring metrics include marine invertebrates, kelps, sea grasses, birds, mammals, and physical parameters. In addition to taxa-specific metrics, monitoring includes recognized important ecological relations that include predator-prey dynamics, measures of nearshore ecosystem productivity, and contamination. The nearshore benthic monitoring program also will integrate physical data collected in PWS, along the GOA shelf and in Cook Inlet, under the Environmental Drivers component of the GWA long-term monitoring program.

Estimated Budget:

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

FY12	FY13	FY14	FY15	FY16	TOTAL
$282.4	$304.1	$331.9	$309.6	$331.9	$1,559.9

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL
$274.0	$274.0	$274.0	$274.0	$392.0	$1,488.0

** Figures given in $1,000 increments*

Date: September 1, 2015

I. EXECUTIVE SUMMARY

The nearshore is an important component of the Gulf of Alaska (GOA) ecosystem, including the region affected by the *Exxon Valdez* oil spill (EVOS), because it provides:

- A variety of habitats for resident organisms (e.g. sea otters, harbor seals, shorebirds, seabirds, nearshore fishes, kelps, seagrasses, clams, mussels, and sea stars).
- Nursery grounds for marine animals that exist as adults in other habitats (e.g. crabs, salmon, herring, and seabirds).
- Feeding grounds for important consumers, including killer whales, harbor seals, sea otters, sea lions, sea ducks, shore birds and many fish and shellfish.
- A source of animals important to commercial and subsistence harvests (e.g. marine mammals, fishes, crabs, mussels, clams, chitons, and octopus).
- An important site of recreational activities including fishing, boating, camping, and nature viewing.
- A source of primary production for export to adjacent habitats (primarily by kelps, other seaweeds, and eelgrass).
- An important triple interface among air, land and sea that provides linkages for transfer of water, nutrients, and species.

Further, the nearshore is sensitive to natural and human disturbances on a variety of temporal and spatial scales. Nearshore systems are especially good indicators of change because organisms in the nearshore are relatively sedentary, accessible, and manipulable, and builds on a growing understanding of mechanistic links between nearshore species and their physical environment that facilitates understanding causes of change.

With respect to the goals of the Gulf Watch Alaska (GWA) long-term monitoring program, the nearshore is the habitat where we may detect relatively localized sources of change, distinguish human-induced from natural changes, and provide suggestions for policies to reduce human impacts. Because many organisms in the nearshore are sessile or have limited home ranges, they can be linked to sources of change. Finally, the nearshore is critically important because it was the habitat most impacted by the 1989 EVOS, and has been a repository for lingering oil linked to protracted injury to resident species.

In 2006, a restoration and ecosystem monitoring plan for the nearshore marine ecosystems in the GOA was completed (EVOSTC Project 050750). The framework for monitoring in the nearshore included sampling of a variety of specified biological and physical parameters (e.g., abundance and growth of intertidal organisms, abundance of selected birds and marine mammals) within specified areas across the GOA. The plan also allowed for conduct of shorter-term studies aimed at identifying important processes regulating or causing changes within a given system. The plan was adopted by the National Park Service Southwest Alaska Network and implemented in Katmai NPP (2006) and in Kenai Fjords NP (2007). In 2010, the EVOSTC funded the long-term nearshore monitoring program in western PWS (Project 10100750). In 2012, the GWA project was initiated to continue and expand the long-term nearshore monitoring, in combination with studies of pelagic systems and environmental drivers. As part of the GWA effort, nearshore monitoring is ongoing in Eastern, Northern and Western PWS, and at Katmai and Kenai Fjords national parks (including 5 sites within each area). Here, we propose to continue the long-term nearshore monitoring program across the GOA in 2015 and 2016.

The list of metrics and projected schedule for monitoring within the nearshore benthic component are outlined in Table 1. Standard operating procedures (SOP's) for all data collection have been fully developed as part of the preparation and implementation of nearshore monitoring in Katmai NP, Kenai Fjords NP, and Western PWS. A protocol narrative (Dean et al. 2014) describes the overall monitoring program, and a series of specific SOP's provide 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. SOP's can be found on the GWA website.

Data analyses and statistical methods used to evaluate changes in the nearshore environment are detailed in Dean et al. (2014). In general, we will examine trends in each metric over time within each location, evaluate similarities 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).

Citation: Dean, T.A., Bodkin, J.L., and Coletti, H.A. 2014. Protocol narrative for marine nearshore ecosystem monitoring in the Gulf of Alaska: Version 1.1. Natural Resource Report NPS/SWAN/NRR—2014/756. National Park Service, Fort Collins, Colorado.

New publications (since Year 4 proposal submission):

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

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:* Science Synthesis Report for the Gulf Watch Alaska Program. December 2014.

Ballachey, B.E., J.L. Bodkin, K.A. Kloecker, T.A. Dean, and H.A. Coletti. 2014. 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.

Bodkin, J.L. 2015. Historic and contemporary status of sea otters in the North Pacific. Chapter 3 in: Larson, S.E., Bodkin, J.L. and VanBlaricom, G.B., eds. Sea Otter Conservation. Academic Press.

Bowen, L., A.K. Miles, B.E. Ballachey, and J.L. Bodkin. 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: Gene Transcript Profiles in Sea Otters from Prince William Sound, Alaska. *Exxon Valdez* Oil Spill Trustee Council Restoration Project Final Report (Project 12120114-Q), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska. *(In review at EVOSTC)*

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. *In:* Science Synthesis Report for the Gulf Watch Alaska Program. December 2014.

Esler, D., and B.E. Ballachey. 2014. 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 Trustee Council Restoration Project Final Report (Project 14120114-Q), U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Esslinger, G. G., J. L. Bodkin, A. R. Breton, J. M. Burns, and D. H. Monson. 2014. Temporal patterns in the foraging behavior of sea otters in Alaska. Journal of Wildlife Management 78(4):689-700. doi:10.1002/jwmg.701

Konar, B., K. Iken, H. A. Coletti,T. A. Dean, and D. H. Monson. 2015. Research Summary: Influence of static habitat attributes on local and regional biological variability in rocky intertidal communities of the northern Gulf of Alaska. *In:* Science Synthesis Report for the Gulf Watch Alaska Program. December 2014.

Monson, D.H. and L. Bowen. 2015. Evaluating the status of individuals and populations: Advantages of multiple approaches and time scales. Chapter 6 in: Larson, S.E., Bodkin, J.L. and VanBlaricom, G.B., eds. Sea Otter Conservation. Academic Press.

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. Inter-annual and spatial variation in Pacific blue mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013. *In:* Science Synthesis Report for the Gulf Watch Alaska Program. December 2014.

Poster presentations (since August 2015 annual report):

Holderied, K., M. McCammon, K. Hoffman, T. Neher, T. Weingartner, R. Hopcroft, M. Lindeberg, and B. Ballachey. 2015. Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska's Changing Ecosystems. Alaska Marine Science Symposium. January 2015. Anchorage, AK.

Konar, B., K. Iken, H. A. Coletti, T. A. Dean, and D. H. Monson. 2015. Static habitat attributes influence biological variability in intertidal communities in the central Gulf of Alaska. Alaska Marine Science Symposium. January 2015. Anchorage, AK.

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. Inter-annual and spatial variation in Pacific blue mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013. Alaska Marine Science Symposium. January 2015. Anchorage, AK.

Outreach activities (since August 2015 annual report):

Coletti, H. (NPS). January 2015. National Park Service Participates in on-line Gulf Watch Alaska curriculum in an outreach partnership effort with the Alaska SeaLife Center (ASLC).

Coletti, H. (NPS). April 2015. Overview of SWAN and GWA to interpretive rangers at Kenai Fjords National Park.

Esler, D. (USGS). January 2015. USGS Alaska Science Center Participates in on-line Gulf Watch Alaska curriculum in an outreach partnership effort with the Alaska SeaLife Center (ASLC).

Esler, D. (USGS). 2015-2016. Delta Sound Connections Article - Tidewater Trends in Nearshore Ecosystems.

Jones, R. (NPS). July 2015. NPS Interpretive Ranger Provides Educational Outreach about NPS SWAN and the Alaska Gulf Watch Program during a Discovery Lab event held at the Alaska Islands & Ocean Visitor Center in Homer, Alaska.

Kloecker, K. (USGS). November 2015. USGS Scientists Participated in STEM Activities for Middle School Students.

Kloecker, K. (USGS). November 2015. USGS Scientists Participated in STEM Activities for Elementary School Students.

Kloecker, K. (USGS). July 2015. USGS Scientist Provides Educational Outreach about the Alaska Gulf Watch Program—26 Years of Ocean Monitoring during a Discovery Lab event held at the Alaska Islands & Ocean Visitor Center in Homer, Alaska.

Kunisch, E. and H. Coletti (NPS). Spring 2015. DOI Newswave Article – Monitoring for Sea Star Wasting Disease in the Northern Gulf of Alaska.

Monson, D. (USGS). October 2014. USGS, USFWS, APU and UAA Partner with OLÉ! To Teach Marine Mammals of Alaska Class.

Numerous Facebook posts about GWA on Katmai NPP and Kenai Fjords NP Facebook pages

II. COORDINATION AND COLLABORATION

A. Within a EVOTC-Funded Program

It is important to recognize that the Nearshore component of Gulf Watch is designed as a highly integrated and coordinated set of metrics, which are measured consistently across broad geographic scales and over a long time frame. The Nearshore group consists of a large number of scientists working together within a coordinated monitoring system that allows unprecedented insights into nearshore ecosystem status and ecological interactions. Although each metric could have been considered as a separate project, the Nearshore component operates as a single, synchronized program, leading to insights and efficiencies that could not be attained otherwise.

We are coordinating closely with the other project within the Nearshore Benthic component of the GWA program, 12120114-L (K. Iken and B. Konar, PIs), which is monitoring nearshore areas within Kachemak Bay. Coordination includes shared protocols for monitoring and data collection, pooling of data sets and a united effort on data analyses and syntheses.

As productivity in the nearshore is strongly influenced by physical oceanographic processes, it is a priority to evaluate whether or not changes noted in nearshore systems are reflected in either oceanographic conditions or in synchronous changes in pelagic species and conditions. To this end, we currently are coordinating with the Environmental Drivers component of the GWA project on data sets that may be relevant to our synthesis and analysis of biological metrics measured at our nearshore sites across the GOA.

In light of the harmful algal bloom observed this summer in the north Pacific, the Nearshore component collaborated with K. Holdried and A. Doroff of the GWA Environmental Drivers component to collect plankton samples at 5 Katmai nearshore sites (2 samples per site, “onshore” and “offshore”).

B. With Other EVOSTC-funded Projects

In July 2014, during our field work at Katmai NPP, we collected oil samples (asphalt and mousse) from three locations within the park, in cooperation with Gail Irvine of the USGS, who has conducted a long-term study of persistence and degradation of oil from the EVOS (most recently as EVOSTC Project 11100112, *Lingering Oil on Boulder-Armored Beaches in the Gulf of Alaska 22 Years after the Exxon Valdez Oil Spill*). These samples have been submitted for laboratory analyses of the oil components. As of summer 2015, all samples have been analyzed and discussions of preliminary results are on-going. Additional analyses include examining asphalt and mousse separately to assess differing weathering patterns. These analyses were funded outside of Project 11100112, but build on the historical datasets.

C. With Trustee or Management Agencies

Our work is contributing to the mission of the US Fish and Wildlife Service, who is the agency charged with management of migratory birds and some marine mammals, including sea otters. We also contribute to the management mission of NOAA, who is responsible for fisheries management. Our work also contributes to management of National Parks, including direct involvement in the nationwide inventory and monitoring program. Our information also may be informative to other land management agencies (e.g., US Forest Service) with units adjacent to our monitoring sites. We also engage scientists from a number of academic and private institutions as Nearshore component collaborators.

We are collaborating with NPS on their Changing Tides project, initiated in 2015 (http://www.nps.gov/articles/changing-tides.htm). During the GWA annual nearshore monitoring trip along the Katmai coast in July 2015, a variety of bivalves were collected, including samples of several species known to be consumed by bears that forage in intertidal areas. Species collected include the Pacific blue or bay mussel (*Mytilus trossulus*), the Pacific razor clam (*Siliqua patula*), the butter clam (*Saxidomus gigantea*), and *Mya* and *Macoma* clams. Clams and mussels were kept alive in small aquarium-like containers and transported to the Alaska SeaLife Center to be measured for information such as length, width, total weight, shell weight, and shell thickness, as well as feeding rates and caloric content. Additional clams and mussels were dissected in the field to obtain gill and mantle tissues, which were preserved. These tissue samples will be analyzed by USGS to measure expression of a selected set of genes indicative of health of individual bivalves and response to a variety of environmental stressors (e.g., elevated temperatures, ocean acidification, pollutants, and pathogens). Overall, the multiple measurements obtained on the clams and mussels will allow us to compare the health of bivalve populations at different sites, assess their responses and sensitivity to environmental stressors, and quantify their energetic value as bear prey.

The GWA Nearshore component continues to collaborate with USGS, SWAN and Kenai Fjords NP on a USGS-led cooperative project funded via a NRPP proposal that enhances our understanding of GWA sea otter foraging observations, and threats to sea otters and the broader nearshore community in that region.

Water samples were collected in 2014 in KATM and in 2015 in KEFJ to send to Woods Hole Oceanographic Institute to measure levels of radiation in sea water. Results for KATM indicate levels are below detection; results from KEFJ are pending. (http://ourradioactiveocean.org/)

III. PROJECT DESIGN – PLAN FOR FY16

A. Objectives for FY16

The fundamental objective of this work is the long-term monitoring of a suite of nearshore benthic species at multiple locations across the Gulf of Alaska, with an overall goal of identifying important processes regulating or causing changes within a given nearshore ecosystem. The specific objectives for the period 2012-2016 include:

1. Continue restoration monitoring in the nearshore to evaluate the current status of injured resources in oiled areas.

2. Identify if those injured resources being monitored may be considered recovered from EVOS effects.

3. Identify potential factors that could inhibit recovery of injured resources, and recommend potential restoration actions.

B. Changes to Project Design

There have been no significant changes in design from that described in the original proposal. The monitoring and research generally is proceeding as initially planned. An exception is the aerial surveys of sea otter abundance, planned for Kenai Fjords NP in summer of 2013 and in Katmai NPP in summer 2014. In both cases, we were prepared and ready to conduct the surveys but at the last minute, the pilot designated to fly the surveys changed plans and was not available. We have made adjustments to correct this problem and conducted a survey at Katmai NPP in summer 2015. Kenai Fjords NP is scheduled for a sea otter survey in summer 2016, and WPWS will not be surveyed in 2016.

IV. SCHEDULE

A. Project Milestones for FY 16 (See Table 1)

Objective 1. Continue restoration monitoring in the nearshore to evaluate the current status of injured resources in oiled areas.
To be met by September 2016

Objective 2. Identify if those injured resources being monitored may be considered recovered from EVOS effects.
To be met by December 2016 (Note: This objective has been addressed in a recent report to the EVOSTC, Ballachey et al. 2014; see publication list above).

Objective 3. Identify potential factors that could inhibit recovery of injured resources, and recommend potential restoration actions.
To be met by December 2016 (Note: This objective has been addressed in a recent report to the EVOSTC, Ballachey et al. 2014; see publication list above).

B. Measurable Project Tasks for FY 16

FY 16, 1st quarter (February 1, 2016 - April 31, 2016)
April: *Sea otter carcass collections, WPWS*

FY 16, 2nd quarter (May 1, 2016-July 30, 2016)
June/July: *Nearshore sampling trips, Kenai, Katmai, WPWS, EPWS*

FY 16, 3rd quarter (August 1, 2016 – October 31, 2016)

August/October: *Data entry, verification, and analysis; report writing*

FY 16, 4th quarter (November 1, 2016- January 31, 2017)

November/January *Data analysis and report writing*

January *AMSS, Anchorage*

V. PROJECT PERSONNEL – CHANGES AND UPDATES

n/a

VI. BUDGET

A. Budget Forms (Attached)

B. Changes from Original Proposal

There are no significant changes in design from the original proposal.

C. Sources of Additional Funding

We have estimated the annual in-kind contributions to this project at $392,000. This consists of staff time from the USGS (Esler, Kloecker, Esslinger, Gyre Captain; $92K), reduced costs for USGS charter vessel ($45K), and significant use of equipment including inflatables/outboards, GPSs, spotting scopes, field laptops, field gear, and sounding equipment for eelgrass sampling ($45K, commodities and equipment). From NOAA, staff time & gear contributions (Lindeberg) are estimated at $10K. From NPS, staff time (Coletti and Shepherd [data manager]) is estimated at $130K; commodities, equipment use and travel costs are valued at $50.0K, and contract costs (Katmai vessel charter) at $20K.

Table 1. Components of the proposed nearshore benthic monitoring plan and schedule accomplished in 2015 and planned for 2016. (*Note*: 5 sites are sampled within each area).

COMPONENT	**2015**	**2016**
Western PWS, intertidal invertebrates and algae	**x**	**x**
Western PWS, kelps and sea grass	**x**	**x**
Western PWS, black oystercatchers	**x**	**x**
Western PWS, sea otter carcass recovery	**x**	**x**
Western PWS, sea otter foraging observations	**x**	**x**
Eastern PWS, intertidal invertebrates and algae		**x**
Eastern PWS, kelps and sea grass		**x**
Northern PWS, intertidal invertebrates and algae	**x**	
Northern PWS, kelps and sea grass	**x**	
Katmai NP, intertidal invertebrates and algae	**x**	**x**
Katmai NP, kelps and sea grass	**x**	**x**
Katmai NP, black oystercatchers	**x**	**x**
Katmai NP, sea otter carcass recovery	**x**	**x**
Katmai NP, sea otter foraging observations	**x**	**x**
Kenai Fjords NP, intertidal invertebrates and algae	**x**	**x**
Kenai Fjords NP, kelps and sea grass	**x**	**x**
Kenai Fjords NP, black oystercatchers	**x**	**x**
Kenai Fjords NP, sea otter carcass recovery	**x**	**x**
Kenai Fjords NP, sea otter foraging observations	**x**	**x**
Western PWS, sea otter aerial survey		
Kenai NP, sea otter aerial survey		**x**
Katmai NP, sea otter aerial survey	**x**	
PWS, nearshore summer marine bird survey (under Pelagic component)		**x**
Katmai NP, nearshore marine bird survey	**x**	**x**
Kenai NP, nearshore marine bird survey	**x**	**x**
Stable isotope analysis of selected nearshore species	**x**	**x**