ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

1. Program Number: *See*, Reporting Policy at III (C) (1).

15120114-P

2. Project Title: *See*, Reporting Policy at III (C) (2).

Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK 1

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Seth Danielson and Thomas Weingartner (School of Fisheries and Ocean Sciences, UAF)

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2015-January 31, 2016

5. Date of Report: *See*, Reporting Policy at III (C) (5).

March 1, 2016

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

www.gulfwatchalaska.org and http://www.ims.uaf.edu/gak1/

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

The basic objectives of this project include sampling based on quasi-monthly conductivity, temperature, and depth (CTD) casts at station Gulf of Alaska (GAK) 1 (periods of sampling given in Table 1) and the recovery and re-deployment of a string of six temperature-conductivity-pressure (TCP) recorders on a mooring at GAK 1. This mooring is recovered and re-deployed annually in March. In addition, we have begun slowly acquiring historical CTD data (via the National Oceanographic Data Center) and CTD data from the Project ARGO floats from the northern Gulf of Alaska. The focus here is on determining if there are long-term temperature and salinity trends over the slope waters of the north Gulf. On an annual basis these waters flow onto the Gulf of Alaska shelf and occupy the deeper (>100m) portion of the shelf.

Anomalously warm conditions in the northeast Pacific were first observed in the central Gulf of Alaska in 2013 and early 2014. These warm anomalies came to be known in the popular press as "the blob." In 2014 there were warm water anomalies in the Bering Sea, the deep northeast Pacific (the blob) and near Baja. In 2015, these three warm anomalies persisted and a fourth warm anomaly - El Nino - developed along the equatorial eastern Pacific. As observed at GAK1 (Figures 1-3), the coastal northern Gulf of Alaska transitioned from a multi-year cool phase into an extremely warm phase in 2015, with 0-250 m water column temperature anomalies of nearly 2 °C.

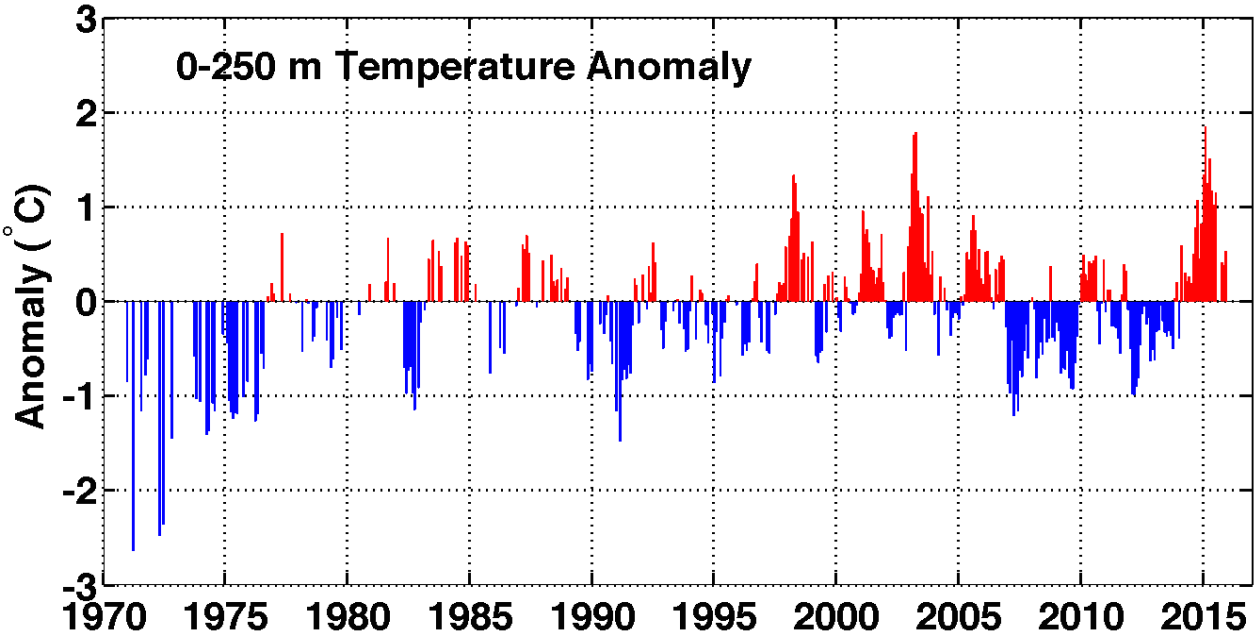

Figure 1. Temperature anomaly averaged over the entire water column at GAK1.

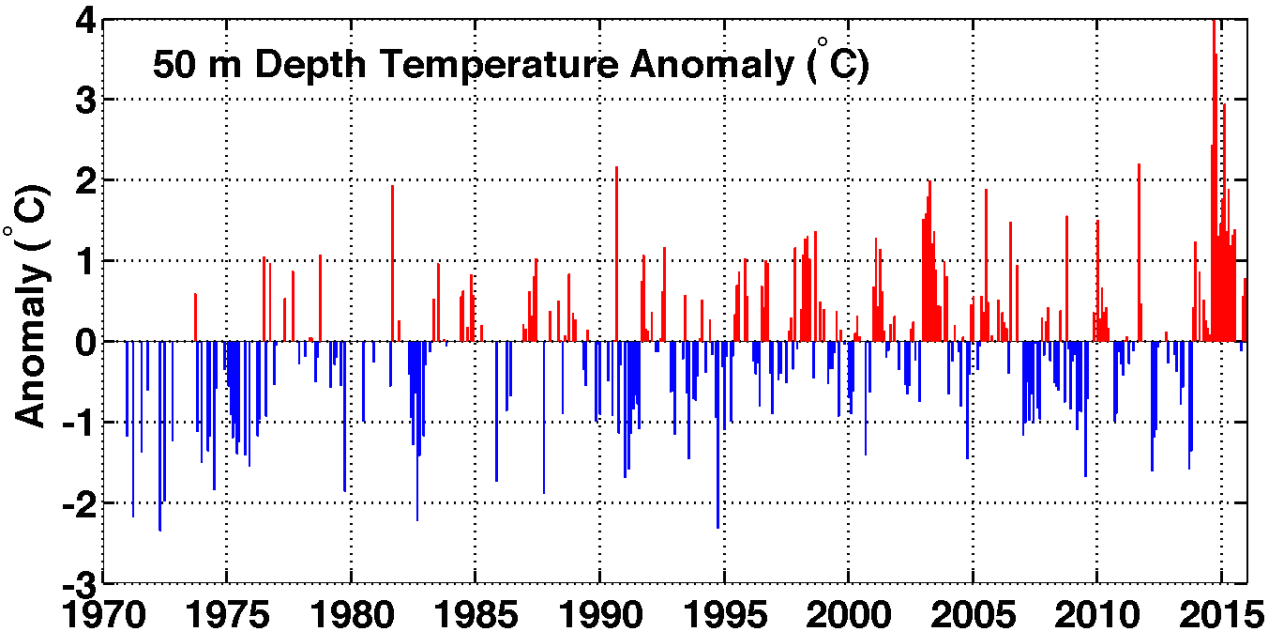

Figure 2. At 50 m depth, the GAK1 temperature anomaly was a full 4 °C higher than normal at the start of the 2014-2015 winter.

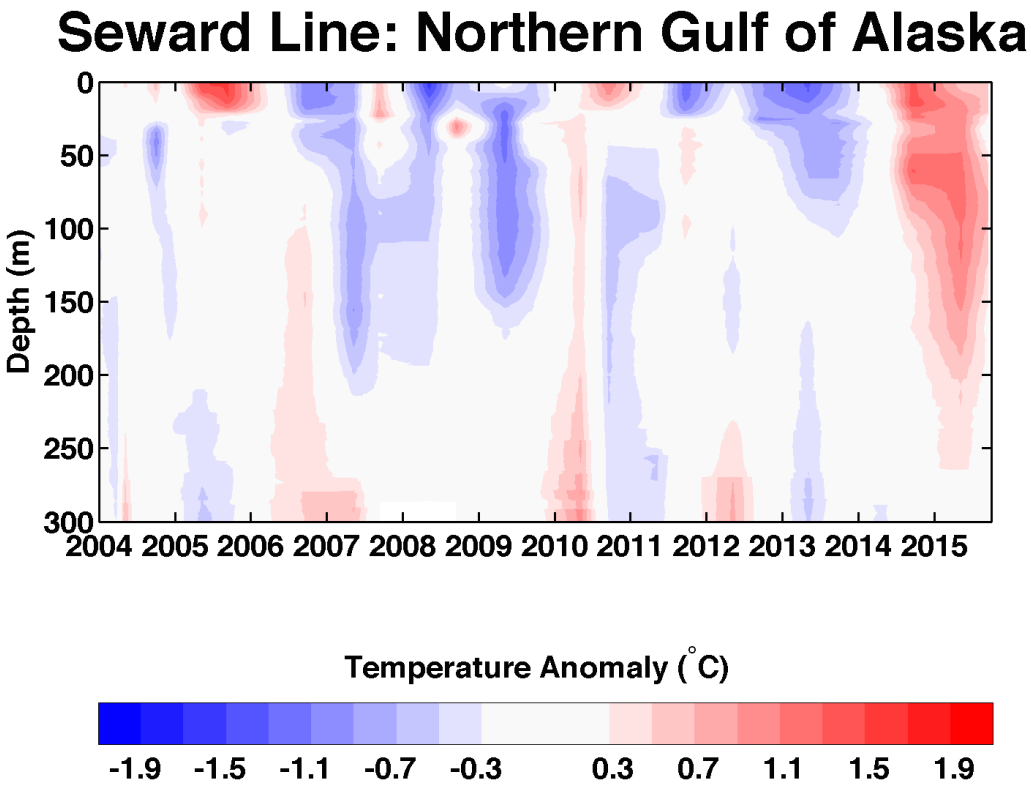

Figure 3. The temperature anomaly extended across the whole shelf in 2014 and through the water column. Above we plot the temperature anomaly averaged over the length of the Seward Line stations GAK1-GAK13 using data collected every May and September from 2004 to the present.

Table 1. Deliverable milestones for GAK 1, year four

Deliverable/Milestone	Status
February 2015 CTD cast at GAK 1	Completed
March 2015 mooring recovery and re-deployment at GAK 1	Completed
March 2015 CTD cast at GAK 1	Completed
April 2015 CTD cast at GAK 1	Completed
May 2015 CTD cast at GAK 1	Completed
June 2015 CTD cast at GAK 1	Completed
September 2015 CTD cast at GAK 1	Completed
October 2015 CTD cast at GAK 1	Completed
November 2015 CTD cast at GAK 1	Completed
January 2016 CTD cast at GAK 1	Completed

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

a. Coordination within and between Council funded programs

GAK-1 data is provided to the other GWA components and programs (e.g.,Nearshore component and Herring Research and Monitoring) and to federal and state agencies. We provide advice on data interpretation and usage when requested. We also integrate the GAK-1 data with data from other GWA

projects, especially with the Environmental Drivers component – see below (Section 9. Information and data transfer) for examples of presentations that integrated amongst the Weingartner (GAK-1), Hopcroft (Seward Line), Batten (Continuous Plankton Recorder), Holderied (Lower Cook Inlet) and Campbell (Prince William Sound) projects.

b. Coordination with other Council funded projects
NA

c. Coordination with management agencies and Trustees

Our project data is provided and available for use on both the GWA program website and the UAF IMS website: http://www.ims.uaf.edu/gak1/ and is available to all of the Trustee and management partners. Since 2010, 69 citations to the data set have been reported since 2010, 14 within the past four years of involvement with the GWA program.

9. Information and Data Transfer: See, Reporting Policy at III (C) (9).

There have been 69 publications that have used the data from GAK1 of which we are aware. These include data sets for eight student Master of Science (MS) theses and Doctoral dissertations, for use in peer-reviewed papers, and by the North Pacific Management Council in their Groundfish Stock Assessment and Fishery Evaluation Reports. See the GAK1 page at http://ims.uaf.edu/gak1/ for a full listing.

- Publications produced during the reporting period;

  Kelley, J., 2015. An Examination of Hydrography and Sea Level in the Gulf of Alaska. M.S. Thesis, University of Alaska Fairbanks

  Fedewa, E.J., J. A. Miller and T.P. Hurst, 2015. Pre-settlement processes of northern rock sole (Lepidopsetta polyxystra) in relation to interannual variability in the Gulf of Alaska. J. Sea Res.2015, http://dx.doi.org/10.1016/j.seares.2015.11.008

  Stearns, L. A., G. S. Hamilton, C. J. van der Veen, D. C. Finnegan, S. O'Neel, J. B. Scheick, and D. E. Lawson. 2015. Glaciological and marine geological controls on terminus dynamics of Hubbard Glacier, southeast Alaska. J. Geophys. Res. Earth Surf., 120, 1065–1081. doi:10.1002/2014JF003341.

- Conference and workshop presentations and attendance during the reporting period;

  Co-principal investigator (PI) Danielson attended the Gulfwatch PI meeting in November 2015, Weingartner and Danielson attended the Alaska Marine Science Symposium in January 2015 and Weingartner attended the EVOSTC Science Meeting in February 2015.

  The following talk was given at the Alaska Marine Science Symposium meeting in January 2015: *Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska's Changing Ecosystems*. Authors K. Holderied, M. McCammon, K. Hoffman, S. Rice, B. Ballachey, T. Weingartner, and R. Hopcroft .

  Danielson attended the Pacific Anomalies Workshop 2 (PAW2) in Seattle (January 2016), and presented a poster and slides using GAK1 and Seward Line data. Title: *1970 to 2015 Thermal and Haline Anomalies on the Northern Gulf of Alaska Continental Shelf,* coauthors T. Weingartner and R. Hopcroft.

Danielson attended the Large Whale Unusual Mortality Event workshop in Anchorage on 25 January 2016, and gave an oral presentation with results from all GWA environmental drivers studies to provide environmental context to the unusual mortality event investigation. Title: *Gulf of Alaska 2015 Anomalous Conditions Workshop: Oceanography*. Coauthors S. Batten, R. Campbell, A. Doroff, K. Holderied, R Hopcroft, R. Thoman and T. Weingartner.

- Data and/or information products developed during the reporting period:

  UAF graduate student James Kelly used the GAK 1 data sets to investigate sea level variability in Seward. His goal was to determine the causes of sea level variations and eventually to determine if Seward Sea level can be used as a proxy for current variations in the Alaska Coastal Current (ACC). He found that the annual cycle of sea level variations at Seward are in-phase with dynamic heath (vertically-integrated density) at GAK 1. At periods of days to ~1 month the sea level variations are significantly coherent with and in-phase with the along-shore winds over the Gulf of Alaska shelf, especially in fall, winter, and early spring. Given that the wind is also coherent with ACC transport at these periods it appears that Seward Sea level anomalies at these periods may be useful as an index of ACC transport. Mr. Kelly graduated with an MS degree in spring 2015 and has worked to acquire the Project ARGO CTD data that began in 1999. Graduate student Jonathan Whitefield acquired the historical CTD data from the northern Gulf of Alaska from NODC.

- Data sets and associated metadata that have been uploaded to the program's data portal.

  All Data through spring 2015 (for the mooring) and November 2015 (for the CTD profiles) have been uploaded to www.gulfwatchalaska.org and our UAF project webpage located at http://www.ims.uaf.edu/gak1/.

10. Response to EVOSTC Review, Recommendations and Comments: See, Reporting Policy at III (C) (10).

No recommendations provided

11. Budget: See, Reporting Policy at III (C) (11).

Please see provided program work book.