FY16 PROJECT PROPOSAL SUMMARY PAGE
Continuing, Multi-Year Projects

Project Title: Long-term monitoring: Environmental Drivers component - Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK 1

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

Primary Investigator(s): Thomas Weingartner, Principal Investigator, (907-474-7993; tjweingartner@alaska.edu. Seth Danielson, Co-PI, (907-474- 7834; sldanielson@alaska.edu) School of Fisheries and Ocean Science, University of Alaska, Fairbanks, AK 99775

Study Location: The fieldwork will be conducted at Station GAK1 at the mouth of Resurrection Bay. The station is at ~59^{o} 51'N, 149^{o} 28'W, and is located on the inner edge of the ACC midway between Prince William Sound and Cook Inlet in approximately 265 m water depth.

Project Website http://www.ims.uaf.edu/gak1/

Abstract*: This project is a component of the integrated Long-term Monitoring of Marine Conditions and Injured Resources and Services submitted by McCammon et. al.

This program continues a 45-year time series of temperature and salinity measurements at hydrographic station GAK 1. The data set, which began in 1970, now consists of monthly CTDs and a mooring with 6 temperature/conductivity recorders throughout the water column. The project monitors two important Alaska Coastal Current ecosystem parameters that will quantify and help understand interannual and longer period variability in: a) Temperature and salinity throughout the 250 m deep water column, and b) Near surface stratification.

In aggregate these variables are basic descriptors of the Alaska Coastal Current, an important habitat and migratory corridor for organisms inhabiting the northern Gulf of Alaska, including Prince William Sound.

Estimated Budget:

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

FY12	FY13	FY14	FY15	FY16	TOTAL
$109.5	$112.5	$115.7	$119.1	$122.5	$579.3

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL
$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

** Funds expressed in $1000 increments*

Date:

I. EXECUTIVE SUMMARY

The purpose of this proposal is to provide long-term monitoring data on the physical oceanography of the Alaska Coastal Current and the northern GoA shelf. The Alaska Coastal Current (ACC) is the most prominent feature of the Gulf of Alaska's shelf circulation. It is a narrow (~40 km), swift, year-round flow maintained by the integrated forcing of winds and coastal freshwater discharge. That forcing is variable and reflected in ACC properties. The current originates on the British Columbian shelf and leaves the Gulf for the Bering Sea through Unimak Pass. Substantial portions of the ACC circulate through Prince William Sound and feed lower Cook Inlet and Kachemak Bay before flowing southwestward through Shelikof Strait. The current controls water exchange and transmits its properties into the fjords and bays between Prince William Sound and the Alaskan Peninsula. The monitoring proposed herein quantifies variability of the Gulf's shelf environment. ACC monitoring provides the broader-scale context for understanding variability in adjacent marine ecosystems and its effect on particular species (e.g., herring, salmon, forage fish). The ACC's variability is transmitted to nearshore habitats around the gulf.

The 45-year GAK 1 time series has documented:

1. The large interannual differences associated with El Nino and La Nina events, including substantial differences in the spring bloom between these phenomena (Weingartner et al., 2003, Childers et al., 2005).
2. The intimate connection between coastal freshwater discharge and the depth-varying evolution of winter and spring temperatures over the shelf (Janout et al., 2010; Janout 2009).
3. That GAK 1 is a reliable index of ACC transports of mass, heat, and freshwater (Weingartner et al., 2005).
4. That GAK 1 near-surface salinities are correlated with coastal freshwater discharge from around the Gulf (Weingartner et al., 2005).
5. Variations in mixed-layer depth in the northern Gulf, which affects primary production (Sakar et al., 2006)
6. Decadal scale trends in salinity and temperature, (Royer, 2005; Royer and Grosch, 2006; Weingartner et al., 2005, and Janout et al., 2010). including an increase in stratification due to surface freshening and increased salinization of deep (>100 m) shelf waters).
7. The relationships between temperature and salinity variations and the Pacific Decadal Oscillation and the strength and position of the Aleutian Low (Royer, 2005; Weingartner et al., 2005, and Janout et al., 2010)
8. That the record can guide understanding the variability in iron concentrations, a potentially limiting micro-nutrient required by many phytoplankton. Preliminary efforts indicate that iron and surface salinity are correlated at least in certain seasons (Wu, et al., 2008).

As shown by Meuter et al., (1994), Meuter (2004), and Spies (2009), these issues affect ecosystem processes on both the shelf and within Prince William Sound and Lower Cook Inlet/Kachemak Bay. Most recently our results have identified a long term increase in upper ocean stratification due to surface freshening and increased salinization of deep (>100 m) shelf waters). The surface freshening corresponds to an increase in coastal freshwater discharge and glacial melting. The subsurface salinization has yet to be explained. It may be because of a decrease in wind speeds (observed), increased surface freshening and thus inhibition of vertical mixing, or a change in the salinity of offshore waters that annually bathe the deeper portions of this shelf.

II. COORDINATION AND COLLABORATION

A. Within a EVOTC-Funded Program

This project is part of the EVOSTC funded Long-term Monitoring Program associated with the Environmental Drivers portion of Gulf Watch Alaska. We share data with all other projects within this portion of the Gulf Watch Program including the following: The Continuous Plankton Recorder, The Seward Line, Oceanographic Condition in Lower Cook Inlet, Oceanographic conditions in Prince William Sound. We share logistics at least twice per year with the Seward Line project. We provide data for the biologists examining phytoplankton and zooplankton distributions as part of the Seward Line and Continuous Plankton Recorder projects. We are examining the spatial and temporal coherence in temperature and salinity with the Cook Inlet and Prince William Sound projects. The latter effort is to determine the degree of spatial heterogeneity in these variables over the inner shelf of the Gulf of Alaska.

B. With Other EVOSTC-funded Projects

The GAK 1 project primarily provides data and interpretation to the Nearshore and Pelagic Ecosystem projects within the Gulf Watch program and to the EVOSTC-funded Herring Research and Monitoring Program. The primary value of the GAK1 data set is to provide the PIs of these other programs an appreciation of the longer-term variability of the Gulf of Alaska as they examine their data sets.

C. With Trustee or Management Agencies

Our data has been used in deliberations by the North pacific Fishery Management Council annually since 2009, see for example: Zador, S. (editor) and coauthors, 2013, North Pacific Fishery Management Council Ecosystem Considerations for 2014 for the North Pacific Groundfish Stock Assessment and Fishery Evaluation Report, Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Seattle, WA.

Our main effort is devoted to posting the data as quickly as possible so that others may use it for their purposes. We do not track the data users, except to ask them if they are using the data, in which case we mention that on our project website. To date we have listed 36 papers that have used or cited these data on our website. Twenty-four of these publications address fisheries issues, while the remaining pertain largely to physical oceanographic variability on the Gulf of Alaska shelf and the North Pacific Ocean.

III. PROJECT DESIGN – PLAN FOR FY16

A. Objectives for FY16

Objectives

The fundamental goal of this program is to provide a high quality, long-term data to quantify and understand monthly, seasonal, interannual and longer period variability of the Gulf of Alaska shelf.

1. Temperature and salinity throughout the water column,
2. Near surface stratification since this affects phytoplankton bloom dynamics,

B. Changes to Project Design

There are no anticipated changes in the project design.

IV. SCHEDULE

A. Project Milestones for FY 16

For each project objective listed (III.A), specify when critical project tasks will be completed, as submitted in your original proposal. Please identify any substantive changes and the reason for the changes. Please format your information as in the following example:

Objective 1. Quasi-monthly CTDs will be updated quarterly and placed on the website and the moored measurements will be made available by March-April following the year that the mooring is recovered. This allows time for the instruments to be calibrated (at the manufacturer and the post-calibrations applied to the data set.

Objective 2. Determine seasonal changes in near surface stratification since this affects phytoplankton bloom dynamics. Updated annually in accordance with the processing of the mooring data.

B. Measurable Project Tasks for FY 16

FY 16, 1st quarter (February 1, 2016 - April 31, 2016)

February, 2014 Project funding available

Begin quasi-monthly CTD sampling at GAK1; recover and re-deploy the GAK 1 mooring

FY 16, 2nd quarter (May 1, 2016-July 30, 2016)

Continue quasi-monthly CTD sampling at GAK1*;*

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

Continue quasi-monthly CTD sampling at GAK1*;* Post data on website and Gulf Watch Data Portal (via AOOS)

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

Continue quasi-monthly CTD sampling at GAK1*;* Post data on website and Gulf Watch Data Portal (via AOOS); prepare annual report.

V. PROJECT PERSONNEL – CHANGES AND UPDATES

Dr. Seth Danielson will be the Co-PI in year 5 and he will be leading this project in the future. His CV follows.

CV OF SETH LOMBARD DANIELSON

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Professional Preparation

University of Alaska Fairbanks, Ph.D. Oceanography, 2012
University of Alaska Fairbanks; M.S. Oceanography, 1996
Lehigh University; B.S. Electrical Engineering, 1990, with honors

Appointments

Research Assistant Professor of Oceanography, IMS-UAF, Fairbanks, AK, 2013-present
Research Professional, IMS-UAF, UAF, Fairbanks, AK, 1997–2013
Driller, Polar Ice Coring Office, IMS-UAF, Fairbanks AK, 1993-1994 and UNL, Lincoln, NB, 1996-1997
Research Assistant, Institute of Marine Science, UAF, Fairbanks, AK, 1994-1996
Junior Engineer, Allen Organ Company, Macungie, PA, 1990-1992

Memberships

American Geophysical Union
The Oceanography Society

Select Peer-Reviewed Publications

Danielson. S. L., L. Eisner, C. Ladd, C. Mordy, L. de Sousa, and T. J. Weingartner (submitted), A comparison

between late summer 2012 and 2013 water masses, macronutrients, and phytoplankton standing crops in the northern Bering and Chukchi Seas, Arctic Eis DSR-II Special Issue

Danielson, S. L., T. W. Weingartner, K. Hedstrom, K. Aagaard, R. Woodgate, E. Curchitser, and P. Stabeno, (2014), Coupled wind-forced controls of the Bering–Chukchi shelf circulation and the Bering Strait through-flow: Ekman transport, continental shelf waves, and variations of the Pacific–Arctic sea surface height gradient. Prog. Oceanogr. http://dx.doi.org/ 10.1016/j.pocean.2014.04.006

Danielson, S.L., E. N. Curchitser, K. Hedstrom, T. J. Weingartner, and P. Stabeno (2011) On ocean and sea ice modes of variability in the Bering Sea, *J. Geophys. Res.*, doi:10.1029/2011JC007389

Janout, M.A., T.J. Weingartner, T. C. Royer, **S. L. Danielson** (2010), On the nature of winter cooling and the recent temperature shift on the northern Gulf of Alaska shelf, JGR Oceans, 2009JC005774R, DOI: 10.1029/2009JC005774

Weingartner, T.J., **S.L. Danielson**, T.C. Royer (2005), Fresh Water Variability in the Gulf of Alaska: Seasonal, Interannual and Decadal Variability, Deep-Sea Res. II, 52 (1-2): 169-191

Okkonen, S.R., T.J. Weingartner, **S.L. Danielson**, D. L. Musgrave and G. M. Schmidt (2003), Satellite and Hydrographic Observations of Eddy-Induced Shelf-Slope Exchange in the Northwestern Gulf of Alaska, JGR Oceans, 108 (C2): Art. No. 3033

Synergistic Activities

Participant and presenter at the Pribilof Island *Bering Sea Days* week of ocean exploration for St. Paul Island and St. George Island students and community members 2011-present.

Participant and presenter in the October 2010 BEST/BSIERP Professional Development Workshop in Anchorage, AK and the October 2009 Center for Ocean Science Education Excellence (COSEE) "Salmon in the Classroom" teacher workshops in Fairbanks AK.

Reviewer on the November 2008 technical final design review (FDR) panel for the NSF-funded Ocean Observatories Initiative (OOI) and in 2010 for the OOI program's awardee (WHOI) during the RFP phase in selecting manufacturers for the buoy power system.

Reviewer for peer reviewed journal articles in: *Geophysical Research Letters, Journal of Geophysical Research, Continental Shelf Research, Deep-Sea Research, Climate Dynamics*

Reviewer for peer-reviewed proposals submitted for funding to EPSCOR, NOAA, NSF, NPRB

Creator of numerous outreach-directed marine science web pages, including:

- Retrospective analysis of Norton Sound benthic communities (www.ims.uaf.edu/NS/)
- GAK1 long-term oceanographic monitoring time series (www.ims.uaf.edu/gak1/)
- GLOBEC NEP monitoring program (www.ims.uaf.edu/GLOBEC/)
- Real-time data and plot delivery webpage for community-based satellite-tracked drifter projects in the Bering and Chukchi Seas (www.ims.uaf.edu/drifters/)

Committee Appointments

2007 SFOS search committee for Marine Superintendent at the Seward Marine Center

2004 UAF search committee for SFOS Dean

Thesis Titles

Variability in the circulation, temperature, and salinity fields of the eastern Bering Sea shelf in response to atmospheric forcing, 2012 Ph.D. Thesis

Chukchi Sea Tidal Currents: Model and Observations, 1996 Masters Thesis.

Collaborators

K. Aagaard, (University of Washington); C. Carothers (University of Alaska Fairbanks); E. Curchitser (Rutgers University); L. De Sousa, (North Slope Borough); G. Eckert (University of Alaska Fairbanks); L. Eisner (National Oceanic and Atmospheric Administration); K. Coyle (University of Alaska Fairbanks); K. Hedstrom (University of Alaska Fairbanks); C. Harui (University of Alaska Fairbanks); R. Hopcroft (University of Alaska Fairbanks); K. Iken, (University of Alaska Fairbanks); M. Janout (Alfred Wegener Institute for Polar and Marine Research), S. Jewett (University of Alaska Fairbanks); Z. Kowalik (University of Alaska Fairbanks); J. Mathis (NOAA-PMEL); A. McDonnell, (University of Alaska Fairbanks); B. Moynahan (National Park Service); F. Mueter, (University of Alaska Fairbanks); B. Norcross (University of Alaska Fairbanks); A. Pinchuk (University of Alaska Fairbanks); T. Royer (ret.); P. Stabeno (National Oceanic and Atmospheric Administration); T. Weingartner (University of Alaska Fairbanks); W. Williams (Institute of Ocean Science, Fisheries and Oceans

Canada); P. Winsor, (University of Alaska Fairbanks); T. Whitledge (University of Alaska Fairbanks); R. Woodgate (University of Washington); J. Zhang (University of Washington).

Related Activities

1997-2004: Global Ocean Ecosystem Dynamics (GLOBEC) program in the Gulf of Alaska (NSF)
1997-present: Monitoring at oceanographic station GAK1 in the Gulf of Alaska (NSF/EVOS/NPRB)
2002-2004: Shelf-Basin Interaction (SBI) program in the Chukchi-Beaufort seas (NSF)
2008-2014: Bering Sea Ecosystem Study (BEST) moorings and larval transport modeling (NSF)
2008-present: Chukchi Sea Environmental Studies Program (CSESP, Shell/Conoco Phillips/Statoil)
2009-present: External advisor and analyst for Glacier Bay National Park and Preserve oceanographic monitoring and associated process studies (NPS)
2010-2013: co-PI, Adaptation of an Arctic Circulation Model (BOEM)
2012-present: co-PI, Arctic Ecosystem Integrated Survey (Arctic Eis, BOEM)
2013-present: PI, Bering-Chukchi transport pathways (NPRB)
2014-present: PI, Ecosystem monitoring and detection of wind and ice-mediated changes through a year-round physical and biogeochemical mooring in the Northeast Chukchi Sea (NPRB, AOOS, Olgoonik-Fairweather, UAF)
2014-present: co-PI Measuring the pulse of the Gulf of Alaska: Oceanographic observations along the Seward Line (NPRB)
2015-present: co-PI, Arctic Marine Biodiversity Observing Network (AMBON; NOPP/Shell)

VI. BUDGET

A. Budget Forms (Attached)

Provide completed budget forms.

B. Changes from Original Proposal

No substantive changes.

C. Sources of Additional Funding

With the arrival of the R/V Sikuliaq in Seward Alaska, we may be able to use this vessel for opportunistic CTD sampling at station GAK 1. It is not possible to determine at this point in time what the vessel's schedule is and if it will be in a position to enhance the monthly CTD sampling effort.