Exxon Valdez **Oil Spill Trustee Council**

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

Annual Project Reporting Form

Project Number: 24120114-D

Project Title: Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf

Principal Investigator(s): Clare Ostle, Marine Biological Association, United Kingdom

Sonia Batten, North Pacific Marine Science Organization

Reporting Period: February 1, 2024 – January 31, 2025

Submission Date (Due March 1 immediately following the reporting period): April 9, 2024

Project Website: https://gulfwatchalaska.org/

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

☒ **Project progress is on schedule.**

The delay in funding has proved difficult, as we have several small local suppliers that we must pay to have the CPR offloaded from the volunteer vessels, serviced, and get the samples back for analysis. We do not want to damage these relationships which are crucial to ongoing success. The CPR survey runs as economically efficiently as we can, and we are able to cushion some delays in funding, but we are reliant on funds coming through within a reasonable timeframe to keep things running smoothly.

☐ **Project progress is delayed**

☐ **Budget reallocation request.**

☐ **Personnel changes.**

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1. Summary of Work Performed:

All 2024 tows were completed as planned, completing 6 transects from April – July and September - October 2024. The continuous plankton recorder (CPR) was deployed on six transects in 2024, monthly from April through July and September through October. The July sample collections were unsuccessful due to a jam in the mesh transportation of the internal CPR

mechanism. The remaining five months were successfully sampled. The location of the ship's transect continues to be consistent from month to month (Fig. 1). At the time of writing, provisional plankton data for May to June are available and the samples are undergoing quality control. In 2024, annual sea surface temperatures (SST) were cooler than the long-term average (2004–2024), as indicated by z-score analysis. They were also lower compared to recent years, especially the heatwave years of 2016 and 2019 (red lines in Fig. 2).

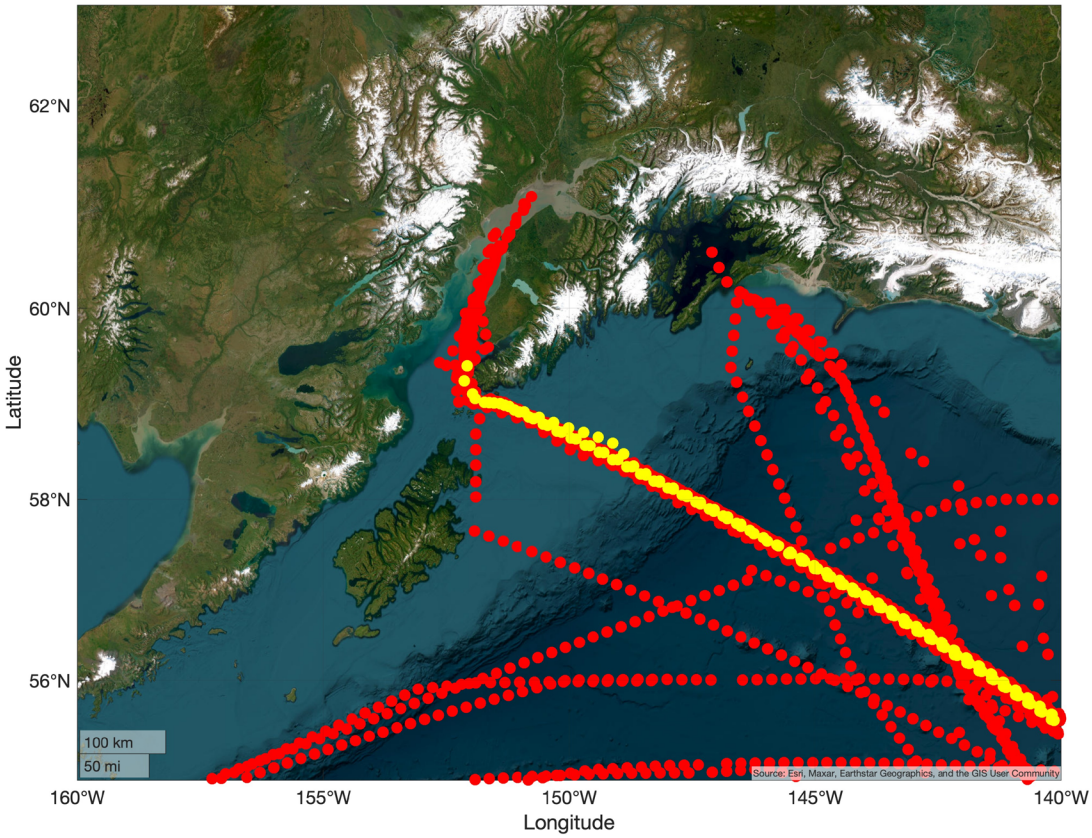

Figure 1. Location of CPR samples, red=historic samples, yellow = samples from 2024.

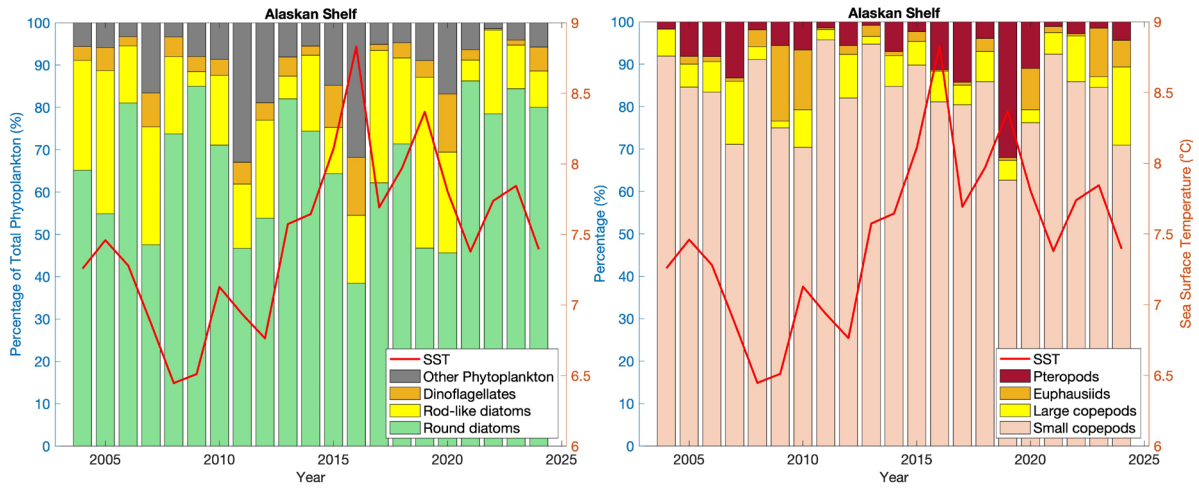

Figure 2. Left panel shows the mean annual percentage of the total phytoplankton (green=round diatoms, yellow=rod-like diatoms, orange=dinoflagellates, grey=all other phytoplankton). Right panel shows the mean annual percentage of the total zooplankton (pink = small copepods, yellow = large copepods, orange = Euphausiids, dark red = Pteropods). 2024 only includes data from May and June and are preliminary. Red line is the annual Sea Surface Temperature within the Alaskan Shelf region from 2004 to 2024, obtained from the International Comprehensive Ocean-Atmosphere Data Set (ICOADS).

Although only some of the data are available at this time (May-June 2024), preliminary analyses suggest that plankton have continued to return to levels that were more similar to those found during pre-heatwave conditions, which began in 2020 and observed in years following (Fig. 2). There was a higher proportion of large-round diatoms in the phytoplankton, and fewer small copepods and a higher proportion of large copepods and Euphausiids in the zooplankton in 2024, than previous years.

Other evidence that supports this suggestion is shown in Fig. 3 and Fig. 4; Firstly, we recorded unusually high numbers of diatoms in May, these were made up of mostly *Chaetoceros* spp. (Fig. 3 left panel). Interestingly, in May 2023 we also recorded the highest abundance of *Chaetoceros* spp. in the area since the CPR sampling began, therefore the preliminary data from spring 2024 show high numbers for the second year running. We are in discussion with the herring and forage fish investigators from the Gulf Watch Alaska Long-Term Research and Monitoring (GWA-LTRM) program about whether impacts from *Chaetoceros* spp. can be seen in any of the young fish samples, as very high concentrations can cause fish mortality due to gill irritation and clogging by the diatom's spiny processes (Albright et al. 1992).

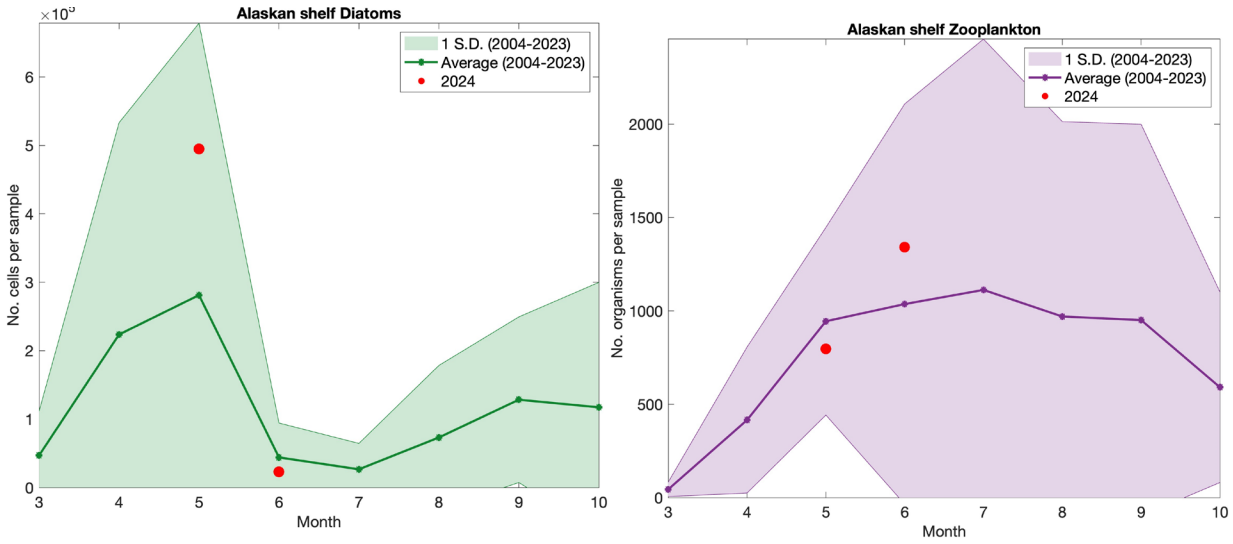

Figure 3. Left panel shows the seasonal mean monthly diatom abundance 2004-2023 with red circles showing the 2024 values (higher abundance than average in the spring) and right panel shows the seasonal mean number of zooplankton. 2024 data are preliminary.

Secondly, as shown in Fig. 4, the abundance of a particular copepod species indicative of warmer conditions in the Gulf of Alaska (*Calanus pacificus*) looks to be low in 2024 (and in the previous four years, 2020-2023).

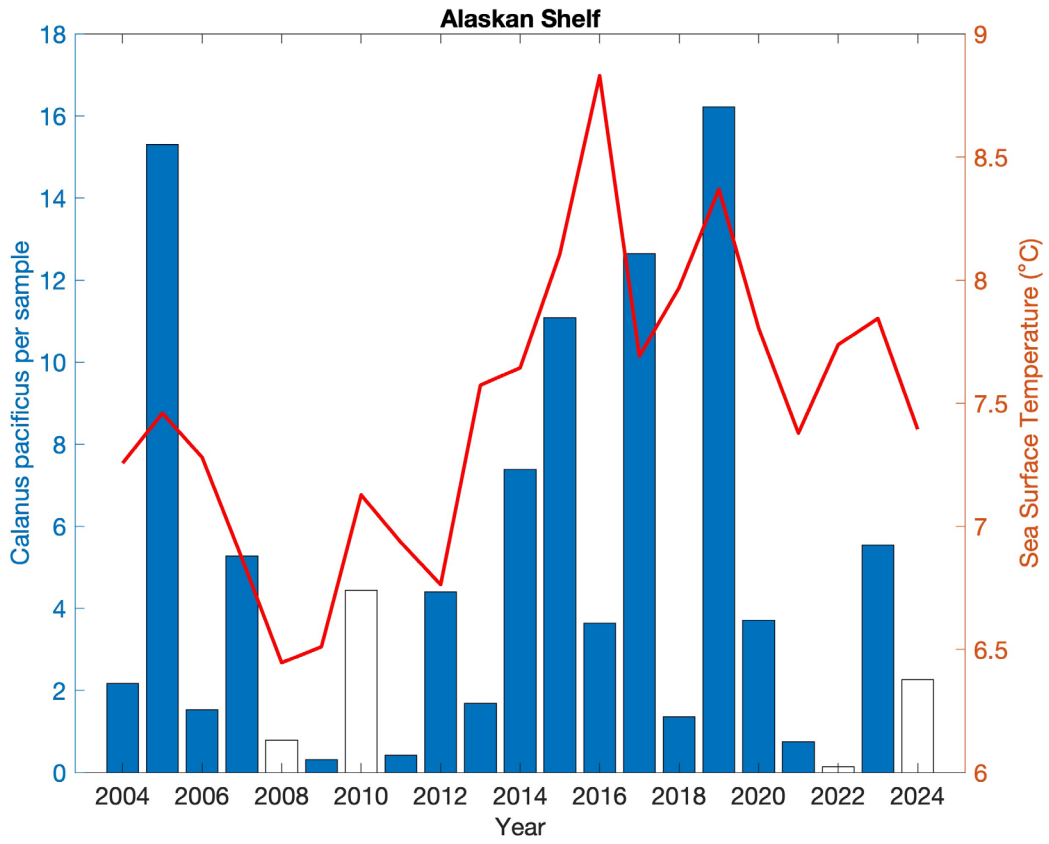

Figure 4. The mean annual abundance of the warm water indicator, Calanus pacificus, (blue bars) together with annual sea surface temperature (SST) (red line). White bars indicate where data are not finalized or there were < 4 months of the year sampled. 2024 data are preliminary.

In summary, these results suggest that the marine heat wave impacts appear to have ended. This is likely to have positive effects on ecosystem functioning. However, we are not yet clear what is causing the large spring blooms of *Chaetoceros* spp. in the last two years (2023 – 2024) and whether there will be adverse consequences for higher trophic levels.

References:

Albright, L. J., S. Johnson, and A. Yousif. 1992. Temporal and spatial distribution of the harmful diatoms *Chaetoceros concavicornis* and *Chaetoceros convolutus* along the British Columbia coast. Canadian Journal of Fisheries and Aquatic Sciences 49:1924–1931.

2. Products:

Peer-reviewed publications:

Kléparski, L., C. Ostle, S. D. Batten, N. Djeghri, C. Hauri, R. Pagès, and S. Strom. In review. How marine heatwaves are reshaping phytoplankton in the Northeast Pacific. Limnology and Oceanography.

Reports:

Boldt, J. L., E. Joyce, S. Tucker, and S. Gauthier, editors. Submitted. State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2023. Canadian Technical Report of Fisheries and Aquatic Sciences.

Ostle, C., and Batten, S. 2024. Continuous Plankton Recorder Data from the Northeast Pacifc, 2002-2023. Pages 77-79 *in* B. E. Ferris, editor. Ecosystem Status Report 2024: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, Anchorage, Alaska. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2023-gulf-alaska

Popular articles:

Jones, N. 2024. Researchers parse the future of plankton in an ever-warmer world. Yale Environment 360. PI Dr. Clare Ostle was interviewed for Yale Environment 360, which features areas of this project: https://e360.yale.edu/features/plankton-climate-change.

Nixey, C. 2024. Plankton are much more interesting than you might think. The Economist. PI Dr. Clare Ostle was interviewed for the article, in which many aspects of CPR activities were discussed, including areas of this project. https://www.economist.com/britain/2024/08/08/plankton-are-much-more-interesting-than-you-might-think.

Conferences and workshops:

Kearns, F. 2025. Communicating ocean sciences workshop. Workshop attendance, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Ostle, C. S. Batten, L. Kléparski, F. Loro, and A. Sastri. 2024. Update on the North pacific CPR survey. Oral presentation, North Pacific Marine Science Organization (PICES) Monitor Technical Committee annual meeting, Victoria British Columbia, Canada, September.

Ostle C., S. Batten, M. Brunetta, L. Gregory, D. Johns, L Kléparski, G. Lawley, F. Loro, R. J. Nelson, A. Sastri, and C. Taylor. 2025. 25 Years of the North Pacific Continuous Plankton Recorder Survey. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Public presentations:

No new contributions for this reporting period.

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

CPR data have been included in the International Group for Marine Ecological Time Series (IGMETS) effort led by the Intergovernmental Oceanographic Commission of UNESCO (IOC), the International Ocean Carbon Coordination Project (IOCCP) and the Ocean Carbon and Biogeochemistry Program (OCB) which seeks to integrate a suite of in situ biogeochemical variables from time-series stations, together with satellite-derived information, to look at holistic changes within different ocean regions. The website http://igmets.net/ has a Time Series Explorer which allows the user to construct time series of available variables and investigate trends. North. Pacific CPR data provide much of the plankton information for the region. The data are also stored in the Ocean Biodiversity Information System (OBIS): https://obis.org/dataset/e981eab6-f849-4891-8fac-495852829456.

Monthly abundances for selected plankton can be generated for user-specified regions sampled by the CPR using this extraction tool:

https://www.dassh.ac.uk/lifeforms/
https://doi.mba.ac.uk/data/3086

Data sets and associated metadata:

Batten, S. 2024. Environmental Drivers: Continuous Plankton Recorders. Gulf of Alaska Data Portal: https://gulf-of-alaska.portal.aoos.org/#metadata/87f56b09-2c7d-4373-944e-94de748b6d4b/project.

Additional Products not listed above:

No new contributions for this reporting period.

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center

Funding has been provided to the North Pacific CPR Survey Consortium through the Alaska Sea Life Center (from the North Pacific Research Board) and the Prince William Sound Science Center (PWSSC) for over a decade. We have thus already developed a good working relationship with the administrators in these organizations. We have participated in the PWSSC outreach program by giving talks to elementary and high school students, and at a public lecture as part of the PWSSC science lecture series in Cordova. We have also contributed articles to Delta Sound Connections. Collaborations with PWSSC researchers on juvenile herring have resulted in published papers and we are currently working on an additional collaborative manuscript.

EVOSTC Long-Term Research and Monitoring Projects

Environmental Drivers Component

This project provides a spatial link between the locally more intensive (but less seasonally resolved) sampling of lower trophic levels from the Seward Line and lower Cook Inlet within the Environmental Drivers component. Although there are differences in sampling design in each place, necessitated by the different sampling conditions, there are techniques available to facilitate integration, as mentioned above. The CPR data can also provide information on seasonal timing changes which will help with interpretation. The time series in Prince William Sound 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 group.

Pelagic Monitoring Component

Productivity of the plankton populations directly influences the organisms monitored by the Pelagic Component and will be a necessary contribution to their studies. A recent collaborative

paper led by Pelagic Component lead Dr. Mayumi Arimitsu describes some of these relationships with forage fish, and we expect such collaboration to continue, particularly as the time-series becomes long term and trends can become validated.

Nearshore Monitoring Component

Nearshore studies 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.

Lingering Oil Monitoring Component

As above, the coastal component of lingering oil is harder to link directly, but we do see some connections with planktonic larval stages and are hoping to explore this further.

Herring Research and Monitoring Component

We have actively collaborated with the Herring Research and Monitoring Component, and a publication has been produced. These time series will be updated during this project, and as they lengthen, we expect further insights. We currently have a further collaborative publication with the Herring research and Monitoring group in preparation.

Synthesis and Modeling Component

Suryan et al. (2021) provides an example of the collaborative efforts of the group with a synthesis report in Scientific Reports on the ecosystem response as a whole to the marine heat wave in the Gulf of Alaska. Such collaborations will continue and results we become more significant as the time-series involved are continued and long-term trends can be described.

EVOSTC Mariculture Projects

As above, plankton underpin many important food webs, particularly fisheries, and also reflect the environmental conditions, it is therefore likely that our plankton time-series will be of significant use to mariculture projects funded by the Council, and we are open to such collaboration and sharing of data.

EVOSTC Education and Outreach Projects

We have a good track record with education and outreach and enjoy getting involved. Sonia Batten has presented at the Cordova elementary and secondary schools and given a public lecture in the area as well as a presentation as part of the PWSSC lecture series. We very much enjoy this aspect of the work and will look to continue to contribute.

Individual EVOSTC Projects

The CPR data from the Gulf of Alaska region are provided to the Data Management project as an annual data product to the data management team. These data are quality controlled and provided in a consistent format for ease of use and dissemination.

As plankton underpin many important food webs and reflect the environmental conditions, we envisage that our data will be of significant use to several of the other projects involved, and we are open to such collaboration.

Trustee or Management Agencies

CPR data are provided as an annual summary to the National Oceanic and Atmospheric Administration (NOAA) Ecosystem Status Report (CPR contributed since 2016), a synthesis report used by fisheries managers, and the Preview of Ecosystem and Economic Conditions (PEEC) meeting (CPR contributed since 2020) to form individual stock-specific assessments (e.g., walleye pollock, Pacific cod and sablefish in the Gulf of Alaska). These contributions will be continued.

Native and Local Communities

The CPR project continues engaging with local communities as we have during the first 10 years of the GWA-LTRM program. Servicing is provided in Anchorage by Kinnetic Laboratories, the volunteer vessel officers and crew are strong supporters of the project and pleased to be participating, providing local involvement and engagement.

4. Response to EVOSTC Review, Recommendations and Comments:

FY22-FY23 Biennial Review: Science Panel Comment:

This project runs a linear Continuous Plankton Recorder (CPR) transect NW across the central GOA, onto the shelf, and into lower Cook Inlet just past Kachemak Bay from a participating cargo vessel. The normal sampling period is Apr-Jul. In 2022 the vessel had to go into drydock early, so an acceptable time adjustment was made to obtain four months of data in Mar-Jun 2022. The transect was sampled five times in 2003—May, Jun, Aug-Oct. The investigators have been productive in publishing peer-reviewed manuscripts, reports, popular articles, scientific and public presentations, and in developing international working relationships. The project is producing useful results of value to collaborators in the GOA and others. It is on track in submitting data and metadata to the Data Management program.

The Science Panel does not have any concerns about this project.

PI Response:

We would like to thank the Science Panel for their positive comments and support of the CPR work in the Gulf of Alaska. We very much enjoy working with the GWA-LTRM group and are excited about the potential for further years of fruitful collaborations. We have a synthesis paper currently in review, that we would like to highlight as it includes CPR data, Seward Line data, and model output from Dr. Claudine Hauri's ocean acidification group:

Kléparski, L., C. Ostle, S. D. Batten, N. Djeghri, C. Hauri, R. Pagès, and S. Strom. In review. How marine heatwaves are reshaping phytoplankton in the Northeast Pacific. Limnology and Oceanography.

FY22-FY23 Biennial Review: Executive Director Comments

I concur with the Science Panel. Funding for this project is managed by NOAA. The expenses on the annual reports are well documented and easy to track. The Fiscal Manager is responsive to budget questions. Staff do not have concerns at this time.

FY22-FY23 Biennial Review: PAC Comments

Whissel asked about the continuous plankton recorder on vessels. Ostle stated they tried various sensors, which had to be autonomous that crew could throw off the vessel. They use a plank tag

that switches itself on/off with contact with seawater and takes different measurements. They also hope to add imaging systems on more routes.

Whissel introduced a motion to proceed with no concerns. Stephens seconded, and there was no opposition. The motion passed unanimously.

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5. Budget:

Cumulative spending through FY24 appears low. This is due to the delay in the release of project funding at the start of the funding cycle, the long delay in NOAA's release of FY24 funds, and because MBA invoices for the project quarterly and the most recent spending is available through November 2023. The delay in funding has proved difficult, as we have several small local suppliers that we must pay to have the CPR offloaded from the volunteer vessels, serviced, and get the samples back for analysis. We do not want to damage these relationships which are crucial to ongoing success. The CPR survey runs as economically efficiently as we can, and we are able to cushion some delays in funding, but we are reliant on funds coming through within a reasonable timeframe to keep things running smoothly.

***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	$39,616	$40,607	$41,622	$42,663	$43,730	$208,238	$104,165
Travel	$1,316	$1,366	$1,399	$1,433	$1,467	$6,980	$3,487
Contractual	$9,304	$9,537	$9,775	$10,020	$10,270	$48,906	$24,998
Commodities	$5,837	$5,985	$6,134	$6,287	$6,445	$30,688	$14,815
Equipment	$0	$0	$0	$0	$0	$0	$0
Indirect Costs Rate = 40%	$22,429	$22,998	$23,572	$24,161	$24,765	$117,925	$58,986
SUBTOTAL	$78,502	$80,492	$82,503	$84,564	$86,676	$412,737	$206,451
General Administration (9% of subtotal)	$7,065	$7,244	$7,425	$7,611	$7,801	$37,146	N/A
PROJECT TOTAL	$85,567	$87,736	$89,928	$92,175	$94,477	$449,884	
Other Resources (In-Kind Funds)	$128,351	$131,605	$134,892	$138,262	$141,715	$674,825	

COMMENTS:
The North Pacific CPR survey is supported by a Consortium managed by the North Pacific Marine Science Organisation, of which the EVOSTC is a member. Costs included here are estimated at 40% of the full costs of acquiring data along the north-south transect. The remining in-kind funds will come from the consortium which currently includes the NPRB, Canadian Dept Fisheries and Oceans and the Marine Biological Association.

Cumulative spending through FY24 appears low. This is due to the delay in the release of project funding at the start of the funding cycle, the long delay in NOAA's release of FY24 funds, and because MBA invoices for the project quarterly and the most recent spending is available through November 2023.

FY22-26	Project Number: 24120114-D Project Title: CPR in the GOA PI(s): Ostle (MBA) & Batten (PICES)	NON-TRUSTEE AGENCY SUMMARY PAGE