Exxon Valdez **Oil Spill Trustee Council**

Long-Term Research and Monitoring, Mariculture, Education and Outreach

Annual Project Reporting Form

Project Number: 22220202

Project Title: Continuation and expansion of ocean acidification monitoring in the *Exxon Valdez* Oil Spill area

Principal Investigator(s): Claudine Hauri, International Arctic Research Center

Reporting Period: February 1, 2022 – January 31, 2023

Submission Date (Due March 1 immediately following the reporting period): March 1, 2023

Project Website: https://gulfwatchalaska.org/

Please check all the boxes that apply to the current reporting period.

☒ **Project progress is on schedule.**

☐ **Project progress is delayed.**

☐ **Budget reallocation request.**

☐ **Personnel changes.**

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1. Summary of Work Performed:

Our team collected water samples for total alkalinity, dissolved inorganic carbon, and pH during the spring (265 samples) and fall (174 samples) Northern Gulf of Alaska Long-Term Ecological Research cruises along the Seward and Kodiak lines and in Prince William Sound. Due to the delay in funding and limited availability of sampling bottles, we were not able to collect water samples on the summer cruise. To maintain the 23 year long time series we prioritized the spring and fall cruises. We finalized the laboratory analysis of all samples and started the purified dye experiment and dye perturbation experiment to additionally improve the quality of the pH measurements. This experiment will continue throughout the year. We already ordered necessary consumables for sample collection and lab analyses and are currently cleaning sampling bottles to be ready for the upcoming field season. Since we have not been able to post-process and QA/QC our data, we do not have results from the data that was collected in 2022. However, data from previous years are being used by graduate student Addie Norgaard to lend spatial context to our continuous pCO2 and pH observations from the Gulf of Alaska Observatory. These data are also being used to evaluate the biogeochemical model simulation that was funded through the

North Pacific Research Board project "Marine heat and acidification events in the Gulf of Alaska." Our team is also part of the National Science Foundation funded Northern Gulf of Alaska Long Term Ecological Research program, within which we are working towards using a combination of data from this project, data from the observatory and the model simulation to better understand the environmental drivers of ocean acidification hot spots.

2. Products:

Conferences and workshops:

Norgaard, A., C. Hauri, B. Irving, and S. Danielson. 2023. Interannual variability in the inorganic carbon system at the Gulf of Alaska Ecosystem Observatory. Poster presentation, Alaska Marine Science Symposium, Anchorage, AK, January.

Data sets and associated metadata:

Hauri, C., and B. Irving. 2021. Inorganic Carbon data from water samples collected during CTD casts at stations during the Northern Gulf of Alaska LTER seasonal cruises, 2018. Research Workspace. https://doi.org/10324431/rw1k45g.

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center

The ocean acidification project collaborates with Prince William Sound Science Center (PWSSC) at a programmatic level because members of the Gulf Watch Alaska-Long-Term Research and Monitoring (GWA-LTRM) program management team work for PWSSC and PWSSC is the fiscal agent for the project through the National Oceanic and Atmospheric Administration grant.

EVOSTC Long-Term Research and Monitoring Projects

The ocean acidification project was added to the Environmental Drivers Component of the Gulf Watch Alaska-Long-Term Research and Monitoring (GWA-LTRM) program after the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) approved FY22-31 projects and FY22 spending. This project shares a research platform with the Seward Line project (22120114-L, Hopcroft and Danielson) and collaborates with the Seward Line and GAK1 project (22120114-I, Danielson) principal investigators (PIs) on a regular basis. We also look forward to possible collaborations

with the continuous plankton recorder project and Nearshore component (project 22120114-H, Coletti et al.). We aim to have our data publicly available within 18 months of collection, however are open to sharing it with interested user groups once it is post-processed.

EVOSTC Mariculture Projects

We participated in a meeting with the EVOSTC-funded Mariculture ReCon project at the winter GWA-LTRM PI meeting at the Alaska Marine Science Symposium. Data on ocean acidification from our project, particularly in Prince William Sound, may be of interest to the mariculture projects funded by EVOSTC. We are happy to work with these projects as appropriate.

EVOSTC Education and Outreach Projects

The ocean acidification project has participated in meetings with members of the CORaL network funded by EVOSTC to evaluate ways the programs can work together on outreach activities.

Individual EVOSTC Projects

The ocean acidification project works with the Data Management program to ensure data collected in the nearshore ecosystem are properly reviewed, have current metadata, and are posted to the Gulf of Alaska data portal within required timeframes. We will work with other individually funded EVOSTC projects if collaborative efforts make sense based on data collected.

Trustee or Management Agencies

We plan to approach Bridget Ferris, National Oceanic and Atmospheric Administration to see whether the collected data can contribute to the Gulf of Alaska Ecosystem Status Report prepared for the North Pacific Fishery Management Council.

Native and Local Communities

We will be presenting at the Chugach Regional Resources Commission's 21st Annual Subsistence Gathering in March 2023.

4. Response to EVOSTC Review, Recommendations and Comments:

May 2021 EVOSTC Science Panel Comment: The Science Panel recognizes this project as one of the environmental drivers projects and its continuation and expansion is appreciated. With a new PI taking over, there were some concerns but the proposal and the PI's expertise were clear. In

our reviews of the existing environmental drivers projects, we suggested better integration across these projects (see reviews for 22120114-D, J, I, J and L). We suggested that a postdoc within the LTRM integration and management proposal synthesize all oceanographic data. If this proposal is recommended for funding, we strongly recommend that the OA monitoring group closely collaborate with others on this effort. The budget is reasonable, for the amount of high value data that will be generated by this long-term project.

PI response: We thank the reviewer for their comments and recommendation. We would be eager to collaborate on efforts, and with a postdoc, focused on synthesizing all oceanographic data across the EVOS area.

We work closely with Dr. Seth Danielson (21120114-I, L) and Dr. Russ Hopcroft (21120114-L) and look forward to continued collaboration and further integration across projects. If funded, we will reach out to the PIs of 21120114-D and J to explore collaborations, noted on p. 17 "Nearshore Monitoring Component".

May 2021 EVOSTC Science Panel Comment: We agree with the external peer reviews and recommend that the PI follows the suggestions of one of the reviewers that include:

- Team members should consider using Millero et al. 2010 for the thermodynamic dissociation constants within CO2SYS due to the estuarine nature of their sampling. While Lueker et al. 2000 is the preferred dataset for typical oceanographic measurements, Millero et al. covers a salinity range from 1-50, and thus likely produces better results in estuarine environments.

PI response: We appreciate the suggestion and look forward to investigating the internal consistency of the marine carbonate system in the EVOS area using our samples. We've updated the budget to reflect this and updated Section 3. Data Analysis and Statistical Methods to more directly address this.

May 2021 EVOSTC Science Panel Comment:

- It may be worthwhile purchasing purified m-cresol purple indicator dye for the spectrophotometric pH measurements. Although somewhat expensive, it will lessen post-processing and improve confidence in the pH data. Additionally, take care with the dye perturbation correction of variable salinity data.

PI response: We thank the reviewers for their insight and have adjusted the budget to reflect using purified m-Cresol Purple (mCP) indicator dye in our spectrophotometric pH measurements. We look forward to doing a detailed investigation to characterize and correct for the differences in pH measurements with the purified mCP (Dr. Byrne's lab in University of

South Florida) and the previously used unpurified mCP indicator (-4-H JENA Engineering GmbH, S0045 from TCI lot number PKFSM-DQ), as recommended by Yao et al. (2007). To further reduce uncertainty of our pH data we will utilize the recent work of Li et al., 2020 to adjust for dye perturbations.

In addition, we have been in communication with Dr. Andrew Dickson to be part of a future inter-laboratory comparison to study correcting unpurified mCP pH measurements (Douglas and Bryne, 2017) to pH measurements obtained with purified mCP.

Please see Section 3. Data Analysis and Statistical Methods for further details.

May 2021 EVOSTC Science Panel Comment:

- Lastly, it may be necessary to allow extra time and/or funding to sort alternate calibration methods for the instrumentation, as there is currently a shortage of standards (CRMs) available for purchase due to COVID. It is possible this will still be a hurdle when the work is scheduled to start (FY22). This is a manageable problem, but will likely take initial expense in the first year to create a stable substandard or to find alternative calibration solutions.

PI response: We appreciate the suggestion and will look into the preparation of sodium carbonate solutions in our lab (Dickson et al., 2007) and storing the standard solutions and/or CRMs in gas-tight bags (e.g., Seelmann et al., 2020b; Cali-Bond bag, Calibrated Instruments, Inc.).

Dickson, A.G.; Sabine, C.L. and Christian, J.R. (eds) (2007) Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8). /Guide_all_in_one.pdfhttp://hdl.handle.net/11329/249. Available: https://cdiac.ess-dive.lbl.gov/ftp/oceans/Handbook_2007

Douglas, N.K., Byrne, R.H. 2017. Achieving accurate spectrophotometric pH measurements using unpurified meta-cresol purple, Marine Chemistry, 190, 66-72,doi.org/10.1016/j.marchem.2017.02.004.

Li, X., García-Ibáñez, M.I., Carter, B.R., Chen, B., Li, Q., Easley, R.A., Cai, W.-J. (2020). Purified meta-cresol purple dye perturbation: how it influences spectrophotometric pH measurements. Mar. Chem., 225 p. 103849. doi: 10.1016/j.marchem.2020.103849

Seelmann, K., Tobias, S., Aßmann, S. and Körtzinger, A. 2020b. Enhance Ocean Carbon Observations: Successful Implementation of a Novel Autonomous Total Alkalinity

Analyzer on a Ship of Opportunity, Frontiers in Marine Science 7, 1030, doi: 10.3389/fmars.2020.571301.

Yao, W.; Liu, X.; Byrne, R. H., 2007. Impurities in indicators used for spectrophotometric seawater pH measurements: assessment and remedies. Mar. Chem., 107 (2), 167–172.

September 2021 EVOSTC Science Panel Comment: This project focuses on an important environmental driver, and we support its continuation and expansion. The planned work would continue high-resolution ocean acidification (OA) monitoring in the Spill Area and add new methodology for analysis of water from estuarine and glaciated environments. There will be strong emphasis on identifying OA "hotspots", important for determining marine resources most vulnerable to OA. The external reviews were detailed and strong. The budget is reasonable, for the amount of high value data that will be generated by this long-term project. We recognize the strong publication record and high reputation of this new PI among researchers in ocean acidification (OA).

In response to the draft proposal and the external reviews, we emphasized the importance of cooperation with the other LTRM projects gathering data on environmental drivers and suggested that a postdoc within the LTRM integration and management proposal synthesize all oceanographic data. They responded very positively, describing existing collaborations with Council-supported projects and identified a further opportunity. The PI noted that she was already performing forecasting/hindcasting modeling and was enthusiastic about working with a postdoc. The PI also gave convincing responses to several technical questions and suggestions from the reviews relating to ensuring internal consistency of OA data from the Spill Area.

In summary, our review of the original proposal already identified this as a strong proposal meriting funding. The subsequent responses from the PI add strength to this recommendation. We further recommend that this project be integrated within the larger 2222LTRM Program Proposal.

PI Response: We would like to thank the Science Panel for these positive comments. We addressed one of the technical recommendations and purchased purified m-cresol purple indicator dye for the spectrophotometric pH measurements and have started conducting purified dye and dye perturbation experiments to additionally improve the quality of the pH measurements. We do not have results from these experiments yet.

Since we are also part of the National Science Foundation funded Northern Gulf of Alaska-Long Term Ecological Research program we work closely with Seward Line and GAK1 projects. We are also currently using the data for model evaluation of our hindcast simulation that has been funded through the North Pacific Research Board.

5. Budget:

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROJECT BUDGET PROPOSAL AND REPORTING FORM

Budget Category:	Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$71,359	$70,768	$57,935	$59,384	$60,869	$320,315	$11,291
Travel	$0	$331	$0	$365	$0	$696	$1,085
Contractual	$0	$0	$0	$0	$0	$0	$5,856
Commodities	$43,875	$30,750	$30,750	$30,750	$31,750	$167,875	$2,194
Direct Costs Exempt from F&A	$0	$0	$0	$0	$0	$0	$0
Equipment	$0	$0	$0	$0	$0	$0	$0
Indirect Costs Rate = 25% (non-equipment)	$28,808	$25,462	$22,171	$22,625	$23,155	$122,221	$5,106
SUBTOTAL	$144,042	$127,311	$110,856	$113,123	$115,774	$611,107	$25,531
General Administration (9% of subtotal)	$12,964	$11,458	$9,977	$10,181	$10,420	$55,000	N/A
PROJECT TOTAL	$157,100	$138,800	$120,900	$123,400	$126,200	$666,400	
Other Resources (In-Kind Funds)	$0	$0	$0	$0	$0	$0	

COMMENTS:
Since funding from EVOSTC was released late we are behind in spending in all categories. Late funding resulted in rebudgeting, such as additional travel costs to deliver sampling bottles to Seward Line in time for a scheduled cruise, shipment and contractual services to ship the alkalinity instrument for repairs and receive a loaner to keep analyzing samples. The grant includedinstrument refurbishment funds but was budgeted under commodities as part of cost per sample. Some purchases are still pending and not reflected in FY22 cumulative spending.

Indirect Costs: Facilities and Administrative (F&A) Costs are calculated at 25.0% of the Modified Total Direct Costs (MTDC), per EVOSTC guidelines. MTDC includes Total Direct Costs minus tuition, scholarships, participant support costs, rental/lease costs, subaward amounts over $25,000, and equipment. A copy of the agreement is available at: http://www.alaska.edu/cost-analysis/negotiation-agreements/.

FY22-26

Project Number: 22220202
Project Title: Ocean Acidification Monitoring
Primary Investigator: Claudine Hauri (UAF)

NON-TRUSTEE AGENCY SUMMARY PAGE

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