EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
FY21 (YEAR 10) CONTINUING PROJECT PROPOSAL SUMMARY PAGE

Project Number and Title

Gulf Watch Alaska: Environmental Drivers Component Project

21120114-D—Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf

Primary Investigator(s) and Affiliation(s)

Clare Ostle, Continuous Plankton Recorder Survey, Marine Biological Association

Sonia Batten, North Pacific Marine Science Organization

Date Proposal Submitted

August 14, 2020

Project Abstract

The Continuous Plankton Recorder (CPR) transect samples the Alaskan shelf from lower Cook Inlet across the slope into the open Gulf of Alaska, providing a now 20-year record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale. Sampling takes place approximately monthly, six times per year, usually between April and September. Outputs from the project include indices of plankton abundance (e.g., large diatom abundances, estimated zooplankton biomass), seasonal cycles (phenology of key groups) and community composition (e.g., appearance of warm water species, change in dominance by some groups). Variability in any, or all, of these indices might be expected to flow-through to higher trophic levels such as herring, salmon, birds and mammals that forage across the region, some of which have been impacted by the *Exxon Valdez* oil spill. Results show that interannual variability in plankton dynamics is high and plankton responded clearly and rapidly to the warm conditions of 2014-2016, with changes evident in abundance, composition and timing. We are not proposing any major changes to this project for FY21.

The 2020 CPR tows have not been impacted by COVID-19 but there will be some delay in finalizing the 2019 CPR data due to restrictions to lab access. We are not proposing any major changes to this project for FY21.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
$76,500	$78,800	$81,200	$83,600	$86,100	$406,200

Non-EVOSTC Funds to be used, please include source and amount per source: (see Section 6C for details)

FY17	FY18	FY19	FY20	FY21	TOTAL
$183,700	$183,900	$186,300	$188,300	$190,300	$932,500

1. PROJECT EXECUTIVE SUMMARY

The Continuous Plankton Recorder (CPR) transect samples the Alaskan shelf across the slope into the open Gulf of Alaska, providing a record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale (Fig. 1). Many important species, including herring, salmon, marine birds, and marine mammals, forage in these regions of the shelf and Gulf of Alaska for at least some of their life history so an understanding of the productivity of these areas is important to understanding and predicting fluctuations in resource abundance, including those recovering from the *Exxon Valdez* oil spill. CPR sampling began in 2000 and there is now an adequate time series available to assess the impacts of climate variability (Batten et al. 2018). Natural, as well as human-related, processes known to influence this region are numerous. For example, on seasonal and interannual time scales the strength of the Alaskan shelf and Alaskan Coastal currents are mediated by freshwater run-off and winds (Royer 1979, Stabeno et al. 2004, Weingartner et al. 2005), persistent coastal down-welling in contrast to most eastern Pacific boundary regions, and eddy-mediated cross-shelf transport of organisms and nutrients (Okkonen et al. 2003, Ladd et al. 2005). Moderate to strong El Niño and La Niña events are also felt on the Alaskan Shelf (Weingartner et al. 2002). Regime shifts, which may be triggered by the climate processes described above, have periodically occurred with lower frequency, such as the 1976/77 shift which changed Alaskan fisheries from shrimp to fish dominated (Francis and Hare 1994). The sudden and unusual warming in the North Pacific in 2014-2016 has also caused widespread impacts on Alaskan marine ecosystems which are still being noted and assessed (Di Lorenzo and Mantua 2016).

With short generation times, limited mobility and lack of a commercial harvest, plankton often respond to changes in their environment more rapidly and less ambiguously than higher trophic levels, so that a relatively short time series of plankton information can provide insights into the responses of the shelf ecosystem to some of the processes described above. Any of, or a combination of, the physical processes described above can influence water column stability and nutrient availability which in turn affects plankton timing, composition, and productivity.

Mean monthly Sea Surface Temperature (SST) data within the Alaskan shelf region from 2004 to 2019 were obtained from the International Comprehensive Ocean-Atmosphere Data Set (ICOADS, 1 degree enhanced data, www.esrl.noaa.gov/psd/data/gridded/data.coads.1deg.html).

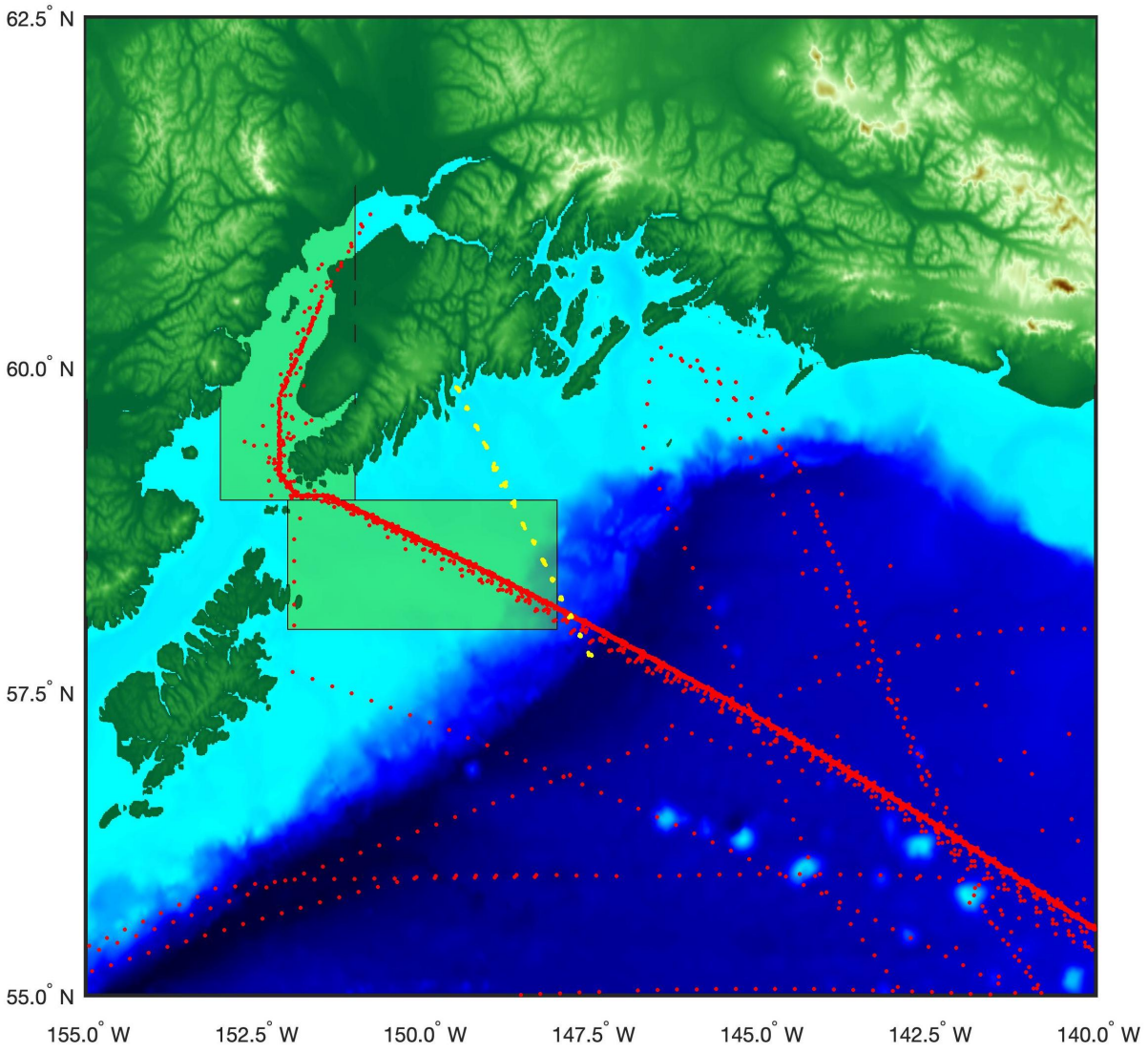

Figure 1. Location of Continuous Plankton Recorder samples in the northern Gulf of Alaska (red dots) from 2000 to 2019 and the Seward Line stations (yellow dots). Since 2004 the transect has sampled into Cook Inlet. The green boxes represent the regions used to select Alaskan shelf data.

The unusually warm conditions in this region from 2014-2016 (Fig. 2), known as a marine heatwave, induced noticeable changes in the plankton. Continued sampling of the CPR transect in 2017-2018 can now be used to determine whether a return to less extreme (although still warm conditions) also saw a return to more typical sub-arctic plankton communities (Fig. 3).

Figure 2. Monthly mean, annual mean and annual standardised z-score Sea Surface Temperature (SST) within the Alaskan shelf region (Fig. 1) from 2004 to 2019. Where positive z-score values signify values above the mean (red) and negative values are below the mean (blue).

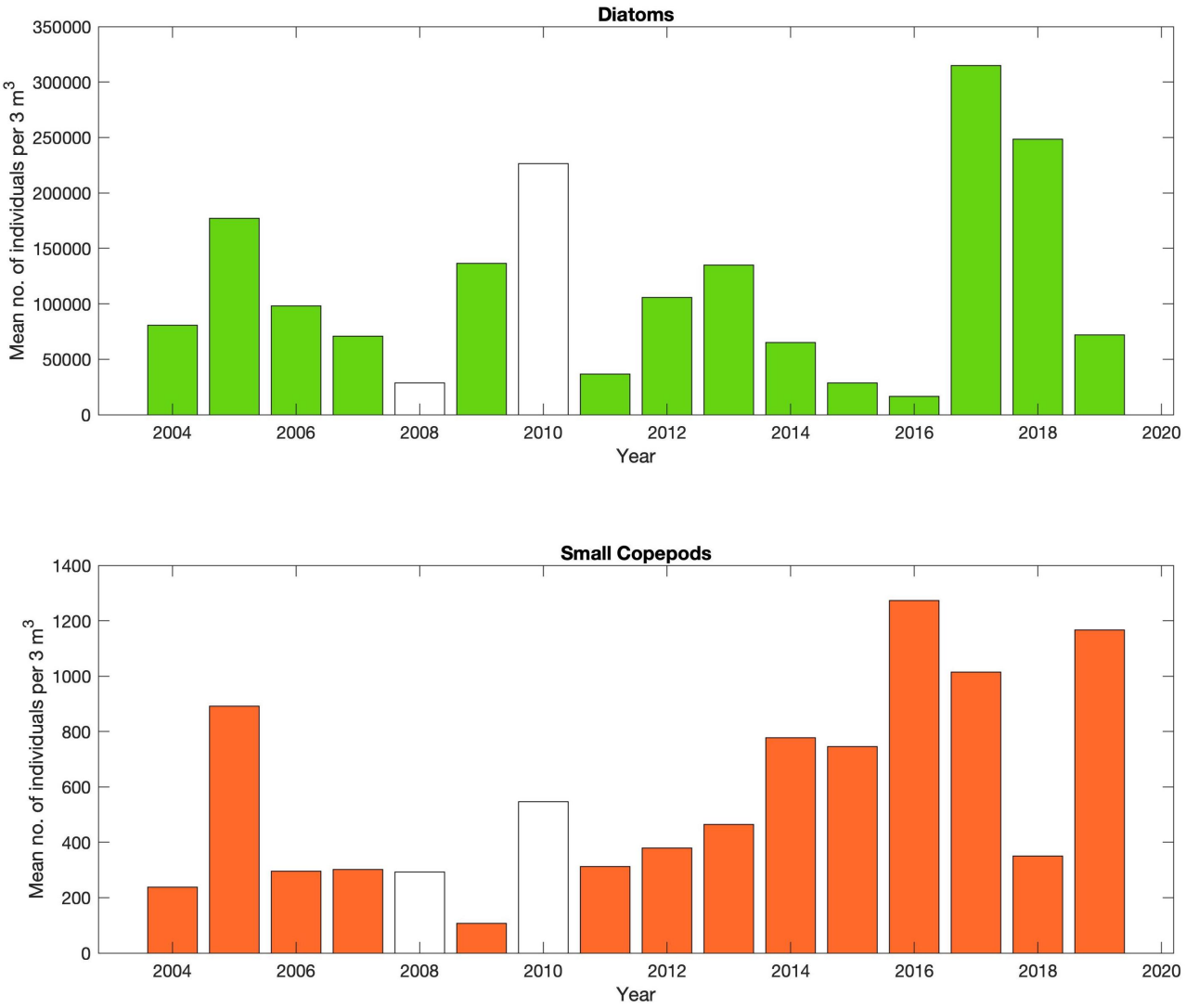

Figure 3. Mean annual abundance of diatoms (green bars) and small copepods (<2mm total length, orange bars) from shelf samples shown in Figure 1. Unfilled bars are years when sampled months <4 and so data are not as robust. Please note that 2019 CPR samples have been analyzed but are not yet finalized.

The results in Fig. 3 show that the heatwave years had low diatom abundance which changed dramatically in 2017 and 2018 to high abundances. Furthermore, the small copepods were very abundant during the heatwave and this abundance continued into 2017 but declined back to average levels in 2018. In 2019 we see that it is another warm year (Fig. 2), with low abundance of diatoms and high abundance of small copepods. It is possible that the low diatoms were the result of increased grazing pressure by the copepods during these years, rather than reduced productivity; however, since in 2017 we recorded high diatoms AND high numbers of small copepods it is more likely that primary productivity was reduced during the heatwave.

By using Species Temperature Indices (STI, the mean temperature that an organism occurs at over its entire sampled range) we have calculated the mean Community Temperature Index (CTI) for the plankton communities. Fig. 4 shows the annual CTI for phytoplankton on the shelf and shows that in 2013, 2015 and 2019 there was an increase in species that prefer warmer water, increasing the mean CTI. Values stayed high through

2016, and dropped in 2018, although still higher than the pre-heatwave years of 2007-2012. Note that the previous warmer period in the mid-2000s also showed warmer CTI values.

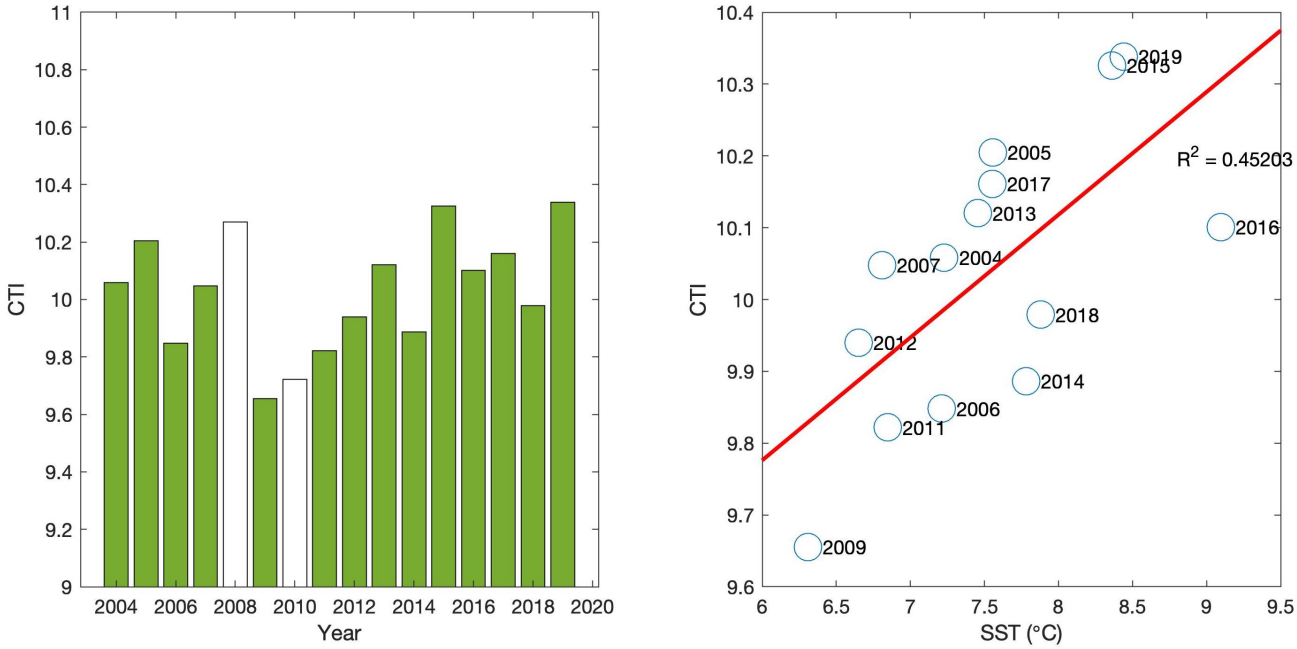

Figure 4. Mean annual Community Temperature Index (CTI) for the phytoplankton community on the shelf (left, unfilled bars are years when sampled months <4 and so data are not as robust.) and relationship with sea surface temperature from the National Oceanic and Atmospheric Administration International Comprehensive Ocean-Atmosphere Data Set sea surface temperature (SST) dataset (right). Years with less than optimal sampling (2008 and 2010) are excluded. The correlation between sea surface temperature and CTI is significant, $p<0.03$.

A manuscript is in preparation that will include more detailed analyses on changes in the species present as well as abundance of major groups of plankton.

The CPR will continue to sample the same transect approximately monthly, six times per year, between about April and September, providing sufficient temporal resolution to detect seasonal shifts and community composition changes. The transect links two of the other plankton sampling regions within the Environmental Drivers component, that of the Seward Line (project 21120114-L) (Fig. 1) and in lower Cook Inlet and Kachemak Bay (project 21120114-J), to provide a larger-scale context for these more intensive regional projects. With similar sampling frequency to the Prince William Sound oceanographic and zooplankton sampling (project 21120114-G), comparisons of lower trophic level fluctuations across the wider region will be made to examine responses to local and regional forcing.

The funding requested for CPR sampling is modest because of the consortium approach (the North Pacific CPR program is funded through a consortium managed by the North Pacific Marine Science Organization, PICES) and is less than half the actual cost of the data collection. Although there will be some delay in finalizing the 2019 CPR data due to COVID-19 restrictions to lab access, the 2020 CPR tows have not been impacted and we are expecting all tows to be completed successfully. We are therefore not proposing any major changes to this project for FY21.

2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

A. Project Milestones and Tasks

Table 1. This table breaks down project deliverables and their status into milestones and task progress by fiscal year and quarter, beginning February 1, 2017. C = completed, X = planned or not completed, V = cancelled due to COVID-19, P = partially completed, due to constraints of COVID-19. Fiscal year quarters: 1 = Feb 1 – April 30; 2 = May 1 – July 31; 3 = Aug. 1 – Oct. 31; 4 = Nov. 1 – Jan. 31.

	FY17				FY18				FY19				FY20				FY21			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Sample collection																				
CPR shipment	C				C								C							
Transect sampling	C	C	C		C	C	C		C	C	C		C	C	X		X	X	X	
CPR winter overhaul			C				C				C				X				X	
Sample Processing																				
Sampling results		C	C	C	C	C	C	C	C	C	C	C	P	P	X	X	X	X	X	
Reporting																				
Progress reports			C				C				C				X				X	
Annual reports					C				C				C				X			
Annual PI meeting				C				C				C				X				X
FY work plan (DPD)			C				C				C				C					

In addition to the primary project deliverables in Table 1, we also contributed indicators to the annual Ecosystem Status Report (Zador et al. 2019), gave one presentation (Section 7) and have a manuscript in preparation for peer-reviewed publication (Section 7). We anticipate completing FY19 and FY20 milestones and tasks as planned.

B. Explanation for not completing any planned milestones and tasks

All sampling, milestones, and tasks for 2019 and first two quarters of 2020 were completed in accordance with our proposal and with sampling protocols available on the Gulf Watch Alaska Research Workspace. Results from sampling in the first half of FY19 have been finalized; however, because of restricted laboratory access due to COVID-19, there has been a delay in finalizing the samples collected in the 3rd and 4th quarter of FY19. While sample processing is ongoing, we consider the task complete when QC is finished; thus, the sampling results task for the last two quarters of FY19 have not been marked complete. Although there will be some delay in finalizing the 2019 CPR data due to COVID-19 restrictions to lab access, the FY20 CPR tows have not been impacted and we are expecting all tows to be completed successfully.

C. Justification for new milestones/tasks

No new tasks are proposed.

3. PROJECT COORDINATION AND COLLABORATION

A. Within an EVOSTC-funded Program

Gulf Watch Alaska

This project provides a spatial link between the locally more intensive (but less seasonally resolved) sampling of lower trophic levels from the Seward Line (project 20120114-L) and Lower Cook Inlet and Kachemak Bay (project 20120114-J) within the Environmental Drivers component. Although there are differences in sampling design in each place, necessitated by the different sampling strategies, there are techniques available to facilitate integration. The CPR data can also provide information on seasonal timing changes which will help with interpretation. The time series in Prince William Sound (project 20120114-G) offers a chance to compare variability across the wider region and examine the degree to which the outer shelf may influence the Sound. There is thus strong collaboration within the Environmental Drivers component. Productivity of the plankton populations directly influences the organisms monitored by the Pelagic component and will be a necessary contribution to their studies. Nearshore studies (project 2012-114-H) are perhaps harder to link directly, but many benthic invertebrates have a planktonic phase. We have already provided a subset of CPR data to other Gulf Watch Alaska principal investigators summarizing the meroplankton to examine the long-term variability in larvae, and we expect such collaboration to continue.

Herring Research and Monitoring

We have actively collaborated with the Herring Research and Monitoring program (Pegau and Moffitt) in the first 5-year funding period, and a publication was produced (Batten et al. 2016). These time series will be updated during this project, and as they lengthen, we expect further insights.

Data Management

This project coordinates with the data management program by submitting data and preparing metadata for publication on the Gulf of Alaska Data Portal and DataONE within the timeframes required.

B. With Other EVOSTC-funded Projects

This project will coordinate with other *Exxon Valdez* Oil Spill Trustee (EVOSTC)-funded projects as appropriate by providing data, discussing the relevance and interpretation of data, and collaborating on reports and publications.

C. With Trustee or Management Agencies

This project is working with the National Oceanic and Atmospheric Administration (NOAA) and provides CPR time series data as indicators in ecosystem assessments and reports to the North Pacific Fisheries Management Council (Stephani Zador, Alaska Fisheries Science Center, Deputy Director, Resource Ecology and Fisheries Management).

4. PROJECT DESIGN

A. Overall Project Objectives

Objective 1

Plankton samples will be collected on the transect between Cook Inlet and Puget Sound approximately monthly from about April to September 2020 (6 transects will be sampled). All shelf samples will be processed and every 4th oceanic sample. Unfortunately, the CTD-F fitted to the CPR and used to collect

environmental data was lost with the CPR it was mounted on in 2018. We are continuing to collect temperature data via a borrowed sensor.

Objective 2

A subset of samples (25%) will be processed within 3 months of and results from this processing will be available in progress reports and on the project website as soon as practicable. Full, quality-controlled data from 2020 will be available by July 2021 as in previous years.

B. Changes to Project Design and Objectives

The project design and objectives have not changed. We are not proposing any major changes to this project for FY21. As stated in Section 2.B., results from sampling in the first half of FY20 have been finalized; however, because of restricted laboratory access due to COVID-19, there has been a delay in finalizing the samples collected in the 3rd and 4th quarter of FY20. While sample processing is ongoing, we consider the task complete when QC is finished; thus, the sampling results task for the last two quarters of FY20 have not been marked complete (Table 1).

5. PROJECT PERSONNEL – CHANGES AND UPDATES

Dr. Clare Ostle (claost@mba.ac.uk) will be replacing Dr. Sonia Batten (sonia.batten@pices.int) as the lead PI on the CPR monitoring of plankton populations on the Alaskan Shelf project, as Clare is taking on the role of co-ordinator of the Pacific CPR survey and Sonia has become the executive secretary of PICES. Sonia will remain on the project as co-PI. Clare's CV is appended to the workplan.

6. PROJECT BUDGET

A. Budget Forms (See GWA FY20 Budget Workbook)

Please see project budget forms compiled for the Gulf Watch Alaska program.

No changes have been made to the FY20 budget for this project.

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

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$35.82	$36.89	$38.00	$39.1	$40.3	$190.2	
Travel	$1.11	$1.15	$1.18	$1.22	$1.25	$5.9	
Contractual	$9.97	$10.26	$10.57	$10.89	$11.22	$52.9	
Commodities	$3.24	$3.34	$3.44	$3.5	$3.65	$17.2	
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Indirect Costs (*40%*)	$20.1	$20.7	$21.3	$21.9	$22.6	$106.5	
SUBTOTAL	$70.2	$72.3	$74.5	$76.7	$79.0	$372.7	$0.0
General Administration (9% of	$6.3	$6.5	$6.7	$6.9	$7.1	$33.5	N/A
PROJECT TOTAL	$76.5	$78.8	$81.2	$83.6	$86.1	$406.2	
Other Resources (Cost Share	$183.7	$183.9	$186.3	$188.3	$190.3	$932.5	

B. Changes from Original Project Proposal

None

C. Sources of Additional Project Funding

The North Pacific CPR survey is supported by a Consortium managed PICES, of which the EVOSTC is a member. There are two CPR transects in the survey, one of which is not in the spill-affected area and which is supported by the other Consortium members. Costs included in the budget are estimated at 40% of the

full costs of acquiring data along the north-south transect shown in Fig. 1. Other members of the Consortium which contribute to this transect's costs are:

- The North Pacific Research Board (NPRB) contributes funding at a similar annual level to that requested here, through the NPRB's Long-Term Monitoring Program. The first year of a 5-year contract began July 2019. Contributions for 2019-2020 are US$64,261 (see attached documentation).
- The Canadian Department of Fisheries and Oceans (DFO) contributes CAD$50-70k annually to PICES as a retroactive payment for the year April 1 -March 31, as well as in-kind support by providing laboratory facilities at the DFO lab in Sidney, BC. The attached Collaborative Agreement is for support for the project for the period 2018-2023. It describes the in-kind support, valued at $4,000 per year (It is worth noting that it would be impossible to rent laboratory space for this amount and the actual in-kind support is much more valuable than this). The Collaborative Agreement is provided as a separate PDF for documentation.
- The CPR parent organization, The CPR Survey at the Marine Biological Association is also providing salary support for the UK-based personnel, and in-kind support through the sampling vessel program it manages, for laboratory equipment (e.g., microscopes, fume hoods, etc.), sample archiving, and curation. See attached documentation for this amount, estimated to be $79,000 per year (see attached documentation).

Owing to the differing financial year cycles of each organization, as well as currency exchange rates, contributing funds per *Exxon Valdez* Oil Spill Trustee Council fiscal year from these combined sources were estimated as best we could.

7. FY17-20 PROJECT PUBLICATIONS AND PRODUCTS

Publications

Batten, S.D. 2017. Continuous Plankton Recorder Data from the Northeast Pacific: Lower Trophic Levels in 2016. Contribution in the 2017 NOAA Ecosystems Considerations Report to the North Pacific Fisheries Management Council.

Batten, S.D. 2018. Continuous plankton recorder data from the northeast Pacific through 2017 *in* Zador, S. G., and E. M. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, AK 99301. https://www.fisheries.noaa.gov/resource/data/2018-status-gulf-alaska-ecosystem

Batten, S.D., and Brown, R. 2018. Long-term Monitoring of plankton populations on the Alaskan Shelf and in the Gulf of Alaska using Continuous Plankton Recorders. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-A). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Batten, S., and R. Brown. 2019. Continuous plankton recorder monitoring of plankton populations on the Alaskan shelf. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-D.

Batten, S., Helaouet, P., Ostle, C. and Walne, A. Responses of Gulf of Alaska plankton communities during and after a marine heatwave. *In prep*.

Batten, S.D., Raitsos, D.E., Danielson, S., Hopcroft, R.R., Coyle, K. and McQuatters-Gollop, A. 2018. Interannual variability in lower trophic levels on the Alaskan Shelf. Deep-Sea Research Part II. http://dx.doi.org/10.1016/j.dsr2.2017.04.023.

Litzow, M., Hunsicker, M. E., J. Ward, E., C. Anderson, S., Jin Gao, Zador, S., Batten, S. Dressel, J. Duffy-Anderson, E. Fergusson, R. Hopcroft, B. Laurel, J.O'Malley, R. (2020). Evaluating ecosystem change as Gulf of Alaska temperature exceeds the limits of preindustrial variability. *Progress in Oceanography*, (accepted), 1–15.

Published and updated datasets

DataONE Published Datasets

Batten, S.D., K. Holderied, M. McCammon, and K. Hoffman. 2017. Continuous Plankton Recorder and Temperature Data, Gulf of Alaska, 2011-2016, Gulf Watch Alaska Environmental Drivers Component. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace. https://doi.org/10.24431/rw1k112.

Batten, S.D. 2018. Continuous Plankton Recorder Final 2016 Plankton Data, Gulf of Alaska, Gulf Watch Alaska Environmental Drivers Component. Dataset. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace. https://doi.org/10.24431/rw1k112.

Gulf of Alaska Data Portal Datasets

Batten, S.D. 2019. Gulf Watch Alaska Continuous Plankton Recorder 2017 physical data. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Gulf of Alaska Data Portal.

Research Workspace Datasets

Batten, S.D. 2019. Gulf Watch Alaska Continuous Plankton Recorder 2018 physical data. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

Batten, S.D. 2019. Gulf Watch Alaska Continuous Plankton Recorder 2017 plankton data. *Exxon Valdez* Oil Spill Trustee Council Long-Term Monitoring program, Gulf Watch Alaska. Research Workspace.

Presentations

Batten, S.D. 2018. Lower Trophic Level Variability Across the Subarctic North Pacific, From Continuous Plankton Recorder Sampling. Oral presentation, RS41A-04, Ocean Sciences February 2018, Portland, Oregon.

Batten, S.D, A. Walne, and P. Helaouet. 2019. Impact of the marine heat wave on Gulf of Alaska plankton communities. Has normal service now been resumed? Oral presentation, Alaska Marine Science Symposium, January 2019, Anchorage, Alaska.

Outreach

No new outreach was performed.

8. LITERATURE CITED

Batten, S.D., S. Moffitt, W.S. Pegau, and R. Campbell. 2016. Plankton indices explain interannual variability in Prince William Sound herring first year growth. Fisheries Oceanography 25:420-432.

DiLorenzo, E., and N. Mantua. 2016. Multi-year persistence of the 2014/15 North Pacific marine heatwave. Nature Climate Change, published online:11 July 2016 DOI:10.1038/ nclimate3082

Francis, R.C., and S.R. Hare. 1994. Decadal-scale regime shifts in the large marine ecosystems of the Northeast Pacific: a case for historical science. Fisheries Oceanography 3:279-291.

Ladd, C., N.B. Kachel, C.W. Mordy, and P.J. Stabeno. 2005. Observations from a Yakutat eddy in the northern Gulf of Alaska, Journal of Geophysical Research - Oceans, 110, C03003, doi: 03010.01029/02004JC002710.

Okkonen, S.R., T.J. Weingartner, S.L. Danielson, and D.L. Musgrave. 2003. Satellite and hydrographic observations of eddy-induced shelf-slope exchange in the northwestern Gulf of Alaska. Journal of Geophysical Research, 108 (C2), 3033, doi:10.1029/2002JC001342.

Royer, T.C. 1979. On the effect of precipitation and runoff on coastal circulation in the Gulf of Alaska. Journal of Physical Oceanography 9:555–563.

Stabeno, P.J., N.A. Bond, A.J. Hermann, N.B. Kachel, C.W. Mordy, and J.E. Overland. 2004. Meteorology and oceanography of the Northern Gulf of Alaska, Continental Shelf Research 24:859-897.

Weingartner, T.J., K.O. Coyle, B. Finney, R. Hopcroft, T. Whitledge, R.D. Brodeur, M. Dagg, E. Farley, D. Haidvogel, L. Haldorson, A. Herman, S. Hinckley, J.M. Napp, P.J. Stabeno, T. Kline, C. Lee, E. Lessard, T. Royer, and S. Strom. 2002. The Northeast Pacific GLOBEC Program: Coastal Gulf of Alaska. Oceanography 15:48-63.

Weingartner, T.J., S.L. Danielson, and T.C. Royer. 2005. Freshwater variability and predictability in the Alaska Coastal Current, Deep Sea Research Part II: Topical Studies in Oceanography 52:169-191.

Zador, S., E. Yasumiishi, and G.A. Whitehouse. 2019. Ecosystem Status Report 2019 Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK.

Dr. CLARE OSTLE
email: claost@mba.ac.uk
phone: +44 (0) 1752 426307

EMPLOYMENT

⇒ 2019-*present* · Research Scientist. CPR survey, Marine Biological Association, Plymouth, UK.
⇒ 2017-2019 · Research Fellow. SAHFOS/MBA, Plymouth, UK.
⇒ 2016-*2017* · Postdoctoral Research Associate. SAHFOS, Plymouth, UK.
⇒ 2015-2016 · Senior Research Associate. The University of East Anglia & Cefas, Norwich, UK.
⇒ *2007-2011* · Production Assistant. English Language Teaching dep., Oxford University Press.

EDUCATION

⇒ *Ph.D. 2011-2015,* The University of East Anglia (UEA), School of Environmental Sciences, Norwich, UK · Thesis: How does plankton distribution and activity influence the variability of carbon dioxide uptake in the North Atlantic? Supervisors: Carol Robinson (UEA), Martin Johnson (UEA, Cefas), Ute Schuster (Exeter), Martin Edwards (SAHFOS), Andrew Watson (Exeter) · Examiners: Stephanie Henson, Corinne Le Quéré
⇒ *B.Sc. Marine Biology, 2008-2011,* Swansea University, School of Biological Sciences, Swansea, UK · *First Class Honours* · Dissertation: *Calanus finmarchicus* and *Calanus helgolandicus* abundance in the northeast Atlantic region from 1958-2009.

RESEARCH INTERESTS

Clare specialises in marine biogeochemistry, data integration, and data analysis. Clare has worked with the Continuous Plankton Recorder (CPR) dataset since 2011. In particular, her interests lie in looking at the plankton community influence on the marine carbonate system and *vice versa*. She also has experience in estimating net community production using oxygen optodes on-board volunteer ships, and is interested in the possibilities of instrument development and sampling enhancements for the CPR. Clare has been involved in a number of syntheses reports, ranging from topics such as the operationalization of ecological indicators for European marine policy, ocean warming, ocean acidification and marine plastics. In 2020 Clare became the co-ordinator of the Pacific CPR survey.

5 RECENT PUBLICATIONS

⇒ Bedford, J., **Ostle, C**., Johns, D. G., et al. (2020). Lifeform indicators reveal large-scale shifts in plankton across the North-West European shelf**.** *Global Change Biology.* *https://doi.org/10.1111/gcb.15066*
⇒ Bedford, J., **Ostle, C**., Johns, D. G., Budria, A., & Mcquatters-gollop, A. (2020). The influence of temporal scale selection on pelagic habitat biodiversity indicators. *Ecological Indicators*, *114*. https://doi.org/10.1016/j.ecolind.2020.106311.
⇒ Batten, S. D., Abu-Alhaija, R., Chiba, S., Edwards, M., Graham, G., Jyothibabu, R., J. A. Kitchener, P. Koubbi, A. McQuatters-Gollop, E. Muxagata, **C. Ostle**, et al. (2019). A Global Plankton Diversity Monitoring Program. *Frontiers in Marine Science*. https://doi.org/10.3389/fmars.2019.00321.
⇒ **Ostle C.,** R. Thompson, D. Broughton, L. Gregory, M. Wootton, D. Johns, (2019). The rise in ocean plastics evidenced from a 60-year time series. *Nature Communications.* doi.org/10.1038/s41467-019-09506-1.

⇒ Mcquatters-Gollop A., A. Atkinson, A. Aubert, J. Bedford, M. Best, E. Bresnan, K. Cook, M. Devlin, R. Gowen, D. Johns, M. Machairopoulou, A. Mckinney, A. Mellor, **C. Ostle,** C. Scherer, P. Tett. (2019) Plankton lifeforms as a biodiversity indicator for regional-scale assessment of pelagic habitats for policy. *Ecological Indicators.* 10.1016/j.ecolind.2019.02.010.

FIELD EXPERIENCE

⇒ *2018-present · RV MBA Sepia ·* Deployment and trials of the ocean indicator and CPR tech.
⇒ *May 2015 · RV Cefas Endeavour ·* Collection of dissolved oxygen, DIC/TA, nutrient samples.
⇒ *Nov-Dec 2014 · RRS Discovery ·* Measuring community respiration and aiding in core samples.
⇒ *Jun-Jul 2012 and Sep-Oct 2012 · MV Benguela Stream ·* Measuring DO, DIC/TA, and pCO2.
⇒ *2009-2011 · RV Noctiluca ·* Grab samples, beam and otter trawling, plankton sampling.

RESEARCH SUPERVISION

Ph.D: Co-supervisor of Guillaume Signoret - Accelerating sea temperature growth and intensified pole-ward heat transfer: global and regional risk implications.

RECENT COLLABORATORS

Through her new role (2020) as Pacific CPR co-ordinator Clare is looking forward to setting up fruitful collaborations. Clare has been leading the set up and funding of new CPR routes within the Arctic Ocean surrounding Alaska and Canada through the BEIS UK-Canada Arctic Bursary programme since 2018, developing the following collaborators:

⇒ Batten Sonia, PICES, Canada
⇒ Chiba, Sanae JAMSTEC, Japan
⇒ Pegau, Scott, PWSSC, USA
⇒ Nelson, John, DFO, Canada
⇒ Melling, Humfrey, DFO, Canada
⇒ Jon, Fisher, Marine Institute, Newfoundland, Canada
⇒ Hunt, Brian, UBC, Canada
⇒ Naviaux, Robert, UCSD, USA

OTHER INFORMATION

Computing Skills: Confident user of Matlab (data-handling, statistical, graphical), with experience in computer modelling, LaTeX, Python, mongoDB (noSQL).
Certified Training: FlowCam MacroCam, Sea-survival, and CSED Teaching Skills.

The Marine Biological Association
Est. 1884, incorporated by Royal Charter 2013

The Laboratory
Citadel Hill
Plymouth
PL1 2PB
United Kingdom

Tel: +44 (0) 1752 426412
Fax: +44 (0) 1752 262049
finance@mba.ac.uk
www.mba.ac.uk

Registered Charity No. 1144206

For the attention of the Exxon Valdes Oil Spill Trustee Council

Contract 17-71-04
In support of the EVOSTC Gulf watch (LTM) project titled "GWA – Continuous Plankton Recorder"

The follwing MBA in-kind resources are used for the above mentioned project:

- The true cost of the Indirects is 98% of Staff costs. The Project funded overhead rate equates to 56% of staff costs therefore an additional 42% of Indirect costs are match funds
- The MBA CPR samples Archive Centre costs are not included in any of the fundec Projects and are currently costing $37000 per annum which is all match funds.
- The true cost of towing the CPR on Commercial vessels, we have calculated, based on our own Research Vessel, amount to $4200 per tow or $21840 per year. This is hugely underestimated as the costs for a large commercial tow would far out cost our Research vessel.
- We have estimated the cost for the entire network of Volunteers we have at Ports for logistics purposes at a conservative rate of $3200 per annum.

These resources amount to approximately $79,000 for 2020 and the in kind contribution by the MBA is expected to be at least this amount, per annum, for the duration of the project.

Lorraine Olver
MBA Finance Supervisor

NORTH PACIFIC RESEARCH BOARD

"Building a clear understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems that enables effective management and sustainable use of marine resources."

1007 West 3rd Avenue, Suite 100 | Anchorage, AK 99501 | tel 907.644.6700, fax 907.644.6780

July 23, 2019

Exxon Valdez Oil Spill Trustee Council
4230 University Drive #220
Anchorage, AK 99508

To Whom it may concern:

North Pacific Research Board confirms the intent to support the Continuous Plankton Recorder project funded under the NPRB Long-Term Monitoring Program for the period July 1, 2019-June 30, 2024. A total of $316,029 will be provided over the five-year period (i.e., approximately $63,000/year). Please direct any questions about NPRB's investment in this project to Danielle Dickson, the Senior Program Manager for the Long-Term Monitoring Program.

Sincerely,

Danielle Dickson

Danielle Dickson
Senior Program Manager/Chief Officer for Collaboration and Synthesis